World Trade Review (2024), **23**, 1–19
doi:10.1017/S1474745623000289

ORIGINAL ARTICLE

Do Lower Tariff Rates Promote Global Value Chain Participation?

Halit Yanikkaya, Pınar Tat* and Abdullah Altun

Department of Economics, Gebze Technical University, Kocaeli, Turkey
*Corresponding author: Pınar Tat, Email: pinartat@gtu.edu.tr

(Received 29 August 2022; revised 21 May 2023; accepted 22 May 2023; first published online 7 August 2023)

Abstract

The trade of intermediates now accounts for a growing share of global trade. In this highly fragmented global production system, any change in tariff rates can generate a higher impact than that of initial direct tariffs. To assess the impact of tariffs on global value chain participation, this study uses value-added trade statistics and cumulative tariff rates for 12 sectors from 168 countries for the years 1990–2015. The visual inspection suggests that initial tariffs result in higher tariff rates (almost 14%) due to a knock-on impact along with supply chains. The main empirical finding is that both faced and imposed tariff rates have significant negative impacts on sectoral global value chain participation. The effect is also persistent in the analysis if we employ cumulative tariff rates. Apart from these policy determinants, sector- and country-level endowments, such as higher relative length, capital intensity, foreign direct investment stock, and human capital appear to be the major drivers for higher total, forward, and backward global value chains participation. Even if our main results are robust, there are also some distinctions in the effects of tariff rates depending on the country- and sector-level heterogeneities. In a policy-related debate, given the cascading impacts of these liberalization initiatives, autonomous, regional, and global liberalization efforts are critical for all sectors to reap the benefits from the global production system.

Keywords: Input tariff; cumulative tariff; global value chains

JEL Codes: F13; F14

1. Introduction

Since the 1980s, the production process of countries has become enormously fragmented across borders/locations in a way that enables countries to specialize in a specific part of the production process according to their comparative advantages. Nowadays, share in world trade is mostly attributable to trade in intermediates used in the production of a product produced in another country (World Development Report, 2020). For this reason, trade policies in the form of tariff and non-tariff barriers draw more attention even if successive autonomous and multinational liberalization efforts have been realized over the decades.

In this highly interconnected world economy, tariffs on intermediates that can cross borders more than once also generate indirect costs to both producers and customers. The amplification of tariff rates, that is the cumulative effect of tariffs, is first systemically analyzed by using input–output (I-O) tables (see Rouzet and Miroudot, 2013). Rouzet and Miroudot mainly suggest that a reduction in tariff rates, including elements such as improvements in transportation and communication technologies, is more likely to increase fragmentation in global value chains (GVCs). However, this inevitably raises the cumulative effect of a tariff because firms face not only tariffs on their imported products but also the tariffs previously paid and embedded in these imported products. In other words, tariffs are multiplied when intermediate products are traded across

© The Author(s), 2023. Published by Cambridge University Press on behalf of The World Trade Organization

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press

borders. Given this argument, firms also expect a higher impact of tariffs in the vertical specialization pattern of trade, that is the transactions of the inputs used in the country's products that are to be exported. At this point, it is crucial to note that even if the study of Rouzet and Miroudot (2013) and many other studies have effectively applied tariff rates provided by the World Integrated Trade Solution (WITS), one caveat is that, in order to encourage the export performance of sectors depending on these intermediates, governments may render the tariffs unbinding for many of these products, which is called the inward processing trade regime (Wang and Yu, 2012; Yu, 2015). In other words, the inward processing regime can be defined as an export incentive system providing effective customs exemption for raw materials or inputs used by exporting sectors to produce products for exportation. Therefore, first, it is important to measure the cumulative tariff rates incurred over recent years with a large number of countries and to understand the extent to which indirect tariff rates can affect sectoral global value chain participation levels. Secondly, it is important to investigate GVC participation by dividing it into two main parts, simple and complex. The simple part measures trade activities with only one cross-bordering and a complex part considers multiple cross-bordering trade – analyzing these two measures enables us to understand the extent of the inward processing regime and the effect of cumulative tariff rates in general.

For these purposes, we first calculate input tariff rates as well as GVC participation (simple and complex) in terms of value-added by employing the decomposition methodology of Wang et al. (2017) because calculating tariffs gross terms also leads to some indirect effects arising from double counting issues in gross trade statistics. We then calculate cumulative tariff rates by employing the calculation strategy of Rouzet and Miroudot (2013). Lastly, we provide a more complete picture of the effects of tariff policy by calculating tariff rates using value-added trade statistics and tracking cumulative tariff rates along with the value chain using sectoral and technological heterogeneities from the Eora26 sample for the years 1990–2015 (Lenzen et al., 2012, 2013).

The main novelty of this study is the calculation of input tariff rates utilizing value-added trade statistics from product-level tariff rates as well as benefitting from the concept of cumulative tariff rates along a GVC. In addition, this study provides empirical evidence regarding the effects of these tariff policy measures on the GVC participation indices, such as backward/forward simple and complex GVC participation. Moreover, as far as we know, this is the first study that employs the position index as one of the drivers of GVC participation. Finally, our study also differs from earlier studies by focusing on tariffs and GVCs in terms of extensive coverage, including many developing countries.

The study is organized as follows. The next section reviews the trade restriction literature with a special focus on (cumulative) tariff rates and the determinants of GVC participation. The third section describes the data we employ in our analysis. The fourth section explains the empirical methodology. The fifth section presents estimation results, and the final section completes the study with some policy recommendations.

2. Literature Review

The concept of cumulative tariffs along a GVC is not new but calculating cumulative tariffs and analyzing their impact on the GVC are quite new research avenues thanks to the newly released inter-country input–output tables – see the World Input–Output Database (WIOD) (Timmer et al., 2015), the Organization for Economic Co-operation and Development (OECD, 2021), and the Eora26 (Lenzen et al., 2012, 2013). In the earliest studies, Yi (2003, 2010) offers a theoretical model investigating a magnified effect of tariff reductions on trade using a multistage production function, that is multiple cross bordering. Ferrantino (2012) illustrates that total trade cost rises exponentially when the number of production stages increases. Baldwin and Venables (2013) characterize production chains as snake and spider types. In their theoretical framework, shipping and any other coordination costs are also included as trade costs through global production chains.

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press

Apart from these conceptual foundations on theoretical models, there are other studies calculating the cumulative cost of trade (Koopman et al., 2010; Fally, 2011; Rouzet and Miroudot, 2013; Muradov, 2017). Koopman et al. (2010) consider gross trade statistics and multistage production as two reasons for the amplification of trade costs. Their findings regarding both transportation and tariff costs reveal that Asian countries have the highest magnification ratios because of their involvement in longer production chains. It is important to note that following their idea, we track the sector's value-added in the GVC and calculate both tariffs and cumulative tariffs by using value-added trade statistics. Fally (2011) employs transportation costs and defines cumulative tariff rates, but does not give any detailed discussion of the concept. Rouzet and Miroudot (2013) elaborate on the concept in a bilateral framework by providing a detailed calculation methodology. Their simulation results suggest that if tariffs on a Chinese product decrease by 30%, cumulative imposed tariffs of the European Union (EU) and Japan on the Chinese product are reduced by 5%. Muradov (2017) proposes two measures, cumulative tariff rates and the number of border crossings, by employing data from 2001, 2005, and 2010. He finds out that while the average number of border crossings increases, the faced cumulative tariff also increases. Some other studies have employed the methodology addressed in these theoretical models and calculated the cumulative tariff burden. Escaith (2017) measures trade costs from the GVC perspective and finds that trade disruptions raise the average production cost by 18%. Recently, Ghodsi and Stehrer (2022) take GVC linkages into account and calculate bilateral ad-valorem equivalents of non-tariff measures. Their results suggest that tariffs have a strong negative impact on both value-added and gross exports. While the impact of technical trade barriers has a significant negative impact on exports, the impact of sanitary and phytosanitary measures is insignificantly positive. Eugster et al. (2022) calculate cumulative tariffs and report the negative impacts of both tariffs and cumulative tariffs on value-added, employment, and productivity. Our study differs from their study in terms of the calculation of tariff rates, dependent variables, and the size/coverage of the datasets. Even if they employ product-level tariff rates as well as the methodology of Rouzet and Miroudot (2013), they reach sector-level tariff rates by using gross trade volumes rather than value-added trade statistics. Also, they are interested in value-added, employment, and productivity rather than GVC participation. Finally, while they employ a country- or sector-level dataset from the Capital, Labor, Energy, Materials, and Service (KLEMS) database, we utilize the country–sector–partner country-level dataset from the Eora26 database, which enables us to gain wider coverage in our analysis. Others (Mao and Görg, 2020; Wu et al., 2021) focus on the trade war between the US and China and present some descriptive results. Our study significantly contributes to the scarce empirical literature related to cumulative tariffs.

