The impact of regulatory divergence in non-tariff measures on cross-border investment of multinationals[1]

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Abstract

In this paper we study the effects of international regulatory convergence in non-tariff measures on cross-border investment of multinational firms. In particular, we verify two main research hypotheses derived from the modified knowledge capital model of multinational enterprise. The first hypothesis postulates that when regulatory divergence with numerous regulatory measures in the destination emerges, trade cost also increases that stimulate horizontal multinational activity. The second hypothesis states that regulatory convergence could reduce trade costs between the two trading partners that facilitates vertical multinational activity. In order to verify these hypotheses, we use firm level data from the Orbis database for the recent 2004-2020 period and the PPML estimation technique. Our estimation results for the full sample of firm show that bigger regulatory divergence is negatively associated with the extent of multinational activity. In addition, TBT convergence seems more important than SPS convergence. Moreover, more productive firms are more able to overcome problems associated with both the TBT and SPS distances. Finally, we find significant heterogeneity across sectors that vary according to technology intensity.

Key words: foreign direct investment, knowledge capital model of multinational firms, non-tariff measures, regulatory divergence, technical barriers to trade, sanitary and phytosanitary measures.

JEL Classification codes: C-21, C-23, F-13, F-14, F-21, F-23.

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1. Introduction

Cross-border investment by multinational enterprises (MNEs) has become a strategy to gain benefits from geographical dispersion of production and supply. Through foreign direct investment (FDI), MNEs have managed for a long time to reorganise their network of operations by sourcing their intermediate inputs and supplying their products crossing numerous borders. This has built the network of global value chains (GVCs) over years. This enabled MNEs to make larger profits by lowering their costs and increasing their revenues. Furthermore, this phenomenon has evolved MNEs to have an expansive network of ownership, experienced managerial skills, agglomerated knowledge and know-how, access to financial resources in numerous countries, and ability to develop novel technologies. However, with the recent COVID-19 pandemic and border closures, demand and supply routes of MNEs and in general GVCs have been significantly disturbed. In addition, intensified geopolitical tensions between the Western powers and non-Western powers that have interrupted both trade and investment linkages exacerbated this disturbance. Supply shortages in high-tech intermediate inputs of production such as semiconductors or primary commodities such as grains and livestock feed that are used in many other industries have caused supply bottlenecks pressurising prices and inflation across the globe. Meanwhile regulatory non-tariff measures (NTMs) such as technical barriers to trade (TBTs) and sanitary and phytosanitary (SPS) measures have targeted traded goods. During 2020-2021, 18 members of the World Trade Organization (WTO) have notified 46 TBTs citing COVID in their measure description while citing Protection of Human health or safety as their objectives in majority of their keywords. During the same period 18 members imposed 51 SPS measures citing COVID in all their measure description while citing animal diseases, plant health, or food safety in most of their keywords as their major objectives. This suggests the important role of these trade policy measures regulating trade during great shocks such as the global pandemic. This paper studies the impact of regulatory divergence in NTMs on FDI at the firm-level during the period 2004-2020.

While the impact of regulatory NTMs on trade has been widely studied in the literature, only few papers (Ghodsi, 2020; Adarov and Ghodsi, 2022; Ghodsi and Jovanovic, 2022) have been devoted to studying their effects on FDI. For instance, several papers study their impact on trade values (Disdier et al., 2008; Bao and Qiu, 2010, 2012; Winchester et al. 2012, Blyde, 2022), trade volumes (Kee et al., 2009; Beghin et al., 2015; Ghodsi et al., 2017; Bratt, 2017; and Niu et al., 2018), trade prices (Cadot and Gourdon, 2016), and quality (Disdier et al., 2018; Fałkowski et al., 2019; Curzi et al., 2020; Ghodsi and Stehrer, 2022; Ghodsi, 2023; Fiankor et al., 2021; Yue, 2022). Furthermore, only few papers in the literature have studied the impact of regulatory convergence on trade (Piermartini and Budetta, 2009; Cadot et al., 2015; Cadot and Ing, 2015, Knebel and Peters, 2018; Nabeshima and Obashi, 2021; Inui et al., 2021). The main motivation behind these studies is that convergence in the use of NTMs classified in the same administrative or procedural categories defined by United Nations Conference on Trade and Development (UNCTAD)-Multi-Agency Support Team (MAST) nomenclature could be a good proxy for harmonization of standards. However, the objectives of regulatory NTMs that are cited in the NTMs notified to the WTO could provide better insights for policymakers targeting specific goals by imposing TBT and SPS measures. The keywords mentioned in the TBTs and SPS measures notified to the WTO will be used to show the objectives of these regulatory measures. Therefore, regulatory divergence in objectives of NTMs will be calculated as the main variable affecting FDI in this study, while divergence in NTMs based on their administrative or procedural classification provided by MAST will be used as a robustness check.[4]

[4] However, objectives of regulatory NTMs might be different from their administrative classification in MAST.

Harmonization of standards and mutual recognition could reduce trade costs related to compliance significantly, which can stimulate trade. The most important example of this phenomenon is the single market of the EU, in which trade in goods flows with least frictions due to harmonization of standards and regulations that are imposed at the EU level, and also mutual recognition of regulations imposed independently by single member states. Nevertheless, the literature lacks a paper that studies the impact of regulatory divergence on cross-border investments.

Therefore, in the current study we tackle this issue by providing an answer to the research question as follows: how does regulatory divergence within TBTs and SPS measures affect cross-border investment in the globe? The regulatory divergence is measured according to the objectives of regulatory NTMs which are cited as keywords of NTMs notified to the WTO. Furthermore, regulatory divergence is also calculated across the three-digit administrative and procedural classes TBTs and SPS measures classified by MAST following the literature. Furthermore, the operating revenues (turnover) and total assets of foreign-owned subsidiaries that are ultimately owned by foreign MNEs are the dependent variables that are measures of multinational activity of MNEs.

The conceptual framework used in the study is in line with the modified knowledge-capital (KC) model originally proposed by Markusen (2002, 2013) and then further developed by Bergstrand and Egger (2007, 2013), Ramondo and Rodríguez-Clare (2013), and Tintelnot (2017). The KC model explains how trade costs could affect the behaviour of MNEs to invest in a country. Based on these models, the following hypotheses will be tested in the analysis.

One major hypothesis is following the 'tariff jumping' motivation behind FDI (Blonigen et al., 2004) or horizontal FDI (Markusen, 1984) that MNEs intend to have access to the market of a country via FDI to circumvent the large cost of exporting. Therefore, a regulatory convergence or similarity between trading partners may reduce trade costs that may stimulate trade. However, when regulatory divergence with numerous regulatory measures in the destination emerges, trade cost also increases that stimulate horizontal FDI. This suggests that firms invest abroad to supply to the market when trade costs increase.

The second hypothesis is following the 'resource seeking' motivation behind FDI (Dunning, 1993 and 1998) or 'export-platform' FDI (Ekholm et al., 2007) in which MNEs intend to have access to more efficient means of production to be able to export their produced goods to another country or the home country. Therefore, a regulatory convergence or similarity between trading partners may stimulate such FDI and regulatory divergence may reduce FDI. It is because regulatory convergence could reduce trade costs between the two trading partners that facilitates vertical fragmentation of production, which motivates the MNE to move parts of its production chain abroad. Therefore, this study helps us understand the role of regulatory divergence in shaping investments at the firm-level across GVCs. Furthermore, regulatory divergence and compliance with new regulatory measures may also increase fixed costs of technological change or/and bureaucratic procedures (Ghodsi, 2023). This will additionally hamper FDI activities in countries with more stringent regulations.

This study provides first a descriptive analysis of both regulatory NTMs and FDI during 2004-2020 which illustrates how these two important issues have evolved over years. Second, unlike earlier studies on regulatory convergence (Piermartini and Budetta, 2009; Cadot et al., 2015; Cadot and Ing, 2015, Knebel and Peters, 2018; Nabeshima and Obashi, 2021; Inui et al., 2021) that construct a measure across all NTM classifications, this study shows divergence in objectives of TBTs and SPS measures and their heterogeneous effects on FDI. Third, in an econometric analysis, it is studied how regulatory divergence in these NTMs affect turnover and total assets of foreign-owned firms in the global economy. In fact, the results of the empirical study show how regulatory divergence in either of these two NTMs affect FDI and in which direction. Furthermore, the importance of firm heterogeneity is explored by controlling relevant variables on size and productivity of firms to draw conclusions on the effectiveness of regulatory convergence across firm characteristics. The results can help policymakers to know how targeting regulatory divergence and in which of these two regulatory measures could achieve more FDI.

The results of the analysis provide guidance to policymakers who are seeking to attract more FDI. When the objectives of policies are to foster the presence of MNEs in a country, the empirical evidence would suggest how to adjust trade policies in terms of regulatory NTMs. The recent literature (Adarov and Ghodsi, 2022; Ghodsi and Jovanovic, 2022) shows that trade costs associated to regulatory NTMs significantly affect the decision of MNEs to undertake investment abroad. However, the impact of regulatory divergence on such decisions is not yet studied in the literature. The current phase of globalization indicates that firms and MNEs that are heavily involved in GVCs could benefit more from trade liberalization, harmonization of standards, and mutual recognition. By regulatory similarity or convergence, the policymakers could substantially reduce trade costs. This will hypothetically intensify the interlinkages across the GVCs which may stimulate FDI by foreign MNEs even further. The regulatory divergence at the time of the COVID-19 pandemic might indicate the breaking pattern of GVC linkages, and less crossborder investment by MNEs.

The structure of the paper is organized as follows. In the next section we discuss our analytical framework that is based on the modified knowledge capital model of multinational enterprise. Then we describe the dataset and provide stylised facts in section three. The empirical methodology is discussed in section four. In section five, estimation results are reported and interpreted. The paper ends with policy recommendations and directions for future research in section six.

2. Theoretical framework

While many theories have been proposed to explain the internationalization of production two distinct reasons why a firm should go multinational have been distinguished in the literature: market seeking and efficiency seeking. According to the first one MNEs are vehicles to overcome distance and lower costs of foreign markets access. Foreign direct investment undertaken to serve local markets is often called horizontal FDI and refers to producing abroad roughly the same goods and services as in the parent country. According to the second one firms internationalize production and become multinationals to get inputs at lower cost. Foreign direct investment undertaken with the aim of reducing production costs is called vertical FDI as it involves slicing production processes and locating different production blocs in countries where factors used intensively in these blocs are relatively cheap.

To explain FDI between similar countries several models of horizontally integrated MNEs were developed. Early examples of this approach include models developed by Krugman (1983) and Markusen (1984) that were later extended, *inter alia*, by Horstmann and Markusen (1987), Brainard (1993), Markusen and Venables (1998, 2000), Helpman *et al.* (2004), Sinha (2010), Collie (2011), and Cieślik and Ryan (2012). Theoretical modelling of horizontally integrated MNEs involves a trade-off between the saving in variable costs of exporting, such as transport costs and tariffs, and the additional fixed costs of setting up a new plant in the host country. The theory predicts that given moderate to high trade costs, horizontally integrated MNEs prevail in equilibrium when countries are similar in size and in relative factor endowments. With falling transportation and communication costs an increasing part of MNE activity is explained by the efficiency seeking motive. The first models of a vertically integrated MNE were developed by Helpman (1984) and Helpman and Krugman (1985). These models were later extended by, *inter alia*, Zhang and Markusen (1999), Markusen and Venables (2000) and Markusen (2002).

Initially, models of horizontally and vertically integrated MNEs were regarded as two separate literature strands. The next step in the development of the MNE theory was focused on combining the horizontal and vertical approaches into an integrated framework. By integrating efficiency and market seeking reasons for FDI Markusen (1996, 1997 & 2002) introduced the so-called knowledge-capital (KC) model to explain both vertical and horizontal FDI. The key economic insight of KC model is that firms own knowledge-based assets that generate firm-level scale economies. These assets are created using skilled labour (human capital) and may include R&D activities, organizational structures, managerial skill, etc.

In the KC model, firms are allowed to build multiple plants and separate headquarter services from the production process. Built upon a 2x2x2 framework, the model involves one constant returns to scale good and second good with plant- and firm-level scale economies; two countries with different relative endowments of skilled labour and unskilled labour, different country size, high and low transport costs and optional FDI ban. In this framework firms can choose between national, horizontal and vertical strategies.

Which type of firms would emerge in equilibrium depends on parameter values. When trade costs were high and FDI was prohibited, only national firms existed in both countries. Moreover, national firms would still exist over most of the parameter space even when the trade was liberalized with FDI remaining prohibited. FDI liberalization would first lead to the existence of horizontal MNEs, while both trade and FDI liberalization allow vertical MNEs to exist as long as factor endowments and factor prices were different. Hence, according to Markusen (2002), horizontal MNEs were more common than vertical MNEs, which only existed for a few host countries in certain industries. He concluded that similarities in market size, factor endowments and transport costs were the key determinants of horizontal FDI, while differences in skilled labour endowments were the main drivers of vertical FDI.

In the subsequent years the KC model has been extended in many directions. These extensions include, *inter alia*, studies by Bergstrand and Egger (2007, 2013), Markusen and Strand (2009), Markusen and Stähler (2011), and Chen *et al.* (2012). However, the most important recent extension of the KC model is the incorporation of physical capital in addition to human capital. This allowed a direct comparison of the KC model with the earlier models of horizontally and vertically integrated MNEs in which relative factor endowments were measured only by international differences in physical capital to labour ratios.

Knowledge-And-Physical-Capital model (KAPC) proposed by Bergstrand and Egger (2007, 2013) is an extension of Markusen's 2x2x2 framework that has addressed two important issues. First, they are sceptical about Markusen's argument (1995) that MNEs completely displace trade in two countries with identical absolute and relative factor endowments and other things equal, horizontal MNE's foreign affiliate sales (FAS) completely displace national firms with identical productivities and trade between the two countries. The fact that both European Union and the United States have largest intra-industry bilateral FDI flows as well as intra-industry trade flows suggests the coexistence of national exporters and horizontal MNEs. Second, regarding empirical approach to FDI determinants, they claim that even though the cross-country pattern of FDI is quite well explained by the gravity relationship, there have been virtually no formal N-country ($N>2$) theoretical frameworks provided to take into account the existence of a third country in gravity equation of aggregate bilateral FDI.

To address both issues, the KAPC model has the following properties. First, besides existing skilled and unskilled labour, the model has a third factor – physical capital, assuming that headquarters (plant) setups require human (physical) capital. Therefore, national exporting firms can co-exist with horizontal MNEs in pairs of countries with the identical relative and absolute factor endowments. Even when two countries converge in size, with skilled labour being not the only factor used to set up both plants and firms, skilled labour is not completely displaced from plant setups to firm setups. Compared with the 2x2x2 model of

Markusen and Venables (2000) where national exporting firms and horizontal MNEs could co-exist under a unique combination of trade costs, investment costs and ratio plant-to-firm setup costs, this three-factor framework, by adjusting the relative price of human to physical capital, allows for a wider range of combinations.

Second, a third country called the rest-of-world (ROW) is introduced in the KAPC model to explain the complementary responses of bilateral trade, FDI and FAS to changes in a pair of countries' characteristics in a typical gravity equation. In a two-country world, especially when the countries are of a similar economic size, gross multilateral and bilateral trades (or FDI) are identical, so national exporting firms and horizontal MNEs would substitute for one another, depending on trade and investment costs. The existence of a third country with physical capital mobility allows two countries' trade and FDI to co-vary positively with increases in economic similarity. Now complementary effect with endogenously adjusted relative prices of physical to human capital replaces substitution effect with exogenous trade and investment costs.

Another difference between the KAPC model and the KC model is that it offers an alternative manner to distinguish between horizontal and vertical FDI. Assuming *"headquarters (plants) use skilled labour (physical capital) relatively intensively in their setups"*, given the single-plant structure of vertical MNEs, vertical MNE headquarters will be relatively more abundant than horizontal MNE headquarters in countries that are abundant in skilled labour relative to physical capital and vice versa. If physical capital is controlled for, MNE headquarters can be prominent in both relatively skilled-labour abundant and skilled-labour scarce home countries. In this case, the KAPC model broadens the context for vertical FDI to appear and helps to find evidence for vertical motivations in FDI activity, which the KC model fails to do. In summary, KAPC model seems to be more powerful than the KC model in capturing real FDI activity. Therefore, in this paper we use this model as our analytical framework.

