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What Drives Global Value Chain Participation?

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Abstract

Cross-border production sharing has intensified in recent decades, leading to the formation and spread of global value chains (GVC). Using a dataset containing more than 150 countries over 1990-2018, our paper tries to identify what drives backward GVC participation and forward GVC participation at the country and aggregate trade levels. We complement this general exercise with a gravity model analysis of the determinants of bilateral foreign value-added in exports. The econometric analyses highlight structural factors such as aggregate income, level of industrialization and distance to economic hubs as highly significant for GVC trade. Foreign direct investment inflows strongly influence GVC participation and are stronger for backward participation. Trade agreements and their depth boost GVC participation, although the expansionary effect of deeper trade agreements on GVC trade decreases over time. We replicate our general analysis for developed and developing countries to account for the differential effects of GVC drivers at different levels of development. We ensure that our gravity estimates are theoretically and analytically consistent by using the Poisson Pseudo Maximum Likelihood estimator and incorporating multilateral resistance.

JEL Classification Numbers: F14, F15, L22

Keywords: Global value chains; trade; fragmentation; gravity model

1 Introduction

The nature of international production and trade has changed significantly over the past three decades. Countries no longer need to produce final goods from start to finish as theorized in the classical models of Ricardo and Heckscher-Ohlin; instead, they specialize in specific stages or "tasks"of the production process Grossman and Rossi-Hansberg (2008)). This has deepened the international division of labour, whereby firms outsource production stages to various locations around the world to reap cost advantages. Value chains - describing how value is added to a product through its inception and manufacturing to final delivery - have thus become global in nature, often spanningmultiple borders.[2] This has been termed as the "second unbundling" (Baldwin (2018)), and has been motivated by large reductions in transportation and coordination costs, and increased trade and financial liberalization.[3] Global value chains (GVC) mediate global production and trade, with over 50% of world trade passing through GVCs in 2019 (World Bank).

Historically, one of the main engines of economic development has been export-driven industrialization, typically led by manufacturing exports.4 However, as noted by Baldwin (2018), Taglioni and Winkler (2016) and others, the emergence of GVCs implies that countries may now simply beable to join specific segments of a value chain, rather than attaining comparative advantage in theproduction of entire goods and services. Empirical evidence suggests real developmental benefits from participating in the international fragmentation of production - such as reduced unemployment, poverty and faster economic growth (World Development Report (2020)). In a sample of 40 countries, Constantinescu et al. (2019) estimated a 10% increase in GVC-related manufacturingtrade to increase average labour productivity by roughly 1.6%. This raises the following question: what helps countries participate in GVC trade in the first place?

Our paper attempts to answer this question, examining determinants that have been suggestedin the GVC and trade literature[5] to be associated with value chain participation. We measure GVC participation using the calculated shares of "foreign value-added in domestic exports" (or backward participation) and "domestic value-added in foreign

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[2] Wang et al. (2017) show that inputs can cross borders more than six times before entering the final destinationmarket.

[3] The first unbundling geographically separated production from consumption, while the second disaggregatedproduction itself.

4 Manufacturing industries are thus often referred to as "escalator" industries, as they have been shown to exhibit unconditional productivity convergence across countries. See Rodrik (2018).

[5] See Section 2.

exports" (or forward participation). Backward participation fosters linkages in the form of greater input trade, vertical thickening be- tween multinational lead firms and local supplier networks and can induce positive spillovers into the rest of the economy. Forward integration leverages these spillovers into increased access to ex- ternal markets, thus expanding the scale and scope of production in the domestic economy. We use the UNCTAD-Eora GVC dataset described in Lenzen et al. (2013) for our analysis, which contains value-added trade data for more than 180 countries over 1990-2019. The time horizon of Eora (1990 onwards) coincides with a rapid rise in international production fragmentation (Baldwin (2018)), making it useful for identifying broad drivers of GVC participation. We replicate our analysis for developed and developing countries to account for the differential effects of key determinants across stages of economic development.

Our explanatory variables can be divided into two groups: structural variables that change slowly (or not at all) over the medium to long-run, and policy variables that can be manipulated more quickly. The former group comprises market size, industrial structure of the economy (i.e., manufacturing GDP), geographical remoteness from world manufacturing hubs and factor endowments. The second group contains measures of trade restrictions and investment openness. We also include regressors capturing various aspects of preferential trade agreements (PTA) – specifically, PTA membership, the number of PTA partners and the depth of PTAs.[6]

We perform two separate exercises. In the first exercise, we estimate GVC participation in a simple OLS (Ordinary Least Squares) specification. Our regression results highlight most of the above predictors as important drivers of GVC participation. Structural variables are found to be consistently significant in explaining both backward and forward participation. In particular, the domestic industrial capacity of economies and their distance from international centers of economic activity register high and significant estimates. Restrictive trade policy (i.e., higher tariffs) is in general found to impede GVC participation, while foreign direct investment (FDI) inflows raise backward participation and reduce forward integration. Factor abundance - in the form of natural resource endowments and skill composition of the labour force - strongly affect GVC participation, although coefficient signs differ across developed and developing countries. We incorporate fixed effects to ensure unbiasedness and consistency in our estimates.

In our second exercise, we specifically attempt to understand the role of trade costs in GVC trade. Our motivation lies in the central role of trade frictions in international trade flows as high- lighted by a large body of literature - especially flows of

[6] For the importance of PTAs and PTA depth on GVC participation and GVC trade, see Ruta (2017), Laget et al. (2018).

intermediates trade embodied in GVCs.[7] In their survey of trade frictions, Anderson and Van Wincoop (2004) estimate a tax equivalent of 'representative' trade costs for advanced economies at roughly 170%, and even larger for developing countries. Johnson and Noguera (2017) show that changes in trade frictions capture almost the entire global decline in the ratio of value-added to gross exports, over 1970-2009. Moreover, as shown by Antràs and De Gortari (2020), trade costs not only affect GVC participation but also the GVC positioning of countries – large economies would tend to specialise in downstream stages of production to avoid compounding effects of trade costs.

Trade costs hinge not only on trade policy measures such as tariffs and quotas but are in fact a function of several factors that contribute to the "cost" of international trade. Among others, these subsume spatial remoteness, cultural and linguistic differences between countries and the efficiency of transportation and logistics in the trading partners. To incorporate these "trade cost" effects, we employ the gravity model of trade, using the value of foreign value-added in exports as our dependent variable.

Gravity models have been used extensively in the literature to analyze bilateral value-added trade flows.[8] Its appeal stems from its strong theoretical underpinnings and its track record of consistently explaining a large percentage of the variation in bilateral trade flows.[9] In this model, our dependent variable captures the backward linkage from the final exporter's perspective and the forward linkage from the perspective of the origin country, whom we term as the originator (along the lines of Kowalski et al. (2015)). To mitigate the problems of zero values and heteroskedasticity in bilateral trade figures, we use the Poisson Pseudo Maximum Likelihood estimator (PPML) introduced by Silva and Tenreyro (2006). To control for the phenomenon of multilateral resistance as raised by Anderson and Van Wincoop (2003), we incorporate both exporter-time and originator- time fixed effects.[10]

Our gravity analysis reaffirms the importance of conventional gravity and trade policy variables in explaining trade costs. Bilateral distance, sociocultural ties, colonial status and tariffs all emerge as significant predictors of bilateral GVC trade, with expected coefficient signs. The impact of PTAs on value-added trade is positive, but their effects

[7] Anderson and Van Wincoop (2004), Miroudot et al. (2009), Johnson and Noguera (2017), Taglioni and Baldwin(2014), Diakantoni et al. (2017).
[8] Brooks and Ferrarini (2014), Anderson et al. (2015), Choi (2015), Raei et al. (2019), etc.
[9] Arkolakis et al. (2012) demonstrate how the gains from trade, emanating from a wide variety of theoretical microfoundations, are preserved in the gravity framework. For the empirical performance of the gravity model, see Head and Mayer (2013).
[10] See Yotov et al. (2016) for best practices in gravity models of trade flows.

are not found to gain significance some years after their entry into force. PTAs are found to raise bilateral value-added trade by 8% within four years of their entry into force. Our gravity model also confirms the positive effect of PTA depth on foreign sourcing. However, we find that beyond a threshold, greater PTA depth in the form of more provisions produces smaller bilateral trade gains.

Our paper expands on the literature on the determinants of GVC participation (see Section 2). While other works have explored this issue, most of them have not explicitly decomposed therole of trade frictions – structural and policy-based – in conjunction with broad drivers of GVC participation. We place the possible determinants in a unified framework and estimate relatively new effects of the depth of PTAs on bilateral value-added trade. Our framework helps highlight differences between overarching participation drivers at the country level and the bilateral level. We conduct our gravity analysis in a framework consistent with the theoretical foundations of Anderson and Van Wincoop (2003).

The remainder of our paper is organized as follows. Section 2 briefly reviews the existing literature on the determinants of bilateral value-added trade flows and GVC participation. Section3 highlights key trends in the evolution of GVC participation over time. Section 4 presents the empirical framework and discusses the results. Section 5 highlights possible extensions of the paper and lays down the conclusion.