Regarding the determinants of GVC participation, the literature is quite rich and consists of many studies at the firm level (Lanz and Miroudot, 2011; Cieślik et al., 2019; Urata and Baek, 2020). At the sector and country level, tariff rates, capital intensity, FDI, and skilled labor are the most frequently utilized determinants or drivers of GVC participation. On the tariff rates, Kowalski et al. (2015) indicate that both faced and imposed tariffs have a negative impact on participation. Similarly, Nordas (2008) emphasizes the importance of open trade policies in the participation of electronics and textile sectors in GVCs. Cheng et al. (2015) show that trade restrictiveness and tariffs imposed on intermediates are negatively associated with the GVC participation of both low- and high-tech manufacturing sectors. Fernandes et al. (2020) claim that lower tariffs are important drivers of GVC participation. The idea is that tariffs do not only generate direct and indirect costs but also impede the potential gains from GVCs, which eventually leads to lower GVC participation ratios. Indeed, these types of losses are not only restricted to partner countries, but their wide-reaching impacts also affect all countries in the entire global production network. Regarding capital intensity, some studies (van der Marel, 2015) reveal that capital endowment has a positive effect on forward linkages whereas others (e.g. Landesmann et al., 2015) find no significant evidence. The studies employing foreign direct

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press

investment inflows in their analyses (Kowalski et al., 2015; Stehrer and Stöllinger, 2015; Buelens and Tirpák, 2017; Banerjee and Zeman, 2020) suggest that there is a significantly positive association between FDI inflow and GVC participation. FDI can develop capital and then boost the participation of domestic sectors in global production networks. In fact, FDI can be seen as a major instrument for multinational enterprises to be involved in GVCs (Amador and Cabral, 2016). Adarov and Stehrer (2021) also claim a strong impact of FDI and capital accumulation on GVC participation. Related to skilled labor, some studies (e.g. Cheng et al., 2015; Taglioni and Winkler, 2016; Farole et al., 2018; Ignatenko et al., 2019) find that the ability of skilled labor to conduct complex operations can lead to a positive relationship between skilled labor and GVC participation.

3. Data

Our study is mainly based on four different databases. The first one is the Eora26 database (Lenzen et al., 2012, 2013). We use inter-country input–output tables covering 186 countries and 26 sectors for the period 1990–2015. Since the tariff rate is mainly relevant in the nine manufacturing, mining, agricultural, and fishing sectors, we continue with these sectors. The manufacturing sectors are food and beverages; textiles and wearing apparel; wood and paper; petroleum, chemical, and non-metallic mineral products; metal products; electrical and machinery; transport equipment; other manufacturing; and recycling. We calculate both forward and backward GVC participation (simple and complex) indices as well as both forward and backward lengths from the database by employing the value-added decomposition methodology of Wang et al. (2017). Forward GVC participation consists of domestic value-added in exported products. If these exported products cross the border only once and are consumed in the partner country, they are classified as simple forward GVC participation. If the exported products cross the border more than once and are consumed in another (third) country other than the trade partner, they are classified as a complex forward GVC participation. Backward GVC participation consists of foreign value-added in imported products. If these imported products cross the border only once and are consumed in the importer country, they are classified as simple backward GVC participation. If the imported products cross the border more than once and are consumed in another (third) country other than the trade partner, they are classified as a complex backward GVC participation.

Production lengths include the number of times these intermediates are utilized in the production process before they are consumed as final products. In other words, a length counts the number of production stages in a value chain both from the user and producer sides. It also shows the fragmentation and complexity level of trade. Following Wang et al. (2017) and UIBE (2017, 2017a, 2017b), we take the ratio of forward length to backward length, called the position index, to reach a more consistent estimate regarding a relative production length. We also use data on gross fixed capital formation and labor compensation of sectors provided by the I-O tables of Eora26. We divide gross fixed capital formation by labor compensation to reach the capital intensity of sectors.

The second database is the WITS database (WITS, 2022). We obtain bilateral effectively applied tariff rates at the product level (HS6 digit codes) from this database. We can gauge whether a specific product of a specific sector is intermediate (INT) or not by utilizing the concordance table (OECD, 2017) provided by the OECD which links the product codes (HS-6) to their broad economic categories and sectors (International Standard Industrial Classification (ISIC) Rev. 3). We calculate tariff revenues by simply multiplying imposed tariff rates with imported values. We sum these country–product–partner country-level data across sectors to obtain the country–sector–partner country-level dataset. We then divide tariff revenues into import in value-added statistics rather than gross import volumes coming from I-O calculations. Since the dataset is bilateral, we just rearrange our dataset to include both imposed and faced

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press

input tariff rates in the dataset. The imposed tariff is the tariff rate that a country imposes when it imports from a partner country. Similarly, the faced tariff rate is the tariff rate that a country sector faces when it exports to a partner country. Furthermore, following the calculation steps indicated in Rouzet and Miroudot (2013), we also calculate the cumulative tariff rates of each measure by taking the number of cross borderings in GVCs into account.

The third database is the FDI database on flows and stock of the United Nations Conference on Trade and Development (UNCTAD) (UNCTAD, 2022). We employ FDI stock as shares of gross domestic product (GDP). As the last database, we utilize the Our World in Data (2022) which combines three published datasets: Lee and Lee (2016), Barro and Lee (2013), and the Human Development Report (UNDP, 2018) of the United Nations Development Program. We utilize the average years of schooling of the population of countries. After merging the variables coming from these four different databases, we end up with 12 sectors and 168 countries as an operational sample. Since Eora26 country and sectoral coverage are relatively wide, we aim to separate analyses for subgroups. To achieve this, we benefit from the historical income classification provided by the World Bank and the research and development (R&D) intensity (technology) classification of the OECD (Galindo-Rueda and Verger, 2016). We categorize sectors mainly into two groups as high and low technology. High-tech sectors are metal products; electrical and machinery; transport equipment; other manufacturing. The low-tech sectors are agriculture; fishing; mining and quarrying; food and beverages; textiles and clothing; wood and paper; petroleum, chemicals, and non-metallic mineral products; and recycling.