3. Statistical data and stylized facts

3.1. Firm-level data

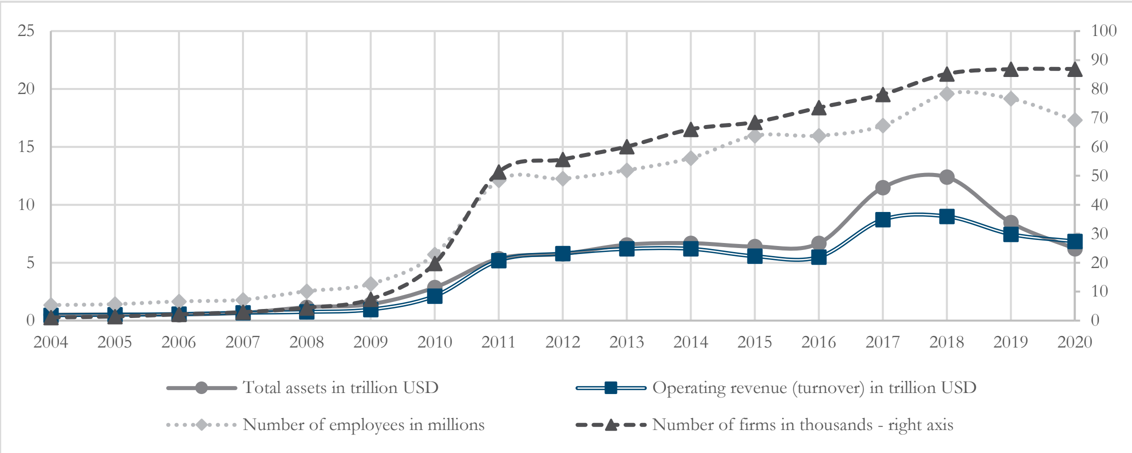
This study is based on the FDI data at the firm level. FDI at the firm-level is defined as subsidiaries with the ownership of at least 50.01% by a foreign firm. Such a foreign MNE is referred to in the data as the global ultimate owner (GUO), which owns the subsidiary either directly or through another subsidiary[5]. The main source of the data is Orbis database provided by Bureau Van Dijk Electronic Publishing GmbH. We use two measures of multinational activity: i) operating revenue (turnover) and ii) total assets of firms that are ultimately owned by foreign MNEs across the globe during the period 2004-2020. Since the study focuses on the impact of regulatory convergence in NTMs that are imposed on trade in goods, the firm-level data is limited to subsidiaries operating in non-services sectors as it is identified as their core and primary activities in the database.

Figure 1 presents the development of aggregate values of indicators of global foreign-owned subsidiaries in non-services sectors during the period 2004-2020. As it is observed on the right vertical axis, the number of foreign owned subsidiaries in non-services sectors across the globe has increased from about 1.2 thousand firms in 2004 to about 87 thousand firms in 2020. Their total assets recorded in the data increased from USD 0.5 trillion in 2004 to its highest peak of USD 12.38 trillion in 2018. According to the data presented

[5] It is important to note that Special Purpose Entities that usually do not employ labour but serve mainly an accounting purpose are not included in the analysis.

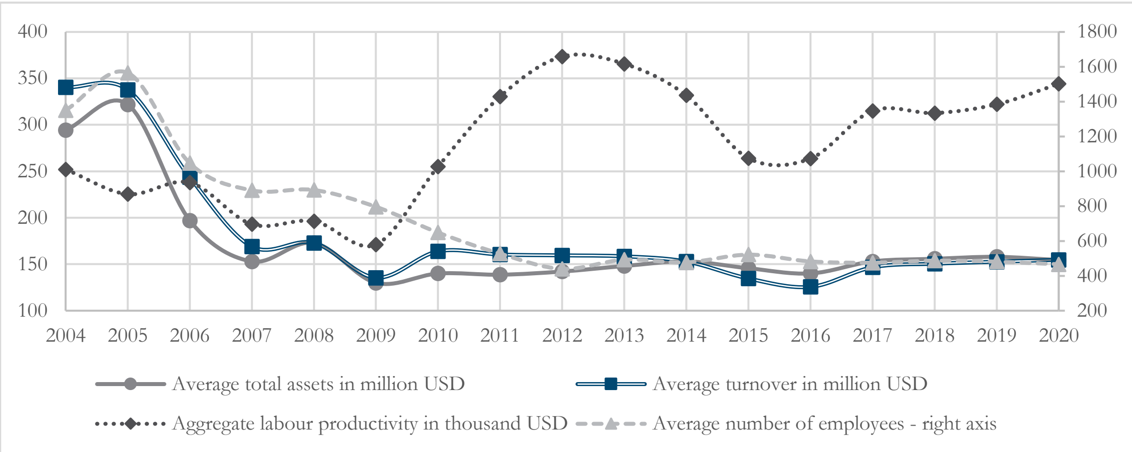
by UNCTAD (2019) investment report, this amounts to 38% of global FDI inward stock and 11% of total assets of foreign affiliates in all sectors in 2018. Nevertheless, there is a gradual reduction afterwards to USD 8.5tr in 2019 and USD 6.2tr in 2020, which could be due to the global slowdown due to COVID pandemic in 2020 and missing data points in more recent years. The turnover of foreign-owned subsidiaries also increased from USD 0.47 trillion in 2004 to its peak of USD 9tr in 2018, which is about 10% of the world GDP in the same year and 33% of sales of foreign affiliates in all sectors reported by UNCTAD (2019). The aggregated turnover of these firms is then reduced to USD 7.5tr in 2019 and USD 6.85 in 2020. These internationalised firms have employed 19.6 million in 2018, which is about 26% of employment by foreign affiliates in all sectors reported by UNCTAD (2019) for the same year.

Figure 1 - Development of aggregate values of indicators of global foreign-owned subsidiaries in non-services sectors during the period (2004-2020)



Source: Orbis, authors' elaboration.

Figure 2 - Development of average values of indicators of foreign-owned subsidiaries in non-services sectors used in the study sample during the period (2004-2020)



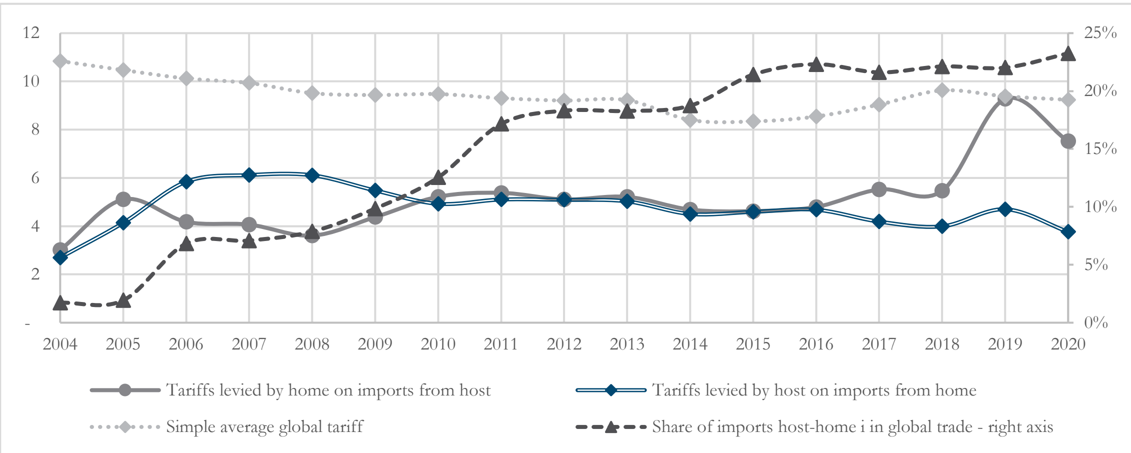
Source: Orbis, authors' elaboration.

Figure 2 presents the development of average values of indicators of foreign-owned subsidiaries in non-services sectors used in the study sample during the period 2004-2020. As it is observed, the fewer firms that were available in the earlier years in the sample of study were usually of larger size in terms of their capital, turnover, and employment. Average total assets of firms in 2005 was USD 322 million as the largest during the period, which is gradually reduced to its lowest in 2009 to USD 130 million, and then, hovering around USD 148 million on average. Average operating revenue of foreign-owned firms in the study sample was USD 340 million, the largest in 2004, which was gradually reduced to its lowest of USD 126 million in 2016. Average number of employees was the highest in 2005 with more than 1565 employees, which was reduced to its lowest value of 440 employees in 2012, as it is shown on the right vertical axis of Figure 2. However, by increasing the number of foreign-owned firms, the average labour productivity is increasing over time, which could be a sign of becoming more competitive. In fact, the lowest labour productivity was USD 171 thousand at the end of the financial crisis in 2009. The average productivity during 2004-2009 was USD 213 thousand, while it was USD 316 thousand during 2010-2020. The peak of labour productivity was USD 373 thousand in 2012.

3.2. Tariffs as traditional trade policy measures

Tariffs as the traditional trade policy measures are collected from World Integrated Trade Solution (WITS), which provides tariffs from two sources of the UNCTDA Trade Analysis Information System (TRAINS) and the WTO Integrated Database (IDB). All tariffs at the six-digit level of the Harmonized System (HS) including those levied on zero trade flows are averaged at NACE two-digit sectors using the appropriate concordance tables. The priority of used tariffs is first on effectively applied tariff rates, and then, preferential tariff rates, and then, MFN tariffs.

Figure 3 - Tariffs between home and host countries, share of sample's bilateral imports in global imports, and global tariffs (2004-2020)



Source: WITS, authors' elaboration.

Figure 3 illustrates the development of tariffs between home and host countries in the study sample, and share of sample's bilateral imports in global imports, and also average global tariffs during the period 2004-2020. As it is observed, due to the liberalisation in trade and the enlargement of the WTO, the average global tariffs levied on all available six-digit tariff lines including those with zero trade values have been generally decreasing over time from 10.84% in 2004 to 9.24% in 2020. However, tariffs levied on products averaged over the bilateral sectors in the sample of study show a different pattern. In fact, tariffs levied by home on imports from host increased from its lowest 3% in 2004 to 9.27% in 2020. Although these are on average lower than all available global tariffs, they have been substantially increased over time. However, tariffs levied by host on imports from home increased from 2.7% lowest in 2004 to its peak of 6.12% in the beginning of the financial crisis, and then gradually decreased to 3.76% in 2020. One can already observe that the liberalisation of trade towards host economies is linked to expansion of total assets of foreign-owned subsidiaries. This is an indication of vertical integration of production across the globe, which facilitated the global value chains by lowering tariffs. However, as it is also shown in Figure 3, the bilateral sectors in the sample of study cover only a small share of global bilateral trade. The share of trade in the bilateral sectors under the FDI analysis had its lowest value of 1.7% of global trade in 2004, which increased over years to 23% in 2020. This first shows that this amount of FDI is related to low value of global trade. Therefore, FDI could be a substitute for trade. This secondly shows that more and more bilateral sectors have been being invested by foreign multinational enterprises (MNEs), which expand to at least one fourth of global trade in 2020. However, it is important to note that gigantic intra-country trade such as Chinese intra-trade, or intra-EU trade are not included in the sample of FDI study here. Moreover, some large country-pair trade such as US-Mexico trade are also not included in the firm-level sample of FDI.

3.3. Regulatory divergence in NTMs

The main sources of data on NTMs will be the WTO I-TIP notifications database and the UNCTAD Trains data[6]. The former data provides detailed information on the regulatory NTMs imposed by members of the WTO on all trading countries targeting various products at the six-digit level of the HS. The latter provides information on the regulatory NTMs imposed by many countries across the globe and 93 countries including EU as a single economy against all trading partners.

UNCTAD regulatory measures are classified by the administrative and procedural classes defined by MAST. Therefore, studying the NTM data provided by UNCTAD could provide insights on how procedural and administrative NTMs are applied by countries over years. Earlier research has been done using the NTM database provided by UNCTAD that classifies NTMs based on MAST classification. These classes of TBTs and SPS measures are presented in Table A3 and Table A4 in the appendix, respectively. However, the database does not provide a comprehensive coverage across all countries over all years. As it is also noted below, the database has breaking points in 2011 and 2016 as thousands of regulations expire in these two years.

Therefore, the benchmark database used in the analysis is the one obtained from the WTO, while robustness checks are done using the UNCTAD NTM data. Following Ghodsi et al. (2017) the WTO notifications data are further improved by finding the HS codes for notifications lacking them. Furthermore, each notification cites certain keywords that are indicating the objectives of the measure rather than its procedure or administration class. Therefore, these objectives are more insightful to policymakers to target certain goals by imposing regulatory NTMs. These keywords could be categorised in keyword classes shown in Table A1 and A2 in the Appendix for TBTs and SPS measures, respectively. As it is observed, there are 32 objectives in TBT notifications and 64 objectives in SPS notifications in the whole database. It is important to note that one NTM notification could cite several keywords which falls into several objectives presented in those Tables. Figure A1 and Figure A2 in the appendix also show the number of TBT and SPS notifications citing each of those keyword classes until the end of 2021. It shows a heterogeneity in the objectives targeted by regulatory NTMs.

[6] https://trainsonline.unctad.org/bulkDataDownload

The regulatory divergence in each bilateral NACE two-digit sector is calculated using the detailed objectives cited as keywords of NTM notifications that are targeting products at six-digit level of HS in the benchmark specification and as detailed three-digit MAST classes in the robustness check. Appropriate concordance tables are used to link HS six-digit products to NACE two-digit sector levels. Following Cadot et al. (2015) a variable on regulatory divergence is measured for each NTM. To construct a measurement on distance in regulatory NTMs at NACE two-digit sector s that includes HS six-digit products h, first a binary variable $I_{jht}^{\tau c}$ is defined that indicates whether an importing country j has a regulatory NTM of type τ (i.e., $\tau \in \{TBT, SPS\}$) on product h in year t in force with an objective c[7] cited in the keyword of the WTO notifications (or within the three-digit class of MAST for UNCTAD NTMs). The regulatory divergence between two trading partners i and j in that regulatory measure τc is then defined as $RD_{ijht}^{\tau c} = \left|I_{jht}^{\tau c} - I_{iht}^{\tau c}\right|$. The aggregation of regulatory divergence over all classes for a traded sector s between the importing country j and exporting country i in year t then yields the regulatory divergence that is calculated as follows:

$$D_{ijst}^{\tau} = \sum_{c}^{HC_{h,\tau}} \frac{RD_{ijht}^{\tau c}}{HC_{h,\tau}}, \quad \tau \in \{TBT, SPS\} \tag{1}$$

where $C_{h,\tau}$ is the total number of classes of NTMs of type τ that are imposed globally on product h and H is the total number of six-digit HS products in sector s. This index converges to unity when the two trading partners impose TBT or SPS measures that cover different NTM classes indicating the full divergence, and it converges to zero when the two trading partners impose TBT and SPS measures in the same classes. Therefore, distance in regulatory NTM increases with this index. To calculate this measure, all trade flows including zero trade values in all six-digit tariff lines are taken into consideration. Otherwise, the measure would be biased towards available tariff lines, on which lower trade costs are presumably incurred[8].

Figure 4 presents the development of average regulatory divergence between home and host countries in the sample of study during the period 2004-2020 using the regulatory NTMs compiled from both sources. As it is observed, proliferation of regulatory NTMs over years has led to an increase in the regulatory divergence between countries. In 2004 only about 25% of non-zero trade flows were targeted by TBT notifications while the proliferation of these TBTs led to the coverage of about 49% of non-zero trade flows that were targeted by these regulatory measures. Therefore, although many countries impose NTMs on an expanding number of products over years, their objectives or their administrative use became very heterogeneous that lead to a larger regulatory divergence over years. It is important to note that this is even though many NTMs are imposed in earlier years and remain in force over years. There are not any TBTs in WTO notifications that has an end year to be disregarded from the sample of analysis. Furthermore, one can observe that the regulatory divergence in TBTs is in general larger than that in SPS measures. This is mainly because the number of affected lines by SPS measures over the period was much smaller than the number of targeted lines by TBTs. In 2004 only about 8.7% of non-zero trade values and in 2020 about 18.7% of non-zero trade values were affected by SPS measures. However, what is observed is that regulatory

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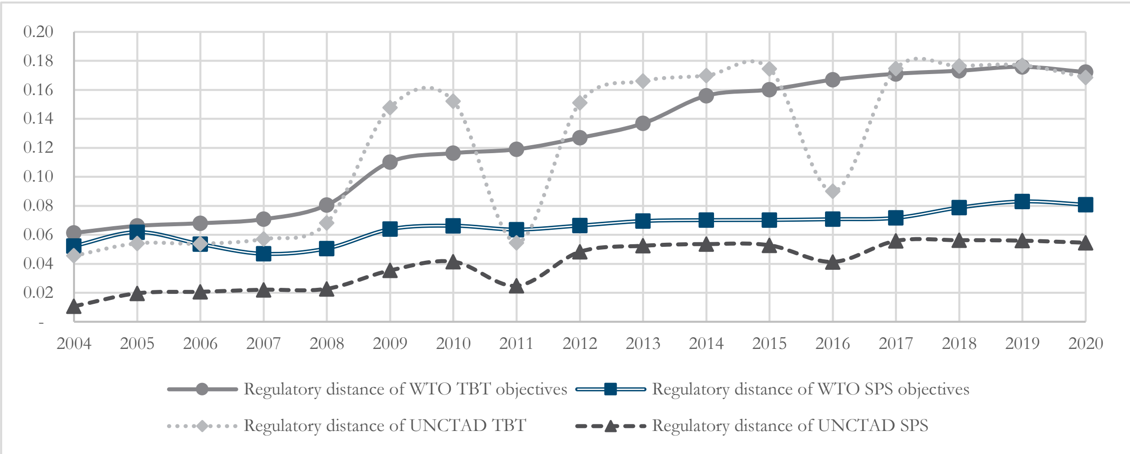
[7] Regulatory measures imposed on a six-digit product are usually of a similar nature. However, there are some other measures that are generally imposed on all products. For instance, labelling is a general TBT imposed on all goods, but its detailed information for specific goods differs. For instance, maximum residue levels (MRLs) of certain substances are unique for specific goods. For example, aflatoxin MRLs could be mostly for nuts targeted by SPS measures and the information on its compliance should be elaborated in its label mandated by a TBT. However, aflatoxin can also affect livestock feed and therefore, SPS and TBTs may also target meat or dairy products that are affected by aflatoxin along their supply chains.