2 Literature Review

The increased intensity of global production fragmentation, particularly in merchandise trade, was noted early on by Feenstra (1998). He observed that over the course of the 20th century, the ratio of merchandise trade to overall merchandise value-added had consistently risen for OECD economies, especially since the 1970s. The decline in tariffs and transportation costs was unable to fully account for the increase; instead, greater trade in parts and components, across multiple borders, was proposed as an explanation. This was formally documented in the pioneering work of Hummels et al. (2001), introducing a measure of the import content of exports, or “vertical specialisation.” Along with Yi (2003), these papers showed that vertical specialisation accounted for more than20% of the post-1970s resurgence in international trade.[11]

Vertical specialisation, especially in the form of inputs traversing multiple borders before entering their final destination, raised difficulties in tracking the value added by each country alongthe value chain of a particular good or service. Conventional trade statistics,

[11] Bems et al. (2011) show that vertically specialized trade similarly fell by more than value-added trade as part of the global trade decline in the wake of the 2008 financial crisis.

measured in gross flows, double counted value-added content since goods already contained imported intermediate inputs and domestic value-added in previous stages. Koopman et al. (2014) and Wang et al. (2013) formally decomposed exports of intermediates and final goods into their domestic value-added and foreign value-added components, enabling value-added trade flows to be traced to the producing countries. This has had important implications for analyzing GVCs, since an accurate analysis ofthe extent of GVC participation across countries could not be undertaken without a full decomposition of trade flows between trading partners.

The literature on the determinants of bilateral value-added trade flows (typically using gravity models) and that of GVC participation, in a sense, complement each other. Noguera (2012) theoretically extends Anderson and Van Wincoop (2003) to include intermediates trade and formulatesa gravity equation relating bilateral value-added trade flows to conventional gravity variables. His gravity equation shows that the importance of multilateral resistance has increased for value-addedtrade, as has production fragmentation.

Choi (2015) examines value-added trade flows inside a gravity model, with domestic value embodied in foreign final demand as the dependent variable. He found that the composition of production factors, in the form of capital-labour ratios and skill levels of the workforce increasingly explain the variations in trade flows observed during the 2000s. The explanatory power of the models riseswhen value-added trade replaces bilateral gross trade flows.

In a detailed study of the drivers of GVC participation, Kowalski et al. (2015) find structural variables to be strongly significant in explaining GVC participation rates across countries. Remoteness from large economic hubs negatively affected GVC participation, while market size increased both. Policy variables also emerged as significant, with tariffs negatively affecting both backward and forward participation, while FDI inflows raised (lowered) backward (forward) participation.

The gravity model analysis in Kowalski et al. (2015) reconfirms the importance of standard gravity covariates in bilateral value-added trade flows. Bilateral geographical distance, distance to manufacturing hubs, linguistic and spatial proximity all strongly affected bilateral value-addedtrade. The authors also examine a larger set of predictors, including the quality of logistics, trans-port connectivity, institutional quality and services trade restrictiveness, among others. Each of these variables had a significant effect on bilateral backward participation.[12] Within this set

[12] The significance of these covariates was found to be stronger when backward participation *levels* were used instead of shares.

of policy-related drivers, the efficiency of logistics had the greatest impact on GVC participation. It is possible that some of these results demonstrate correlation rather than causality, due to high collinearity between predictors.

Buelens and Tirpák (2017) explore the relationship between investment openness and GVC participation in 40 developed and emerging economies. Capital-scarce economies aim to attract FDI to overcome technological and capital deficits, which naturally hinder GVC participation. Using a gravity framework augmented with bilateral FDI flows, the authors find a positive effect of FDI on the bilateral import component of exports and trade in final and intermediate goods. Similarly, Cheng et al. (2015) find investment restrictions to be particularly detrimental for GVC participation in low-tech manufacturing.

Pathikonda and Farole (2016) posit a country's "capability index" as the central force behind its GVC participation. Capabilities comprise an economy's overall capital stock - human, natural,[13] physical and institutional - and other factors influencing its ability to attract GVC-oriented FDI, such as wages and proximity to key markets. Using a compiled dataset covering 87 countries and 81% of global trade, the authors found "capabilities" to powerfully influence trade in GVC and intermediate goods. Logistics and market access emerged as critical determinants of GVC trade, underscoring their importance in a global economy marked by extensive fragmentation, coordination costs and just-in-time production.

An important component of a country's "capability index" is its overall endowment of inputs into production. While the importance of factor abundance in international trade has been documented (see Romalis (2004)), its explicit relevance for vertically fragmented trade has not been studied widely. A notable exception is Fernandes et al. (2020), which explicitly incorporates different types of factor endowments into a broad study of the determinants of GVC participation. They find that factor endowments explain 43% of the variation in backward participation, followed by geographical remoteness (21%), political stability (18%), tariffs and FDI (13%) and manufacturing GDP (4%). However, they also find that capital stock does not significantly influence forward participation, an explanation of which is provided by Antràs and De Gortari (2020). Capital-abundance should enhance forward integration, but FDI may alter this relationship. For example, FDI has conferred Nigeria - a capital-scarce country - competitiveness in oil-extraction, which is a capital-intensive activity. Thus, the effect of FDI may be hard to separate from that of natural capital abundance.

[13] Pathikonda and Farole (2016) measure natural capital by the aggregate (US) dollar value of an economy's crop, pastureland, timber, non-timber forest, protected areas, oil, natural gas, coal, and minerals.

There also exists an extensive literature on the relationship between trade policy and global production sharing. A large number of studies have found contractionary effects of trade frictions on GVC and intermediates trade.[14] Trade costs arising from the presence of high tariffs impede GVC trade sharply, since GVC trade often entails inputs crossing borders multiple times.[15] This "cascade effect" strengthens if production is characterized by a cumulative succession of inputs converging into the final good or service (Baldwin and Venables (2013)). Yi (2010) shows how gains from trade can magnify under tariff liberalization when multi-stage production is dominant.[16]

Trade costs are significantly shaped by trade policy, which are often shaped by the outcomes oftrade agreements. PTAs have become increasingly important in directing global trade flows, and they have multiplied rapidly over time.[17] Moreover, PTAs have expanded to include "not just trade but additional policy areas, such as international flows of investment and labor, and the protection of intellectual property rights and the environment, among others" (Mattoo et al. (2020)). In otherwords, PTAs are becoming "deeper". Deep trade agreements can stimulate GVC participation by going beyond conventional trade policies (tariffs) to target institutional bottlenecks relevant for smooth GVC trade - such as enforcement of property rights, customs administration, etc. If the signatories are regional trading partners, this can further amplify trade effects by improving trade-facilitating measures throughout the region.[18]

From the above discussion, we can see that a host of factors may be important in driving GVC participation. They can be classified into: (A) structural factors that change slowly over the short to medium-run, and (B) policy variables, that can change much more quickly in the samespan of time. The former in turn comprises country-specific structural determinants such as (a) domestic industrial capacity; (b) stage of development of the domestic economy; (c) geographical location; (d) structure of factor endowments; (e) linguistic and colonial proximity. Policy variables driving GVC participation through changes in trade costs, on the other hand, can be expected to consist of (f) import tariffs; (g) investment openness; (h) membership in regional and preferential trade agreements; (i) depth of PTAs; and (j) transportation and logistics efficiency. We focus our attention

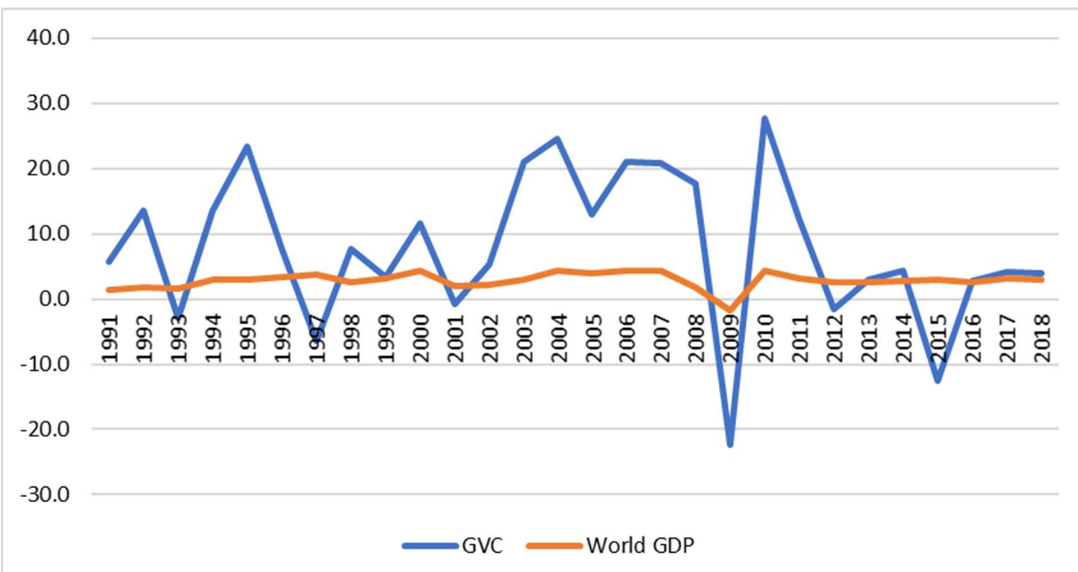
[14] See Miroudot et al. (2009), Diakantoni et al. (2017), De Backer and Miroudot (2013), Kowalski et al. (2015).
[15] Diakantoni et al. (2017).
[16] Magnification effects are however found to be modest when calibrated to observed flows of input trade in multi-stage production models. See Johnson and Moxnes (2019).
[17] There were roughly 300 PTAs in 2019, compared to 50 in the early 1990s (Mattoo et al. (2020)).
[18] Ruta (2017) observes a positive correlation between deep PTAs and GVC integration. Laget et al. (2018) calculate backward (forward) GVC linkages to rise by 0.3% (0.4%) when trade agreements contain one extra provision (i.e., more depth).

on the above factors for ease of exposition and their broad relevance in the international fragmentation of production.

