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Does Global Value Chain Participation Enhance Export Diversification?*

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This paper examines the effect of global value chain (GVC) participation on export diversification using a dataset covering 134 countries from 2002 to 2018. Applying the two-step System GMM estimator, we find that GVC participation contributes to the diversification of both export products and export partners. Our empirical results further reveal that this positive effect powerfully works through backward GVC participation, while the impact of forward GVC participation on export product diversification varies among countries with different levels of trade liberalization and policy stability.

JEL Classification: F10, F14, F23
Keywords: export diversification, GVC participation, backward linkage, forward linkage

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1. INTRODUCTION

A global value chain (GVC) is the series of stages in producing a product or service for sale to consumers with at least two stages of production accomplished in two different countries (World Bank, 2020). Nowadays, countries integrate GVCs by specializing in defined segments of the production process, which create value added to final products (Koopman *et al.*, 2014). Especially, trade costs have been declining due to technological developments, advances in information and communication technologies, and the adoption of trade-liberalizing policies. As a result, fragmentize the production processes has been expanded in a global level and broaden the extensive margin of trade in terms of both products and markets (Bernard *et al.*, 2011; UNCTAD, 2013; Baldwin and Robert-Nicoud, 2014). Thus, with the presence of GVCs, international trade becomes more diversified by exchanging intermediates goods as well as final goods (Grossman and Rossi-Hansberg, 2008). World Bank (2020) indicates that GVCs have considerably contributed to better economic development, especially export performance. Due to international fragmentation, countries not only exclusively rely on domestic resources to produce export commodities but also take advantage of factor endowments as well as the advanced technology of the countries from which they import intermediate goods. Many studies have also explored the crucial role of GVC participation in upgraded quality of exported products (Gideon, 2021) as well as enhanced productivity (Halpern *et al.*, 2015; Criscuolo and Timmis, 2017; Constantinescu *et al.*, 2019; Costa and Delgado, 2019; Antràs and Gortari, 2020).

GVCs allow countries to exploit their comparative advantages not only in different sectors but also in different stages of production within sectors. Besides, participating in GVCs is an efficient way for countries to better access a greater number of less costly and higher-quality intermediate inputs. Since GVCs typically involve long-term relationships between firms in the entire production chain, GVCs play a crucial role in transferring technology and knowledge. Interdependent firms from different countries are likely to share

technology and knowledge, which boosts their productivity and sales. Therefore, GVCs participation is highly predicted to positively promote exporting firms to create new products for exports and broaden their export markets.

However, to the best of our knowledge, in the literature on GVC participation effectiveness, little attention has been paid to the impact of GVC participation on export diversification. We fill this gap by empirically investigating the effect of GVC participation on export diversification. In particular, we separately examine two types of GVC participation (i.e., backward and forward GVC participation) to acquire deeper insights. The rest of this paper is organized as follows. Section 2 provides theoretical channels through which GVC participation affects export performance and export diversification before section 3 describes data and the empirical specification. Section 4 discusses the results while concluding remarks are presented in section 5.

2. LITERATURE REVIEW

There have been a number of studies exploring the various channels through which GVCs affect export performance. Firstly, GVCs bring opportunities for countries to access high-quality intermediate inputs at lower prices and make use of knowledge, technology, innovation, and global competition spillovers (Benguria, 2014; Kee, 2015; Zhang and Gallagher, 2016; Criscuolo and Timmis, 2017; De Marchi *et al.*, 2017; Supriya *et al.*, 2018; Cainelli *et al.*, 2018), followed by their productivity improvement. Importing intermediates, which can be seen as technological progress, enable firms to reduce the average cost of inputs and induce skill improvements through the production of new products (Grossman and Rossi-Hansberg, 2008; Crino, 2012). Secondly, diversification in importing inputs, especially sophisticated intermediate inputs allow developing countries to create new products for export and enhance productivity by increasing import competition and expanding access to advanced technology (Fernandes, 2007; Cadot *et al.*, 2013;

Colantone and Crino, 2014; Bas and Strauss-Kahn, 2014; Edwards *et al.*, 2017). To investigate the effect of services offshoring on productivity, Amiti and Wei (2009) use a dataset of manufacturing industries in the US for 1992-2000, while Winkler (2010) uses a dataset of manufacturing sectors in Germany from 1995 to 2006. Both studies get similar results to elucidate the productivity gains through offshoring. Using a dataset of 13 sectors in 40 countries for 1995-2009, Constantinescu *et al.* (2019) show that GVC participation, especially backward participation, is positively associated with productivity. Banh *et al.* (2020) use firm-level data of Estonia from 2000 to 2016, and they confirm that GVC participation is considered as a determinant of productivity upgrading. They also reveal that exporting firms gain more from GVC participation than non-export firms.

Some studies also focus on the links between related issues of GVC participation and export. Benguria (2014) employs a dataset of low-income countries during 1962-2000 to evaluate the role of trade in intermediate inputs and trade policy on export performance. The author finds that importing various cheap intermediate inputs and trade liberalization can create an opportunity for low-income countries to produce new products for export. Colantone and Crino (2014) use production and trade data from 25 European countries to prove that diversified new inputs exert a strong association with product creation. Using firm-level data in France between 1996 and 2005, Bas and Strauss-Kahn (2014) reveal that importing various intermediate inputs positively impacts the creation of exported products. Studying two distinct types of FDI firms in Lesotho's apparel industry (i.e., Taiwanese transnational producers and South African regional investors), Morris and Staritz (2016) uncover the positive effect of integration into GVCs on the product and production process upgrading and the extension of the export markets. By using a dataset of over 14,000 Swedish manufacturing firms from 2001 to 2012, Castellani and Fassio (2019) demonstrate that the importation of new inputs is a critical factor for exporting firms to broaden their export basket, and this positive impact is notably stronger for small firms. Using panel data of 18 manufacturing industries in China for the period 2000-2014, Peng and Zhang

(2020) show that upgrading the GVC position of the Chinese manufacturing industry significantly improves the domestic technology content of manufacturing exports. Studying 49 countries from 1995 to 2011, Brumm *et al.* (2019) indicate that economies with greater GVC participation exhibit larger current account balances. Jangam and Rath (2020) examine 24 emerging market economies from 1995 to 2011 and find that participation in GVCs enhances economic upgrading in the form of improvements in domestic value-added exports. Using a dataset of 100 countries from 1999 to 2018, Neha and Rupa (2020) reveal that GVC participation, through both backward and forward integration, is positively associated with the increase in the sophistication of exports.