[8] This means that the data are collected through a strongly balanced panel database of 198 importing countries, 238 exporting countries, 5130 six-digit products, and 17 years, which has in total 4,109,684,040 observations.

divergence in TBTs in the recent years is very similar for both data sources. However, one can observe a large drop in regulatory divergence of NTMs collected from the UNCTAD Trains. This is mainly because many regulations in this source have an ending year in 2011 and 2016. In fact, 25,588 TBTs end in 2011 and 110,340 TBTs end in 2016, which causes a large drop in regulatory divergence in TBTs. A similar pattern also exists for SPS measures indicating a drop in these two years. Due to this braking point in the data collected from UNCTAD, the data collected from WTO notifications will be used in the benchmark econometrics analysis, while the data collected from UNCTAD will be used in the robustness check.

Figure 4 - Regulatory divergence between home and host countries in the sample of study (2004-2020)



Source: WTO I-TIP, UNCTAD Trains I-TIP, authors' elaboration.

4. Empirical Methodology

The information on the sector of activity, location of firm, and location of its foreign owner will allow us to have a variable on total assets $K_{fgijs\varrho,t}$ invested in firm f and a variable on its turnover $Y_{fgijs\varrho,t}$ that is active in sector s in a host country j that is owned by a GUO g in home country i in sector ϱ in year t. As noted earlier, this includes all subsidiaries in the global economy operating in non-services sectors that have a foreign GUO that owns at least 50.01% of the ownership of the subsidiary. This is how FDI activity is defined in the analysis. These two variables will be then estimated in equations including regulatory divergence in TBTs D_{ijst}^{TBT} and in SPS measures D_{ijst}^{SPS} that are targeting the trade flows in sector s between the two trading partners i and j. Control variables are also included in the model which are the size of the subsidiary f in terms of number of its employees l_{ft} in year t; its labour productivity $prod_{ft}$ in year t; tariffs imposed by the host j on the imports in the sector s from home country i in year t as T_{jist}; tariffs imposed by the home i on the imports in the sector s from host country j in year t as T_{ijst}; three main variables derived from the theories of KC model that comprise similarity in size of the two countries GDP_{jit}^{sim}; difference in human capital of both countries HC_{jit}^{dif}, difference in capital to labour ratio of both countries KL_{jit}^{dif} in year t; and six sets of fixed effects γ as follows:

$$Y_{fgijs\varrho,t+1} = EXP\,[\gamma + \gamma_1 D_{ijst}^{TBT} + \gamma_2 D_{ijst}^{SPS} + \gamma_3 prod_{ft} \times D_{ijst}^{TBT} + \gamma_4 prod_{ft} \times D_{ijst}^{SPS} + \gamma_5 \operatorname{arc} T_{jist} + \gamma_6 \operatorname{arc} T_{ijst} + \gamma_7 prod_{ft} + \gamma_8 l_{ft} + \gamma_9 GDP_{jit}^{sim} + \gamma_{10} HC_{jit}^{dif} + \gamma_{11} KL_{jit}^{dif} + \gamma_f + \gamma_g + \gamma_{ist} + \gamma_{jst} + \gamma_{ijs} + \gamma_{\varrho t}] + \nu_{fgijs\varrho,t+1} \quad (2)$$

where instead of turnover $Y_{fgijs\varrho,t+1}$, another model is estimating capital $K_{fgijs\varrho,t+1}$ of subsidiary f in host country j in sector s that is owned by GUO g in home country i that is active in sector ϱ in year $t+1$ in equation (2); γ_f, γ_g control for the subsidiary- and GUO-fixed effects; γ_{ist}, γ_{jst}, γ_{ijs}, and $\gamma_{\varrho t}$ are respectively home-sector-time, host-sector-time, home-host-sector, and sector of GUO-time fixed effects that control for the multilateral resistance terms of trade policy measures following the gravity literature (Yotov et al., 2016). Home-sector-time, host-sector-time fixed effects also control for any other factors in the sector of home and host, respectively, such as demand and supply shocks that vary over years. Home-host-sector fixed effects control for any time-unvarying relations in the sector between the two trading partners and similarities and differences in cultural characteristics, language, history, and geographical distance. Sector of GUO-time fixed effects also control for the time-varying changes in the sector of the headquarter.

The equation suggests that the independent variables are lagged for one year to control for the potential endogeneity bias due to the simultaneity bias. Therefore, equation (2) shows us how regulatory divergence in TBT and SPS measures in achieving similar objectives affect investment decision of MNEs during the period of analysis. Since these regulatory NTMs are imposed only on trade in goods, subsidiaries operating in non-services sectors are included in the analysis. This means that agricultural, mining, and manufacturing sectors are included in the sample.

Difference in human capital HC_{jit}^{dif} is simply the logarithm of absolute value in the difference of human capital of both countries. Difference in capital endowment HC_{jit}^{dif} is simply the logarithm of absolute value in the difference of physical capital stock to number of employees of both countries. The data on these country-level variables are collected from the 2021 edition of Penn World Table 10.0[9] provided by Feenstra et al. (2015). Furthermore, the similarity in size of the two countries GDP_{jit}^{sim} is calculated as follows:

$$GDP_{jit}^{sim} = log\left[\left(\frac{GDP_i}{GDP_i + GDP_j}\right) \times \left(\frac{GDP_j}{GDP_i + GDP_j}\right)\right] \quad (3)$$

When country i and j are identical in size, similarity is maximized ($GDP_i = GDP_j \leftrightarrow GDP_i = \frac{1}{2} \times (GDP_i + GDP_j) \leftrightarrow GDP_{jit}^{sim} = \frac{1}{4}$). As discussed in the aforementioned theoretical framework, one can identify whether horizontal or vertical FDI is more dominant in the data based on the estimation results on these relative country-level variables. For instance, when the coefficient of the size similarity in GDP is positive, it would suggest the dominance of horizontal FDI. When the coefficient of the difference in the physical capital to labour ratio is positive, one can argue for the dominance of vertical FDI. Controlling for these two, when the coefficient of difference in human capital becomes positive, the abundance of vertical FDI between knowledge-intensive headquarters and subsidiaries could be concluded. Therefore, the coefficients of these variables will inform us about the dominance of types of FDI and the horizontal versus vertical GVC positioning of subsidiaries with respect to their parent. It is important to note that in about 12% of subsidiary-GUO relations in the estimated sample, the core four-digit NACE sectors of both subsidiary and GUO are identical. However, the vertical integration could take place even within this detailed four-digit sector. For example, a GUO like Mercedes Benz Group is active in the manufacture of motor vehicles (NACE 2910) that has subsidiaries in the same sector in 12 countries in the sample of our

[9] https://www.rug.nl/ggdc/productivity/pwt/?lang=en

study. However, these subsidiaries are specialised in the production of different parts and components that are used in the final assembly in another country. Thus, by using the sectors of activity one cannot easily draw a conclusion on the type of FDI or the GVC positioning of subsidiaries with respect to parent firms.

Furthermore, robustness tests will be carried out on the sample of firms with ownership of 100% share in the subsidiary where the information is available[10]. To explore various aspects of firm heterogeneity, the main variables of regulatory divergence will be interacted with the productivity variable to see how the regulatory divergence in NTMs could affect decision of foreign MNEs to increase the total assets of their subsidiaries or to boost their turnover. This may explain better how the mechanisms behind NTM-FDI linkages could work across different types of firms. Furthermore, robustness checks will be run on the sample of firms active in a separate group of sectors based on their technology intensity in addition to the agricultural sector. The definitions of technology intensity of sectors at NACE two-digit level are borrowed from Eurostat[11]. Furthermore, as noted above, because of harmonization and mutual recognitions of regulations and standards within the EU, intra-EU relations are excluded from the sample of analysis. Robustness checks including intra-EU relations are available from the authors upon request.

The model is estimated using Poisson pseudo-maximum likelihood (PPML) estimation technique following the gravity literature (Yotov et al., 2016; Santos Silva and Tenreyro, 2006; and Correia et al., 2019a,b). This estimation technique is robust against heteroscedasticity. Furthermore, since there are zero and positive values in the dependent variables, this technique is the most appropriate technique applied in the literature (Mullahy and Norton, 2022). The estimation sample includes more than 100 zero values in total assets and more than 1000 zero values in turnover. Additionally, PPML works with high-dimensional fixed effects efficiently (Correia, et al. 2020) as equation (2) includes many sets of fixed effects.

In a robustness check, the sample of estimation excludes all ownership relationships between the subsidiary and the foreign GUO that is done through a merger and acquisition (M&A) deal during the period. The data on M&A deals between the two firms are downloaded from Amadeus and Orbis Crossborder Investment databases that are provided by Bureau Van Dijk Electronic Publishing GmbH. These results are reported in Table A7 in the appendix.

Furthermore, countries may pursue economic integration via preferential trade agreements (PTAs). In fact, some PTAs have special provisions on TBTs and SPS measures that lead to harmonization, mutual recognition, or ease of conformity assessment between signatories, which stimulates trade and integration in value chains. In a robustness check, PTAs with provisions on TBT and SPS measures are included in the analysis. These variables are also interacted with the TBT and SPS divergence to infer conclusions. The results of these robustness checks are shown in Table A8 in the appendix. Data on deep PTAs is borrowed from the World Bank Deep Preferential Trade Agreements database (Hofmann et al., 2017) and updated for more recent years by the authors. The maximum value of this variable in the data equals 4, which is for EU member states indicating four different agreements that were signed over time which deepened the integration between these countries.

In another set of robustness checks, the estimations are run on the samples of country-pair groups. Country-pair groups are based on the host-home relations. Country groups are separated into developed, developing,

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[10] For some firms, ownership information is not available, but Orbis identifies that the major share of the subsidiary firm (i.e. more than 50.01%) is owned by the GUO either directly or indirectly through another subsidiary.

[11] https://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf

Association of Southeast Asian Nations (ASEAN), and the whole world. Developed economies are all EU-27 plus OECD countries excluding Columbia, Costa Rica, and Mexico. 10 ASEAN members can be found also on the website of ASEAN[12]. The results of estimations on the samples of these country-pair groups are reported in Table A9 in the appendix.

In addition to PPML, robustness tests are run using the normal OLS and difference GMM (Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998; Roodman, 2009; Hayakawa, 2009). However, as the dependent variables include zero values, arcsine log transformation is used instead of natural logarithm following the literature (Mullahy and Norton, 2022). Furthermore, one could be interested in the flows of FDI rather than FDI stocks measured in total assets of the subsidiaries. Therefore, in additional estimated specifications, the arcsine log transformation of the first difference in total assets of the subsidiaries is used as the dependent variable. Furthermore, to control for the potential endogeneity bias, a difference GMM is used to estimate both total assets and turnover of subsidiaries. The results on these robustness checks are reported in Table A10 in the appendix.

5. Estimation results

In this section we discuss the following sets of our estimation results. First, we report our baseline results for the full sample of firms from all non-services industries in Table 1. Then, in Tables 2-6 we discuss the estimation results obtained for specific manufacturing sectors composed of two-digit industries that differ with respect to technology intensity: i) high-tech, ii) medium high-tech, iii) medium low-tech and iv) low tech and agricultural sectors.

In the first column of Table 1 we report the estimation results obtained from the specification in which we used total turnover of foreign affiliates as our main measure of multinational activity. In particular, it turns out that the TBT distance variable is statistically significant at the 1% level and displays the expected negative sign. At the same time, the SPS distance variable is significant at the 10% level and also displays the expected negative sign. This means that our first measure of multinational activity is negatively associated with bigger regulatory divergence in terms of both TBT and SPS. In other words, according to the coefficient of the first column to the left in Table 1, when a full convergence in regulatory TBT on a given bilateral sector (i.e. $D_{ijst}^{TBT} = 0$) turns into a full divergence (i.e., $D_{ijst}^{TBT} = 1$), it is expected that the turnover of foreign subsidiary to decrease by 1.64%[13], while according to the second column, it is expected to decrease the total assets of that subsidiary by about 7.65%[14]. Such a reduction in FDI activity in foreign-owned subsidiaries that are active in the GVC network of MNEs could be either due to the increased trade costs or fixed costs of technological change or/and bureaucratic procedures induced by regulatory divergence as described in Ghodsi (2023). The interaction terms between firm productivity and the TBT and SPS distance variables are positive and statistically significant at the 1 and 10% levels, respectively. This means that the more productive firms are, the more able are to overcome problems associated with both the TBT and SPS divergence. The estimated parameters on the home and host country tariffs display positive signs and are statistically significant at 5 and 10% levels, respectively. These results support the horizontal nature of multinational activity. Both firm productivity and employment variables display positive signs and are

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[12] https://asean.org/member-states/

[13] That is equal to $100 \times (exp^{-4.11})$.

[14] That is equal to $100 \times (exp^{-2.57})$.

statistically significant at the 1% level. This suggests that more productive and larger firms are more involved in international production. The estimated parameter on the GDP similarity measure is positive and statistically significant at the 5% level which supports the horizontal nature of multinational activity. Finally, the difference in relative human capital endowments is statistically significant at the 5% level while the estimated parameter on the capital to labour ratio is not statistically significant at any of the usually accepted levels of significance. This means that only human capital endowment seems to matter for vertical multinational activity.

Table 1 – Benchmark estimation results on total assets and turnover of global foreign-owned subsidiaries in non-services sectors, 2004-2020, using WTO NTM notifications

Dep. var.:	$Y_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$	$Y^{100\%}_{fgijs\varrho,t+1}$	$K^{100\%}_{fgijs\varrho,t+1}$
D^{TBT}_{ijst}	-4.11***	-2.57***	-3.49***	-2.55***
	(0.82)	(0.50)	(0.73)	(0.57)
D^{SPS}_{ijst}	-1.19*	-0.025	-0.26	0.86
	(0.72)	(0.57)	(0.95)	(0.76)
$prod_{ft} \times D^{TBT}_{ijst}$	0.46***	0.25***	0.40***	0.23***
	(0.088)	(0.052)	(0.075)	(0.057)
$prod_{ft} \times D^{SPS}_{ijst}$	0.10*	-0.026	0.13**	-0.016
	(0.058)	(0.034)	(0.059)	(0.032)
$\text{arc}\,T_{ijst}$	0.14*	0.16**	0.67***	1.02***
	(0.082)	(0.075)	(0.24)	(0.22)
$\text{arc}\,T_{jist}$	0.28**	0.33***	0.019	1.03***
	(0.12)	(0.12)	(0.28)	(0.33)
$prod_{ft}$	0.17***	0.040***	0.20***	0.035***
	(0.028)	(0.012)	(0.016)	(0.010)
l_{ft}	0.46***	0.18***	0.49***	0.12***
	(0.029)	(0.015)	(0.023)	(0.026)
GDP^{sim}_{jit}	0.14**	0.13	0.21*	0.19
	(0.064)	(0.095)	(0.11)	(0.12)
HC^{dif}_{jit}	0.015**	0.023***	0.019*	0.014*
	(0.0063)	(0.0061)	(0.011)	(0.0085)
KL^{dif}_{jit}	-0.0058	-0.021***	-0.0016	-0.0096
	(0.0044)	(0.0058)	(0.0071)	(0.0070)
Constant	18.0***	20.8***	17.4***	20.1***
	(0.41)	(0.32)	(0.36)	(0.36)
Observations	165262	164436	64785	64635
Pseudo R-squared	0.989	0.990	0.987	0.990
AIC	1.21429e+12	1.18961e+12	3.81645e+11	2.60726e+11

Robust Standard errors in parentheses: * p<0.1; ** p<0.05; *** p<0.01

Estimations include subsidiary γ_f, GUO γ_g, home-sector-time γ_{ist}, host-sector-time γ_{jst}, home-host-sector γ_{ijs}, and sector of GUO-time $\gamma_{\varrho t}$ fixed effects.

In the second column we report the estimation results obtained from the specification in which we used the alternative measure of multinational activity, i.e. the value of total assets. In this case there are some notable differences compared to the first set of results. In particular, it turns out that now only the TBT divergence variable is statistically significant at the 1% level and displays the expected negative sign while the SPS divergence variable is no longer statistically significant. The interaction term between the TBT distance and firm productivity remains statistically significant at the 1% level and displays the expected positive sign. At the same time, the interaction term between the SPS divergence and firm productivity is no longer significant. The estimated parameters on both home and host country tariffs display positive signs and are statistically significant at 1 and 5% levels. Both firm productivity and employment display positive signs and remain statistically significant at the 1% levels. The GDP similarity measure is not statistically significant. Both measures of differences in relative factor endowments are statistically significant at the 1% level, however, the difference in capital to labour ratio displays a counterintuitive negative sign.