Table 1 presents the descriptive statistics of the variables we employ in the empirical analysis. We observe higher mean values, which are mainly driven by the manufacturing sectors, of backward GVC participation compared to those for forward GVC participation for both country groups. In addition, both imposed and faced tariff rates are approximately 6% of the full sample. Note that in contrast to developed countries, developing countries have relatively higher imposed tariffs. Both faced and imposed cumulative tariffs are one percentage point higher than the simple tariffs. There is no noticeable difference in a position index, which is the relative forward length, for developed and developing economies. We observe the higher capital intensity and FDI stock share in developing countries, whereas the mean years of schooling for developed countries are much higher than that of developing countries. It is important to reiterate that capital intensity is calculated by dividing gross fixed capital formation by labor compensation, which can be a reason for the lower level of capital intensity of developed countries with the higher level of labor compensation in these countries compared to that of developing countries.

Figure 1 depicts faced simple and cumulative tariff rates as well as shares of simple and complex parts in the GVC indices from 1990 to 2015. The first notable aspect is that simple and cumulative tariff rates are highly correlated to each other and follow a similar path. The cumulative tariff rate is 1% higher than the simple tariff rate. The second aspect is the decreasing share of the simple part of GVC participation and the increasing share of the complex part of GVC except for the 2008 Global Financial Crisis. Since the complex part of the GVC presents the trade volumes that cross the border more than once, this points out the importance of the cumulative tariff along with supply chains and reveals the threat of the amplified effect of input tariff.

Figure 2 presents the position index of sectors (weighted averages of countries by trade) over six points in time (1990, 1995, 2000, 2005, 2010, and 2015). To reiterate, the position index is defined as the ratio of forward linkages over backward linkages, that is the division of the distance of a particular production stage, that is the distance from starting stage to the ending stage. Since we employ the forward production length by deciding the optimal level of cross bordering, we aim to analyze the trends in a position index, that is relative forward length in Figure 2. Recycling; petroleum, chemical, and non-metallic mineral products; mining; and metal products sectors are in the relatively upstream part of a production chain.

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press

Table 1. Summary statistics

	Total			Developed Countries			Developing Countries		
Variables	Obs.	Mean	SD	Obs.	Mean	SD	Obs.	Mean	SD
GVC/VA (%)	2,177,626	0.88	8.00	745,589	0.58	4.28	1,432,037	1.04	9.36
Simple GVC/VA (%)	2,177,626	0.50	5.36	745,589	0.30	2.85	1,432,037	0.60	6.28
Complex GVC/VA (%)	2,177,626	0.38	4.97	745,589	0.27	2.03	1,432,037	0.44	5.95
Forward GVC/VA (%)	2,522,693	0.29	3.48	860,717	0.22	1.16	1,661,976	0.34	4.20
Forward simple GVC/VA (%)	2,522,693	0.19	3.00	860,717	0.13	0.92	1,661,976	0.22	3.64
Forward complex GVC/VA (%)	2,522,693	0.10	0.59	860,717	0.08	0.35	1,661,976	0.11	0.69
Backward GVC/VA (%)	2,177,626	0.57	6.98	745,589	0.35	3.96	1,432,037	0.68	8.12
Backward simple GVC/VA (%)	2,177,626	0.29	4.24	745,589	0.17	2.61	1,432,037	0.36	4.87
Backward complex GVC/VA (%)	2,177,626	0.27	4.86	745,589	0.19	1.94	1,432,037	0.32	5.83
iTariff_faced	2,397,108	0.06	0.12	819,690	0.07	0.12	1,577,418	0.06	0.12
iTariff_imposed	2,069,235	0.06	0.09	739,989	0.02	0.05	1,329,246	0.08	0.11
icuTariff_faced	2,397,108	0.07	0.12	819,753	0.08	0.12	1,577,355	0.06	0.12
icuTariff_imposed	2,069,235	0.07	0.10	740,047	0.02	0.05	1,329,188	0.09	0.11
Position	2,485,346	0.97	0.22	849,164	0.94	0.20	1,636,182	0.98	0.22
GFCF_LC	2,523,272	0.34	13.66	860,736	0.01	0.29	1,662,536	0.51	16.83
FDI/GDP	2,435,016	0.78	12.19	840,454	0.62	1.55	1,594,562	0.86	15.02
Schooling	2,384,684	8.51	2.95	808,423	10.80	1.73	1,576,261	7.33	2.74

Notes: Income classification is based on the country's 1990 income level, which is the initial year of our dataset (World Development Indicators (WDI)-World Bank, 2020). 'SD' stands for standard deviation. 'GVC' is the summation of forward and backward GVC linkages. 'VA' indicates sectoral value-added, and all trade measures are expressed as their shares in sectoral value added. 'i' and 'icu' mean simple input and cumulative input tariffs, respectively. iTariff_faced is faced simple input tariff and iTariff_imposed is imposed simple input tariff. icuTariff_faced is faced cumulative input tariff and icuTariff_imposed is imposed cumulative input tariff. GFCF_LC is calculated by dividing gross fixed capital formation by labor compensation.