Several studies have investigated the drivers of export diversification. In these studies, it has been found that export diversification is enhanced by factors such as GDP per capita, human capital development, aid for trade, FDI, financial development, and trade liberalization (Agosin, 2011; Bernard *et al.*, 2011; Tadesse and Shukralla, 2011; Gnangnon, 2018; Osakwe *et al.*, 2018; Kim, 2019; Jangam and Akram, 2020). Although these studies all purvey valuable insights, even relevant insights on the importance of GVC integration for diversifying exports, none of them employ measures of GVC participation as a critical determinant of export diversification. Therefore, in this paper, we contribute to current literature not only by applying the comprehensive measure of GVC participation, which captures all sources of value-added in gross exports, but also examining the impact of GVC participation on export diversification and sequentially assessing the effects of two types of GVC participation (i.e., forward and backward involvement) on export diversification. Using a panel dataset of 134 countries from 2002 to 2018, we find that GVC participation plays a crucial role in improving export product diversification and export market diversification of exporting countries. We further find an interesting result that this positive effect strongly works through backward GVC participation. Meanwhile, forward GVC participation contributes to export market diversification, and its impact on export product diversification varies among countries with different levels of trade

liberalization and policy stability.

3. DATA SOURCE AND MODEL SPECIFICATION

3.1 Measure of GVC Participation

Based on Input-Output (IO) tables, Hummels *et al.* (2001) first introduced a measure of GVC participation by calculating the imports content of exports. However, Koopman *et al.* (2010) indicate that this measure contains the problem of double counting because intermediates can cross borders more than once, and they propose a measure of GVC participation that captures all sources of value-added in gross exports. This later measure of GVC participation is widely used by many scholars (Banh *et al.*, 2020; Gideon, 2021) as well as international organizations (OECD, 2019; WTO, 2020). Therefore, we follow Koopman *et al.* (2010) to define the extent of GVC participation of country *i* in year t as follows:

$$GVCparticipation_{i,t} = \frac{FVA_{i,t} + DVX_{i,t}}{GE_{i,t}} \times 100. \quad (1)$$

$FVA_{i,t}$ is the foreign value-added which is defined as the value added of foreign inputs imported from other countries to produce export goods and services of country *i* in year *t*. $DVX_{i,t}$ is the indirect value-added exports of country *i*, which is domestic value-added inputs embodied in the exports of other countries in year *t*. $GE_{i,t}$ is the gross export of country *i* in year *t*. The larger the value of this index, the more intensive participation in global value chains. The indicator comprises two components that reflect the upstream and downstream integrations in international production chains: backward participation and forward participation, respectively. Backward participation reflects the demand perspective of a country in GVCs as the country imports intermediates to produce products for export. Forward GVC participation reflects the supply perspective in GVCs as it captures the domestic value-

added of that country embodied in inputs of other countries to produce exports. Backward participation and forward participation are calculated as follows:

$$Backward\ participation_{i,t} = \frac{FVA_{i,t}}{GE_{i,t}} \times 100,$$

$$Forward\ participation_{i,t} = \frac{DVX_{i,t}}{GE_{i,t}} \times 100.$$

To compute these indicators of GVC participation, we download data of foreign value added (FVA), indirect value-added (DVX), and gross export (GE) from UNCTAD-Eora Global Value Chain Database, which provides the most extensive coverage of countries (189 countries) and the most prolonged period (from 1990 to 2018).

3.2. Measure of Export Diversification

In this paper, we measure export diversification in several ways. Firstly, we focus on the Herfindahl-Hirschmann Index (HHI) to measure export product diversification, and the data of HHI is extracted from the database of the United Nations Conference on Trade and Development (UNCTAD). Based on the Standard International Trade Classification (SITC) Revision 3, UNCTAD used the three-digit group level of export products to calculate the HHI as follows:

$$HHI\_product_j = \frac{\sqrt{\sum_{i=1}^{n}\left(\frac{x_{ij}}{X_j}\right)^2} - \sqrt{1/n}}{1-\sqrt{1/n}},$$

where:

$X_j = \sum_{i=1}^{n} x_{ij}$;

$HHI\_product_j$ is the export product concentration index of country j;

x_{ij} is the value of export of product *i* in country j; and

n is the number of export products at the three-digit group level.

The values of *HHI_product* range from 0 to 1. The higher the value of *HHI_product*, the higher the export product concentration or the lower the export diversification. In other words, a country with *HHI_product* closer to 1 will highly focus on exporting a few products. On the contrary, a decrease in the value of this index indicates that exports are more homogeneously distributed among various types of products. It also means a country with *HHI_product* closer to 0 reflects higher export product diversification.

Secondly, we use the Herfindahl-Hirschmann Index to measure the export market concentration (denoted by "*HHI_market*"). This is what we call export partner diversification. By using bilateral trade data derived from the BACI database of CEPII, we calculate the export market concentration index as follows:

$$HHI\_market_j = \frac{\sqrt{\sum_{i=1}^{m}\left(\frac{z_{ij}}{Z_j}\right)^2} - \sqrt{1/m}}{1-\sqrt{1/m}},$$

where:

$Z_j = \sum_{i=1}^{m} z_{ij}$;

HHI_market_j is the export market concentration index of country j;

z_{ij} is the value of export of country j to partner *i;* and

m is the total number of trading countries in the world.