In third and fourth columns we report estimation results obtained for the subsample of firms that are 100% foreign owned. These columns are the direct counterparts of the first and the second columns. In both cases we can note that only the TBT divergence variable is statistically significant at the 1% level and displays the expected negative sign while the SPS divergence variable is not statistically significant. The interaction term between the TBT divergence and firm productivity is statistically significant at the 1% level and displays the expected positive sign in both columns. However, the interaction term between the SPS distance and firm productivity is significant only in the third column where the dependent variable is the volume of sales of subsidiaries which is similar to the result reported in the first column. Interestingly, the estimation results show that the parameters on the home and host country tariffs display the positive signs and are both statistically significant only when the dependent variable is the value of total assets. Similar to the results reported in the first two columns the firm productivity and employment display positive signs and are significant at the 1% level. The GDP similarity measure is statistically significant only when the dependent variable is the volume of sales which is similar to the result reported in the first column. Finally, the difference in relative human capital endowments is statistically significant at the 10% level in both columns while the estimated parameter on the capital to labour ratio is not statistically significant in any of the columns. This means that vertical multinational activity is driven only by the relative human capital endowments.

Estimation results using the regulatory divergence in administrative and procedural NTM classes defined by MAST on the whole sample of foreign-owned subsidiaries in non-services sectors are presented in Table A5 in the appendix. As it is observed, the results are generally similar to the results presented in Table 1. However, the variables on regulatory divergence in TBTs and SPS measures are not statistically significant on the sample of all firms. The variable of regulatory divergence in TBTs is negative and statistically significant at 1% level when the sample includes only subsidiaries with 100% ownership share for both turnover and total assets. The variable of regulatory divergence in SPS measures is positive and statistically significant at 5% level for total assets of firms owned 100% by foreign MNEs, which indicates a tariff-jumping motive behind these procedural and administrative SPS measures. The interaction between the regulatory divergence in TBTs and productivity of the subsidiary is statistically significant and positive, for the models including firms with 100% foreign ownership. This indicates, that when the productivity of subsidiary increases, the firm will be able to comply with procedural and administrative TBTs and thus increase its turnover and total assets of, compensate some parts of the direct negative impact of regulatory divergence in TBTs. The results for other variables remain very similar to results presented in Table 1.

Table A6 in the appendix presents the results of the benchmark estimation when labour productivity is not interacted with the regulatory divergence variables. It indicates that the variables of regulatory divergence in either of the two NTMs are statistically insignificant. Since the Akaike information criteria (AIC) has much smaller statistics in the models presented in Table 1, the results including the interaction terms are econometrically preferred over the results excluding them. This suggests the importance of firm heterogeneity and labour productivity of foreign-owned subsidiaries in defining their turnover and total assets in response to regulatory divergence.

Table A7 in the appendix reports the estimation results on total assets and turnover of global foreign-owned subsidiaries in non-services sectors excluding M&A deals relations. The sample size shrinks slightly after the exclusion of M&A deal relations during the period. However, the results remain consistent with the benchmark results shown in Table 1.

Table A8 shows the estimation results on total assets and turnover of global foreign-owned subsidiaries in non-services sectors, including PTAs with NTM provisions. While these results remain consistent with the benchmark results, one can observe that deep PTAs with TBT provisions stimulate total assets of foreign subsidiaries while deeper PTAs with SPS provisions reduce the total assets of foreign subsidiaries in a statistically significant way. These effects are less significant for turnover of foreign subsidiaries. Furthermore, the interaction of PTA with NTM variables indicate that when countries have deeper integration with PTAs with TBT provisions, the divergence in their regulatory TBTs causes larger negative impact on FDI than the main effect of TBT convergence on total assets shown in the first row. This negative impact is partially reduced by the larger productivity of the subsidiary. This indicates that when global value chains are negatively affected by regulatory divergence in TBTs leading to smaller total assets or turnover of subsidiaries, firms with larger productivity may reduce some parts of such a negative impact. However, the net effect of regulatory divergence remains negative and larger, especially for countries integrated by deeper PTAs.

Table A9 in the appendix displays the estimation results on total assets and turnover of global foreign-owned subsidiaries in non-services sectors by country-pair groups. For the estimations on turnover, the coefficient of regulatory divergence in TBTs is significant and negative only for developed host economies and developing home economies with a much larger magnitude than the benchmark estimation presented in Table 1. Again, a larger productivity of the subsidiary reduces this negative impact partially. The regulatory divergence in TBTs has a significant positive impact on the turnover of global subsidiaries of GUOs originated in ASEAN countries. Furthermore, the tariffs imposed by the home country in ASEAN against the host country has a negative impact on total assets of the subsidiaries, which shows that investment increases when trade costs to the headquarter increases that is not in line with the vertical integration in production[15]. A similar pattern is observed on the positive impact of the divergence in SPS measures on the turnover of subsidiaries of GUOs in ASEAN. This indicates a tariff jumping FDI by ASEAN MNEs investing in other parts of the world. Such a horizontal FDI by ASEAN MNEs is also acknowledged by the strong positive coefficient of size similarity. One could also observe that subsidiaries of ASEAN MNEs with larger productivity could better circumvent the trade barriers related to the regulatory divergence in both types of NTMs, which reduces their turnover due to tariff jumping motives. It is important to note that a similar pattern is observed for the total assets of subsidiaries owned by GUOs located in ASEAN. However, regulatory divergence in TBTs shows negative and significant coefficients on total assets of subsidiaries in both developed and developing economies when their GUOs are in the developed economies. This indicates the importance of the vertical integration in GVCs of such FDI relations. The regulatory divergence in SPS measures, however, acts as tariff jumping motive for the total assets of subsidiaries in developing economies when the GUOs are in the developed economies, while the opposite is the case for the total assets of firms in developed economies that are owned by the GUOs in developed economies.

[15] These GUOs are in Indonesia with 11 firms, Malaysia with 61 firms, Philippines with 9 firms, Singapore with 142 firms, Thailand with 54 firms, and Vietnam with 30 firms. Furthermore, 22 countries out of which four are among ASEAN are the hosts of 529 foreign subsidiaries in the sample of this estimation. Majority of subsidiaries are in China with 220 subsidiaries, in Vietnam with 89 subsidiaries, in Russia with 80 subsidiaries, and in Great Britain with 47 subsidiaries. The positive significant coefficients of regulatory divergence in both TBTs and SPS measures indicate that the FDI originated in ASEAN is dominated by horizontal FDI rather than vertical. However, only 28% of the subsidiaries in the sample are active in the same two-digit NACE sectors as their GUO's sectors of activity. This may additionally suggest that although the sectors of the subsidiaries and GUOs are different for 72% of the sample, they are still horizontal FDI. This means that the increased regulatory divergence leads to more investment in the subsidiaries to comply with such regulations, which also leads to larger turnover due to larger demand for the products with higher quality. The aggregated total assets of subsidiaries of ASEAN GUOs averaged over the period 2010-2020 stands at USD 42.12 billion while the turnover stands at USD 38.4 billion.

Finally, Table A10 presents the robustness estimation results on total assets and turnover of global foreign-owned subsidiaries in non-services sectors using OLS and GMM. While the regulatory divergence in TBTs has a negative impact on total assets of all non-services subsidiaries like in Table 1, it has a positive impact on their turnover. Furthermore, regulatory divergence in SPS measures now has a positive impact on total assets of subsidiaries. For the total assets of subsidiaries with 100% ownership by foreign GUOs, regulatory divergence in TBTs has a negative coefficient, which is statistically significant at 5% level. Column five and column six from the left show the estimation results on the flows of FDI or the change in total assets of subsidiaries of all non-services firms and those with 100% ownership, respectively. One can also observe that the R-squared for flows of FDI is much smaller than the FDI in levels. Regulatory divergence in neither type of NTMs has any significant impact on flows of FDI. However, the interaction of productivity and these regulatory measures yield significant coefficients. The last two columns in Table A10 presents the results of GMM estimations on turnover and total assets of all non-services subsidiaries. As it is observed, regulatory divergence in TBTs has a negative impact on total assets, which is statistically significant at only 10% level. This negative impact is reduced partially when the subsidiary is more productive.

5.1. Heterogenous results across sectors

In the remaining tables we report the estimation results obtained for specific manufacturing sectors that differ with respect to technology intensity and the agricultural sector. These results reveal a great deal of heterogeneity across the sectors. In most of these results, the variable of regulatory divergence is statistically significant and negative like the results for all manufacturing sectors. However, the impact becomes statistically insignificant for the sectors with lower technology. This indicates that divergence in TBTs is more costly for high-tech and most importantly for medium-high tech sectors as shown in Table 2 and Table 3.

Table 2 – Estimation results on total assets and turnover of global foreign-owned subsidiaries in high-tech manufacturing sectors, 2004-2020, using WTO NTM notifications

Dep. var.:	$Y_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$	$Y^{100\%}_{fgijs\varrho,t+1}$	$K^{100\%}_{fgijs\varrho,t+1}$
D^{TBT}_{ijst}	-7.61***	-5.61**	-3.03	0.74
	(1.96)	(2.25)	(1.93)	(1.81)
D^{SPS}_{ijst}	-3.94*	-1.24	-6.64**	-7.87***
	(2.08)	(1.64)	(3.10)	(2.57)
$prod_{ft} \times D^{TBT}_{ijst}$	0.78***	0.35	0.47***	0.041
	(0.19)	(0.22)	(0.15)	(0.11)
$prod_{ft} \times D^{SPS}_{ijst}$	0.22	0.029	0.078	0.091
	(0.14)	(0.12)	(0.17)	(0.13)
$\mathrm{arc}\,T_{ijst}$	-3.29**	-2.46	-2.03	1.38
	(1.48)	(2.19)	(2.32)	(1.97)
$\mathrm{arc}\,T_{jist}$	1.67*	-0.27	-0.034	0.84
	(0.97)	(0.92)	(1.25)	(1.14)
$prod_{ft}$	0.089*	0.015	0.19***	0.099***
	(0.047)	(0.055)	(0.036)	(0.026)
l_{ft}	0.43***	0.17***	0.47***	0.16***
	(0.038)	(0.022)	(0.041)	(0.020)
GDP^{sim}_{jit}	0.54***	0.52***	0.42	1.26***
	(0.16)	(0.20)	(0.30)	(0.33)
HC^{dif}_{jit}	0.028	0.016	0.14***	0.11***
	(0.022)	(0.016)	(0.046)	(0.025)
KL^{dif}_{jit}	-0.0071	-0.044***	-0.0051	0.049*
	(0.015)	(0.015)	(0.026)	(0.026)

Dep. var.:	$Y_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$	$Y^{100\%}_{fgijs\varrho,t+1}$	$K^{100\%}_{fgijs\varrho,t+1}$
Constant	20.6***	23.6***	18.7***	21.6***
	(0.81)	(0.89)	(1.10)	(1.07)
Observations	19218	18809	8417	8197
Pseudo R-squared	0.984	0.987	0.979	0.980
AIC	4.49417e+11	3.39011e+11	1.76075e+11	8.82273e+10

Robust Standard errors in parentheses: * p<0.1; ** p<0.05; *** p<0.01

Estimations include subsidiary γ_f, GUO γ_g, home-sector-time γ_{ist}, host-sector-time γ_{jst}, home-host-sector γ_{ijs}, and sector of GUO-time $\gamma_{\varrho t}$ fixed effects.

According to Table A11 in the appendix, the total assets of foreign-owned firms of the high-tech sectors and medium-high tech sectors in the sample are the largest across all sectors. In fact, the foreign owned firms in manufacture of high-tech computer, electronic and optical products or the digital manufacturing sector that is an important engine of the modern economy are invested by total USD 572 billion per annum, which is more than 15% of the total assets in the sample of study. The foreign-owned firms in this high-tech sector earn also the largest amount of total turnover of USD 823 billion which is about 22.5% of the turnover of the whole sample per annum. In terms of employment foreign subsidiaries in this sector employs the largest amount of 3.5 million employees that is about 28% of the employment per year in the whole sample. These indicators show the importance of the high-tech and medium-high tech sectors, which are significantly affected by the regulatory divergence in TBTs. Furthermore, as Table 3 shows, the negative impact of regulatory divergence in TBTs on turnover and total assets of foreign-owned subsidiaries is partially offset by larger productivity of subsidiaries. This is especially the case in the medium-high-tech manufacturing sectors such as the manufacture of motor vehicles, trailers and semi-trailers.

Table 3 – Estimation results on total assets and turnover of global foreign-owned subsidiaries in medium-high-tech manufacturing sectors, 2004-2020, using WTO NTM notifications

Dep. var.:	$Y_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$	$Y^{100\%}_{fgijs\varrho,t+1}$	$K^{100\%}_{fgijs\varrho,t+1}$
D^{TBT}_{ijst}	-3.26**	-3.86***	-3.29***	-2.50***
	(1.32)	(0.82)	(0.87)	(0.68)
D^{SPS}_{ijst}	3.06	0.098	2.23	5.02**
	(2.76)	(1.47)	(2.60)	(2.20)
$prod_{ft} \times D^{TBT}_{ijst}$	0.39***	0.36***	0.41***	0.22***
	(0.15)	(0.092)	(0.090)	(0.074)
$prod_{ft} \times D^{SPS}_{ijst}$	-0.17	-0.19**	-0.16	-0.17*
	(0.26)	(0.095)	(0.12)	(0.088)
$\text{arc}T_{ijst}$	-0.71	-0.32	1.58*	1.54**
	(0.58)	(0.53)	(0.83)	(0.65)
$\text{arc}T_{jist}$	0.27	1.29***	-0.11	1.52***
	(0.45)	(0.42)	(0.62)	(0.56)
$prod_{ft}$	0.19***	0.020	0.20***	0.018
	(0.041)	(0.016)	(0.021)	(0.017)
l_{ft}	0.52***	0.19***	0.53***	0.10**
	(0.031)	(0.044)	(0.023)	(0.045)
GDP^{sim}_{jit}	-0.19**	-0.15	0.089	-0.60***
	(0.086)	(0.095)	(0.13)	(0.14)
HC^{dif}_{jit}	0.022***	0.023***	0.0056	-0.0069
	(0.0081)	(0.0086)	(0.0098)	(0.010)
KL^{dif}_{jit}	-0.0076	-0.012*	-0.0036	-0.029***
	(0.0065)	(0.0073)	(0.0088)	(0.0089)
Constant	16.5***	19.7***	16.8***	18.5***
	(0.59)	(0.41)	(0.40)	(0.42)
Observations	56189	55007	21941	21501
Pseudo R-squared	0.987	0.987	0.988	0.988
AIC	3.72432e+11	3.67447e+11	1.13193e+11	9.09405e+10

Robust Standard errors in parentheses: * p<0.1; ** p<0.05; *** p<0.01

Dep. var.:	$Y_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$	$Y^{100\%}_{fgijs\varrho,t+1}$	$K^{100\%}_{fgijs\varrho,t+1}$

Estimations include subsidiary γ_f, GUO γ_g, home-sector-time γ_{ist}, host-sector-time γ_{jst}, home-host-sector γ_{ijs}, and sector of GUO-time $\gamma_{\varrho t}$ fixed effects.

Regulatory divergence in SPS measures affects negatively turnover and total assets of foreign owned subsidiaries with 100% foreign ownership in a statistically significant manner. They also negatively affect the turnover of foreign-owned subsidiaries in medium-low-tech manufacturing sectors in a statistically significant way as shown in Table 4.

Table 4 – Estimation results on total assets and turnover of global foreign-owned subsidiaries in medium-low-tech manufacturing sectors, 2004-2020, using WTO NTM notifications

Dep. var.:	$Y_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$	$Y^{100\%}_{fgijs\varrho,t+1}$	$K^{100\%}_{fgijs\varrho,t+1}$
D^{TBT}_{ijst}	-2.73*	-1.19	-1.76	1.74
	(1.64)	(1.59)	(1.84)	(1.61)
D^{SPS}_{ijst}	-13.7***	-2.14	-13.9***	-0.71
	(3.33)	(2.64)	(4.80)	(3.10)
$prod_{ft} \times D^{TBT}_{ijst}$	0.29*	0.12	0.0092	0.094
	(0.17)	(0.15)	(0.17)	(0.085)
$prod_{ft} \times D^{SPS}_{ijst}$	1.94***	-0.18	1.42***	-0.64***
	(0.37)	(0.22)	(0.52)	(0.19)
$\text{arc}\,T_{ijst}$	0.84	1.60**	3.14***	0.82
	(0.61)	(0.63)	(0.79)	(0.76)
$\text{arc}\,T_{jist}$	-0.078	-0.82*	0.38	0.17
	(0.44)	(0.47)	(0.72)	(0.79)
$prod_{ft}$	0.071	0.036	0.20***	0.038***
	(0.058)	(0.026)	(0.050)	(0.014)
l_{ft}	0.31***	0.076***	0.52***	0.067***
	(0.095)	(0.021)	(0.043)	(0.015)
GDP^{sim}_{jit}	0.14	-0.26*	0.34*	-0.084
	(0.12)	(0.15)	(0.18)	(0.21)
HC^{dif}_{jit}	-0.019**	0.041***	-0.048***	-0.032**
	(0.0092)	(0.010)	(0.013)	(0.016)
KL^{dif}_{jit}	0.00073	-0.028***	0.019**	0.0061
	(0.0076)	(0.0087)	(0.0095)	(0.012)
Constant	19.1***	20.4***	17.2***	19.1***
	(0.92)	(0.47)	(0.68)	(0.50)
Observations	33468	33296	13372	13326
Pseudo R-squared	0.991	0.992	0.990	0.993
AIC	1.54958e+11	1.81350e+11	3.46375e+10	2.68665e+10

Robust Standard errors in parentheses: * p<0.1; ** p<0.05; *** p<0.01

Estimations include subsidiary γ_f, GUO γ_g, home-sector-time γ_{ist}, host-sector-time γ_{jst}, home-host-sector γ_{ijs}, and sector of GUO-time $\gamma_{\varrho t}$ fixed effects.