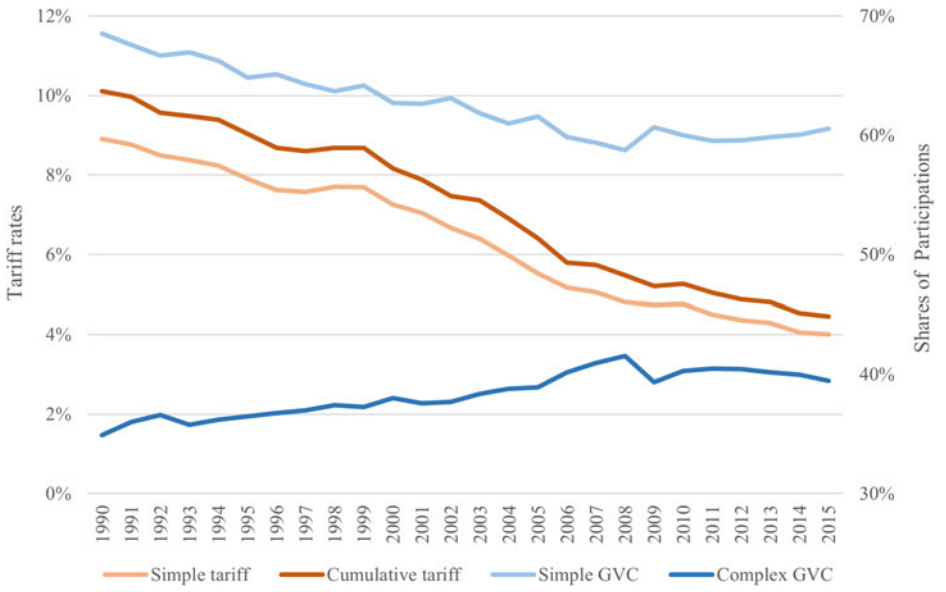

Figure 1. Tariffs rates and GVC participation

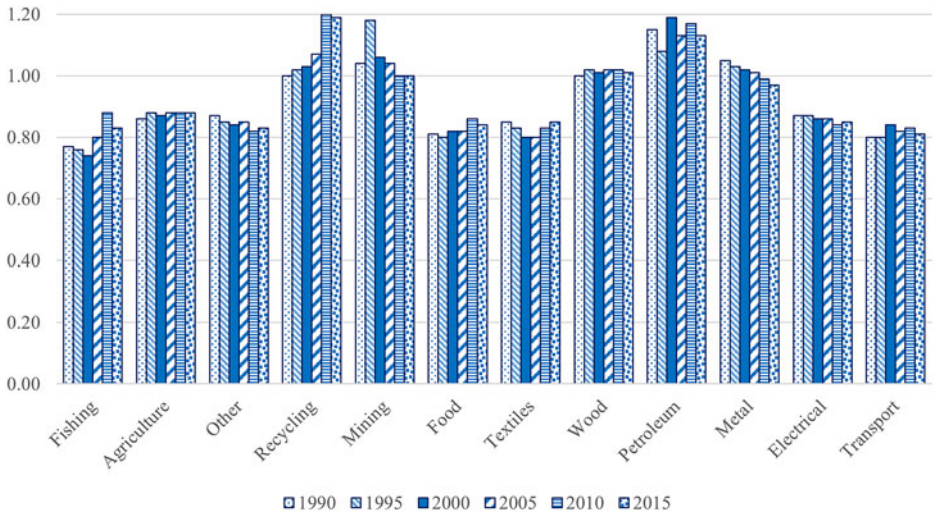

Figure 2. Production lengths of sectors

Notes: Other: Other manufacturing. Mining: mining and quarrying. Food: food & beverages; Textiles: textiles and wearing apparel. Wood: wood and paper. Petroleum: petroleum, chemical, and non-metallic mineral products. Metal: metal products. Electrical: electrical and machinery. Transport: transport equipment. Dotted, diagonal stripes downward, solid, diagonal stripes upward, horizontal stripes, and confetti fills in columns show the year 1990, 1995, 2000, 2005, 2010, and 2015, respectively.

4. Estimation Methodology

Following the models discussed in Cheng et al. (2015) and Fernandes et al. (2020), we specify the following empirical model to investigate the association between tariff rates and GVC participation.

$$GVC\_Participation_{c,s,p,\ t} = \beta_0 + \beta_1 Tariff\_faced_{c,s,p,t} + \beta_2 Tariff\_imposed_{c,s,p,t} + \beta_3 P_{c,s,p,t} + \beta_4 P^2_{c,s,p,t} + \beta_5 S_{c,s,t} + \beta_6 C_{c,t} + \beta_7 T_t + \varepsilon_{c,s,p,t} \quad (1)$$

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press

c, s, p, and t stand for the country, sector, partner country, and year, respectively. $GVC\_Participation_{c,s,p,t}$ signifies the vector of the total, forward, and backward GVC participation (simple and complex parts as well). $Tariff\_faced_{c,s,p,t}$ stands for faced tariff and $Tariff\_imposed_{c,s,p,t}$ stands for imposed tariff. These tariffs are calculated by utilizing both value-added trade statistics and a cumulative tariff procedure. In the analysis, we employ total GVC participation as the left-hand side variable, we then examine the impacts of both faced and imposed tariff rates on participation. Similarly, we consider the impact of faced (imposed) tariffs on the (backward) forward GVC participation. We expect that while a faced tariff (which can be considered as a market access tariff) inevitably leads to a rise in the price of products in which import duties are levied, the competitiveness of sectors in an international market may deteriorate, and an imposed tariff is more likely to raise the production cost of sectors considering the higher dependence of sectors on intermediates in the sample (see the descriptive statistics in Table 1). We also assess the total effect of these tariffs along with the GVC by employing cumulative tariff rates.

$P_{c,s,p,t}$ denotes the relative production length, which is the position index of related trade flows. We also include the square term of the position index to catch the U-shape relationship between GVC participation and production stages (if any). Shih (1996) and Mudambi (2008) develop the concept of the smile curve and claim that the sectors located at the first and end stages of the production chains create a higher value-added relative to sectors located in the middle stages (fabrication stages). Therefore, we expect a negative coefficient on the position index and a positive coefficient on the square term of the position index. $S_{c,s,t}$ denotes the capital intensity of sectors. $C_{c,t}$ denotes the vector of country-level characteristics, such as the share of foreign direct investment stock in GDP, of a country, and the mean years of schooling. T_t stands for year dummies. Given the positive impact that the literature finds (Kowalski et al., 2015; Stehrer and Stöllinger, 2015; Buelens and Tirpák, 2017; Banerjee and Zeman, 2020), we expect that FDI stock and schooling also to appear as significant drivers for GVC participation in sectors. Attracting foreign direct investment enables industries to meet new technology, production processes, and better managerial practices (Martínez-Galán and Fontoura, 2019). Better-educated workers are well-equipped to succeed in complex and the knowledge-intensive activities required to participate in the GVC (De Vries et al., 2016).[1]

The empirical models are estimated by employing the Fixed Effects (FE) estimation procedure to capture the impacts of possible unobservable time-invariants that vary over country–sector–partner country units and to get rid of the omitted variable bias.[2]

5. Results

This section presents and interprets the estimation results, in three subsections 5.1, benchmark results (Table 2), 5.2 estimations with sectoral heterogeneity (Table 3), and 5.3 estimations with technological heterogeneity (Table 4).

5.1 Benchmark Results

This subsection presents the benchmark results for the determinants of GVC participation. In columns (1)–(3) of Table 2, we employ total GVC participation ratios by summing up backward and forward linkages. In columns (4)–(6) and (7)–(9), we estimate the determinants of forward

[1]We also include the bilateral transportation cost of countries by utilizing the Economic and Social Commission for Asia and the Pacific (ESCAP) World Bank: International Trade Costs database (World Bank, 2022). Since the data is limited for some countries, this decreases the number of observations in our analysis. For this reason, we do not present these results, but they are quite similar to the results presented here and they are available upon request.

[2]We also employ the lagged value of tariff rates because they are predetermined and assumed to be uncorrelated with the current changes in industries' performance. We also run our model with the Ordinary Least Squares Estimates (OLS) with country–sector–partner country and time-fixed effects. We obtain very similar results.

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press

Table 2. Tariffs and GVC participation

Panel I:	GVC	Simple GVC	Complex GVC	Forward GVC	Forward Simple GVC	Forward Complex GVC	Backward GVC	Backward Simple GVC	Backward Complex GVC
Simple Tariffs	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Tariff_faced	−0.296***	−0.206***	−0.095**	−0.129***	−0.102***	−0.027***			
	(0.063)	(0.034)	(0.046)	(0.023)	(0.020)	(0.004)			
Tariff_imposed	−0.704***	−0.437***	−0.272***				−0.639***	−0.393***	−0.251***
	(0.088)	(0.063)	(0.051)				(0.070)	(0.044)	(0.047)
Pos	−0.397***	−0.175**	−0.230**	−0.405***	−0.322***	−0.082***	0.081	0.200***	−0.127
	(0.137)	(0.079)	(0.101)	(0.057)	(0.048)	(0.011)	(0.112)	(0.050)	(0.096)
Pos_sq	0.008***	0.004**	0.005**	0.009***	0.007***	0.002***	−0.002	−0.004***	0.003
	(0.003)	(0.002)	(0.002)	(0.001)	(0.001)	(0.000)	(0.002)	(0.001)	(0.002)
Capital intensity	0.643***	0.241***	0.404***	0.061***	0.040***	0.020***	0.563***	0.189***	0.377***
	(0.092)	(0.031)	(0.080)	(0.016)	(0.014)	(0.003)	(0.085)	(0.025)	(0.076)
FDI stock	0.017***	0.008**	0.010***	0.003	0.002	0.002*	0.012**	0.004	0.008**
	(0.007)	(0.004)	(0.004)	(0.002)	(0.002)	(0.001)	(0.006)	(0.003)	(0.003)
Schooling	0.023*	0.007	0.017*	−0.000	−0.000	0.000	0.028**	0.008*	0.020**
	(0.013)	(0.008)	(0.009)	(0.006)	(0.005)	(0.001)	(0.011)	(0.005)	(0.009)
Constant	2.666***	1.261***	1.425***	0.820***	0.616***	0.203***	1.637***	0.511***	1.144***
	(0.268)	(0.141)	(0.204)	(0.091)	(0.080)	(0.015)	(0.219)	(0.080)	(0.188)
# of Obs.	1,850,839	1,850,839	1,850,839	2,182,737	2,182,737	2,182,737	1,930,148	1,930,148	1,930,148
R-squared	0.482	0.440	0.549	0.356	0.345	0.526	0.529	0.503	0.563