3 Trends in International GVC Participation

Since the 1990s, the growth of GVC trade has been rapid, relative to world GDP growth (Figure 1). The internationalization of value chains has produced a stronger co-movement between the growth rates of world GDP and trade over time. The correlation coefficient between world trade and GDP growth has risen from 0.44 over 1980-1995, to 0.74 over 1996-2018.[19] The spread of GVC activities has contributed to what Subramanian and Kessler (2013) refer to as the "hyper-globalization" of trade: international trade occupied more than 60% of global GDP in 2019, relative to 39% in 1990 (World Bank figures). Within trade itself, the share of GVC activities had grown to 50.6% in 2017.[20] This means that over half of world trade now passes through global value chains.

Figure 1: Growth Rates, GVC Trade and World Trade (%)



Source: GVC trade growth rate computed from UNCTAD-Eora GVC Database. World GDP growth rate from World Bank.

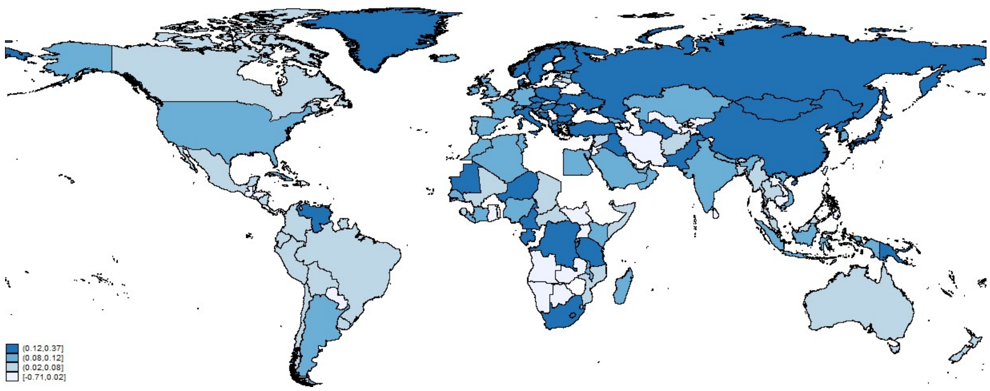
[19] Calculated from World Bank data.
[20] Calculated from World Bank figures and the Eora database. Degain et al. (2017) note that this has been led by the spread of "complex" GVC activities, when value-added embodied in intermediate exports crosses national bordersmore than once. Complex GVC activities contributed powerfully to the growth of global GDP during 1995-2000 and2000-2008.

Moreover, deeper GVC participation has been observed not only in developed economies, but throughout the world (below). In this section, we summarize a few salient features that have cometo dominate the landscape of international production as observed through GVCs.

Fact 1: GVC Participation has increased globally over time

GVC participation, as measured by the sum of backward and forward participation shares, has increased noticeably since the 1990s. Figure 2 illustrates the change in the shares of aggregate GVC participation for 174 countries from the UNCTAD-Eora GVC database, over 1990-2018.[21]

Figure 2: Change in GVC Participation Index, 1990-2018



Source: Calculated from UNCTAD-Eora GVC Database.

Virtually all countries over the past three decades have experienced increased participation in GVCs. The growth of international trade has been significant in developing countries - they havehad the highest trade-to-GDP ratios over 2006-2019.[22] Intensification of GVC activities can beseen in the EU, China, ASEAN region and in parts of Africa and the Middle East. Deepening GVC trade as shown in Figure 1 has moreover occurred in all sectors, led by high-tech and medium-tech manufacturing (Dollar et al. (2019)). Complex GVC activities heavily democratized supply chains after 2000.

[21] In this section and the analysis that follows, we exclude 15 countries and territories whose exports equaled zero for all the years in the dataset: Belarus, Benin, Burkina Faso, Congo, Eritrea, Ethiopia, Former USSR, Guinea, Guyana, Libya, Moldova, Rest of World, Serbia, Sudan and Zimbabwe.

[22] Excluding LDCs. See UNCTAD (2020b).

However, since the above figure depicts the sum of both backward and forward participation, it does not necessarily imply a high degree of integration into vertical manufacturing chains for all countries exhibiting high total GVC participation. The next fact shows this more clearly.

Fact 2: Backward and Forward GVC Participation rates differ considerably across regions

Figure 2 hides substantial cross-country heterogeneity in forward and backward GVC participation (see Figure 3). For instance, West Asian and African economies had the highest forward participation rates worldwide in 2017. This is primarily a consequence of their export structure, heavily biased towards primary goods and extractive industries. 77% of merchandise exports from Africa in 2019 consisted of primary goods (fuels 42%).[23] Countries specializing in the exports of such products - especially derivatives of fuel-based exports - typically have downstream processing linkages that are more pronounced relative to their foreign value-added share of exports (UNCTAD (2013)). The low degree of backward participation observed in Africa, South America and West Asia may reflect their poorer participation in vertically integrated manufacturing. Manufacturing exporters are located primarily in North America, Europe and South-East Asia (UNCTAD (2021)).[24]

EU and South-East Asian countries display the highest participation rates. Asia has experienced a very rapid growth in its GVC participation (see Table 1), and this has produced a shift in the regional shares of international trade flows. From 31.6% in 2005, Asia's share of global trade flows (exports plus imports of goods and services) had risen to almost 40% in 2019.[25] The EU bloc re- mains the leading regional trader with 40.1% of global trade (2019) passing through the Euro area. The trade shares of all other regions remained relatively steady throughout this time period. North America was the third largest regional trader, accounting for 12.6% of international trade in 2019.[26]

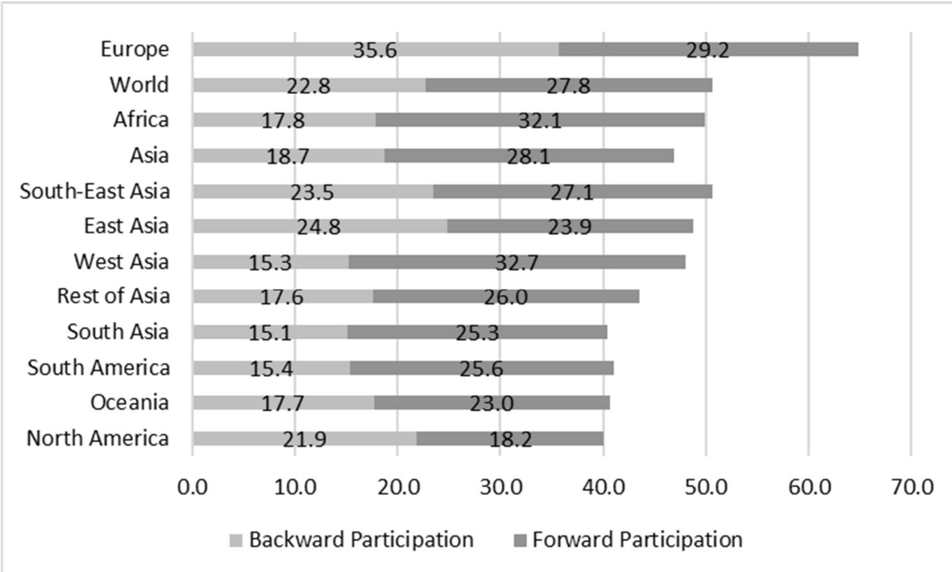
[23] UNCTAD (2020a).

[24] Cross-border backward linkages are the deepest in manufacturing industries. De Backer and Miroudot (2013) report the following five industries with the highest incidence of fragmentation: television and communication equipment, motor vehicles, basic metals, electrical machinery and textiles, leather and footwear. Services and primary exports are closely associated with forward linkages, though certain service sectors such as education, health care and consumer services have high backward participation (Degain et al. (2017)).

[25] UNCTAD Statistics.

[26] It should be noted here that despite having the highest regional growth rate of GVC activities, South Asia's participation rates remain well below the world average. This is due to a base effect since most South Asian economies had very low GVC participation levels to begin with. The second reason is because of India's presence in the sample. India devotes a substantial share of

Figure 3: GVC Participation, Regional Average, 2017



Source: Calculated from UNCTAD-Eora GVC Database.

Table 1: CAGR, FVA and DVX, 1990-2018

	FVA	**DVX**
South Asia	13.04	11.54
South-East Asia	8.67	10.04
East Asia	9.51	8.94
Rest of Asia	8.67	13.24
South America	9.71	8.74
Europe	6.91	6.72
Africa	7.65	8.16
North America	7.32	6.40
West Asia	7.43	7.85
Oceania	8.46	8.08

Source: Calculated from UNCTAD-Eora GVC Database.
FVA = Foreign Value-Added in Exports
DVX = Domestic Value-Added in Foreign Exports

its exports to services, which utilizes a much lower share of intermediate inputs and thus deflates its backward participation (Lund et al. (2019)).