Regulatory divergence in SPS measures increases total assets of subsidiaries with 100% foreign ownerships in medium-high-tech manufacturing sectors and low-tech manufacturing sectors in a statistically significant manner as shown in Table 5. This motivates the tariff-jumping hypothesis behind regulatory divergence in SPS measures which usually pursue hygiene objectives. It is no coincidence that low-tech manufacturing sectors such as manufacture of food products that provide consumer goods should be affected positively by regulatory divergence in SPS measures. One would expect that SPS measures are dominantly imposed on agricultural and food products. However, these measures are also imposed on manufactured goods. As Figure A7 in the appendix also shows, regulatory divergence in SPS measures is also large and dominant in the manufacture of basic pharmaceutical products, which is a high-tech sector. The manufacture of chemicals and chemical products is also targeted by large number of SPS measures that increases the regulatory divergence in this set of goods.

Table 5 – Estimation results on total assets and turnover of global foreign-owned subsidiaries in low-tech manufacturing sectors, 2004-2020, using WTO NTM notifications

Dep. var.:	$Y_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$	$Y^{100\%}_{fgijs\varrho,t+1}$	$K^{100\%}_{fgijs\varrho,t+1}$
D^{TBT}_{ijst}	-1.80	-0.099	-4.29***	-0.46
	(1.65)	(0.81)	(1.62)	(0.93)
D^{SPS}_{ijst}	0.31	1.37**	1.15	1.99***
	(0.73)	(0.61)	(1.08)	(0.77)
$prod_{ft} \times D^{TBT}_{ijst}$	0.17	0.0052	0.38**	0.000014
	(0.17)	(0.084)	(0.17)	(0.088)
$prod_{ft} \times D^{SPS}_{ijst}$	-0.063	-0.13***	-0.0018	-0.10***
	(0.059)	(0.045)	(0.072)	(0.038)
arc T_{ijst}	0.15*	0.16**	0.72***	0.99***
	(0.083)	(0.074)	(0.25)	(0.24)
arc T_{jist}	0.14	0.18*	-0.23	1.53***
	(0.10)	(0.10)	(0.22)	(0.40)
$prod_{ft}$	0.31***	0.17***	0.24***	0.11***
	(0.020)	(0.014)	(0.024)	(0.014)
l_{ft}	0.58***	0.29***	0.44***	0.15***
	(0.037)	(0.016)	(0.034)	(0.017)
GDP^{sim}_{jit}	0.49***	0.035	0.26	0.20
	(0.12)	(0.15)	(0.21)	(0.19)
HC^{dif}_{jit}	0.0040	0.015	-0.030	-0.023
	(0.012)	(0.013)	(0.024)	(0.023)
KL^{dif}_{jit}	-0.0052	-0.0043	-0.0045	0.014
	(0.0077)	(0.0098)	(0.015)	(0.016)
Constant	16.8***	18.1***	16.9***	18.3***
	(0.40)	(0.42)	(0.60)	(0.51)
Observations	39786	39727	14979	14989
Pseudo R-squared	0.991	0.991	0.992	0.994
AIC	1.32262e+11	1.43726e+11	3.26428e+10	2.42464e+10

Robust Standard errors in parentheses: * p<0.1; ** p<0.05; *** p<0.01

Estimations include subsidiary γ_f, GUO γ_g, home-sector-time γ_{ist}, host-sector-time γ_{jst}, home-host-sector γ_{ijs}, and sector of GUO-time $\gamma_{\varrho t}$ fixed effects.

Estimation results on total assets and turnover of global foreign-owned subsidiaries in agricultural sectors are reported in Table 6. These results show that the regulatory divergence in SPS measures is more important than TBT measures. Such a divergence leads to lower turnover and total assets of subsidiaries in a very significant manner when all agricultural firms are included in the sample. However, larger productivity could reduce such a negative impact only on turnover of subsidiaries. When the sample shrinks to subsidiaries with 100% ownership, divergence in SPS measures cause a tariff jumping motive for FDI in agricultural firms. Furthermore, there is a significant positive impact of regulatory divergence in TBT measures on total assets of firms in agricultural sectors, which indicates a tariff jumping motive behind FDI.

Table 6 – Estimation results on total assets and turnover of global foreign-owned subsidiaries in agricultural sectors, 2004-2020, using WTO NTM notifications

Dep. var.:	$Y_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$	$Y^{100\%}_{fgijs\varrho,t+1}$	$K^{100\%}_{fgijs\varrho,t+1}$
D^{TBT}_{ijst}	-0.60	3.25**	-3.39	2.32
	(1.82)	(1.57)	(3.56)	(2.31)
D^{SPS}_{ijst}	-8.79***	-6.04***	8.04***	3.78**
	(2.01)	(2.29)	(2.70)	(1.71)
$prod_{ft} \times D^{TBT}_{ijst}$	0.049	-0.21	0.52	-0.28
	(0.21)	(0.18)	(0.42)	(0.30)
$prod_{ft} \times D^{SPS}_{ijst}$	0.87***	0.27	-0.034	0.022
	(0.19)	(0.22)	(0.26)	(0.13)
arc T_{ijst}	1.28	3.40***	-3.05**	-2.91***
	(1.24)	(1.16)	(1.39)	(1.09)
arc T_{jist}	-1.04	3.03*	-15.9***	-0.88

Dep. var.:	$Y_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$	$Y^{100\%}_{fgijs\varrho,t+1}$	$K^{100\%}_{fgijs\varrho,t+1}$
	(1.90)	(1.61)	(3.12)	(1.90)
$prod_{ft}$	0.17***	0.072	0.13**	0.11**
	(0.045)	(0.050)	(0.060)	(0.046)
l_{ft}	0.58***	0.16***	0.57***	0.14***
	(0.031)	(0.037)	(0.069)	(0.046)
GDP^{sim}_{jit}	-0.58**	-1.29***	0.28	2.16***
	(0.29)	(0.49)	(0.89)	(0.81)
HC^{dif}_{jit}	-0.013	0.022	0.48**	0.47***
	(0.085)	(0.083)	(0.19)	(0.14)
KL^{dif}_{jit}	-0.061***	-0.068***	0.18**	0.038
	(0.023)	(0.017)	(0.079)	(0.052)
Constant	15.5***	15.3***	14.1***	21.3***
	(0.93)	(1.47)	(2.58)	(2.16)
Observations	11342	11893	4267	4553
Pseudo R-squared	0.987	0.974	0.991	0.984
AIC	9.21007e+09	2.66007e+10	1.11280e+09	2.28264e+09

Robust Standard errors in parentheses: * p<0.1; ** p<0.05; *** p<0.01

Estimations include subsidiary γ_f, GUO γ_g, home-sector-time γ_{ist}, host-sector-time γ_{jst}, home-host-sector γ_{ijs}, and sector of GUO-time $\gamma_{\varrho t}$ fixed effects.

6. Conclusion and policy implications

In this paper we study the effects of international regulatory convergence in non-tariff measures on cross-border investment of multinational firms. In particular, we verified two main research hypotheses derived from the modified knowledge capital model of multinational enterprise. The first hypothesis postulated that when regulatory divergence with numerous regulatory measures in the destination emerges, trade cost also increases that stimulate horizontal multinational activity. The second hypothesis stated that regulatory convergence could reduce trade costs between the two trading partners that facilitates vertical multinational activity. To verify these hypotheses, we used firm level data from the Orbis database for the recent 2004-2020 period and the PPML estimation technique of gravity model. Our estimation results for the full sample of foreign-owned firms active in all non-services sectors shows that bigger regulatory divergence is negatively associated with the extent of multinational activity. In addition, TBT convergence seemed more important than SPS measure convergence. Moreover, more productive firms were more able to overcome problems associated with both the TBT and SPS distances. Finally, we found significant heterogeneity across sectors that vary according to technology intensity.

The empirical evidence in this paper provides informative insights to policymakers. Regulatory NTMs such as TBTs and SPS measures are frequently used by policymakers to regulate the importing markets when the market fails to automatically adjust for negative externalities related to bad products or harmful production procedures. The study shows that due to the proliferation of both TBT and SPS measures with heterogenous objectives or procedural characteristics, divergence in these regulatory measures have increased over years. Such a divergence has indeed resulted in less FDI. Total assets and turnover of foreign-owned subsidiaries in non-services sectors that are heavily involved in the global value chains (GVCs) have been affected negatively by the divergence in these regulatory NTMs. This regulatory divergence has effectively disturbed the sourcing of intermediate inputs of production across the GVC that resulted in less vertical FDI across the globe. To improve the linkages across GVCs and to stimulate vertical FDI, policymakers are advised to pursue harmonization of standards that reduce the divergence in regulatory NTMs. As the evidence presented here indicates, when a full divergence in TBTs imposed on bilateral sector turns into a full convergence, one should expect that the total assets of foreign-owned subsidiaries to increase by 7.65%.

This impact is reported to be heterogenous across sectors based on their technology-intensity. Furthermore, productivity of the foreign-owned subsidiary could also reduce the negative impact of regulatory divergence on the activities of the foreign-owned firms. This provides an additional guidance to the policymakers. In fact, competitiveness of these firms should be additionally supported by providing training and education to their employees, or to by encouraging innovation.

References

Adarov, A., & Ghodsi, M. (2022). Heterogeneous effects of nontariff measures on cross-border investments: Bilateral firm-level analysis. Review of International Economics, 2022. https://doi.org/10.1111/roie.12621

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. The review of economic studies, 58(2), 277-297.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. Journal of econometrics, 68(1), 29-51.

Bao, X., & Qiu, L. D. (2010). Do technical barriers to trade promote or restrict trade? Evidence from China. Asia-Pacific Journal of Accounting & Economics, 17(3), 253-278.

Bao, X., & Qiu, L. D. (2012). How do technical barriers to trade influence trade?. Review of International Economics, 20(4), 691-706.

Beghin, J. C., Disdier, A. C., & Marette, S. (2015). Trade restrictiveness indices in the presence of externalities: An application to non-tariff measures. Canadian Journal of Economics/Revue canadienne d'économique, 48(4), 1513-1536.

Bergstrand, J. H., & Egger, P. (2007). A knowledge-and-physical-capital model of international trade flows, foreign direct investment, and multinational enterprises. Journal of International Economics, 73(2), 278-308.

Bergstrand, J. H., & Egger, P. (2013). Shouldn't physical capital also matter for multinational enterprise activity?. Review of International Economics, 21(5), 945-965.

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.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. Journal of econometrics, 87(1), 115-143.

Blyde, J. S. (2022). Your assessment is welcome here: the trade impacts of mutual recognition agreements. Applied Economics Letters, 1-7.

Brainard, L.S. (1993). A simple theory of multinational corporations and trade with a tradeoff between proximity and concentration, NBER Working Paper 4269.

Bratt, M. (2017). Estimating the bilateral impact of nontariff measures on trade. Review of International Economics, 25(5), 1105-1129.

Cadot, O., & Gourdon, J. (2016). Non-tariff measures, preferential trade agreements, and prices: new evidence. Review of World Economics, 152(2), 227-249.

Cadot, O., & Ing, L. Y. (2015). Non-tariff Measures and Harmonisation: Issues for the RCEP. ERIA Discussion Paper Series, (2015-61).

Cadot, O., Asprilla, A., Gourdon, J., Knebel, C., & Peters, R. (2015). Deep regional integration and non-tariff measures: A methodology for data analysis. UN. POLICY ISSUES IN INTERNATIONAL TRADE AND COMMODITIES RESEARCH STUDY SERIES No. 69.

Chen, Y., Horstmann, I.J. & Markusen, J.R. (2012). Physical capital, knowledge capital, and the choice between FDI and outsourcing, Canadian Journal of Economics, 45(1), 1-15.

Cieślik, A., & Ryan, M. (2012). Productivity differences and foreign market entry in an oligopolistic industry, Open Economies Review, 23(3), 531-557.

Collie, D.R. (2011). Multilateral trade liberalization, foreign direct investment and the volume of world trade, Economics Letters, 113(1), 47-49.

Correia, S., Guimarães, P., & Zylkin, T. (2019a). ppmlhdfe: Fast Poisson estimation with high-dimensional fixed effects, arXiv.org.

Correia, S., Guimarães, P., & Zylkin, T. (2019b). Verifying the existence of maximum likelihood estimates for generalized linear models. arXiv preprint arXiv:1903.01633.

Correia, S., Guimarães, P., & Zylkin, T. (2020). Fast Poisson estimation with high-dimensional fixed effects. The Stata Journal, 20(1), 95-115.

Curzi, D., Schuster, M., Maertens, M., & Olper, A. (2020). Standards, trade margins and product quality: firm-level evidence from Peru. Food Policy, 91, 101834.

Disdier, A. C., Fontagné, L., & Mimouni, M. (2008). The impact of regulations on agricultural trade: Evidence from the SPS and TBT agreements. American Journal of Agricultural Economics, 90(2), 336-350.

Disdier, A. C., Gaigné, C., & Herghelegiu, C. (2018). Do Standards Improve the Quality of Traded Products?. ECARES Working Papers, 2018.

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.

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.

Fałkowski, J., Curzi, D., & Olper, A. (2019). Contracting institutions, agro-food trade and product quality. Journal of Agricultural Economics, 70(3), 749-770.

Feenstra, R. C., Inklaar, R., & Timmer, M. P. (2015). The next generation of the Penn World Table. American economic review, 105(10), 3150-82.

Fiankor, D. D. D., Curzi, D., & Olper, A. (2021). Trade, price and quality upgrading effects of agri-food standards. European Review of Agricultural Economics, 48(4), 835-877.

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. (2023). Exploring the 'non-tariff measures black box': Whose regulatory NTMs on which products improve the imported quality?. International Economics, 173, 45-67. https://doi.org/10.1016/j.inteco.2022.11.007

Ghodsi, M., & Jovanovic, B. (2022). Determinants and Effects of Foreign Direct Investment in Austria: Spillovers to Novel Innovative Environmental Technologies (No. VIII-001). FIW. https://fiw.ac.at/fileadmin/Documents/Publikationen/Studien2022/FIW_RR_01_2022_Determinants_and_Effects_of_FDI_in_Austria.pdf

Ghodsi, M., & Stehrer, R. (2022). Non-Tariff Measures and the quality of imported products. World Trade Review, 21(1), 71-92.

Ghodsi, M., Grübler, J., Reiter, O., & Stehrer, R. (2017). The evolution of non-tariff measures and their diverse effects on trade. The Vienna Institute for International Economic Studies (wiiw), Research Report 419.

Hayakawa, K. (2009). A simple efficient instrumental variable estimator for panel AR (p) models when both N and T are large. Econometric Theory, 25(3), 873-890.

Helpman, E., & Krugman, P. (1985). Market structure and foreign trade: Increasing returns, imperfect competition and the international economy, MIT Press, Cambridge M.A.

Helpman, E., Melitz, M.J., & Yeaple, S.R. (2004). Export versus FDI with heterogeneous firms, American Economic Review, 94(1), 300-316.

Hofmann, C., Osnago, A., & Ruta, M. (2017). Horizontal depth: a new database on the content of preferential trade agreements. (February 22, 2017). World Bank Policy Research Working Paper No. 7981, Available at SSRN: https://ssrn.com/abstract=2923535

Horstmann, I., & Markusen, J.R. (1987). Strategic investments and the development of multinationals, International Economic Review, 28, 109-121.

Inui, T., Ikeuchi, K., Obashi, A., & Yang, Q. (2021). The impact of regulatory divergence from global standards on a country's centrality in global value chains. International Economics, 166, 95-115.

Kee, H. L., Nicita, A., and Olarreaga, M. (2009). Estimating trade restrictiveness indices. The Economic Journal, 119(534), 172-199.

Knebel, C., & Peters, R. (2018). Non-tariff measures and the impact of regulatory convergence in ASEAN. Non-tariff Measures in ASEAN, edited by Lili Yan Ing, Olivier Cadot, & Ralf Peters. Jakarta: Economic Research Institute for ASEAN and East Asia.