As same as the export product concentration index, the values of *HHI_market* range from 0 to 1. The higher the value of *HHI_market*, the higher the export market concentration or the lower the export market diversification.

3.3. Model Specification

As discussed above, participation in GVCs can promote export diversification because countries have more opportunities to access various intermediates at cheaper prices and higher quality, make use of innovation and technology spillovers, as well as enhance competition. Therefore, we construct the baseline model for performing the empirical analysis as follows:

$$\begin{aligned} HHI_{it} = {} & \alpha_0 + \alpha_1 HHI_{it-1} + \alpha_2 GVC_{it} + \alpha_3 HHI\_imp_{it} + \alpha_4 \log(GDPC)_{it} \\ & + \alpha_5 [\log(GDPC)_{it}]^2 + \alpha_6 \log(POP)_{it} + \alpha_7 TP_{it} \\ & + \alpha_8 POST_{it} + \alpha_9 \log(FDI)_{it} + \gamma_t + \varepsilon_{it}, \end{aligned} \tag{2}$$

Where *i* denotes the country's indices and *t* represents the annual period. α_0 to α_9 are parameters to be estimated; γ_t are year dummies; and ε_{it} is an error term. Our dependent variable HHI_{it} are export diversification. Our key variable of interest, GVC_{it}, represents the index of GVC participation which is calculated based on the equation (1). Based on the extant literature on the determinants of exports and export diversifications, we also consider factors that would matter for the impact of GVC participation on export diversification.

3.3.1. Import diversification

Many studies reveal the crucial role of diversified intermediate inputs on export diversification. Using a dataset of low-income countries during 1962-2000, Benguria (2014) finds a positive correlation between the intermediate inputs diversification and the likelihood of creating new products for export. Castellani and Fassio (2019) examine over 14,000 manufacturing firms in Sweden from 2001 to 2012 and demonstrate that the importation of new inputs is a critical factor for exporting firms to broaden their export basket, and this positive impact is remarkably stronger for small firms. The strong positive association between import diversification of inputs and export product

creation is also strengthened by the study of Bas and Strauss-Kahn (2014), who use firm-level data in France between 1996 and 2005. Therefore, we expect import diversification to correlate with export diversification positively. Our import diversification variable is denoted by HHI_*imp* and measured by Herfindahl-Hirschmann Index for imports.

3.3.2. GDP per capita

GDP per capita is another macroeconomic factor related to export diversification, representing economic development. When the per capita income rises, countries not only have easier access to a wider range of high-quality inputs and equipment, but they also have more opportunities to approach foreign technology embedded in these imported inputs and equipment, followed by an increase in their productivity and likelihoods to produce new profitable products (Grossman and Helpman, 1991). Imbs and Wacziarg(2003) indicate that the production structure follows an inverted U-shaped pattern. That is, countries tend to diversify production with an increase in income per capita up to a certain level of income and then specialize again. Similarly, using a dataset of 60 countries for the period from 1985 to 2004, Parteka and Tamberi (2013) confirm the non-linear nexus between real per capita income and export diversification. Hence, we include both the log of GDP per capita and its squared term in our model to test the existence of a non-linear relationship between GDP per capita and export product diversification.

3.3.3. Population

The size of the total population is denoted by “POP”. It captures the size of an economy. Parteka and Tamberi (2013) demonstrate that the larger the market size, the higher the opportunity of export diversification. Similarly, Ali (2017) uses a dataset on manufacturing sectors of 130 countries and finds that expansion in the size of an economy is one of the potential determinants

contributing to the diversification of a firm's export product portfolio. Therefore, we include the log of the population in our model as one possible determinant of export diversification.

3.3.4. Trade policy

Trade policy is denoted by "TP" and measured by the "freedom to trade internationally" index which is computed by the Heritage Foundation. This index provides an annual absolute measurement of the level of liberalization in trade policy of a given country and comprises both tariff and non-tariff measurements that affect trade. The impact of trade liberalization on export diversification remains controversial. Some studies have found that trade openness promotes export diversification by broadening trade networks and increasing demand for trading products while other studies have shown that trade liberalization leads to specialization as countries will focus on trading the commodities in which they have a comparative advantage. For instance, Aditya and Acharyya (2015) indicate that trade liberalization via reductions in tariffs positively contributes to the diversification of export baskets, while Agosin *et al.* (2011) provide evidence to support their conclusion that in economies, which highly depend on exports of primary products, trade openness induces higher export specialization by increasing the benefits for traditional sectors. In their study about developing countries, Dennis and Shepherd (2011) show that trade facilitation by reducing customs costs plays an essential role in promoting export diversification, especially in developing countries. We expect that greater trade liberalization will facilitate export product diversification.

3.3.5. Political stability

Political stability is denoted by "POST", and it reflects the institutional and governance quality of a country. It is widely believed that countries with good institutional and governance quality offer more favorable environments

for export as well as other economic activities. For instance, Parteka and Tamberi (2013) indicate that institutional quality is a principal determinant of growth and proportionally associated with diversification opportunities. Similarly, Zhu and Fu (2013) verify that better institutional quality positively correlates with export upgrading. In this paper, we use the index of "Political Stability and Absence of Violence" taken from Worldwide Governance Indicators (WGI) to present for political stability.

3.3.6. FDI inflow

FDI is one of the key channels for international knowledge and technology diffusion. By directly engaging in the production of host countries, foreign firms are believed to transfer productive capacities to local firms. These productive capacities include skilled labors, capital equipment, technology, and production techniques (Girma, 2005; Zhu and Jeon, 2007; Urban, 2010; Jude, 2015). Accumulating those productive capabilities, firms in host countries are likely to produce and diversify their export basket. Previous literature has reinforced the positive relationship between FDI and export diversification. Using a dataset of 131 countries from 1984 to 2004, Tadesse and Shukralla (2011) reveal that an increase in FDI stock positively links with export product diversification, and the different stages of diversification experience different degrees of this effect. Examining 83 countries from 1995 to 2010, Gnangnon and Roberts (2017) find that FDI inflows lead to diversification in exports and are associated with more significant improvement in the quality of export products. Therefore, we include log of FDI inflow in our model as another determinant of export diversification.