Fact 3: Global value chains are more regional than global

Europe, Asia and North America collectively account for more than 90% of world trade flows, and this predominance is observed for GVC activities as well. We decomposed the absolute values of FVA for 189 countries from Eora and mapped them against their source and destination regions (see 5). A clear trend emerges from our breakdown (see Table 2): there has been a shift towards Asia as an exporter of intermediate inputs. This has led to the emergence of "Factory Asia" alongside Factories Europe and North America (Baldwin and Lopez-Gonzalez (2015)), indicating the importance of these three regions in GVC-linked trade flows. Lund et al. (2019) confirm that value chains in automotives and electronics are becoming more regionally concentrated in Asia and Europe, with producers locating near large markets. On the other hand, the weight of South America and Africain GVCs still remains marginal and has been declining over time.[27]

High-income economies are usually located in downstream parts of the value chain and closerto final demand (Antràs and De Gortari (2020)). They tend to outsource lower value-added downstream parts of the production process to developing countries and reimport them in the form of final goods or semi-finished intermediates. What Table 2 shows, however, is that this trend has subtly changed over time: economies based out of Asia are capturing a larger share of foreign value-added in global production. Thus, the distribution of value-added between regions is becoming more even. In fact, Kummritz and Quast (2017) show that developing countries as a whole have consistently increased their share of GVC trade over 1995-2011 (more than 25% as of 2011).

Table 2: Regional Shares of Global FVA

	1990	**2018**
Asia	22.2	37.9
Europe	56.1	44.1
Africa	2.2	2.3
North America	16.1	11.7
South America	1.9	2.5
Oceania	1.5	1.5

Source: Calculated from UNCTAD-Eora GVC Database.[28]

[27] Abreha et al. (2020) find that linkages to manufacturing GVCs in Africa have become stronger for non-oil resource-rich countries but weaker for non-resource-rich countries as a whole.
[28] The FVA share shows how much of global foreign value-added in exports - summed across all countries in Eora- originates from each region.

The concentration of GVC flows between Europe-Asia-North America illustrates the importance of proximity to large economies in driving international production fragmentation. The top five sources of value-added in the world - China, Germany, USA, Japan and UK - supply 45% of global foreign value-added embodied in exports. Similarly, Germany, Netherlands, Belgium, France and China purchase 38% of foreign inputs produced globally. Countries also source their FVA largely from neighbouring countries. More than 60% of foreign value added by intermediate goods inthe exports of European countries was from other European economies (De Backer and Miroudot (2013)). A similar trend has been observed for North America (Rugman et al. (2009)) and Asia. Consequently, the share of intra-regional trade flows within these three regions is well above 50% of their aggregate trade (Degain et al. (2017)).[29] Amador and Cabral (2014) and Krapohl and Fink (2013) argue that RTAs have played a key role in fostering these patterns of regional agglomerationin value chains and thus the role of geographical contiguity to regional production blocks.

4 Data and Estimation Approach

We use the UNCTAD-Eora GVC database (Lenzen et al. (2013)) for the key GVC indicators usedin our empirical analysis of the determinants of GVC participation - FVA and DVX. Eora providesa global multi-region input-output table (MRIO) to extract value-added in trade figures for 189 countries, over 1990-2019. It also contains granular value-added data disaggregated across origin and final-use industries. Other databases used for the purpose of value-added analysis are, among others, the OECD-WTO TiVA tables, based on national input-output tables harmonised by theOECD; World Input-Output Database (WIOD) based on national supply-use tables; Global Trade Analysis Project (GTAP) based on input-output data provided by the GTAP consortium of countries. Our preference for Eora stems from its extensive geographical and time coverage. It assumes a broader perspective of value-added flows emanating from and concluding in developing countries.[30]

At the same time, there are inherent limitations present in Eora. In particular, many countriesdo not provide national supply-use tables used in the construction of international input-output tables. Eora harmonizes these accounting discrepancies - for instance, raw data on exports and imports - using various interpolation and balancing techniques, which would inevitably be subject to measurement errors. This can provide unreliable figures for low-income countries, and at deeper levels of sectoral

[29] In final and intermediate manufactured goods.
[30] For a comparison of the approaches adopted by different MRIOs, see Engel et al. (2016), Appendix 1.

disaggregation. As countries publish more detailed supply-use tables, one would expect the accuracy of the Eora database to improve.

MRIO tables also suffer from other drawbacks. They are unable to account for services value-added in trade with a similar degree of certainty. They also utilize two assumptions that may not accurately describe the empirical nature of international trade and production. The first of these assumptions is known as the ”proportionality” assumption and it implies that each sector imports inputs for exports in the same proportion as they are used domestically. Secondly, MRIO construction assumes that all firms within the same sector use inputs uniformly, referred to as the ”homogeneity” assumption. Both of these assumptions seem unduly restrictive in a global economy where international production is heavily fragmented and often carried out across different countries on the basis of factor cost differentials. Nonetheless, MRIO tables are currently our best source of information for tackling value-added trade flows.

We conduct two exercises to identify determinants associated with GVC participation. First, we run a standalone econometric analysis of potential drivers of GVC participation at the overall country level. Our dependent variables are the shares of backward participation and forward participation, respectively, computed from Eora, while the time-period covers 1990-2017. We replicate the regressions for developed and developing countries separately to highlight differences in certain drivers of value-added trade between rich and poor countries.

To look more closely at the role of trade costs in GVC trade, we additionally perform a gravity model analysis of bilateral value-added trade flows. The bilateral framework permits us to accommodate explanatory variables whose coverage is too poor for direct inclusion in the standalone specification, such as measures of logistics performance and depth of PTAs. The sources and definitions of the regressors for both the analyses, as laid out at the conclusion of Section 2, are contained in the Appendix, Table C.

4.1 General Analysis of the Determinants of GVC Participation

Our empirical specification in this analysis adopts OLS estimators, for the regressions on the shares of backward and forward participation separately. Thus, our linear econometric equation is as follows:

$$BWD_{it} = \beta_0 + \beta_1 X_{it} + \mu_t + \varepsilon_{it} \quad (1)$$

$$FWD_{it} = \beta_0 + \beta_1 X_{it} + \mu_t + \varepsilon_{it}, \quad (2)$$

where BWD_{it} (FWD_{it}) denotes the backward (forward) participation ratio of country i in year t; X is a vector of structural and policy variables expected to drive GVC integration; μ_t contains year dummies capturing year fixed effects; and ε_{it} is the random disturbance term. Our OLS specification controls for heteroskedasticity and autocorrelation through the use of Newey-West standard errors and the results are reported in Tables 3 and 4.

The estimates confirm that structural factors are significantly and consistently associated with GVC participation, at all levels of development. The manufacturing value-added share of GDP positively (negatively) affects backward (forward) participation. This is consistent with the stylised path of economic development. As a country transitions from primary goods specialization to manufacturing, its backward linkages are expected to rise because of two reasons. First, trade in manufacturing intermediates is extensively fragmented globally, offering exporting countries the opportunity to source the most cost-effective inputs from third countries. Second, manufacturing output involves a higher degree of vertical integration than services or primary sectors (De Backer and Miroudot (2013)). Conversely, forward participation declines since services and primary sectors (such as mining, agriculture and extractive resource activities) are naturally more upstream than manufacturing (Dollar et al. (2019)).

Table 3: Determinants of Backward Participation

	All Countries	**Developed**	**Developing**
Manufacturing Value-Added	-1.631* (0.294)	-4.887* (0.678)	-0.731** (0.357)
Manufacturing Share of GDP	0.117** (0.050)	0.713* (0.132)	0.096** (0.047)
Tariffs on Intermediates	-0.182* (0.066)	1.948** (0.902)	-0.211* (0.067)
FDI Share of GDP	0.207** (0.082)	0.100** (0.041)	0.543* (0.084)
Distance to Manufacturing Hub	-2.229* (0.526)	-6.152* (0.652)	-1.350* (0.721)
Distance to Economic Activity	-1.986* (0.526)	1.580 (0.652)	-1.426** (0.721)
Resource Rents' Share of GDP	-0.327* (0.039)	-0.803** (0.322)	-0.346* (0.035)
Medium and High-Skill Share of Labour Force	0.166* (0.029)	0.001 (0.077)	-0.424* (0.090)
Number of PTA Partners	0.052** (0.022)	0.142* (0.028)	0.061* (0.023)
ASEAN	11.442* (2.084)		
EU	8.485* (1.301)		
NAFTA	4.794 (2.917)		
MERCOSUR	1.131 (1.277)		
COMESA	4.141* (1.242)		
Productive Capacity Index	0.600* (0.087)	0.317* (0.183)	0.756* (0.117))
Year Fixed Effects	Yes	Yes	Yes
Observations	1696	472	1224

Standard errors in parentheses.