Krugman, P. (1983). The 'New Theories' of international trade and multinational enterprise. In D.B. Audretsch & Ch.P. Kindleberger (eds.), The Multinational Corporation in the 1980s (Ch.3.). Cambridge MA: MIT Press.

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

Markusen, J.R. (2002). Multinational firms and the theory of international trade. MIT press.

Markusen, J.R. (2013). Multinational firms. In: Bernhofen, D., Falvey, R., Greenaway, D., Kreickemeier, U. (Eds.), Palgrave Handbook of International Trade. Palgrave Macmillan.

Markusen, J.R., & Stähler, F. (2011). Endogenous market structure and foreign market entry, Review of World Economics, 147(2), 195-215.

Markusen, J.R., & Strand, B. (2009). Adapting the knowledge-capital model of the multinational enterprise to trade and investment in business services, World Economy, 32(1), 6-29.

Markusen, J.R., & Venables, A.J. (1998). Multinational firms and the new trade theory, Journal of International Economics, 46, 183-203.

Markusen, J.R., & Venables, A.J. (2000). The theory of endowment, intra-industry and multinational trade, Journal of International Economics, 52, 209-234.

Mullahy, J., & Norton, E. C. (2022). Why Transform Y? A Critical Assessment of Dependent-Variable Transformations in Regression Models for Skewed and Sometimes-Zero Outcomes (No. w30735). National Bureau of Economic Research.

Nabeshima, K., & Obashi, A. (2021). Impact of regulatory burdens on international trade. Journal of the Japanese and International Economies, 59, 101120.

Niu, Z., Liu, C., Gunessee, S., & Milner, C. (2018). Non-tariff and overall protection: Evidence across countries and over time. Review of World Economics, 154(4), 675-703.

Piermartini, R., & Budetta, M. (2009). A mapping of regional rules on technical barriers to trade. In A. Estevadeordal, K. Suominen, & R. Teh (Eds.), Regional Rules in the Global Trading System (WTO Internal Only, pp. 250-315). Cambridge: Cambridge University Press. doi:10.1017/CBO9780511814334.006

Ramondo, N., & Rodríguez-Clare, A. (2013). Trade, multinational production, and the gains from openness. Journal of Political Economy, 121(2), 273-322.

Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. The stata journal, 9(1), 86-136.

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

Sinha, U.B. (2010). Strategic licensing, exports, FDI, and host country welfare, Oxford Economic Papers, 62(1), 114-131.

Tintelnot, F. (2017). Global production with export platforms. The Quarterly Journal of Economics, 132(1), 157-209.

UNCTAD. (2019). World investment report 2019: Special economic zones. World Investment Report 2019, Special Economic Zones. 2019, United Nations, New York, New York 10017, United States of America, ISBN 978-92-1-112949-6

Winchester, N., Rau, M. L., Goetz, C., Larue, B., Otsuki, T., Shutes, K., ... & Nunes de Faria, R. (2012). The impact of regulatory heterogeneity on agri-food trade. The World Economy, 35(8), 973-993.

Yotov, Y. V., Piermartini, R., Monteiro, J. A., & Larch, M. (2016). An advanced guide to trade policy analysis: The structural gravity model. Geneva: World Trade Organization. https://vi.unctad.org/tpa/web/vol2/vol2home.html

Yue, K. (2021). Non-tariff measures, product quality and import demand. Economic Inquiry. https://doi.org/10.1111/ecin.13059

Zhang, K. & Markusen, J. (1999). Vertical multinationals and host-country characteristics. Journal of Development Economics, 59(2), 233-252.

Appendix

Table A1 / List of TBT keywords and keyword classes in WTO notifications

TBT keywords Nr.	TBT keywords	Keyword class
1	Consumer information	1- Consumers
2	Consumer protection	
3	Crime protection	
4	Human health	
5	Prevention of deceptive practices and consumer protection	
6	Protection of Human health or safety	
7	Safety	
8	Food additives	2- Food
9	Food standards	
10	Genetically modified organisms	
11	Nutrition information	
12	Organic agriculture	
13	Conformity assessment	3- Trade
14	Harmonization	
15	Labelling	
16	Trade facilitation	
17	Quality requirements	4- Quality
18	Biofuels	5- Environment
19	Plant health	
20	Protection of animal or plant life or health	
21	Protection of the environment	
22	NA	6- Other
23	Other	
24	Cost saving and increasing productivity	7- Market
25	Metrology	
26	Packaging	
27	Electromagnetic compatibility	8- ICT
28	Telecommunication/Radiocommunication	
29	Animal feed	9- Animals
30	Animal health	
31	Animal welfare	
32	National security requirements	10- National

Table A2 / List of SPS keywords and keyword classes in WTO notifications

SPS keywords Nr.	SPS keywords	Keyword class
1	Food safety	
2	Human health	1- Consumer
3	Protect humans from animal/plant pest or disease	
4	Aflatoxins	
5	Allergens	
6	Contaminants	
7	Dioxins	
8	Feed additives	
9	Food additives	
10	Heavy metals	
11	Irradiation	
12	Maximum residue limits (MRLs)	2- Tolerance limits
13	Mycotoxins	
14	Ochratoxin	
15	Pesticides	
16	Polychlorinated biphenyls	
17	Tolerance exemption	
18	Toxins	
19	Veterinary drugs	
20	Animal diseases	
21	Animal feed	
22	Animal health	
23	Animal welfare	
24	Avian Influenza	
25	Bluetongue	
26	Bovine Spongiform Encephalopathy (BSE)	
27	Classical Swine Fever	
28	Foot and mouth disease	
29	Fruit fly	3- Animal Diseases
30	H1N1 influenza	
31	Invasive species	
32	Nematode	
33	Newcastle Disease	
34	Pests	
35	Scrapie	
36	Transmissible Spongiform Encephalopathy (TSE)	
37	Zoonoses	
38	Citrus canker	
39	Fungi	
40	Plant diseases	4- Plant health
41	Plant health	
42	Plant protection	
43	Protect territory from other damage from pests	

SPS keywords Nr.	SPS keywords	Keyword class
44	Sudden Oak death	
45	Regionalization	5- Regionalization
46	Territory protection	
47	Certification	6- Market
48	control and inspection	
49	HACCP Plan requirements	
50	Labelling	
51	Packaging	
52	Traceability	
53	Wood packaging / ISPM15	
54	Equivalence	7- Other
55	Seeds	
56	Bacteria	8- Microbiological
57	Escherichia coli	
58	Listeria monocytogenes	
59	Salmonella	
60	Beverages	9- Beverages
61	Biological control agents	10- Biological
62	Biotechnology	
63	Genetically modified organisms	
64	Pharmaceutical products	11- Pharmaceutical

Table A3 / List of three-digit TBT subgroups in MAST classification 2019

Three-digit TBT subgroup Nr.	Three-digit TBT subgroup	Two-digit TBT subgroup
B14	Authorization requirements for importing certain products	B1 Import authorization/licensing related to technical barriers to trade
B15	Authorization requirements for importers	
B19	Import authorization/licensing related to technical barriers to trade not elsewhere specified	
B21	Tolerance limits for residues of or contamination by certain substances	B2 Tolerance limits for residues and restricted use of substances
B22	Restricted use of certain substances	
B31	Labelling requirements	B3 Labelling, marking and packaging requirements
B32	Marking requirements	
B33	Packaging requirements	
B41	Technical barriers to trade regulations on production processes	B4 Production or post-production requirements
B42	Technical barriers to trade regulations on transport and storage	
B49	Production or post-production requirements not elsewhere specified	
B6	Product identity requirements	B6 Product identity requirements
B7	Product quality, safety or performance requirements	B7 Product quality, safety or performance requirements
B81	Product registration/approval requirements	B8 Conformity assessment related to technical barriers to trade
B82	Testing requirements	
B83	Certification requirements	
B84	Inspection requirements	
B85	Traceability requirements	
B89	Conformity assessment related to technical barriers to trade not elsewhere specified	
B9	Technical barriers to trade measures not elsewhere specified	B9 Technical barriers to trade measures not elsewhere specified

Table A4 / List of three-digit SPS subgroups in MAST classification 2019

Three-digit SPS subgroup Nr.	Three-digit SPS subgroup	Two-digit SPS subgroup
A11	Prohibitions for sanitary and phytosanitary reasons	A1 Prohibitions/restrictions of imports for sanitary and phytosanitary reasons
A12	Geographical restrictions on eligibility	
A13	Systems approach	
A14	Authorization requirement for sanitary and phytosanitary reasons for importing certain products	
A15	Authorization requirement for importers for sanitary and phytosanitary reasons	
A19	Prohibitions or restrictions of imports for sanitary and phytosanitary reasons, not elsewhere specified	
A21	Tolerance limits for residues of or contamination by certain (non-microbiological) substances	A2 Tolerance limits for residues and restricted use of substances
A22	Restricted use of certain substances in foods and feeds and their contact materials	
A31	Labelling requirements	A3 Labelling, marking and packaging requirements
A32	Marking requirements	A3 Labelling, marking and packaging requirements
A33	Packaging requirements	A3 Labelling, marking and packaging requirements
A41	Microbiological criteria of the final product	A4 Hygienic requirements related to sanitary and phytosanitary conditions
A42	Hygienic practices during production related to sanitary and phytosanitary conditions	
A49	Hygienic requirements not elsewhere specified	
A51	Cold or heat treatment	A5 Treatment for elimination of plant and animal pests and disease-causing organisms in the final product or prohibition of treatment
A52	Irradiation	
A53	Fumigation	
A59	Treatments to eliminate plants and animal pests or disease-causing organisms in the final product not elsewhere specified or prohibition of treatment	
A61	Plant-growth processes	A6 Other requirements relating to production or post-production processes
A62	Animal-raising or -catching processes	
A63	Food and feed processing	
A64	Storage and transport conditions	
A69	Other requirements relating to production or post-production processes not elsewhere specified	
A81	Product registration and approval requirement	A8 Conformity assessment related to sanitary and phytosanitary conditions
A82	Testing requirements	
A83	Certification requirements	
A84	Inspection requirements	
A85	Traceability requirements	
A86	Quarantine requirements	
A89	Conformity assessment related to sanitary and phytosanitary conditions not elsewhere specified	
A9	Sanitary and phytosanitary measures not elsewhere specified	A9 Sanitary and phytosanitary measures not elsewhere specified

Table A5 – Estimation results on total assets and turnover of global foreign-owned subsidiaries in non-services sectors, 2004-2020, using UNCTAD NTMs

Dep. var.:	$Y_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$	$Y^{100\%}_{fgijs\varrho,t+1}$	$K^{100\%}_{fgijs\varrho,t+1}$
D^{TBT}_{ijst}	-1.02*	-0.048	-1.90***	-0.93***
	(0.59)	(0.39)	(0.45)	(0.36)
D^{SPS}_{ijst}	-0.095	-0.057	-0.22	0.72**
	(0.55)	(0.32)	(0.52)	(0.34)
$prod_{ft} \times D^{TBT}_{ijst}$	0.077	-0.0050	0.17***	0.078**
	(0.062)	(0.040)	(0.043)	(0.031)
$prod_{ft} \times D^{SPS}_{ijst}$	0.023	0.027	0.034	-0.045
	(0.057)	(0.032)	(0.051)	(0.030)
$\text{arc}\, T_{ijst}$	0.15*	0.17**	0.68***	1.01***
	(0.083)	(0.077)	(0.24)	(0.22)
$\text{arc}\, T_{jist}$	0.27**	0.30**	-0.12	0.92***
	(0.12)	(0.12)	(0.28)	(0.33)
$prod_{ft}$	0.24***	0.078***	0.26***	0.065***
	(0.021)	(0.011)	(0.013)	(0.013)
l_{ft}	0.46***	0.17***	0.49***	0.12***
	(0.029)	(0.015)	(0.023)	(0.025)
GDP^{sim}_{jit}	0.13**	0.14	0.21*	0.22*
	(0.064)	(0.094)	(0.11)	(0.12)
HC^{dif}_{jit}	0.017***	0.022***	0.023**	0.014*
	(0.0063)	(0.0061)	(0.011)	(0.0084)
KL^{dif}_{jit}	-0.0041	-0.020***	0.00029	-0.0072
	(0.0043)	(0.0058)	(0.0072)	(0.0070)
Constant	17.4***	20.4***	17.0***	19.9***
	(0.36)	(0.32)	(0.36)	(0.37)
Observations	165262	164436	64785	64635
Pseudo R-squared	0.988	0.990	0.987	0.990
AIC	1.22271e+12	1.19281e+12	3.82665e+11	2.61380e+11

Robust Standard errors in parentheses: * $p<0.1$; ** $p<0.05$; *** $p<0.01$

Estimations include subsidiary γ_f, GUO γ_g, home-sector-time γ_{ist}, host-sector-time γ_{jst}, home-host-sector γ_{ijs}, and sector of GUO-time $\gamma_{\varrho t}$ fixed effects.

Table A6 – Estimation results on total assets and turnover of global foreign-owned subsidiaries in non-services sectors, 2004-2020, using WTO NTM notifications, without interaction terms

Dep. var.:	$Y_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$	$Y^{100\%}_{fgijs\varrho,t+1}$	$K^{100\%}_{fgijs\varrho,t+1}$
D^{TBT}_{ijst}	0.065	-0.26	0.089	-0.45
	(0.19)	(0.19)	(0.30)	(0.29)
D^{SPS}_{ijst}	-0.52	-0.46	0.85	0.41
	(0.43)	(0.46)	(0.67)	(0.67)
$\text{arc}\,T_{ijst}$	0.15*	0.16**	0.70***	1.03***
	(0.083)	(0.076)	(0.24)	(0.22)
$\text{arc}\,T_{jist}$	0.27**	0.32***	-0.12	0.98***
	(0.12)	(0.12)	(0.28)	(0.33)
$prod_{ft}$	0.25***	0.078***	0.28***	0.075***
	(0.017)	(0.0081)	(0.013)	(0.012)
l_{ft}	0.46***	0.17***	0.49***	0.12***
	(0.030)	(0.015)	(0.023)	(0.025)
GDP^{sim}_{jit}	0.14**	0.14	0.23**	0.22*
	(0.065)	(0.095)	(0.11)	(0.12)
HC^{dif}_{jit}	0.017***	0.023***	0.022**	0.015*
	(0.0063)	(0.0062)	(0.011)	(0.0085)
KL^{dif}_{jit}	-0.0033	-0.020***	0.0013	-0.0082
	(0.0044)	(0.0058)	(0.0072)	(0.0071)
Constant	17.3***	20.5***	16.7***	19.8***
	(0.34)	(0.31)	(0.36)	(0.37)
Observations	165262	164436	64785	64635
Pseudo R-squared	0.988	0.990	0.987	0.990
AIC	1.22352e+12	1.19281e+12	3.83734e+11	2.61516e+11

Robust Standard errors in parentheses: * $p<0.1$; ** $p<0.05$; *** $p<0.01$

Estimations include subsidiary γ_f, GUO γ_g, home-sector-time γ_{ist}, host-sector-time γ_{jst}, home-host-sector γ_{ijs}, and sector of GUO-time $\gamma_{\varrho t}$ fixed effects.

Table A7 – Estimation results on total assets and turnover of global foreign-owned subsidiaries in non-services sectors excluding M&A deals relations, 2004-2020, using WTO NTMs

Dep. var.:	$Y_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$	$Y^{100\%}_{fgijs\varrho,t+1}$	$K^{100\%}_{fgijs\varrho,t+1}$
D^{TBT}_{ijst}	-3.93***	-2.65***	-2.93***	-2.91***
	(0.84)	(0.51)	(0.70)	(0.54)
D^{SPS}_{ijst}	-1.24*	0.12	0.55	1.36*
	(0.75)	(0.54)	(0.91)	(0.78)
$prod_{ft} \times D^{TBT}_{ijst}$	0.44***	0.27***	0.36***	0.30***
	(0.091)	(0.053)	(0.072)	(0.052)
$prod_{ft} \times D^{SPS}_{ijst}$	0.089	-0.027	0.086	-0.025
	(0.059)	(0.035)	(0.056)	(0.036)
$\text{arc}\,T_{ijst}$	0.13	0.16**	0.69***	0.95***
	(0.084)	(0.078)	(0.24)	(0.23)
$\text{arc}\,T_{jist}$	0.19	0.31***	-0.11	1.23***
	(0.12)	(0.12)	(0.28)	(0.40)
$prod_{ft}$	0.16***	0.041***	0.20***	0.044***
	(0.029)	(0.013)	(0.017)	(0.0095)
l_{ft}	0.45***	0.18***	0.48***	0.16***
	(0.030)	(0.011)	(0.023)	(0.011)
GDP^{sim}_{jit}	0.16**	0.10	0.18	0.18
	(0.065)	(0.10)	(0.12)	(0.13)
HC^{dif}_{jit}	0.013*	0.022***	0.023*	0.023**
	(0.0066)	(0.0067)	(0.013)	(0.0098)
KL^{dif}_{jit}	-0.0065	-0.021***	0.0011	-0.011
	(0.0047)	(0.0066)	(0.0081)	(0.0081)
Constant	18.2***	20.5***	17.2***	19.7***
	(0.42)	(0.33)	(0.38)	(0.34)
Observations	157504	156766	61017	60908
Pseudo R-squared	0.988	0.989	0.987	0.989
AIC	1.11807e+12	1.09867e+12	3.32123e+11	2.21952e+11

Robust Standard errors in parentheses: * p<0.1; ** p<0.05; *** p<0.01

Estimations include subsidiary γ_f, GUO γ_g, home-sector-time γ_{ist}, host-sector-time γ_{jst}, home-host-sector γ_{ijs}, and sector of GUO-time $\gamma_{\varrho t}$ fixed effects.