Our final sample is an unbalanced panel dataset covering 134 countries during 2002-2018. This set of countries and the period is chosen based on data availability. Sources of the variables used in the regressions are reported in table A1, while the descriptive statistics and pairwise correlations of these variables are provided in table 1 and table 2, respectively. Table A2 purveys the list of 134 countries used in the analysis.

Table 1 Basic Summary Statistics of Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
HHI_product	2,271	0.312	0.195	0.058	0.961
HHI_market	2,274	0.316	0.154	0.121	0.925
HHI_imp	2,272	0.131	0.082	0.045	0.851
Log(*GDPC*)	2,274	8.558	1.451	5.486	11.354
[Log(*GDPC*)]^2	2,274	75.335	24.804	30.097	128.903
Log(*POP*)	2,274	15.998	1.714	11.32	21.055
Log(*FDI*)	2,150	13.997	2.245	3.466	19.972
POST	2,274	−0.081	0.928	−2.974	1.755
TP	2,205	72.973	13.026	15	95
GVC	2,274	51.219	12.785	24.581	85.24
BP	2,274	22.994	12.979	3.196	66.494
FP	2,274	28.225	9.872	6.856	63.373

Table 2 Pairwise Correlations of Variables

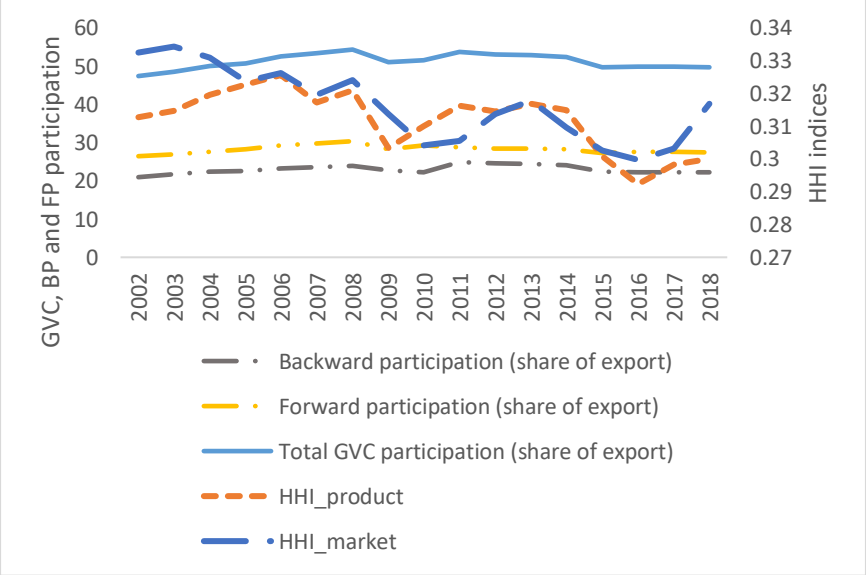
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)	1.00											
(2)	0.32	1.00										
(3)	–0.22	–0.35	1.00									
(4)	0.31	–0.25	0.37	1.00								
(5)	–0.45	–0.16	0.71	–0.40	1.00							
(6)	–0.25	–0.25	0.40	–0.06	0.43	1.00						
(7)	–0.25	–0.25	0.41	–0.05	0.44	1.00	1.00					
(8)	0.13	0.03	–0.03	–0.09	0.04	–0.16	–0.15	1.00				
(9)	–0.19	–0.20	–0.10	0.20	–0.25	–0.14	–0.14	–0.26	1.00			
(10)	–0.35	–0.21	0.32	–0.10	0.39	0.49	0.49	–0.13	0.04	1.00		
(11)	–0.20	–0.07	0.38	–0.16	0.50	0.63	0.64	–0.05	–0.44	0.35	1.00	
(12)	–0.32	–0.33	0.28	0.03	0.25	0.60	0.60	–0.18	0.49	0.43	0.21	1.00

Note: Variables are (1) *HHI_product*, (2) *HHI_market*, (3) *GVC*, (4) *FP*, (5) *BP*, (6) log(*GDPC*), (7) [log(*GDPC*)]^2, (8) *HHI_imp*, (9) log(*POP*), (10) *TP*, (11) *POST*, and (12) log(*FDI*).

3.4. Data Analysis

Figure 1 describes the trend over the entire sample from 2002 to 2018 of the average total GVC participation, backward participation, forward participation, and HHI export indicators. As the figure shows, the GVC participation content of export experienced an up and down trend during 2002- 2018. To be more specific, after a sharp rise from 47.41% in 2002 to 54.35% in 2008, the GVC participation share of exports dropped significantly to 51.04% in 2009 due to the global financial crisis, after which the growth of GVCs has also considerably slowed down. Notably, it only climbed slowly for the next two years before going down again. Over the period 2002-2018, the top 5 countries with the highest average GVC participation were Slovakia (82.08%),

Figure 1 Trend of GVC Participation and HHI over the Entire Sample (2002-2018)



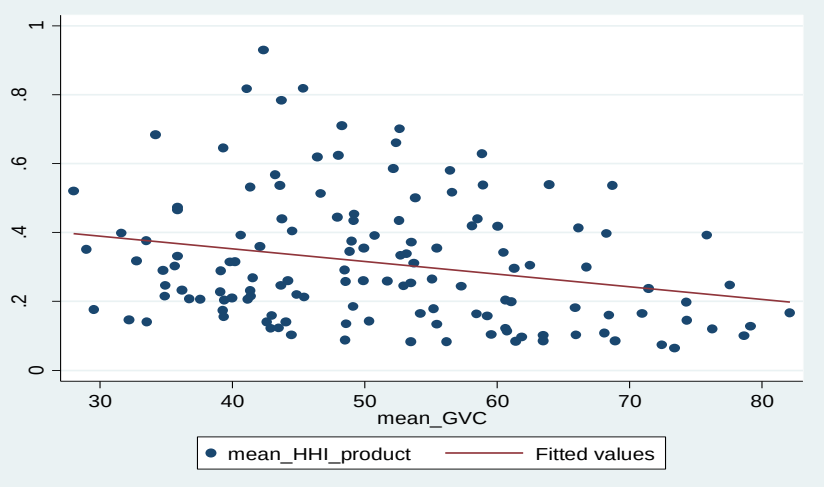
Source: Authors' calculation based on data derived from UNCTAD-EORA Global Value Chains Database and UNCTAD database.