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press

Table 2. (*Continued.*)

Panel II: Cumulative Tariffs	GVC (1)	Simple GVC (2)	Complex GVC (3)	Forward GVC (4)	Forward Simple GVC (5)	Forward Complex GVC (6)	Backward GVC (7)	Backward Simple GVC (8)	Backward Complex GVC (9)
Tariff_faced	−0.282***	−0.196***	−0.090**	−0.122***	−0.096***	−0.026***			
	(0.062)	(0.034)	(0.045)	(0.024)	(0.021)	(0.004)			
Tariff_imposed	−0.686***	−0.430***	−0.262***				−0.628***	−0.389***	−0.245***
	(0.089)	(0.063)	(0.051)				(0.068)	(0.042)	(0.047)
Pos	−0.396***	−0.177**	−0.228**	−0.404***	−0.321***	−0.082***	0.079	0.198***	−0.127
	(0.137)	(0.079)	(0.102)	(0.056)	(0.048)	(0.011)	(0.112)	(0.050)	(0.096)
Pos_sq	0.008***	0.004**	0.005**	0.009***	0.007***	0.002***	−0.002	−0.004***	0.003
	(0.003)	(0.002)	(0.002)	(0.001)	(0.001)	(0.000)	(0.002)	(0.001)	(0.002)
Capital intensity	0.649***	0.240***	0.411***	0.060***	0.040***	0.020***	0.570***	0.188***	0.384***
	(0.092)	(0.031)	(0.080)	(0.016)	(0.014)	(0.003)	(0.086)	(0.025)	(0.076)
FDI stock	0.017***	0.008**	0.010***	0.003	0.002	0.002*	0.012**	0.004	0.008**
	(0.007)	(0.004)	(0.004)	(0.003)	(0.002)	(0.001)	(0.006)	(0.003)	(0.003)
Schooling	0.023*	0.007	0.017*	−0.000	−0.000	0.000	0.027**	0.008*	0.020**
	(0.013)	(0.008)	(0.009)	(0.006)	(0.005)	(0.001)	(0.011)	(0.005)	(0.009)
Constant	2.689***	1.266***	1.443***	0.819***	0.616***	0.203***	1.663***	0.517***	1.165***
	(0.268)	(0.142)	(0.204)	(0.092)	(0.080)	(0.015)	(0.219)	(0.079)	(0.189)
# of Obs.	1,850,479	1,850,479	1,850,479	2,182,701	2,182,701	2,182,701	1,930,021	1,930,021	1,930,021
R-squared	0.482	0.441	0.548	0.356	0.345	0.526	0.529	0.504	0.562

Notes: Clustered robust standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

and backward GVC participation, respectively. In Panel I, the results of simple tariff rates are presented. Regarding the tariff variables, the estimated coefficients on tariff rates in the first three columns suggest that both faced and imposed tariffs have negative effects on total, simple, and complex GVC participation, with the higher impact being imposed tariffs. The estimated coefficients in the first column suggest that a 1% increase in faced tariffs (imposed tariffs) leads to 0.3% (0.7%) decreases in total GVC participation. When we investigate each linkage separately, we notice that the significant adverse effects of trade barriers continue to exist. It is important to note that the effects of these tariffs on GVC participation are relatively higher in a simple part compared to a complex part. This may suggest that the initial impact of any policy changes mostly harms the simple part of GVC, that is intermediates cross the border only once and are consumed in the partner country. The results imply that not only faced tariffs impede the realization of benefits coming from participation in forward GVC but also tariffs that countries impose on imported intermediates hinder imported inputs.

Regarding the sectoral control variables, we observe a U-shaped pattern between relative production stages, i.e. the position in GVC and almost all types of GVC participation. Given this significant result, we can argue that moving from the fabrication stages to the pre- or post-fabrication stages improves GVC participation because these movements raise the lengths of GVC. To realize this benefit, sectors can adopt new functions in their production process (Humphrey, 2004). Capital intensity displaying the sectoral endowments has a positive influence on GVC participation regardless of forward and backward linkages. Regarding the country-level control variables, FDI stock and years of schooling are the other significant determinants to boost GVC participation. The presence of FDI stock can reshape the economic structure in a way that higher productivity and production are realized (Buelens and Tirpák, 2017).

Panel II repeats the same exercise by using cumulative tariff rates instead of simple tariffs. The results are very similar and the conclusion we get is the same as that we infer from Panel I. The faced and imposed tariffs negatively affect the GVC participation level of sectors regardless of simple and complex parts. One of the possible explanations for the similar effect of cumulative tariffs can be related to the existence of an inward processing regime. Under this regime, which many countries utilize, there is already an exemption of tariffs imposed on intermediates used for exporting purposes, which thus mitigates the impact of tariffs utilized in the complex parts of GVC participation.

Without considering country- and sector-level heterogeneities, the results from the aggregate sample significantly prove the detrimental impact of any protective measures on accession and integration into GVCs. Even if countries aim to liberalize their economies, the results show that tariffs still matter. To improve GVC participation, countries should decrease tariff rates. Furthermore, to raise GVC participation, countries/sectors should develop their capacity by building up new functions along with the GVC, investing in capital stock, and foreign investment, and encouraging employees to obtain better skills. The findings related to capital intensity, FDI stock, and schooling ‘are in line with the current empirical literature. The findings of the position index provide new evidence for the GVC literature. Since the results are very similar in the analysis when we employ cumulative tariff rates, we present only the estimations for simple tariffs in the rest of the paper.

5.2 Results with Sectoral Heterogeneity

This subsection presents the results for trade pairs depending on their income levels as well as sectoral levels. Table 3 presents the result of the total GVC participation. The pairs developed–developed, developed–developing, developing–developed, and developing–developing indicate the income levels of the country and partner country. For instance, in the first column, we are interested in the GVC participation of developed economies if they trade with developed economies.

For manufacturing sectors, while both faced and imposed tariff rates reduce GVC participation between developing–developing pairs, the faced tariff is only significant for

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press

Table 3. Tariffs and GVC participation by sectors

	Developed–Developed	Developed–Developing	Developing–Developing	Developing–Developed
Total	(1)	(2)	(3)	(4)
Tariff_faced	0.282	−0.262***	−0.238***	0.353
	(0.258)	(0.056)	(0.081)	(0.800)
Tariff_imposed	−2.484**	−0.010	−0.490***	−1.639***
	(1.226)	(0.045)	(0.126)	(0.262)
# of Obs.	148,506	513,473	787,066	401,794
R-squared	0.516	0.586	0.374	0.576
Manufacturing	(1)	(2)	(3)	(4)
Tariff_faced	0.193	−0.271***	−0.253***	0.296
	(0.274)	(0.060)	(0.093)	(0.846)
Tariff_imposed	−3.181**	−0.019	−0.597***	−1.981***
	(1.466)	(0.051)	(0.150)	(0.321)
# of Obs.	117,166	427,154	649,763	323,127
R-squared	0.486	0.584	0.367	0.566
Agriculture & Mining	(1)	(2)	(3)	(4)
Tariff_faced	0.427	−0.139**	−0.102**	0.051
	(0.278)	(0.054)	(0.047)	(0.220)
Tariff_imposed	0.778	0.054	0.067	−0.073
	(0.630)	(0.088)	(0.091)	(0.099)
# of Obs.	31,340	86,319	137,303	78,667
R-squared	0.890	0.617	0.853	0.950

Notes: We employ the first specification in Table 2. We use the same control variables in all panels, but they are not reported here. Clustered robust standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

developed–developing pairs, and imposed tariff is significant for developed–developed and developing–developed country pairs. In other words, tariffs that developed countries impose on sectors of developed economies and tariffs that developing economies impose on sectors of all countries impede GVC participation. This may be related to the higher variations in tariff rates in these specific sub-samples and indicates the intense competition among developed countries and the protectionist policies of developing economies. Therefore, developed countries should decrease tariff policies on products coming from developed countries. The same is valid for developing countries regardless of the income level of trade partners to sustain the flows in the GVCs.