Table A8 – Estimation results on total assets and turnover of global foreign-owned subsidiaries in non-services sectors, including PTAs with NTM provisions, 2004-2020, using WTO NTMs

Dep. var.:	$Y_{fgijs\varrho,t+1}$	$Y_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$	$Y^{100\%}_{fgijs\varrho,t+1}$	$Y^{100\%}_{fgijs\varrho,t+1}$	$K^{100\%}_{fgijs\varrho,t+1}$	$K^{100\%}_{fgijs\varrho,t+1}$
D^{TBT}_{ijst}	-4.15***	-3.95***	-2.58***	-2.06***	-3.52***	-3.02***	-2.52***	-1.43**
	(0.82)	(0.86)	(0.50)	(0.52)	(0.72)	(0.76)	(0.57)	(0.58)
D^{SPS}_{ijst}	-1.13	-0.81	0.034	0.38	-0.22	0.27	0.83	0.67
	(0.72)	(0.70)	(0.57)	(0.54)	(0.95)	(0.96)	(0.76)	(0.77)
$prod_{ft} \times D^{TBT}_{ijst}$	0.46***	0.43***	0.25***	0.21***	0.40***	0.37***	0.23***	0.16***
	(0.088)	(0.092)	(0.052)	(0.054)	(0.075)	(0.077)	(0.057)	(0.057)
$prod_{ft} \times D^{SPS}_{ijst}$	0.10*	0.11*	-0.026	0.0034	0.14**	0.073	-0.018	-0.019
	(0.058)	(0.061)	(0.034)	(0.034)	(0.059)	(0.060)	(0.032)	(0.033)
$\text{arc}\,T_{jist}$	0.11	0.10	0.14*	0.085	0.64***	0.69***	1.12***	1.07***
	(0.082)	(0.083)	(0.075)	(0.077)	(0.24)	(0.25)	(0.22)	(0.23)
$\text{arc}\,T_{ijst}$	0.21*	0.22*	0.27**	0.32***	-0.030	-0.062	1.23***	1.25***
	(0.12)	(0.12)	(0.12)	(0.12)	(0.29)	(0.29)	(0.33)	(0.33)
$prod_{ft}$	0.16***	0.17***	0.040***	0.046***	0.20***	0.21***	0.035***	0.041***
	(0.028)	(0.029)	(0.012)	(0.012)	(0.016)	(0.017)	(0.010)	(0.010)
l_{ft}	0.46***	0.46***	0.18***	0.17***	0.49***	0.49***	0.12***	0.12***
	(0.028)	(0.029)	(0.015)	(0.015)	(0.023)	(0.023)	(0.026)	(0.025)
GDP^{sim}_{jit}	0.13**	0.13**	0.12	0.14	0.21*	0.21*	0.21*	0.27**
	(0.064)	(0.064)	(0.095)	(0.095)	(0.11)	(0.11)	(0.12)	(0.12)
HC^{dif}_{jit}	0.013**	0.015**	0.021***	0.021***	0.019*	0.019*	0.014	0.012
	(0.0064)	(0.0064)	(0.0061)	(0.0061)	(0.011)	(0.011)	(0.0085)	(0.0085)
KL^{dif}_{jit}	-0.0037	-0.0046	-0.020***	-0.021***	-0.00042	-0.00033	-0.011	-0.012*
	(0.0044)	(0.0044)	(0.0058)	(0.0058)	(0.0069)	(0.0069)	(0.0070)	(0.0070)
PTA^{TBT}_{jit}	0.12	0.87*	0.34***	1.41***	-0.0082	1.27**	0.40***	2.04***
	(0.15)	(0.45)	(0.11)	(0.28)	(0.14)	(0.53)	(0.11)	(0.37)
PTA^{SPS}_{jit}	-0.18	-0.24	-0.39***	-0.66***	-0.016	-0.73*	-0.34***	-1.17***
	(0.15)	(0.41)	(0.11)	(0.25)	(0.13)	(0.44)	(0.11)	(0.20)
$PTA^{TBT}_{jit} \times D^{TBT}_{ijst}$		-2.90**		-4.69***		-2.56		-6.80***
		(1.41)		(1.42)		(1.77)		(2.06)
$PTA^{SPS}_{jit} \times D^{SPS}_{ijst}$		-0.46		0.35		-3.03**		0.64
		(1.16)		(1.05)		(1.19)		(0.81)
$PTA^{TBT}_{jit} \times prod_{ft}$		-0.091**		-0.12***		-0.14***		-0.18***
		(0.041)		(0.028)		(0.052)		(0.041)
$PTA^{SPS}_{jit} \times prod_{ft}$		0.011		0.045*		0.085**		0.11***
		(0.038)		(0.026)		(0.041)		(0.020)
$PTA^{TBT}_{jit} \times prod_{ft} \times D^{TBT}_{ijst}$		0.35**		0.48***		0.24		0.63***
		(0.15)		(0.15)		(0.19)		(0.23)
$PTA^{SPS}_{jit} \times prod_{ft} \times D^{SPS}_{ijst}$		0.021		-0.13		0.34***		-0.11
		(0.13)		(0.11)		(0.13)		(0.085)
Constant	18.0***	17.9***	20.8***	20.7***	17.3***	17.2***	20.1***	20.2***
	(0.41)	(0.42)	(0.32)	(0.32)	(0.36)	(0.37)	(0.36)	(0.35)
Observations	165262	165262	164436	164436	64785	64785	64635	64635
Pseudo R-squared	0.989	0.989	0.990	0.990	0.987	0.987	0.990	0.990
AIC	1.21381e+12	1.21244e+12	1.18926e+12	1.18721e+12	3.81626e+11	3.81168e+11	2.60618e+11	2.58899e+11

Robust Standard errors in parentheses: * p<0.1; ** p<0.05; *** p<0.01

Estimations include subsidiary γ_f, GUO γ_g, home-sector-time γ_{ist}, host-sector-time γ_{jst}, home-host-sector γ_{ijs}, and sector of GUO-time $\gamma_{\varrho t}$ fixed effects.

Table A9 – Estimation results on total assets and turnover of global foreign-owned subsidiaries in non-services sectors by country-pair groups, 2004-2020, using WTO NTMs

Dep. var.:	$Y_{fgijs\varrho,t+1}$	$Y_{fgijs\varrho,t+1}$	$Y_{fgijs\varrho,t+1}$	$Y_{fgijs\varrho,t+1}$	$Y_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$	$K_{fgijs\varrho,t+1}$
Host-Home	**Developed-developed**	**Developing-developed**	**Developed-developing**	**ASEAN - World**	**World-ASEAN**	**Developed-developed**	**Developing-developed**	**Developed-developing**	**ASEAN - World**	**World-ASEAN**
D_{ijst}^{TBT}	-2.30	-0.37	-21.6***	3.98	13.5***	-2.88*	-1.40**	-3.11	-1.83	6.78***
	(2.91)	(0.87)	(5.58)	(3.52)	(3.88)	(1.55)	(0.55)	(2.46)	(1.71)	(2.49)
D_{ijst}^{SPS}	-1.15	1.33	5.94	-2.96	4.19*	-2.44*	1.65**	2.64	-3.17	2.89*
	(1.54)	(0.86)	(6.62)	(3.34)	(2.15)	(1.40)	(0.72)	(4.75)	(2.10)	(1.54)
$prod_{ft} \times D_{ijst}^{TBT}$	0.33	0.13	2.62***	-0.70**	-1.31***	0.36**	0.18***	0.69***	-0.063	-0.65***
	(0.32)	(0.081)	(0.60)	(0.32)	(0.39)	(0.16)	(0.049)	(0.23)	(0.14)	(0.24)
$prod_{ft} \times D_{ijst}^{SPS}$	0.0096	0.15**	-0.16	0.23	-0.52***	-0.064	0.048	-0.20	-0.19	-0.37***
	(0.15)	(0.067)	(0.35)	(0.25)	(0.17)	(0.11)	(0.036)	(0.19)	(0.18)	(0.12)
$\text{arc}\,T_{ijst}$	0.057	0.083	1.65	4.24	0.53	0.25	0.27***	2.14	24.2*	3.77***
	(0.12)	(0.075)	(2.18)	(15.7)	(0.98)	(0.16)	(0.060)	(1.46)	(12.7)	(1.11)
$\text{arc}\,T_{jist}$	0.38	0.45***	5.87***	-0.076	-0.45	0.65	0.44***	8.61***	-0.35	-3.99
	(0.42)	(0.16)	(2.19)	(0.73)	(3.31)	(0.43)	(0.15)	(2.16)	(0.62)	(3.25)
$prod_{ft}$	0.26**	0.19***	-0.29**	0.38***	0.63***	0.041	0.038***	-0.12***	0.13***	0.29***
	(0.10)	(0.020)	(0.14)	(0.057)	(0.080)	(0.035)	(0.014)	(0.037)	(0.026)	(0.039)
l_{ft}	0.61***	0.43***	0.31***	0.43***	0.83***	0.23***	0.17***	0.061***	0.16***	0.36***
	(0.049)	(0.021)	(0.065)	(0.061)	(0.057)	(0.018)	(0.015)	(0.020)	(0.030)	(0.025)
GDP_{jit}^{sim}	0.35**	-0.13	0.48		4.11***	1.31***	-0.14	0.99**		-0.73
	(0.17)	(0.089)	(0.35)		(1.21)	(0.49)	(0.100)	(0.43)		(2.32)
HC_{jit}^{dif}	0.014*	0.22***	-0.097***	0.12**	0.043	0.028***	0.18***	-0.10***	-0.14***	0.067**
	(0.0072)	(0.051)	(0.033)	(0.058)	(0.031)	(0.0075)	(0.035)	(0.028)	(0.042)	(0.030)
KL_{jit}^{dif}	-0.00021	0.042***	-0.12***	0.44**	-0.17***	-0.020***	-0.054***	-0.000053	0.70***	-0.073*
	(0.0044)	(0.014)	(0.042)	(0.20)	(0.057)	(0.0075)	(0.012)	(0.021)	(0.17)	(0.041)
Constant	17.2***	15.9***	24.3***	10.5***	25.4***	23.9***	19.2***	22.9***	9.87***	16.1***
	(1.27)	(0.38)	(2.02)	(2.27)	(3.52)	(1.27)	(0.34)	(0.91)	(2.10)	(6.16)
Observations	78855	47197	14877	3080	2783	77799	47006	14951	3088	2749
Pseudo R-squared	0.992	0.984	0.994	0.996	0.988	0.991	0.985	0.995	0.998	0.994
AIC	4.07556e+11	2.73066e+11	6.27212e+10	6.63604e+09	1.80772e+10	5.91441e+11	2.01143e+11	4.91429e+10	3.35192e+09	1.16598e+10

Robust Standard errors in parentheses: * $p<0.1$; ** $p<0.05$; *** $p<0.01$

Estimations include subsidiary γ_f, GUO γ_g, home-sector-time γ_{ist}, host-sector-time γ_{jst}, home-host-sector γ_{ijs}, and sector of GUO-time $\gamma_{\varrho t}$ fixed effects.

Table A10 – Estimation results on total assets and turnover of global foreign-owned subsidiaries in non-services sectors excluding using OLS and GMM, and first difference of total assets, 2004-2020, using WTO NTMs

	OLS	OLS	OLS	OLS	OLS	OLS	GMM	GMM
Dep. var.:	$\text{arc}\,Y_{fgijs\varrho,t+1}$	$\text{arc}\,K_{fgijs\varrho,t+1}$	$\text{arc}\,Y^{100\%}_{fgijs\varrho,t+1}$	$\text{arc}\,K^{100\%}_{fgijs\varrho,t+1}$	$\text{arc}\,\Delta K_{fgijs\varrho,t}$	$\text{arc}\,\Delta K^{100\%}_{fgijs\varrho,t}$	$\text{arc}\,Y_{fgijs\varrho,t}$	$\text{arc}\,K_{fgijs\varrho,t}$
D^{TBT}_{ijst}	4.20***	-0.87**	2.69	-1.56**	2.71	8.32	14.1	-12.9*
	(1.08)	(0.42)	(1.67)	(0.71)	(5.91)	(10.6)	(11.7)	(7.05)
D^{SPS}_{ijst}	0.28	1.03**	0.81	0.15	0.45	-15.0	-3.96	16.4
	(1.16)	(0.46)	(2.34)	(0.82)	(7.32)	(13.1)	(16.2)	(10.7)
$prod_{ft} \times D^{TBT}_{ijst}$	-0.49***	0.059	-0.37**	0.0095	-0.77*	-1.60**	-1.41	2.19***
	(0.12)	(0.042)	(0.18)	(0.069)	(0.46)	(0.77)	(1.23)	(0.66)
$prod_{ft} \times D^{SPS}_{ijst}$	0.18*	0.0052	0.26*	0.037	1.04***	1.95***	-0.17	-1.50
	(0.096)	(0.035)	(0.15)	(0.060)	(0.37)	(0.59)	(1.96)	(1.23)
$\text{arc}\,T_{ijst}$	0.43*	0.30	1.56***	1.34***	-2.45	1.64	-1.51	-4.45**
	(0.23)	(0.22)	(0.56)	(0.40)	(2.41)	(5.42)	(3.38)	(2.12)
$\text{arc}\,T_{jist}$	-0.58	-0.089	0.040	0.42	-6.46*	-18.3*	-4.71*	-2.21
	(0.56)	(0.19)	(0.57)	(0.42)	(3.50)	(10.4)	(2.69)	(2.34)
$prod_{ft}$	0.58***	0.11***	0.50***	0.11***	-0.87***	-0.81***	1.05***	-0.051
	(0.023)	(0.0071)	(0.035)	(0.011)	(0.070)	(0.11)	(0.18)	(0.084)
l_{ft}	1.10***	0.36***	0.95***	0.32***	-2.51***	-2.38***	1.22***	0.43***
	(0.021)	(0.0092)	(0.031)	(0.015)	(0.13)	(0.23)	(0.16)	(0.11)
GDP^{sim}_{jit}	0.15	-0.028	0.32	0.033	-4.15***	-5.02*	-0.98	1.61**
	(0.15)	(0.081)	(0.27)	(0.15)	(1.50)	(2.88)	(0.63)	(0.66)
HC^{dif}_{jit}	-0.018*	0.0074	-0.025	0.011	-0.042	0.53*	-0.073	-0.080
	(0.010)	(0.0057)	(0.016)	(0.0099)	(0.16)	(0.29)	(0.27)	(0.22)
KL^{dif}_{jit}	0.013	0.0062	0.043*	0.022***	-0.26**	-0.055	0.18	0.026
	(0.011)	(0.0052)	(0.024)	(0.0082)	(0.11)	(0.20)	(0.22)	(0.12)
$Y_{fgijs\varrho,t-1} \wedge K_{fgijs\varrho,t-1}$							0.040	0.12***
							(0.071)	(0.020)
$Y_{fgijs\varrho,t-2} \wedge K_{fgijs\varrho,t-2}$							0.0069	-0.0039
							(0.020)	(0.017)
Constant	10.9***	15.5***	11.5***	15.4***	5.30	2.40	1.78	12.2***
	(0.43)	(0.22)	(0.73)	(0.39)	(4.01)	(7.48)	(3.13)	(3.16)
Observations	167016	164455	65681	64652	159359	62779	250423	256236
R-squared	0.921	0.961	0.933	0.969	0.409	0.446		
Adjusted R-squared	0.896	0.948	0.902	0.955	0.205	0.183		
AIC	495751.6	266362.0	193097.9	100133.7	1226563.8	476933.9		
P AR(1) in first differences							0.033	0
P AR(2) in first differences							0.345	0.599

P Sargan test of overid. Restrictions	0.227	0.667
P Hansen test of overid. Restrictions	0.535	0.09

Robust Standard errors in parentheses: * p<0.1; ** p<0.05; *** p<0.01

Estimations include subsidiary γ_f, GUO γ_g, home-sector-time γ_{ist}, host-sector-time γ_{jst}, home-host-sector γ_{ijs}, and sector of GUO-time $\gamma_{\varrho t}$ fixed effects.

For GMM estimation on $\boldsymbol{Y_{fgijs\varrho,t}}$, **i**nstruments for first differences equation: Difference in L(2/3).($\boldsymbol{prod_{ft}}$, and $\boldsymbol{l_{ft}}$); instruments for levels equation: year-fixed effects, and $max\{\boldsymbol{PTA_{jit}^{TBT}}, \boldsymbol{PTA_{jit}^{SPS}}\}$.