Hungary (79.12%), Netherlands (78.63%), Singapore (77.56%), Estonia (76.25%). Backward and forward participation witnessed very similar trends as the GVC participation content of export. At the same time, the HHI indicators significantly fluctuated over the studied period. *HHI_product* quickly increased from 2002 to 2006, then fell substantially from 2006 to 2009, which reflects a greater level of export product diversification. For the rest period, after an increasing trend from 2009 to 2013, *HHI_product* went down considerably from 2013 to 2016 and then went up again in 2017 and 2018. In the meanwhile, *HHI_market* dropped noticeably from 2002 to 2010, which reflects a greater level of export market diversification. Then, after a quick increase from 2010 to 2013, *HHI_market* declined markedly to 2016, followed by a rise in 2017 and 2018.

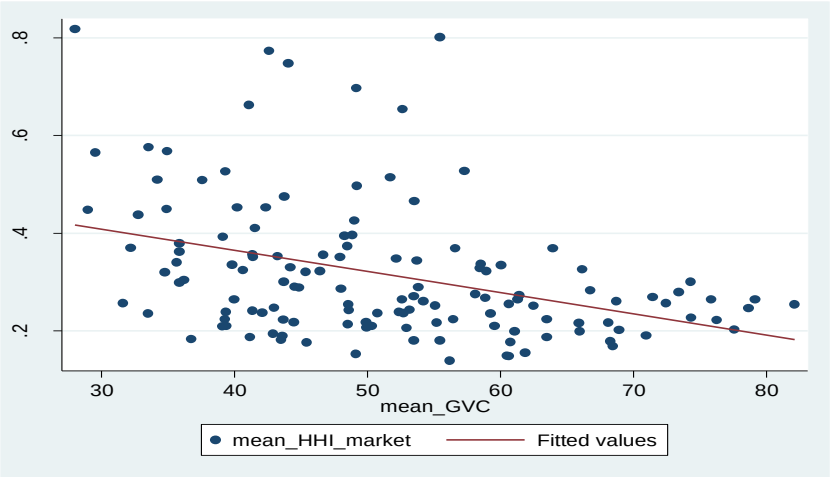
We present a first insight into the relationship between GVC participation and export diversification by providing the two-way graphs in figure 2 describing

Figure 2 Relationship between GVC Participation and Export Diversification over the Entire Sample (2002-2018)

A. Relationship between GVC Participation and Product Diversification



B. Relationship between GVC Participation and Market Diversification



Note: Data reported in figure 2 reflects the average of total GVC participation, *HHI_product*, and HHI_market during the period of 2002- 2018 of 134 countries over the entire sample.
Source: Authors calculation based on data derived from UNCTAD-EORA Global Value Chains Database and UNCTAD database.

the correlation trend between "GVC" variables, export product diversification (*HHI_product*), and export market diversification (*HHI_market)* variable over the whole sample. These graphs reveal that GVC participation is negatively correlated with export product and export market concentration indices, reflecting a positive association with export diversification.

4. EMPIRICAL RESULTS

We perform a two-step system GMM estimation to deal with endogeneity problems with the lagged dependent variable. The estimation results are displayed in tables 3, 4, and 5. Arellano-Bond (AR) and Hansen tests results support the two-step system GMM specification.

4.1. Impact of GVC Participation on Export Diversification

First, we examine the impact of GVC participation on export diversification. The regression results are displayed in table 3.

Table 3 Impact of GVC Participation on Export Diversification

Variable	(1)	(2)
	HHI_product	*HHI_market*
Dependent Variable (Lag1)	0.709***	0.617***
	(0.0323)	(0.0277)
GVC	−0.00218***	−0.00333***
	(0.000779)	(0.000857)
Log(*GDPC*)	−0.121**	0.0901
	(0.0563)	(0.0652)
[Log(*GDPC*)]^2	0.00717**	−0.00381
	(0.00312)	(0.00377)
HHI_imp	0.139***	0.0592*
	(0.0385)	(0.0351)
Log(*POP*)	−0.0107**	0.0115*
	(0.00524)	(0.00686)
TP	−0.000604**	6.87e−05
	(0.000299)	(0.000338)
POST	−0.0105*	−0.0193***
	(0.00558)	(0.00696)
Log(*FDI*)	0.00288**	−0.00387*
	(0.00143)	(0.00222)
Constant	0.849***	−0.340
	(0.248)	(0.271)
Year effects	YES	YES
Observations	1,967	1,967
Number of countries	134	134
AR(1)	0.000	0.000
AR(2)	0.871	0.916
Hansen	0.432	0.432
Number of Instruments	71	71

Note: All regressions apply the two-step System GMM estimator. "*GVC*" variables have been considered to be endogenous and are used as instruments with a maximum of three lags. The other variables are treated as predetermined. Year dummies are included in all regressions. Standard errors are in parentheses. *, **, and *** reflect statistical significance at the 10%, 5% and 1% level, respectively.