For agriculture and mining sectors, faced tariffs in the case of exports to developing countries have negative impacts on total GVC participation. In other words, protective measures implemented by developing countries in the agriculture and mining sectors can be seen as detrimental barriers in the front of GVC participation of developed and developing countries. This significant

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press

result may be related to the higher protection for agriculture and mining sectors in developing economies to protect their vulnerable industries. Similar to the manufacturing industry, developing countries should also mitigate applied tariff rates to better integrate into the GVCs.

5.3 Results with Technological Heterogeneity

This subsection presents the results for trade pairs depending on their income levels as well as the technology level of sectors. Table 4 presents the impact of tariffs on total GVC participation. To reiterate, we categorize sectors mainly into two groups as high and low technology by utilizing the R&D intensity (technology) classification of the OECD (Galindo-Rueda and Verger, 2016).

For high-tech sectors, while faced tariffs have negative impacts on the GVC participation of developed economies regardless of the income level of the trading partner, imposed tariffs have significantly negative impacts on the GVC participation of developing economies regardless of the income level of the trading partner.

Table 4. Tariffs and GVC participation by technology classification

	Developed–Developed	Developed–Developing	Developing–Developing	Developing–Developed
Total	(1)	(2)	(3)	(4)
Tariff_faced	0.282	−0.262***	−0.238***	0.353
	(0.258)	(0.056)	(0.081)	(0.800)
Tariff_imposed	−2.484**	−0.010	−0.490***	−1.639***
	(1.226)	(0.045)	(0.126)	(0.262)
# of Obs.	148,506	513,473	787,066	401,794
R-squared	0.516	0.586	0.374	0.576
High Technology	(1)	(2)	(3)	(4)
Tariff_faced	−0.463*	−0.253***	−0.118	1.225
	(0.275)	(0.080)	(0.095)	(1.853)
Tariff_imposed	−4.826	−0.056	−0.392***	−2.505***
	(2.947)	(0.053)	(0.091)	(0.581)
# of Obs.	56,739	213,044	315,421	156,000
R-squared	0.437	0.544	0.524	0.562
Low Technology	(1)	(2)	(3)	(4)
Tariff_faced	0.837**	−0.271***	−0.332***	−0.249
	(0.417)	(0.078)	(0.121)	(0.245)
Tariff_imposed	−0.749*	0.021	−0.552***	−1.083***
	(0.416)	(0.069)	(0.198)	(0.209)
# of Obs.	91,767	300,429	471,645	245,794
R-squared	0.740	0.612	0.352	0.592

Notes: We employ the first specification in Table 2. We use the same control variables in all panels, but they are not reported here. Clustered robust standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press

For low-tech sectors, both faced and imposed tariffs seem to hinder GVC participation among developing countries. These results simply imply that to improve the integration of developed countries as well as developing countries into the world economy, further reduction in tariff rates is needed.

Overall, trade protection mostly harms the trade flows of the low-tech sectors of developing countries considering both backward and forward linkages. Given the higher fraction of sectors that produce low-tech products, easy substitutability, and thereby relatively more elastic world demand for this type of product, more responsiveness of low-tech sectors to any change in tariff rates regarding different trade pairs compared to high-tech sectors becomes more apparent. While changing the origin of low-tech input is easier, changing the origin of high-tech input is rather difficult because of the complexity/uniqueness of high-tech products and the incompatibility of the production process with new inputs.

5.4 Robustness Checks

This subsection presents the several robustness checks for the benchmark results by including different sets of country, sector, partner country, and year dummies to exploit different variations in tariffs and GVC participation. Table 5 provides the estimations employing a variety of different dummies. In Panel I, we use country–partner country, country–sector, and time dummies. In Panel II, we utilize country–partner country, country–sector, country–time, partner country–time, and sector–time dummies. In Panel III, we employ country–sector–partner country, and time dummies. In Panel IV, we utilize country–sector–partner country, country–time, partner country–time, and sector–time dummies.

Panels I and II present similar results as reported in the benchmark results (Table 2). Our variables of interest are mostly statistically significant. This can be explained by the lack of ability of the specification to catch the variations in tariff rates coming from interactions with the country–sector–partner country. Panels III and IV in this table prove the robustness of the results as reported in Table 2. For all panels of Table 5, the explanatory power of our models improves with the inclusion of the interactions of dummy variables.[3]

6. Conclusion

This study investigated the effects of tariffs on GVC participation by utilizing value–added trade statistics and the concept of cumulative tariff rates for 12 sectors from 168 countries from 1990 to 2015. The main finding is that tariff rates significantly deteriorate the GVC participation of sectors in these highly fragmented production networks. Moreover, simple tariffs can then turn into even higher cumulative tariff rates via a knock-on effect along with supply chains which means an important cost for producers in the value chain.

Our visual graphs show that while the simple tariff is around 6%, the cumulative tariff is 7%, implying that the share of the indirect tariff accumulated along with GVCs in cumulative tariff is approximately 14%. According to the empirical findings, both simple and cumulative tariffs have detrimental impacts on total, forward, and backward GVC participation. To realize the benefits of GVCs, country–sector capacity building is just as crucial as trade liberalization. Given the strong U-shaped pattern of the position index, adding new functions, such as adding more productive

[3]We also treat the European Union (EU) as a single entity and repeat our analysis. The significances continue to exist for all tariff measures. The estimated coefficients are higher than those in the benchmark results (Table 2). This may be related to the fact when we employ the EU as a single entity, we can catch higher variation across country–partner country pairs. For further robustness checks, we also estimate our model considering several different explanatory variables such as GDP, GDP per capita, and free trade agreements. These estimations do not alter our conclusions. The estimation results are available upon request.

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press

Table 5. Tariffs and GVC participation (with different set of dummies)

	GVC	Simple GVC	Complex GVC	Forward GVC	Forward Simple GVC	Forward Complex GVC	Backward GVC	Backward Simple GVC	Backward Complex GVC
Panel I	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Tariff_faced	−0.143	−0.186***	0.041	−0.117***	−0.093***	−0.024***			
	(0.101)	(0.033)	(0.093)	(0.021)	(0.018)	(0.004)			
Tariff_imposed	−0.764***	−0.514***	−0.258***				−0.665***	−0.456***	−0.217***
	(0.122)	(0.097)	(0.060)				(0.103)	(0.078)	(0.057)
# of Obs.	1,867,151	1,867,151	1,867,151	2,208,222	2,208,222	2,208,222	1,948,017	1,948,017	1,948,017
R-squared	0.220	0.179	0.241	0.136	0.119	0.290	0.213	0.176	0.227
Panel II	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Tariff_faced	−0.033	−0.110***	0.076	−0.072***	−0.058***	−0.013***			
	(0.104)	(0.031)	(0.097)	(0.018)	(0.015)	(0.003)			
Tariff_imposed	−1.092***	−0.725***	−0.396***				−0.784***	−0.518***	−0.292***
	(0.207)	(0.175)	(0.072)				(0.106)	(0.080)	(0.060)
# of Obs.	1,867,151	1,867,151	1,867,151	2,208,222	2,208,222	2,208,222	1,948,017	1,948,017	1,948,017
R-squared	0.233	0.194	0.248	0.144	0.126	0.307	0.224	0.193	0.232
Panel III	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Tariff_faced	−0.291***	−0.201***	−0.094**	−0.124***	−0.097***	−0.027***			
	(0.059)	(0.031)	(0.044)	(0.021)	(0.018)	(0.003)			
Tariff_imposed	−0.687***	−0.430***	−0.263***				−0.624***	−0.387***	−0.242***
	(0.083)	(0.059)	(0.048)				(0.066)	(0.041)	(0.045)