For GMM estimation on $\boldsymbol{K_{fgijs\varrho,t}}$, **i**nstruments for first differences equation: Difference in L(2/3).($\boldsymbol{K_{fgijs\varrho,t-1}}$, $\boldsymbol{prod_{ft}}$, and $\boldsymbol{l_{ft}}$); instruments for levels equation: year-fixed effects, and $max\{\boldsymbol{PTA_{jit}^{TBT}}, \boldsymbol{PTA_{jit}^{SPS}}\}$.

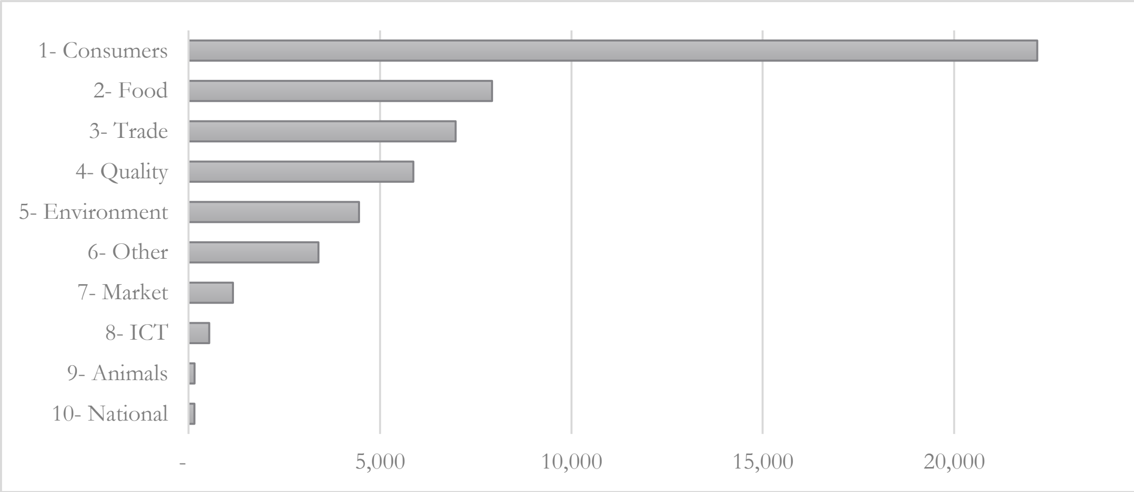
Table A11 – summary statistics on indicators of foreign-owned firms in the sample of study averaged over the period by NACE two-digit sector

Technology category	NACE	Description	Total assets, $billion	Turnover, $billion	Number of employees, thousands	Number of firms	Average total assets, $million	Average turnover, $million	Simple average labour productivity, $thousands	Average number of employees	Aggregate labour productivity, $thousand
Agriculture	01	Crop and animal production, hunting	29	19	143	1756	17	11	141	81	131
Agriculture	02	Forestry and logging	3	1	5	94	32	15	859	56	266
Agriculture	03	Fishing and aquaculture	3	2	5	120	24	20	322	38	527
Mining	05	Mining of coal and lignite	174	77	94	100	1738	769	9173	937	821
Mining	06	Extraction of crude petroleum and gas	183	115	49	208	881	555	11809	237	2342
Mining	07	Mining of metal ores	127	58	187	176	721	331	4714	1060	313
Mining	08	Other mining and quarrying	32	13	37	356	90	35	229	105	336
Low-tech	10	Manufacture of food products	227	264	920	2249	101	117	1567	409	287
Low-tech	11	Manufacture of beverages	112	73	294	495	227	147	2336	595	246
Low-tech	12	Manufacture of tobacco products	20	33	51	47	429	707	1520	1090	649
Low-tech	13	Manufacture of textiles	21	20	178	449	47	45	688	397	115
Low-tech	14	Manufacture of wearing apparel	15	14	183	540	29	27	554	338	79
Low-tech	15	Manufacture of leather and products	4	6	201	197	18	30	407	1019	30
Low-tech	16	Manufacture of wood and of products, except furniture	13	11	61	555	24	20	304	110	179
Low-tech	17	Manufacture of paper and paper products	111	86	311	538	207	159	1307	578	276
Low-tech	18	Printing and reproduction of recorded media	6	6	40	298	21	21	532	135	157
Medium-low-tech	19	Manufacture of coke and refined petroleum products	83	103	33	103	805	1000	9218	316	3169
Medium-high-tech	20	Manufacture of chemicals and chemical products	342	316	657	2262	151	140	2114	291	481
High-tech	21	Manufacture of basic pharmaceutical products	293	211	373	629	466	336	1832	593	566
Medium-low-tech	22	Manufacture of rubber and plastic products	102	105	492	1770	58	60	945	278	215
Medium-low-tech	23	Manufacture of other non-metallic mineral products	115	72	303	1044	110	69	3608	290	238
Medium-low-tech	24	Manufacture of basic metals	182	157	505	640	284	246	1021	789	312
Medium-low-tech	25	Manufacture of fabricated metal products, except machinery	104	94	493	2014	52	47	742	245	191
High-tech	26	Manufacture of computer, electronic and optical products	572	823	3500	2519	227	327	5359	1389	235
Medium-high-tech	27	Manufacture of electrical equipment	155	172	796	1434	108	120	2469	555	216
Medium-high-tech	28	Manufacture of machinery and equipment n.e.c.	241	241	868	2963	81	81	1248	293	278
Medium-high-tech	29	Manufacture of motor vehicles, trailers and semi-trailers	291	444	1215	1793	162	248	3104	677	366
Medium-high-tech	30	Manufacture of other transport equipment	74	49	205	431	171	114	1713	477	240
Low-tech	31	Manufacture of furniture	6	7	59	288	20	23	354	207	110
Low-tech	32	Other manufacturing	84	76	329	1097	77	70	1650	300	232

Table A12 – summary statistics on indicators of foreign-owned firms in the sample of study averaged over the period by host economy

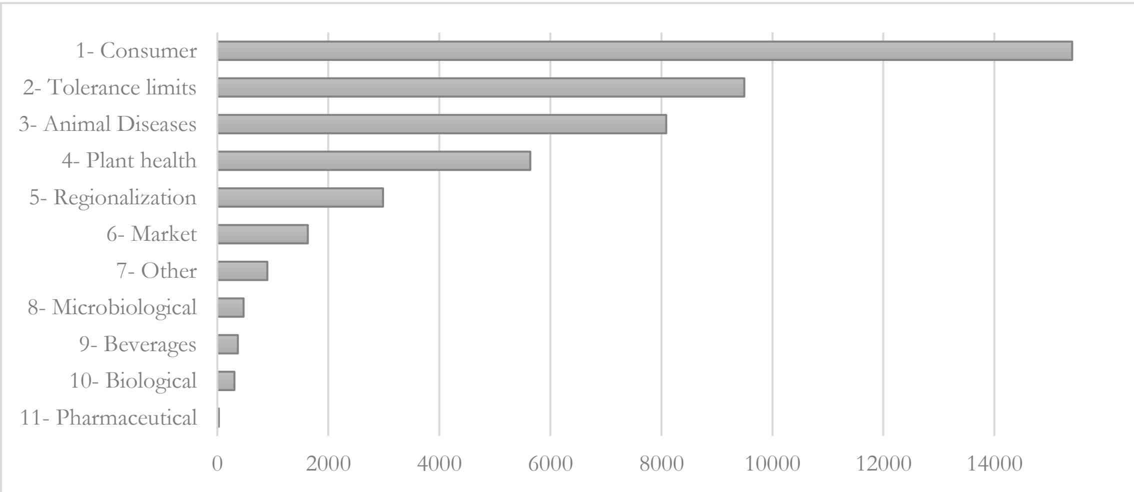
ISO3	Host	Total assets, $billion	Turnover, $billion	Number of employees, thousands	Number of firms	Average total assets, $million	Average turnover, $million	Simple average labour productivity, $thousands	Average number of employees	Aggregate labour productivity, $thousand
AUS	Australia	363.13	210.90	383.24	539	674	391	7125	711	550
AUT	Austria	27.66	32.79	71.21	193	143	170	849	369	460
BEL	Belgium	118.85	99.23	80.25	427	278	232	986	188	1237
BGD	Bangladesh	0.76	0.64	5.26	8	95	81	226	658	123
BGR	Bulgaria	4.90	4.59	40.18	236	21	19	109	170	114
BRA	Brazil	0.03	0.02	0.19	2	16	11	116	94	114
CHE	Switzerland	0.20	0.15	0.61	2	102	76	303	303	251
CHL	Chile	0.39	0.28	1.72	2	194	141	180	858	165
CHN	China	888.88	1,123.58	5,206.49	5147	173	218	7269	1012	216
CYP	Cyprus	1.40	0.63	7.05	2	701	316	78	3527	90
CZE	Czech Republic	29.59	39.16	156.87	596	50	66	211	263	250
DEU	Germany	231.97	275.43	539.16	1773	131	155	976	304	511
DNK	Denmark	15.86	10.33	23.33	93	171	111	1453	251	443
EGY	Egypt	0.24	0.23	0.88	2	119	114	1048	438	261
ESP	Spain	81.77	78.71	151.01	770	106	102	497	196	521
EST	Estonia	0.71	0.79	5.93	48	15	16	148	124	133
FIN	Finland	15.54	14.45	35.70	162	96	89	1159	220	405
FRA	France	92.69	114.43	251.84	1139	81	100	434	221	454
GBR	United Kingdom	529.49	440.29	822.14	2400	221	183	1011	343	536
GHA	Ghana	0.07	0.10	1.15	2	37	48	84	573	84
GRC	Greece	0.80	0.70	1.57	15	54	47	318	104	448
HKG	Hong Kong	145.95	122.44	659.79	51	2862	2401	413	12937	186
HRV	Croatia	5.69	4.71	30.91	272	21	17	163	114	153
HUN	Hungary	24.27	26.50	95.41	206	118	129	1861	463	278
IDN	Indonesia	21.42	20.25	101.66	28	765	723	596	3631	199
IND	India	37.49	41.66	164.62	71	528	587	445	2319	253
IRL	Ireland	185.21	99.41	46.95	209	886	476	4684	225	2118
ISL	Iceland	2.70	2.05	4.86	21	129	98	639	232	422
ISR	Israel	3.22	1.50	3.59	4	804	375	283	898	418
ITA	Italy	127.51	117.36	222.54	1618	79	73	461	138	527
JPN	Japan	16.75	16.87	31.05	60	279	281	483	517	543
KAZ	Kazakhstan	25.55	16.42	146.46	51	501	322	131	2872	112
KOR	South Korea	69.86	83.07	132.74	486	144	171	906	273	626
LKA	Sri Lanka	0.13	0.32	1.75	2	65	161	201	875	184
LTU	Lithuania	1.94	1.77	13.66	90	22	20	115	152	130
LUX	Luxembourg	2.63	6.36	6.21	11	239	578	977	564	1024
LVA	Latvia	0.88	1.17	5.99	230	4	5	93	26	196
MDA	Moldova	0.48	0.45	7.94	27	18	17	115	294	56
MEX	Mexico	0.39	0.30	2.34	9	44	33	142	260	129
MLT	Malta	0.48	0.45	2.34	8	60	56	1853	292	194
MYS	Malaysia	16.44	27.36	126.56	122	135	224	404	1037	216
NGA	Nigeria	3.85	2.86	12.36	11	350	260	211	1124	231
NLD	Netherlands	112.77	125.44	135.43	336	336	373	5145	403	926
NOR	Norway	54.83	34.77	48.26	337	163	103	690	143	721
PAK	Pakistan	3.12	5.40	22.57	20	156	270	297	1129	239
POL	Poland	40.14	53.63	241.63	646	62	83	280	374	222
PRT	Portugal	6.31	6.45	30.77	225	28	29	311	137	210
ROU	Romania	12.68	15.01	126.12	910	14	16	101	139	119
RUS	Russia	135.83	132.47	792.08	2614	52	51	276	303	167
SGP	Singapore	0.35	0.64	9.01	3	117	214	820	3003	71
SVK	Slovak Republic	15.13	25.53	77.49	280	54	91	287	277	329
SVN	Slovenia	4.17	4.02	18.15	67	62	60	237	271	222
SWE	Sweden	40.68	49.74	86.27	434	94	115	462	199	576
TUR	Turkey	2.98	3.14	15.34	20	149	157	263	767	204
TWN	Taiwan	0.70	0.52	2.04	3	235	175	285	680	257
TZA	Tanzania	0.33	0.26	0.64	2	163	128	406	320	401
UKR	Ukraine	29.14	26.69	364.75	3209	9	8	63	114	73
USA	United States	98.85	54.92	185.92	36	2746	1526	325	5165	295
VNM	Vietnam	56.08	81.06	787.37	875	64	93	921	900	103
ZAF	South Africa	12.73	10.59	37.32	3	4242	3529	239	12440	284

Figure A5 / Number of TBT notifications (based on keywords class) in force in 2021 globally



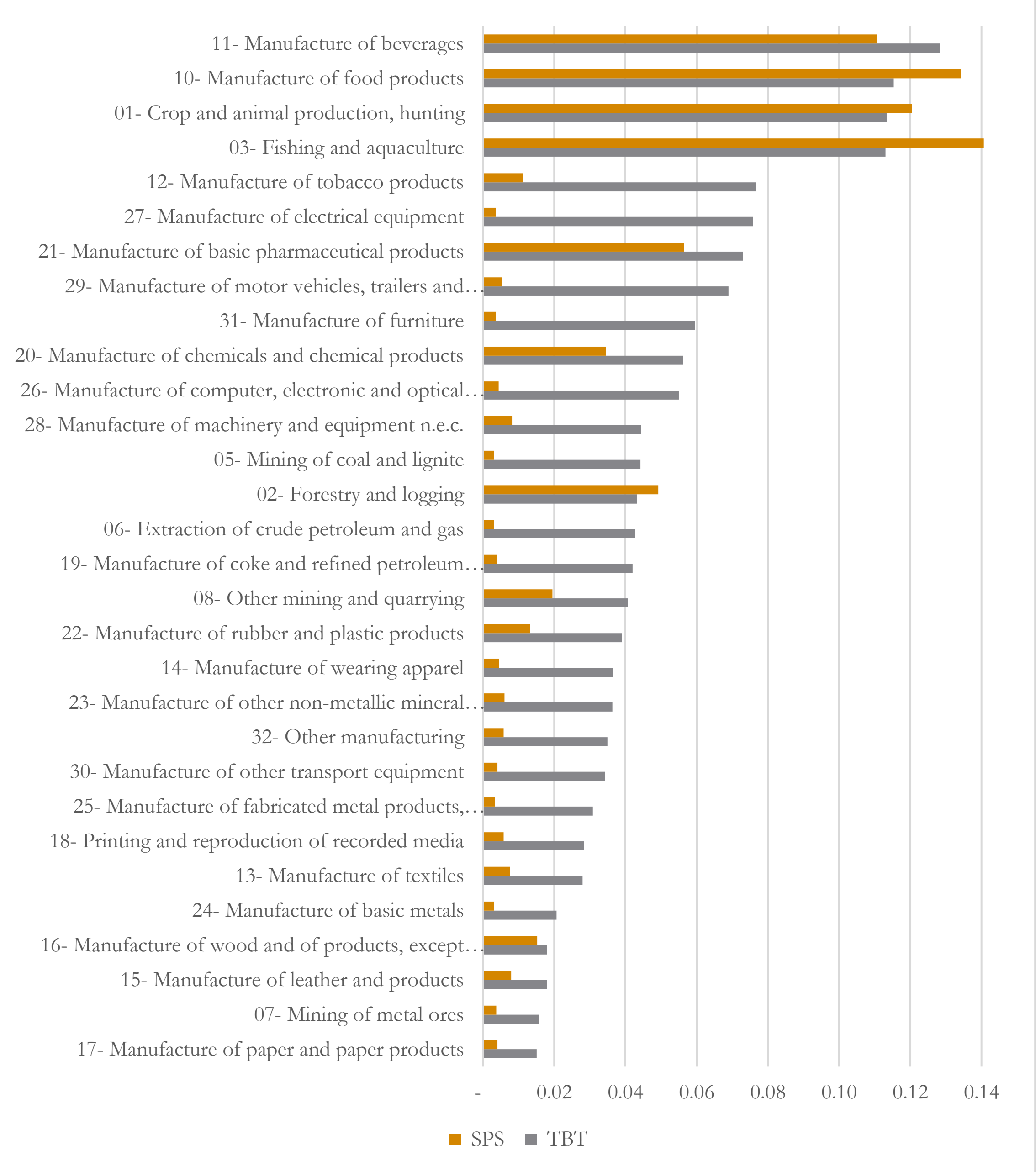
Source: WTO I-TIP, authors' elaboration.

Figure A6 / Number of SPS notifications (based on keywords class) in force in 2021 globally



Source: WTO I-TIP, authors' elaboration.

Figure A7 / Global regulatory divergence in TBT and SPS across NACE sectors averaged over the period 2004-2020



Source: WTO I-TIP, authors' elaboration.