Columns (1) and (2) report the results when we use export product diversification (*HHI_product*) and export market diversification (*HHI_market)* as dependent variables. As seen in columns (1) and (2), over the entire sample, GVC participation has negative effects on both export product concentration and export market concentration. That means GVC participation is positively correlated with the diversification of both export products and export partners. To be more specific, a 1 percentage increase in "*GVC*" is associated with a 0.00218 point decrease in "*HHI_product*" and a 0.00333 point decrease in "*HHI_market*."

In terms of control variables, we will focus on results in column (1) as GVC participation directly reflects the production aspect of an economy. The results are as follows:

4.1.1. GDP per capita

We find that the GDPC variable and its squared term are both statistically significant at the 5% level, with the former being negative and the latter being positive. It means countries tend to diversify export production with an increase in income per capita up to a certain level of income and then specialize again. This threshold of the log of real per capita income to 16.87 (=0.121/0.00717), where 0.121 and 0.00717 are the estimated coefficients of the GDPC variable and its squared term, respectively. Countries with a log of real per capita income lower than 16.87 experience an adverse effect on export product concentration (positive association with export diversification). In contrast, countries with a log of real per capita income higher than 16.87 tend to specialize in some products for export. However, in our sample, the threshold of the log of the GDPC variable exceeds the maximum of its value (see table 1). Therefore, we could conclude that real per capita income is positively associated with export product diversification on average over the full sample. This is supported by Imbs and Wacziarg (2003), who argue that although there is the existence of the non-linear nexus, in terms of an inverted U-shaped, between real per capita income and export diversification, the

turnaround point arrives quite late in the path of development and at a high level of income per capita. Therefore, countries are likely to diversify their production over most of their development process, and only a few wealthy countries experience a re-specialization.

4.1.2. Import diversification

The coefficient of HHI_*imp* is positive and statistically significant at the 1% level. That means import diversification has a positive relationship with export diversification. This complements the result of Benguria (2014), who finds that the diversification in intermediate inputs promotes export diversification in low-income countries. Likewise, according to Castellani and Fassio (2019), import diversification of inputs plays a vital role in broadening the export basket of Swedish manufacturing firms.

4.1.3. Population

Market size is found to have a negative association with export product concentration. This implies that the larger the population size, the greater the diversification in exports. This result is consistent with Parteka and Tamberi (2013) and Ali (2017), who specify that population size is directly associated with the degree of product differentiation, with bigger countries being less specialized and likely to produce a broader range of products.

4.1.4. Trade policy

As expected, trade liberalization induces more export product diversification. Our finding is in line with Dennis and Shepherd (2011), and Aditya and Acharyya (2015). Intuitively, trade liberalization promotes competition between domestic and foreign firms, which is the crucial motivation for innovation and development. Moreover, as the freedom to trade increases, domestic firms reduce the production costs by lowering the

cost of imported intermediate inputs, but they can also decrease the cost of exports, followed by an increase in the likelihood of creating new products and diversifying their export basket.

4.1.5. Political stability

Our evidence supports the results of Parteka and Tamberi (2013) and Zhu and Fu (2013), who indicate that political stability positively affects export product diversification. The more stable the political issues, the lower the uncertainty and risks in economic activities and the greater the overall trade environment. Moreover, a country with political stability is preferred by other countries worldwide as it is considered as a more stable source of supply for both intermediate and final goods. As a result, that country would have more chances to broaden its export basket.

4.1.6. FDI inflow

FDI inflow has a negative effect on export diversification, which contradicts our theoretical expectation. It may reflect different impacts across countries in the sample and may suggest that the impact of FDI inflow on diversification of exports might depend on other factors. We have already examined the impact of FDI inflow on export diversification under various levels of GVC participation by including the interaction variable between "*FDI*" and "GVC" variables in equation (2). We find that higher FDI inflow induces greater export product diversification in the countries that enjoy a higher level of GVC participation. The regression result is upon request as FDI is not our primary variable of interest.

4.2. Impact of Forward and Backward GVC Participation on Export Diversification

This section pays attention to the two subcomponents of GVC participation,

namely backward and forward GVC participation. We examine their individual effects on export product diversification and export partner diversification by subsequently replacing the "*GVC*" variable in model (2) with "*BP*" and "*FP*", which represent backward participation and forward participation, respectively. The results are reported in table 4.

The results in columns (1), (3) of table 4 suggest that backward participation in GVCs, which reflects the "buyer" side of GVCs where countries import inputs for production of their exports, is positively associated with both export product diversification and export partner diversification. It is due to the fact that insertion into GVCs through backward linkages allows countries to access technology and knowledge embodied in foreign intermediate inputs, a variety of low-cost and high-quality inputs, and benefits from offshoring activities, followed by the higher possibility to create new products and broaden export markets. Our outcome is consistent with the previous related literature arguing that accessing more diversified, higher-quality, and cheaper intermediate inputs are positively correlated with export product creation and market expansion (Benguria, 2014; Bas and Strauss-Kahn, 2014; and Castellani and Fassio, 2019).

Table 4 Impact of Backward and Forward GVC Participation on Export Diversification.

Variable	(1)	(2)	(3)	(4)
	HHI_product	*HHI_product*	*HHI_market*	*HHI_market*
Dependent Variable (Lag1)	0.678***	0.801***	0.609***	0.640***
	(0.0303)	(0.0301)	(0.0302)	(0.0323)
FP		0.00376***		−0.00232***
		(0.000814)		(0.000865)
BP	−0.00290***		−0.00211***	
	(0.000743)		(0.000763)	
Log(*GDPC*)	−0.0948*	−0.140***	0.0597	−0.0853
	(0.0521)	(0.0450)	(0.0622)	(0.0584)
[Log(*GDPC*)]^2	0.00568**	0.00761***	−0.00285	0.00501
	(0.00286)	(0.00257)	(0.00352)	(0.00342)