(*Continued*)

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press

Table 5. (*Continued.*)

	GVC	Simple GVC	Complex GVC	Forward GVC	Forward Simple GVC	Forward Complex GVC	Backward GVC	Backward Simple GVC	Backward Complex GVC
Panel I	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
# of Obs.	1,848,981	1,848,981	1,848,981	2,187,477	2,187,477	2,187,477	1,929,987	1,929,987	1,929,987
R-squared	0.480	0.437	0.549	0.356	0.345	0.520	0.527	0.497	0.563
Panel IV	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Tariff_faced	−0.119**	−0.087***	−0.033	−0.047***	−0.037***	−0.011***			
	(0.056)	(0.023)	(0.047)	(0.009)	(0.007)	(0.002)			
Tariff_imposed	−1.033***	−0.665***	−0.397***				−0.734***	−0.443***	−0.315***
	(0.206)	(0.175)	(0.066)				(0.070)	(0.043)	(0.050)
# of Obs.	1,848,981	1,848,981	1,848,981	2,187,477	2,187,477	2,187,477	1,929,987	1,929,987	1,929,987
R-squared	0.491	0.448	0.555	0.365	0.352	0.538	0.535	0.509	0.567

Notes: We include all control variables in all panels, but not reported for the simplicity of the table. In Panel I, we use country–partner country, country–sector, and time dummies. In Panel II, we utilize country–partner country, country–sector, country–time, partner country–time, and sector–time dummies. In Panel III, we employ country–sector–partner country, and time dummies. In Panel IV, we utilize country–sector–partner country, country–time, partner country–time, and sector–time dummies. Clustered robust standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

processes to manufacturing, can be considered as a good tool for moving along the production chain or functional upgrading. Other factors encouraging GVC participation include increasing capital intensity, attracting more FDI stock, and rewarding higher education levels in general. While the overall findings are consistent across the different definitions of GVC participation and calculations of tariff rates, there are some differences in the effects of tariff rates based on the income level of countries and sector heterogeneities. In general, manufacturing industries, low-tech sectors, developing countries, and trade between developing and developing countries are seen as more vulnerable to any trade barriers. Removal of trade barriers that sub-groups can encounter in their backward and forward linkages can boost their GVC participation.

Overall, while GVCs get larger and longer, a particular interest is drawn into tariff policies. Trade barriers especially in the form of tariff rates are still a significant concern because of their cumulative effect on GVCs. Given the significant results of this study, we can claim that policymakers ought to track the domestic value-added of sectors along with the value chain and focus on the indirect effect of tariff rates by taking the length of trade flows into account. Accordingly, the findings driven by the precise assessment of these new measures should be discussed and given place in national policies and international negotiations. Specifically, even if there are successive rounds to liberalize the trade of intermediates, the inward processing regime, and specific tariff exemption on some sectors, tariffs on intermediates still matter for sectoral performance while also considering country- and sector-level heterogeneities. Therefore, autonomous, and global liberalization efforts are quite crucial for all sectors to benefit from the global production system considering cascading effects of these liberalization efforts.

Supplementary Materials. To view supplementary material for this article, please visit https://doi.org/10.1017/S1474745623000289.

Acknowledgements. The first author acknowledges support from the Turkish Academy of Sciences.

Conflict of interest. The authors declare that they have no conflict of interest.

Data Availability. The data that support the findings of this study are openly available at https://worldmrio.com/eora26/, https://wits.worldbank.org/, https://unctadstat.unctad.org/, and https://ourworldindata.org/.

References

Adarov, A. and R. Stehrer (2021) 'Implications of Foreign Direct Investment, Capital Formation and its Structure for Global Value Chains', *The World Economy* 44(11), 3246–3299.

Amador, J. and S. Cabral (2016) 'Global Value Chains: A Survey of Drivers and Measures', *Journal of Economic Surveys* 30(2), 278–301.

Baldwin, R. and A.J. Venables (2013) 'Spiders and Snakes: Offshoring and Agglomeration in the Global Economy', *Journal of International Economics* 90(2), 245–254.

Banerjee, B. and J. Zeman (2020) *Determinants of Global Value Chain Participation: Cross Country Analysis*. National Bank of Slovakia, Bratislava.

Barro, R.J. and J.W. Lee (2013) 'A New Data Set of Educational Attainment in the World, 1950–2010', *Journal of Development Economics* 104, 184–198.

Buelens, C. and M. Tirpák (2017) 'Reading the Footprints: How Foreign Investors Shape Countries Participation in Global Value Chains', *Comparative Economic Studies* 59(4), 561–584.

Cheng, M.K.C., S. Rehman, M. Seneviratne, and S. Zhang (2015) 'Reaping the Benefits from Global Value Chains', International Monetary Fund, IMF Working Paper WP/15/204.

Cieślik, A., J.J. Michałek, and K. Szczygielski (2019) 'What Matters for Firms? Participation in Global Value Chains in Central and East European countries', *Equilibrium. Quarterly Journal of Economics and Economic Policy* 14(3), 481–502.

De Vries, G.J., Q. Chen, R. Hasan, and Z. Li. (2016) 'Skills and Activity Upgrading in Global Value Chains: Trends and Drivers for Asia', Asian Development Bank, Economics Working Paper Series, (496).

Escaith, H. (2017) 'Accumulated Trade Costs and their Impact on Domestic and International Value Chains', in D. Dollar, J.G. Reis, and Z. Wang (eds.), *Global Value Chain Development Report. Measuring and Analyzing the Impact of GVCs on Economic Development*. International Bank for Reconstruction and Development, The World Bank. Washington. pp. 112–132.

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press

Eugster, J., M.F. Jaumotte, M.M. MacDonald, and M.R. Piazza. (2022) 'The Effect of Tariffs in Global Value Chains', International Monetary Fund, Working Paper. WP/22/40.

Fally, T. (2011) '*On the Fragmentation of Production in the US*', University of Colorado mimeo. https://www.etsg.org/ETSG2011/Papers/Fally.pdf.

Farole, T., C. Hollweg, and D. Winkler. (2018) *Trade in Global Value Chains. An Assessment of Labor Market Implications*. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/30249.

Fernandes, A.M., H.L. Kee, and D.E. Winkler (2020) 'Determinants of Global Value Chain Participation: Cross-Country Evidence', World Bank, Policy Research Working Paper, (9197).

Ferrantino, M.J. (2012) 'Using Supply Chain Analysis to Examine the Costs of Non-Tariff Measures (NTMs) and the Benefits of Trade Facilitation', US International Trade Commission, Working paper, 2012.

Galindo-Rueda, F. and F. Verger (2016) 'OECD Taxonomy of Economic Activities Based on R&D Intensity', OECD Science, Technology and Industry, Working Papers 2016/04.

Ghodsi, M. and R. Stehrer (2022) 'Trade Policy and Global Value Chains: Tariffs Versus Non-Tariff Measures', *Review of World Economics* 158(3), 887–916..