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

Table 4: Determinants of Forward Participation

	All Countries	**Developed**	**Developing**
Manufacturing Value-Added	0.371 (0.225)	2.132* (0.594)	0.541** (0.247)
Manufacturing Share of GDP	-0.124* (0.030)	-0.141 (0.125)	-0.092* (0.027)
Tariffs on Intermediates	0.148** (0.067)	0.493 (0.701)	0.171* (0.066)
FDI Share of GDP	-0.095** (0.043)	-0.068** (0.033)	-0.188* (0.056)
Distance to Manufacturing Hub	-2.330* (0.471)	0.629 (0.984)	-1.194* (0.658)
Distance to Economic Activity	2.806* (0.445)	-3.800* (1.426)	1.111** (0.483)
Resource Rents' Share of GDP	0.429* (0.039)	2.163* (0.322)	0.456* (0.035)
Medium and High-Skill Share of Labour Force	0.063* (0.016)	0.019 (0.046)	-0.178 (0.127)
Number of PTA Partners	0.107* (0.022)	0.055 (0.034)	0.103* (0.026)
ASEAN	-1.273 (1.111)		
EU	5.263* (1.416)		
NAFTA	-15.233* (2.547)		
MERCOSUR	-2.960* (0.864)		
COMESA	3.652* (1.077)		
Productive Capacity Index	0.096 (0.080)	-0.084 (0.200)	-0.312* (0.192))
Year Fixed Effects	Yes	Yes	Yes
Observations	1696	472	1224

Standard errors in parentheses. $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$

The domestic industrial capacity of an economy, captured by total manufacturing value-added, has been found to significantly influence both conventional trade and

GVC integration (Arkolakis et al. (2012), Fernandes et al. (2020)). Theoretically, increasing manufacturing value-added can either deepen or reduce GVC participation. A larger supply of manufacturing inputs implies a greater variety and quantity of local intermediates to source from, reducing the exporter's reliance on foreign intermediates and thus backward integration. By the same token, a greater variety of inputs implies more opportunities to integrate them into the exports of third countries – this increases forward participation. However, these relationships may go the other way as well. GVC trade, by definition, involve multi-stage production processes, which are often highly interdependent on each other. To minimize disruptions and delays arising from cross-hauling of processed and semi-processed intermediates, countries with larger industrial bases tend to host adjacent production stages within their own boundaries. This leads them to specialize in more downstream stages of production, raising backward participation (Antràs and De Gortari (2020)). Our regressions find the first channel to dominate, but only for backward participation. This effect is stronger for developed countries, suggesting that manufacturing agglomeration within richer nations has a more powerful effect on local sourcing than that found at the global level. Forward participation is positively associated with industrial size for all countries, suggestive of the large-scale production of intermediate inputs through industrial clustering.

Geographical remoteness is found to impede GVC participation for all countries. Remoteness is proxied by the internal distance between the two largest centers of economic activity in the country and by the distance to the country's closest manufacturing hub. We consider three hubs in our analysis, namely, the USA, Germany and China, in view of their centrality in global production andhigh levels of structural integration into GVCs (Taglioni and Winkler (2016)). Empirical research supports this negative relationship. In their long-run analysis of trends in value-added over three decades, Johnson and Noguera (2017) calculate that the ratio of value-added to gross exports has fallen much faster for nearby trading partners.

As noted earlier, factor resource endowments are critical determinants of international trade flows and GVC participation. Natural resource inputs are typically found at upstream stages of a value chain, where they are exported downstream for further processing and incorporation into final goods. The share of natural resource rents to GDP is thus expected to negatively (positively) affect backward (forward) participation, and this is borne out by our results. Similarly, we find thatthe composition of the labour force should be important for integration into production networks. A more skilled workforce is found to raise forward participation for the world as whole. The share of medium and high-skilled labour positively affects backward participation but not in developing countries, where low-skilled labour catalyses backward participation. This is largely consistent with recent work on low-skilled labour and GVC participation,[31] but overall, the empirical evidence ismixed. Moran (2014) observes that over 1990-2011, manufacturing FDI in developing countries have moved towards higher-skilled sectors such as machinery and equipment, electrical and electronics, chemicals, metal products, etc. Abreha et al. (2020) find skilled labour to be the strongest determinant of backward and forward integration in Sub-Saharan Africa.

In an influential study, Timmer et al. (2014) find that the factor income shares of low-skilled labour in GVC production have consistently declined in both high-income and low-income countries, over 1995-2008. More generally, GVC production has been moving away from low-skill activities towards a more intensive usage of capital and higher skilled labour. Rodrik (2018) extends this argument and suggests that the advent of labour-saving technologies like automation may raise the likelihood of reshoring production chains and thus attenuate the relationship between low-skilled labour and entry into manufacturing value chains. In light of these trends, it remains to be seen whether the associations seen here between labour force skill and GVC participation hold in the future.

Trade costs arising from tariffs on intermediate inputs are found to negatively affect GVC participation. Tariffs contract backward participation more in developing countries than the global economy as a whole – perhaps unsurprising since tariffs are typically much higher in developingcountries. Antràs and De Gortari (2020) point out that tariff escalation policies often reinforce upstream specialization in developing countries, lowering vertical integration and foreign value-added in their exports. Tariffs are found to be higher in economies exhibiting higher forward participation. An intuitive explanation might be import-competing industries expanding to take advantage of lower spending on foreign inputs and thus broadening the production of domestic intermediates. Baldwin and Venables (2015) theoretically explore this issue, with the elasticity of substitution between domestic and imported parts playing an important role in the final effect.

The effect of FDI on GVC participation is perhaps the most unambiguous that we find in our analysis. It raises backward participation, depresses forward participation and is much stronger for developing countries. This suggests that by and large, foreign investment is largely used to establish facilities and subsidiaries to process imported inputs for exports - rather than being used in conjunction with local inputs (Kowalski et al. (2015)). Thus a country wishing to attract FDI in order to develop

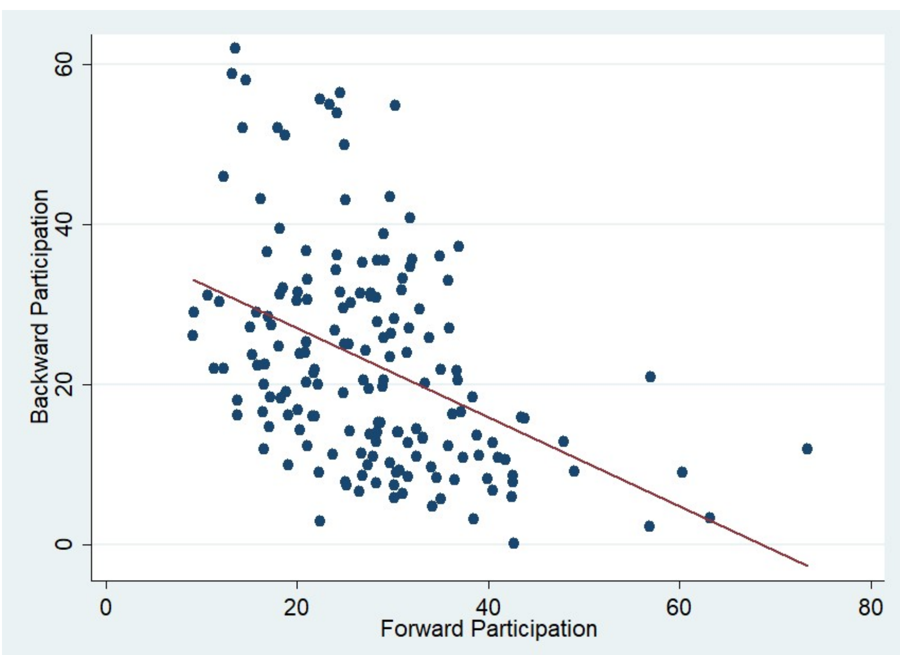
[31] See Fernandes et al. (2020).

export platforms may also need to liberalize its trade policies for multinational firms to source the most efficient inputs from foreign countries.

In its taxonomy of factors driving GVC participation, World Development Report (2020) characterizes FDI and import tariffs as important factors for raising backward participation in developing countries. It notes that backward GVC integration in South Asia and sub-Saharan Africa would rise by 16% if they improved their average FDI levels to best performers in Europe and Central Asia. Similarly, if South Asia reduced its tariff rates (the highest in the world) to best performer levels, its backward integration would be expected to rise by 20%.

Trade agreements emerge as significant predictors of GVC participation. A larger network of PTA partners in general increases both backward and forward participation, although the precise PTAs to which countries belong seem to matter. ASEAN, EU and COMESA raise backwardparticipation, while all PTAs except COMESA reduce forward participation of its members. While there does not seem to exist a theoretically intuitive channel for this particular observation, we note that backward and forward participation shares are negatively correlated over our entire sample of countries (see Figure 4).

Figure 4: Backward and Forward Participation Rates, 2017



Source: Calculated from UNCTAD-Eora GVC Database.

This relationship becomes stronger when we calculate correlations by the five trading blocs above (Table 5). A proximate reason for these trends may lie in the logic of regionalized production. Regional manufacturing hubs in each of the trading blocs supplies a large part of the aggregate foreign value-added, and this can increase backward participation for each of their regional tradingpartners. By virtue of the same channel, an individual economy may not see significant increases in its forward participation shares, owing to competition from neighbouring countries and the dominant regional hubs.