HHI_imp	0.132***	0.152***	0.0569	0.100***
	(0.0408)	(0.0360)	(0.0351)	(0.0356)
Log(*POP*)	−0.0205***	−0.0174***	0.00565	0.0118*
	(0.00651)	(0.00466)	(0.00692)	(0.00626)
TP	−0.000647**	−0.00073***	0.000107	−0.000114
	(0.000293)	(0.00028)	(0.000325)	(0.000283)
POST	−0.00999*	−0.00284	−0.0109*	−0.00402
	(0.00568)	(0.00611)	(0.00632)	(0.00679)
Log(*FDI*)	0.00388***	0.00472***	−0.00368	−0.00687***
	(0.00136)	(0.00131)	(0.00225)	(0.00189)
Constant	0.854***	0.828***	−0.186	0.424*
	(0.274)	(0.210)	(0.283)	(0.226)
Year effects	YES	YES	YES	YES
Observations	1,967	1,967	1,967	1,967
Number of countries	134	134	134	134
AR(1)	0.000	0.000	0.000	0.000
AR(2)	0.839	0.863	0.950	0.978
Hansen	0.600	0.579	0.294	0.201
Number of Instruments	71	71	71	71

Note: All regressions apply the two-step System GMM estimator. "*BP*", "*FP*" and interaction variables have been considered as endogenous and are used as instruments with a maximum of three lags. The other variables are treated as predetermined. Year dummies are included in all regressions. Standard errors are in parentheses. *, **, and *** reflect statistical significance at the 10%, 5% and 1% level, respectively.

In terms of forward participation, our evidence indicates that insertion into GVCs through forward linkages promotes export product concentration and export market diversification. One of the possible explanations for the negative effect of forward GVC participation on export product diversification could be that forward participation, which captures the "supply" side of GVCs where countries export inputs for exports of other countries, reflects the specialization in core tasks of countries in GVCs. If countries more deeply participate in GVCs through forward linkages, they tend to use their limited production resources to produce and export the products in which they have a competitive advantage. The specialization in core tasks allows countries to make cheaper and higher-quality products thanks to the economies of scale. Thus, forward GVC participation will likely lead to export product concentration and export market diversification. However, in another aspect, previous studies indicate that forward participation in GVCs also enhance

production and productivity of the home country, primarily via offshoring activities of advanced economies when they transfer soft skills, knowledge as well as production technology to its suppliers (Neha and Rupa, 2020; Jangam and Rath, 2020). Hence, countries participating in GVCs via forward links can still benefit from technology and knowledge spillovers. We suppose that the negative impact of forward GVC participation on export product diversification in our result reflects a general average effect across all countries in the entire sample. Different countries with different specifics may witness differentiated effects of forward GVC participation on export product diversification. This is our motivation to delve deeper into the impact of forward GVC participation on export product diversification for various levels of trade liberalization and political stability, which are the two crucial macro factors directly affecting trade as well as spillover effects of these trading activities. We expect that forward participation in GVCs promotes export product diversification in countries that experience higher levels of trade freedom and political stability.

4.3. Does the Effect of Forward Participation in GVCs on Export Product Diversification Vary for Different Levels of Trade Liberalization and Political Stability?

In this section, we mainly focus on *HHI_product* to examine the effect of forward GVC participation on export product diversification for various levels of trade liberalization and political stability. This involves estimating two other specifications of the model (2) in which we replace the "*GVC*" variable with the forward participation variable (denoted by "*FP*") and include in the model (2) the interactions between the "*FP*" variable and the trade policy (*TP*) or political stability (*POST*) variables. The estimated results are reported in table 5.

Outcomes in columns (1) and (2) of table 5 indicate that the coefficient of the "*FP*" variables are always positive and statistically significant at the 1% level, whereas the interaction terms between "*FP*" and "*TP*" or "*POST*"

variables are all negative and statistically significant at the 1% level and 10% level, respectively. These reveal that forward participation positively affects export product diversification once the degree of trade liberalization and political stability surpass certain thresholds. These thresholds to 113.94 (=0.00987/8.58e − 0.5, where 0.00987 and 8.58e − 0.5 are the estimated coefficients of the "*FP*" variable and the interaction term between the "*FP*" and "*TP*" variable, respectively) for trade liberalization and 1.44 (=0.00307/0.00213, where 0.00307 and 0.00213 are the estimated coefficients of the "*FP*" variable and the interaction term between the "*FP*" and "*POST*" variable, respectively) for political stability. Therefore, we conclude that forward GVC participation induces greater export product diversification when countries experience better political stability and trade liberalization.

Table 5 Impact of Forward GVC Participation on Export Product Diversification for Various Levels of Trade Liberalization and Political Stability

Variable	(1)	(2)
	HHI_product	*HHI_product*
Dependent Variable (Lag1)	0.807***	0.800***
	(0.0271)	(0.0323)
FP	0.00978***	0.00307***
	(0.00193)	(0.00104)
*FP*TP*	−8.58e-05***	
	(2.59e-05)	
*FP*POST*		-0.00213*
		(0.00113)
Log(*GDPC*)	−0.0990**	−0.204***
	(0.0405)	(0.0535)
[Log(*GDPC*)]^2	0.00518**	0.0113***
	(0.00228)	(0.00307)
HHI_imp	0.151***	0.142***
	(0.0287)	(0.0377)
Log(*POP*)	−0.0154***	−0.0157***
	(0.00425)	(0.00539)
TP	0.00168**	−0.000698**
	(0.000814)	(0.000285)

POST	−0.00476 (0.00573)	0.0522 (0.0328)
Log(*FDI*)	0.00360*** (0.00122)	0.00390*** (0.00137)
Constant	0.471** (0.204)	1.100*** (0.253)
Year effects	YES	YES
Observations	1,967	1,967
Number of countries	134	134
AR (1)	0.000	0.000
AR (2)	0.844	0.862
Hansen	0.660	0.659
Number of Instruments	74	74

Note: All regressions apply the two-step System GMM estimator. "FP" and interaction variables have been considered as endogenous and are used as instruments with a maximum of three lags. The other variables are treated as predetermined. Year dummies are included in all regressions. Standard errors are in parentheses. *, **, and *** reflect statistical significance at the 10%, 5% and 1% level, respectively.