Humphrey, J. (2004) Upgrading in Global Value Chains. Available at SSRN 908214.

Ignatenko, A., F. Raei, and B. Mircheva (2019) 'Global Value Chains: What are the Benefits and Why do Countries Participate?', IMF Working Paper WP/19/18, www.imf.org/en/Publications/WP/Issues/2019/01/18/Global-Value-Chains-What-are-the-Benefits-and-Why-Do-Countries-Participate-46505.

Koopman, R., W. Powers, Z. Wang, and S.J. Wei (2010) 'Give Credit Where Credit is Due: Tracing Value Added in Global Production Chains (No. w16426)', National Bureau of Economic Research.

Kowalski, P., J. Lopez Gonzalez, A. Ragoussis, and C. Ugarte (2015) *Participation of Developing Countries in Global Value Chains: Implications for Trade and Trade-Related Policies,* OECD Trade Policy Papers, No. 179. Paris: OECD Publishing. doi: 10.1787/5js33lfw0xxn-en

Landesmann, M., S. Leitner, and R. Stehrer (2015) 'Competitiveness of the European Economy', EIB Working Papers no. 2015/01, Luxemburg, Luxembourg: European Investment Bank. http://www.eib.europa.eu/attachments/efs/economics_working_paper_2015_01_en.pdf.

Lanz, R. and S. Miroudot (2011) *Intra-Firm Trade: Patterns, Determinants and Policy Implications*, OECD Trade Policy Papers, No. 114, Paris: OECD Publishing. doi:10.1787/5kg9p39lrwnn-en

Lee, J.W. and H. Lee (2016) 'Human Capital in the Long Run', *Journal of Development Economics* 122, 147–169.

Lenzen, M., K. Kanemoto, D. Moran, and A. Geschke (2012) 'Mapping the Structure of the World Economy', *Environmental Science & Technology* 46(15), 8374–8381.

Lenzen, M., D. Moran, K. Kanemoto, and A. Geschke (2013) 'Building Eora: A Global Multi-Region Input–Output Database at High Country and Sector Resolution', *Economic Systems Research* 25(1), 20–49.

Mao, H. and H. Görg (2020) 'Friends Like This: The Impact of the US–China Trade War on Global Value Chains', *World Economy* 43(7), 1776–1791.

Martínez-Galán, E. and M.P. Fontoura (2019) 'Global Value Chains and Inward Foreign Direct Investment in the 2000s', *The World Economy* 42(1), 175–196.

Mudambi, R. (2008) 'Location, Control and Innovation in Knowledge-Intensive Industries', *Journal of Economic Geography* 85, 699–725.

Muradov, K. (2017) 'Trade Costs and Borders in Global Value Chains', *Review of World Economics* 153(3), 487–509.

Nordas, H.K. (2008) 'Vertical Specialization and its Determinants', *Journal of Development Studies* 44, 1037–1055.

Organization for Economic Co-operation and Development (OECD) (2017) 'FromHSToISICToEC – OECD', www.oecd.org/sti/ind/ConversionKeyBTDIxE4PUB.xlsx.

Organization for Economic Co-operation and Development (OECD). (2021) 'OECD Inter-Country Input–Output Database', http://oe.cd/icio.

Our World in Data (2022) 'Average Years of Schooling', https://ourworldindata.org/grapher/mean-years-of-schooling-long-run.

Rouzet, D. and S. Miroudot (2013) 'The Cumulative Impact of Trade Barriers Along the Value Chain: An Empirical Assessment Using the OECD Inter-Country Input–Output Model', GTAP Resources. No. 4184.

Shih, S. (1996) *Me-Too is Not My Style: Challenge Difficulties, Breakthrough Bottlenecks, Create Values*. Taipei: The Acer Foundation.

Stehrer, R. and R. Stöllinger (2015) 'The Central European Manufacturing Core: What is Driving Regional Production Sharing?', FIW-Research Reports 2014/15 No 2, The Vienna Institute for International Economic Studies.

Taglioni, D. and D. Winkler (2016) *Making Global Value Chains Work for Development*. World Bank Publications. Washington.

Timmer, M.P., E. Dietzenbacher, B. Los, R. Stehrer, and G.J. De Vries (2015) 'An Illustrated User Guide to the World Input–Output Database: The Case of Global Automotive Production', *Review of International Economics* 23(3), 575–605.

United Nations Conference on Trade and Development (UNCTAD). (2022) 'Foreign Direct Investment: Inward and Outward Flows and Stock, Annual', https://unctad.org/topic/investment/investment-statistics-and-trends.

United Nations Development Programme. (UNDP). (2018) 'Human Development Report (2018 Statistical Update)', https://hdr.undp.org/sites/default/files/2018_human_development_statistical_update.pdf.

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press

University of International Business and Economics (UIBE) GVC Index Team. (2017) 'Data Files Structure of the UIBE GVC Index System', http://139.129.209.66:8000/d/daedafb854/.
University of International Business and Economics (UIBE). (2017a) 'Data Files Structure of the UIBE GVC Index System', https://v2.fangcloud.com/share/a26979974d538c7e5aeb24b55a?folder_id=63000172546&lang=en.
University of International Business and Economics (UIBE). (2017b) 'UIBE Global Value Chain Indexes System – Concept Note', https://v2.fangcloud.com/share/a26979974d538c7e5aeb24b55a?folder_id=63000172546&lang=en.
Urata, S. and Y. Baek. (2020) 'The Determinants of Participation in Global Value Chains: A Cross-Country, Firm-Level Analysis', ADBI Working Paper Series. No: 1116.
van der Marel, E. (2015) 'Positioning on the Global Value Chain Map: Where do You Want to be?', ECIPE Occasional Paper no.1/2015.
Wang, Z. and Z. Yu (2012) 'Trading Partners, Traded Products and Firm Performances of China's Exporter-Importers: Does Processing Trade Make a Difference?', *The World Economy* 35(12), 1795–1824.
Wang, Z., S.J. Wei, X. Yu, and K. Zhu (2017) 'Measures of Participation in Global Value Chains and Global Business Cycles (No. w23222)', National Bureau of Economic Research.
World Bank (2020) 'World Bank Country and Lending Groups', https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.
World Bank (2022) Economic and Social Commission for Asia and the Pacific (ESCAP) World Bank: International Trade Costs, https://databank.worldbank.org/source/escap-world-bank-international-trade-costs#.
World Development Report (2020) *Trading for Development: In the Age of Global Value Chains*. Washington: International Bank for Reconstruction and Development/The World Bank.
World Integrated Trade Solution (WITS). (2022). https://wits.worldbank.org/.
Wu, J., J. Wood, K. Oh, and H. Jang (2021) 'Evaluating the Cumulative Impact of the US–China Trade War Along Global Value Chains', *The World Economy* 44(12), 3516–3533.
Yi, K.M. (2003) 'Can Vertical Specialization Explain the Growth of World Trade?', *Journal of Political Economy* 111(1), 52–102.
Yi, K.M. (2010) 'Can Multistage Production Explain the Home Bias in Trade?', *American Economic Review* 100(1), 364–93.
Yu, M. (2015) 'Processing Trade, Tariff Reductions and Firm Productivity: Evidence from Chinese Firms', *The Economic Journal* 125(585), 943–988.

Cite this article: Yanikkaya H, Tat P, Altun A (2024). Do Lower Tariff Rates Promote Global Value Chain Participation? *World Trade Review* **23**, 1–19. https://doi.org/10.1017/S1474745623000289

https://doi.org/10.1017/S1474745623000289 Published online by Cambridge University Press