Table 5: Correlation between Backward and Forward Participation Rates, Major Trade Blocs (1995-2017)

ASEAN	EU	NAFTA	MERCOSUR	COMESA
−0.734(***)	−0.380(***)	−0.961(***)	−0.402(***)	−0.528(***)

*** denotes significance at 1% level.
Source: Calculated from UNCTAD-Eora GVC Database.

Within the determinants, we also use an index of productive capacity (PC) developed by UNCTAD. It combines an extensive set of indicators designed to measure the domestic productive capacity of an economy – human capital, natural capital, energy, transport, information and communications technology, institutions, private sector efficiency and structural change. These factorshave been highlighted by the literature as important drivers of participation in global value chains,but the paucity of data on some of these indicators prevent their separate inclusion. Domestic PC as a whole is found to significantly raise backward participation but is generally not significant asa factor behind forward integration. The components of the PC index are highly correlated with each other and with other explanatory variables such as industrial capacity and natural resource rents.

A shortcoming of our econometric analysis is that it performs much better for backward participation than forward. This may be because forward linkages essentially depend on supply-sidefactors and idiosyncratic productivity differences between countries. Exports of advanced manufacturing products (e.g., by Poland) may be driven by determinants that are substantially differentfrom exports of primary commodities (e.g., by Ethiopia and Tanzania). Backward participation reflects demand-side measures, and these can be captured more clearly by structural characteristics of economies.

4.2 Gravity Analysis of Bilateral GVC Participation

A large part of international production splintering can be attributed to trade frictions faced by countries (Johnson and Noguera (2017)). Another paper, by Miroudot et al. (2009), shows that gravity model estimates of imports of intermediates are more sensitive to trade costs and are less dependent on bilateral market size, relative to final goods. Combined, both of these imply that the significance of trade frictions for international trade has increased in a world of cross-border production sharing, vertical integration and trade in parts and components. Since it is plausible that countries may differ widely in the magnitude and content of trade restrictions they face, it is reasonable to assume that this naturally gives rise to cross-country heterogeneity in GVC participation. We specifically explore the role of trade costs in GVC participation in this section, througha gravity model of bilateral value-added trade flows. Our dependent variable is the absolute level of foreign value-added in exports (FVAEXP), provided by Eora. We use the PPML estimator proposed by Silva and Tenreyro (2006) to account for potentially large numbers of zero trade pairs inour sample, and to ensure that our estimates are unbiased, consistent and robust to heteroskedasticity. The PPML estimator also ensures consistency with the structural gravity model pioneeredby Anderson and Van Wincoop (2003).

Our empirical specification is as follows:

$$FVA_{ijt} = \exp(\beta_0 + \beta_1 LNDIST_{ij} + \beta_2 CONTIG_{ij} + \beta_3 COMLANG_{ij} + \beta_4 COMCOL_{ij} + \beta_5 COl45_{ij} + X_{ijt} + \mu_{it} + \lambda_{jt} + \varepsilon_{it}) \quad (3)$$

where i, j and t respectively denote the exporting country, origin country and year. FVA_{ijt} denotes the foreign value-added by country j (the originator) in the exports of country i (the exporter) at time t (1990-2019). Our dependent variable conveys the backward participation component fromthe perspective of the exporter and forward participation from the perspective of the originator. LNDIST is the logarithm of a population-weighted measure of bilateral distance (see 5). CONTIG, COMLAND, COMCOL and COL45 are dummies representing, respectively, presence of a common border, a common official language, a common former colony and colonial status post-1945. X contains trade policy variables consisting of membership in PTAs, tariffs on intermediate goods and the depth of PTAs.

X also contains an index of logistics efficiency. The Logistics Performance Index (LPI) is a composite function of transportation, connectivity, customs efficiency and the state of infrastructure inthe economy. Collectively, the variables in X aim to capture trade frictions that aren't structural. ε_{ijt} is the random error term. To allow for a non-linear phasing in effect of PTAs on trade flows, we lag the RTA dummies by up to 8 years.

Core policy areas in trade agreements cover provisions relating to the mobility of goods, services, capital, people and ideas. Besides these, they may also include policy areas regarding customs, rules of origin, public procurement, etc., for the purposes of enforcing the core policy provisions. Finally, they may also aim to regulate welfare by incorporating provisions addressing labour and environmental standards in economic production.

PTA depth was constructed from the recently released Deep Trade Agreements database of the World Bank, using the methodology followed by Hofmann et al. (2017). Formally, total depth of a PTA is defined as the simple sum of the number of *provisions* (such as that of intellectual property protection) included in the PTA. We sum up the number of provisions in each PTA whether or not they are legally enforceable. Thus,

$$PTA\ Depth = \sum_{k=1}^{52} Provision_k, \tag{4}$$

where k denotes a specific provision in a trade agreement. According to Hofmann et al. (2017), PTAs have thus far contained a maximum of 52 provisions; thus the number of provisions, or the "depth" of a PTA, can be at most 52.

The main usefulness of (3) is that we are able to incorporate exporter-time and originator-time fixed effects - μ_{it} and λ_{jt}, respectively. This accounts for the "multilateral resistance" terms raised by Anderson and Van Wincoop (2003). Multilateral resistance captures the intuition that countries trade more the closer they are to each other and the farther they are from the rest of the world. This becomes important when we are trying to isolate the effects of variables such as tariffs, RTA membership, etc. For instance, lower tariffs between two countries can increase trade between them but reduce trade with all of their other training partners by raising their multilateral resistance. This can have feedback effects on the original liberalizing partners and thus need to be controlled for in gravity estimations. Country-year fixed effects also potentially control for any other observable and unobservable characteristics that influence trade costs specific to the exporter and originator.

In order to capture the effect of non-categorical X variables, we take the simple mean of each of these variables over the exporter and originator. This produces a unique observation correspondingto each combination of exporter-originator-year and is thus not absorbed by country-year fixed effects.

Our regression results are reported in Table 6, and they are broadly in line with economic intuition. Countries sharing a common border or common language emerge as more active trading partners. A common colonizer does not seem to boost value-added flows; a possible explanation might be the decreasing importance of colonial ties in an era of heightened globalization. Most of the gravity variables making up trade costs significantly influence value-added trade, with the negative effect of distance being the strongest. A 10% reduction in bilateral distance raises foreign value-added in exports by roughly 8%. However, we are aware that the estimate of distance obtained in this section is not complete. This can be due to "missing globalization" effects, working through intranational trade costs and covariates such as RTA membership, which have deepened trade integration and reduced the effects of distance. Nonetheless, remoteness still remains a fundamental obstacle to GVC trade and integration, especially for low-income countries (Borchert and Yotov (2017)). The2019 GVC Development Report states that distance may matter more – not less – for bilateral trade, as complex GVC trade has become more concentrated between major regional traders.

Table 6: Determinants of Bilateral VAEXP

VARIABLES	FVAEXP
LNDIST_WEIGHTED	-0.8145***
	(0.0180)
Contiguity	0.1122***
	(0.0250)
COMLANG_OFF	0.2330***
	(0.0318)
COMCOL	-0.0614
	(0.0624)
COL45	0.6019***
	(0.0741)
Tariffs on Intermediate Goods	-0.1285***
	(0.0461)
RTA	0.0550
	(0.1696)
RTA_LAG4	0.0764*
	(0.0447)
RTA_LAG8	0.1483***
	(0.0353)
RTA#tariffs	0.0580
	(0.0455)
PTA Depth	0.0095***
	(0.0029)
PTA Depth_Sq	-0.0001***
	(0.0000)
LPI_Rank	-0.0216***
	(0.0050)
Constant	22.1038***
	(0.2900)
Observations	15,312

Standard errors in parentheses.

$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

The most direct measure of trade costs in our framework - tariffs on intermediate goods - are found to reduce FVAEXP significantly. A 1% tariff reduction on intermediate manufacturing goods stimulates value-added trade by 0.12%. The impact of tariffs, however, is smaller relative to thatof structural gravity variables. UNCTAD (2011) notes that tariff levels are quite low in developed countries in general. For many sectors there does not seem to be evidence of high tariffs inducing delocalization of firmly established production blocks, and thus bilateral sourcing of FVA. Furthermore, it is also possible that the effects of tariffs are subsumed under RTAs, as they lower tariffs preferentially between regional trading partners.

We obtain interesting effects of RTA membership and RTA depth on GVC participation. First, entry into an RTA does not immediately produce a significant impact on trade flows. Within 4 years of formation, however, RTAs increase value-added trade by roughly 8%, which increases to 16% within 8 years. This can occur due to several reasons. Trade flows can naturally take time to adjust to policy changes, as regional integration measures take time to lock in. Moreover, weak RTAs may be strengthened by more comprehensive negotiations over time. This is related to our second observation - PTA depth is positively and significantly related to GVC trade.[32] Interestingly, however, value-added trade follows the law of diminishing returns with respect to PTAs: the *expansionary* effect of deeper PTAs reduces with extra provisions in PTAs.

The rationale for trade agreements has changed in a GVC world. Offshoring magnifies the possibility that governments may no longer be able to resolve policy inconsistencies by exploiting simple rules of reciprocity and non-discrimination in traditional PTAs (Antràs and Staiger (2012)). Ruta (2017) stresses the importance of deep integration as an effective tool for internalizing these cross-border policy spillovers; they can also regulate complexities regarding rules of origin, customs and border procedures. They may also act as a signalling mechanism by lending more credibility to government assurances of investor protection and policy certainty, than shallower PTAs.