5. CONCLUSION

This article examines the effect of participation in GVCs on export diversification by applying the two-step system GMM estimator to a dataset of 134 countries over the period from 2002 to 2018. In this study, we apply the measure of GVC participation developed by Koopman *et al.* (2010), which captures sources of value-added in gross exports. Our findings indicate that a higher integration into GVCs is associated with both export product diversification and export partner diversification, and this positive effect powerfully works through backward linkages into GVCs. The results imply that accessing cheap, diversified, and high-quality intermediate inputs is essential in promoting export diversification. In addition, we also find that forward GVC participation leads to the diversification of export markets, while it encourages export product concentration as it reflects the specialization in GVCs. However, if a country surpasses a certain level of trade liberalization and political stability, its integration into GVCs via forward links could allow the country to make use of the knowledge and technology diffusion and enhance the diversification of the export baskets. Therefore, based on the

potential economic benefits of export diversification, our analysis suggests that countries should not only formulate strategies that aim at enhancing the quality of export products, but they should also further liberalize their trade policies as well as improve their institutional quality to create a more favorable trade environment which facilitates to fully exploit benefits from both backward and forward linkages into GVCs.

APPENDIX

Table A1 Definition and Sources of Variables Used in the Regression

Variable	Definition	Source
BP	This is the measure of backward participation in the global value chain and is computed by the foreign value-added (FVA) share of total export. FVA represents how much foreign value-added is embodied in exports of a country.	The authors calculate by using FVA and total export indices derived from the UNCTAD-Eora Global Value Chain (GVC) database https://worldmrio.com/unctadgvc/
FP	This is the measure of forward participation in the global value chain and is computed by the indirect value-added exports (DVX) share of total exports. DVX represents how much of the country's domestic value-added enters as an intermediate input in the value-added exported by other countries.	The authors calculate by using DVX and total export indices derived from the UNCTAD-Eora Global Value Chain (GVC) database https://worldmrio.com/unctadgvc/
GVC	This is the measure of total global value chain participation. It simply is the sum of BP and FP.	UNCTAD-Eora Global Value Chain (GVC) database
HHI_product	This is the export product concentration index. It is calculated using the Herfindahl-Hirschmann Index and its values range from 0 to 1.	United Nations Conference on Trade and Development (UNCTAD) Database. See online:http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=120
HHI_market	This is the export product concentration index. It is calculated using the Herfindahl-Hirschmann Index and its values range from 0 to 1.	The authors calculated by using the bilateral trade data taken from CEPII, BACI http://www.cepii.fr/CEPII/en/bdd_modele/download.asp?id=37
HHI_imp	This is the import product concentration index. It is calculated using the Herfindahl-Hirschmann Index and its values range from 0 to 1. The higher value of HHI_imp, the higher is the import product concentration or the lower is the import diversification.	United Nations Conference on Trade and Development (UNCTAD) Database. See online: http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=120
GDPC	Gross Domestic Product Per capita (constant 2015 US$).	United Nations Conference on Trade and Development (UNCTAD) Database
POP	Total Population.	World Development Indicators (WDI)
POST	This represents the institutional and governance quality in a given country. Higher values of this index imply the better governance and institutional quality, and lower values reflect poor governance or institutional quality.	World Bank Governance Indicators (WGI)

TP	This represents trade policy and is measured by the score of the freedom to trade internationally. It is the measure of the absence of tariff and non-tariff barriers, which directly affect imports and exports of goods and services. It ranges from 0 to 100, with higher values reflecting lower trade barriers or a higher level of trade liberalization.	Heritage Foundation https://www.heritage.org/index/explore
FDI	This is inward flow of foreign direct investment (million US$)	United Nations Conference on Trade and Development (UNCTAD) Database

Table A2 List of 134 Countries in the Study

Afghanistan	Colombia	Ireland	Nepal	Slovakia
Albania	Costa Rica	Israel	Netherlands	Slovenia
Algeria	Croatia	Jamaica	New Zealand	Spain
Angola	Cyprus	Japan	Nicaragua	Sri Lanka
Armenia	Denmark	Jordan	Niger	Suriname
Australia	Djibouti	Kazakhstan	Nigeria	Switzerland
Austria	Dominican Republic	Kenya	Norway	Syria
Azerbaijan	Ecuador	Kuwait	Oman	Tajikistan
Bahamas	Egypt	Kyrgyzstan	Pakistan	Thailand
Bahrain	El Salvador	Lao People's Dem. Rep.	Panama	Togo
Bangladesh	Estonia	Latvia	Papua New Guinea	Trinidad and Tobago
Barbados	Fiji	Lebanon	Paraguay	Tunisia
Belize	Finland	Liberia	Peru	Turkey
Bhutan	France	Lithuania	Philippines	Turkmenistan
Bosnia	Gabon	Madagascar	Plurinational State of Bolivia	Uganda
Brazil	Gambia	Malawi	Poland	Ukraine
Bulgaria	Georgia	Malaysia	Portugal	United Arab Emirates
Burundi	Germany	Maldives	Qatar	United Republic of Tanzania
Cabo Verde	Ghana	Mali	Republic of Korea	United Kingdom
Cambodia	Greece	Malta	Romania	Uruguay
Cameroon	Guatemala	Mauritania	Russia	USA
Canada	Haiti	Mauritius	Rwanda	Uzbekistan
Central African Republic	Honduras	Mexico	Saudi Arabia	Vanuatu
Chad	Hungary	Mongolia	Senegal	Venezuela
Chile	Iceland	Montenegro	Seychelles	Viet Nam
China	Indonesia	Morocco	Sierra Leone	Zambia
China, Hong Kong	Iran	Mozambique	Singapore	

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