Better performance in the LPI - an index of the functioning of logistics, infrastructure, and customs procedures is positively associated with value-added trade.[33] This confirms the importance of trade-enabling indices for GVC trade, as well as the beneficial role of infrastructure in providing connectivity and transportation. The role of logistics and transport in trade is related to the problem of greater trade costs that countries more remote from manufacturing hubs have to absorb in order to

[32] As the complexity of PTAs continues to evolve, they can exert larger and larger impacts on trade. PTAs alone have led to strong declines in value-added relative to gross exports for the manufacturing sector by driving down bilateral trade frictions, over the last 40 years (Johnson and Noguera (2017)).

[33] We use LPI ranks instead of scores, hence the negative coefficient.

participate in value chains. Countries surrounding key centres of economic activity may still be unable to reap the benefits of proximity because of transport inefficiency andhigh logistics costs. Hummels and Schaur (2012) find that a shipment delay of one day in the USAincurs a tariff equivalent of 0.6% to 2.3% – and this is especially relevant for just-in-time trade flows characteristic of intermediates trade.

In summary, our OLS and gravity regressions reemphasize certain drivers of GVC participation that have emerged in recent research as significant for explaining international trade flows. Structural factors play an important role in determining the extent of GVC participation, especially thespatial distance from key manufacturing hubs and the domestic market size. The composition of factor endowments also clearly matters, as does foreign direct investment and policy instrumentslike tariffs. Finally, regional and preferential trade agreements turn out to significantly influence production fragmentation, as the world trading system becomes ever more tightly integrated (albeit regionally).

5 Conclusion

Global value chains (GVC) have considerably changed the nature of international production and the global distribution of associated factor incomes. Countries increasingly house production”stages” in which they produce a specific component of a commodity or service, rather than the entire commodity itself. This has introduced an alternative developmental path for countries, throughwhich they can bypass the traditional strategy of wholesale industrialization. The benefits conferred to low-income countries by international production sharing have been empirically observed, although much research remains to be done on quantifying the gains from GVC trade.

We try to identify potential factors that drive country participation in GVCs, at the aggregate level. We perform a general analysis of the determinants of backward and forward GVC participation, as well as a gravity analysis of the determinants of bilateral GVC trade. Both our exercises highlight the important role of ”fundamental” factors such as income, the manufacturing share ofGDP, labour force quality and distance to key economic and manufacturing hubs as important in explaining GVC trade. Policy variables also emerged as significant predictors of GVC trade, suchas manufacturing tariffs and participation in trade agreements. FDI in particular was found to strongly affect GVC participation, indicating that multinational lead firms play a critical role in the organization and distribution of international production. We account for heteroskedasticity and zero trade pairs in our analysis by using the PPML estimator suggested by Silva and Tenreyro(2006). Our analysis covers more than 100 countries over 1990-2018, reflecting both cross-country heterogeneity and a long time panel. Interestingly, GVC participation appears to be driven by similar factors in both developed and developing countries, although the relative significance of these variables differs across income levels.

A limitation of our analysis is that it does not quantify the welfare impacts of GVC participation. Participation in GVCs is not sufficient for economic development. Nor does it follow that the benefits of GVC participation would necessarily be shared widely, because of the rising skill-intensity of technological progress and trade. Technological advancements such as automation may further reduce the economic dividends for low-income countries in GVCs, as advanced economies look to reshore production. Governmental policy must ensure that unskilled workers are no longer left behind in the wake of ”globalization”. Trade barriers that restrict access to efficient producer inputs may need to be rationalized, especially in developing countries. In order to maximise the benefits from GVC participation, policy must increasingly harmonize industrial and trade policy. This will not only result in a more equitable distribution of the benefits and risks from GVC participation, but also help countries upgrade to higher value-added stages of production chains.

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Appendix

Table A: FVA in Regional Exports (1990)

	Asia	Europe	Africa	NAM	SAM	Oceania
Afghanistan	44.4	28.6	7.1	9.7	5.6	4.6
Albania	11.1	77.3	2.8	4.6	2.5	1.7
Algeria	9.1	76.1	1.6	11.4	1.1	0.6
Andorra	18.6	61.9	5.0	7.0	4.4	3.3
Angola	9.2	49.7	21.3	12.0	6.9	0.9
Antigua	17.8	19.4	4.6	47.5	7.6	3.2
Argentina	12.4	38.6	1.8	21.0	25.4	0.7
Armenia	30.2	49.3	3.1	12.7	2.5	2.2
Aruba	13.5	29.9	3.0	36.2	15.3	2.0
Australia	36.5	21.8	1.5	34.0	1.3	4.9
Austria	8.5	82.0	1.4	7.2	0.7	0.3
Azerbaijan	18.2	66.3	2.1	10.6	1.5	1.2
Bahamas	5.3	6.9	1.1	84.1	2.0	0.7
Bahrain	31.0	49.5	1.5	13.5	1.9	2.7
Bangladesh	66.8	19.9	1.3	8.2	1.6	2.2
Barbados	13.4	22.4	2.2	54.6	5.3	2.1
Belarus	31.6	28.5	17.2	9.0	7.4	6.3
Belgium	10.0	75.2	3.1	9.7	1.5	0.6
Belize	17.6	17.1	4.1	52.6	5.6	2.9
Benin	23.3	48.5	10.9	8.7	5.1	3.4
Bermuda	30.4	26.3	4.3	32.4	3.9	2.7
Bhutan	39.6	26.4	8.9	10.6	8.4	6.0
Bolivia	13.8	23.3	2.1	24.2	35.2	1.4
Bosnia and Herzegovina	7.0	84.3	1.8	4.4	1.5	1.0
Botswana	7.2	13.4	72.8	4.2	1.3	1.1
Brazil	14.7	36.9	3.2	30.6	13.9	0.7
British Virgin Islands	32.4	32.7	7.3	15.6	6.8	5.1
Brunei	56.1	21.4	1.6	15.2	1.5	4.1
Bulgaria	7.9	82.8	1.5	5.7	1.6	0.4
Burkina Faso	32.0	38.0	8.1	9.5	8.1	4.4
Burundi	30.9	30.1	10.8	11.3	10.1	6.7
Cambodia	51.9	20.8	6.8	9.8	5.4	5.4
Cameroon	12.9	67.7	8.3	8.3	1.8	1.1
Canada	13.9	18.3	0.7	64.8	1.4	0.8

Cape Verde	25.0	46.5	7.3	9.6	7.0	4.6
Cayman Islands	17.1	25.8	4.4	31.6	18.2	2.9
Central African Republic	29.4	35.9	10.9	10.1	8.1	5.7
Chad	29.0	35.7	9.5	12.1	7.9	5.7
Chile	13.9	26.5	2.4	27.0	29.3	1.0
China	54.4	25.5	1.5	13.0	1.7	4.0
Colombia	12.0	30.9	1.0	40.3	15.4	0.5
Congo	19.7	48.7	10.4	14.2	4.2	2.6
Costa Rica	10.9	20.1	0.8	60.6	7.0	0.5
Croatia	6.4	85.3	2.0	5.1	0.8	0.4
Cuba	10.3	57.7	1.2	20.7	9.5	0.6
Cyprus	17.1	68.9	1.6	10.2	1.2	0.9
Czech Republic	7.5	84.4	1.1	5.9	0.8	0.4
Cote dIvoire	13.9	64.2	12.4	6.8	1.8	0.9
North Korea	49.5	29.7	5.0	7.3	5.5	3.1
DR Congo	13.2	46.3	30.1	6.5	2.3	1.7
Denmark	8.2	82.2	0.8	6.9	0.9	1.0
Djibouti	33.0	34.4	8.3	11.2	7.8	5.3
Dominican Republic	14.2	27.3	1.2	48.8	7.8	0.7
Ecuador	11.9	21.7	1.5	36.8	27.5	0.6
Egypt	19.0	63.2	1.9	12.9	1.6	1.2
El Salvador	14.7	16.7	1.2	58.7	7.6	1.1
Eritrea	30.0	36.0	8.4	12.1	7.8	5.8
Estonia	11.8	78.9	1.6	5.5	1.3	1.0
Ethiopia	26.9	39.5	10.8	11.4	6.7	4.6
Fiji	30.0	13.0	3.0	8.7	2.8	42.4
Finland	11.5	77.7	0.7	8.4	1.0	0.7
France	12.7	71.8	4.1	9.6	1.3	0.5
French Polynesia	16.6	53.6	2.8	15.1	2.5	9.3
Gabon	14.7	61.0	6.7	13.8	2.3	1.5
Gambia	26.1	43.2	9.4	10.0	7.1	4.2
Georgia	13.7	68.4	3.0	9.9	3.0	2.1
Germany	15.0	69.1	2.4	11.3	1.6	0.7
Ghana	19.4	53.2	10.9	11.5	2.5	2.4
Greece	16.6	74.4	2.2	5.3	0.8	0.5
Greenland	10.2	77.5	2.6	5.3	2.6	1.8
Guatemala	11.2	18.9	1.0	61.6	6.5	0.9
Guinea	23.6	45.9	9.8	13.4	4.3	3.0
Guyana	11.5	17.2	1.7	54.3	13.6	1.7

Haiti	22.7	23.7	4.3	39.7	6.5	3.1
Honduras	10.9	11.6	1.2	69.1	6.3	1.0
Hong Kong	65.3	19.8	0.8	11.3	0.6	2.2
Hungary	13.5	78.4	0.8	6.3	0.7	0.3
Iceland	10.0	72.0	1.4	13.6	1.5	1.5
India	30.3	48.9	2.3	12.9	1.5	4.1
Indonesia	52.7	22.3	1.4	15.7	1.4	6.5
Iran	30.4	54.2	1.4	6.4	3.0	4.5
Iraq	36.8	49.9	3.4	5.2	3.1	1.5
Ireland	18.4	54.7	0.8	25.1	0.6	0.5
Israel	13.5	63.7	2.6	18.7	1.0	0.6
Italy	12.1	73.5	3.6	8.3	1.8	0.7
Jamaica	10.3	16.0	1.6	65.1	5.6	1.4
Japan	36.5	23.6	2.2	28.1	2.4	7.3
Jordan	27.5	56.7	2.4	10.4	1.5	1.5
Kazakhstan	10.3	76.9	1.7	8.0	1.9	1.1
Kenya	29.4	46.3	10.3	8.1	2.3	3.7
Kuwait	30.2	44.9	1.8	18.6	1.7	2.8
Kyrgyzstan	32.8	41.3	5.5	11.7	5.2	3.5
Laos	52.6	21.9	6.2	8.6	5.7	5.0
Latvia	8.0	83.0	1.7	4.9	1.4	1.1
Lebanon	20.7	63.4	2.9	10.3	1.5	1.1
Lesotho	56.7	19.3	7.1	8.6	4.7	3.5
Liberia	34.1	29.0	9.4	11.5	9.1	7.0
Libya	11.9	75.1	6.2	3.8	2.3	0.7
Liechtenstein	35.3	26.4	10.1	11.6	9.4	7.2
Lithuania	6.3	87.3	1.0	3.8	0.9	0.6
Luxembourg	5.6	86.1	1.2	6.0	0.7	0.4
Macao SAR	64.9	18.2	1.3	11.1	1.2	3.3
Madagascar	25.5	50.5	8.7	9.2	3.4	2.7
Malawi	19.8	21.1	46.1	6.7	3.6	2.7
Malaysia	56.8	20.9	0.7	16.9	0.9	3.8
Maldives	48.5	23.6	6.4	10.0	5.4	6.1
Mali	22.1	43.6	17.6	9.4	4.4	2.9
Malta	20.6	64.6	2.3	10.0	1.4	1.2
Mauritania	18.6	53.2	11.7	9.3	4.3	2.8
Mauritius	37.6	39.6	12.4	5.5	1.4	3.5
Mexico	13.9	18.5	0.4	64.3	2.6	0.4
Monaco	33.5	26.4	10.5	11.8	10.5	7.3
Mongolia	38.9	36.7	5.4	9.9	5.1	4.0

Montenegro	30.5	27.8	10.9	11.6	11.8	7.5
Morocco	9.4	79.7	2.5	6.5	1.5	0.5
Mozambique	17.5	21.5	48.3	6.7	3.4	2.7
Myanmar	47.4	21.5	8.6	10.1	7.4	5.1
Namibia	6.2	13.2	74.5	3.9	1.1	1.0
Nepal	53.0	28.2	3.4	8.5	3.1	3.9
Netherlands	17.7	65.6	2.0	12.2	1.9	0.6
Netherlands Antilles	16.2	27.9	1.6	32.7	20.3	1.3
New Caledonia	17.9	50.2	3.4	6.9	2.9	18.7
New Zealand	22.0	26.3	1.1	23.3	1.2	26.1
Nicaragua	17.9	16.5	2.4	53.8	7.5	2.0
Niger	23.0	41.2	16.4	11.5	4.5	3.3
Nigeria	21.7	57.4	5.2	12.1	3.0	0.6
Norway	10.3	76.0	1.2	10.8	1.2	0.6
Gaza Strip	36.7	40.9	4.6	10.7	3.9	3.2
Oman	52.4	33.7	1.4	8.3	1.7	2.5
Pakistan	40.5	41.0	2.7	11.1	1.8	2.8
Panama	15.4	20.2	1.1	51.3	11.4	0.6
Papua New Guinea	36.7	11.4	2.0	7.5	1.9	40.5
Paraguay	21.2	19.4	1.2	14.5	43.0	0.7
Peru	14.3	29.9	1.5	30.6	22.6	1.1
Philippines	69.8	14.3	0.5	13.0	0.6	1.7
Poland	10.3	80.2	1.7	6.0	1.3	0.4
Portugal	9.9	80.3	3.1	4.8	1.5	0.3
Qatar	47.3	36.6	1.6	11.3	1.4	1.8
South Korea	58.9	19.0	1.1	16.2	1.4	3.4
Moldova	32.9	28.9	10.9	11.1	8.6	7.6
Romania	6.4	84.9	1.4	5.3	1.3	0.8
Russia	15.3	70.1	1.6	9.9	2.0	1.0
Rwanda	29.7	32.0	12.3	11.9	8.7	5.4
Samoa	32.3	23.7	8.6	14.2	8.3	13.0
San Marino	29.0	22.1	22.8	11.7	8.6	5.8
Sao Tome and Principe	31.9	32.6	9.6	10.9	8.6	6.4
Saudi Arabia	25.0	50.0	1.9	19.4	1.5	2.2
Senegal	14.1	64.6	10.6	6.8	2.5	1.4
Serbia	35.6	26.3	9.8	11.3	10.2	6.8
Seychelles	29.8	32.8	16.1	9.6	6.2	5.4
Sierra Leone	29.6	37.0	8.7	11.6	7.5	5.5
Singapore	53.1	22.4	0.7	19.6	1.0	3.3
Slovakia	8.0	85.8	1.0	4.4	0.6	0.3

Slovenia	7.3	85.3	1.3	5.0	0.7	0.4
Somalia	33.3	27.5	9.8	12.2	10.0	7.2
South Africa	23.4	51.3	2.7	17.3	2.0	3.3
South Sudan	32.1	27.0	10.9	11.6	11.0	7.4
Spain	13.1	71.7	5.1	7.7	1.9	0.5
Sri Lanka	55.2	29.6	1.9	8.2	1.1	4.0
Sudan	34.9	26.6	10.1	11.9	9.1	7.3
Suriname	36.4	28.7	5.9	18.3	7.1	3.5
Swaziland	8.0	9.8	76.1	3.6	1.4	1.2
Sweden	9.9	80.3	0.8	7.6	0.9	0.5
Switzerland	8.7	77.5	1.2	11.2	1.0	0.4
Syria	24.0	62.5	2.3	8.2	2.1	0.8
Taiwan	52.9	17.5	1.5	23.6	1.0	3.6
Tajikistan	24.5	54.8	4.9	8.2	4.7	2.9
Thailand	54.4	27.5	1.1	12.2	0.9	3.8
TFYR Macedonia	10.9	78.3	2.5	4.7	2.1	1.5
Togo	21.7	49.6	12.5	8.3	4.6	3.4
Trinidad and Tobago	13.0	22.3	2.5	48.2	12.6	1.4
Tunisia	8.7	80.0	3.2	6.7	1.0	0.5
Turkey	15.5	72.8	2.7	7.4	1.0	0.6
Turkmenistan	27.5	62.5	1.5	6.0	1.3	1.1
Former USSR	30.8	27.4	11.0	11.8	11.3	7.6
Uganda	29.2	31.9	24.6	7.8	3.5	3.1
Ukraine	9.3	84.2	1.1	3.8	0.9	0.7
UAE	32.6	46.4	2.5	14.3	1.8	2.4
UK	17.3	61.1	2.2	17.1	1.2	1.1
Tanzania	30.6	35.0	20.8	7.7	2.0	3.9
USA	30.8	33.6	2.8	21.8	9.4	1.5
Uruguay	14.5	31.2	2.3	14.1	36.5	1.5
Uzbekistan	35.0	33.1	7.8	11.9	7.2	5.0
Vanuatu	34.0	24.0	8.5	10.8	8.4	14.3
Venezuela	9.3	31.4	1.1	38.5	19.0	0.7
Viet Nam	74.3	13.2	1.2	8.1	0.9	2.3
Yemen	41.7	38.1	3.9	11.1	3.2	2.0
Zambia	12.3	17.7	60.6	6.1	1.7	1.5
Zimbabwe	12.4	22.2	55.9	6.2	1.7	1.6

Table B: FVA in Regional Exports (2018)

	Asia	Europe	Africa	NAM	SAM	Oceania
Afghanistan	72.3	15.2	4.5	4.8	1.8	1.4
Albania	20.7	68.4	2.8	5.1	1.9	1.1
Algeria	24.8	38.5	2.9	30.1	2.9	0.8
Andorra	21.6	64.1	4.4	5.5	2.6	1.8
Angola	31.4	37.0	6.1	14.6	9.7	1.3
Antigua	23.7	20.0	6.2	38.5	8.9	2.7
Argentina	23.8	27.3	1.5	11.0	35.9	0.5
Armenia	39.5	45.7	2.8	8.8	1.6	1.6
Aruba	23.8	29.4	4.4	23.1	17.7	1.5
Australia	56.5	16.5	1.2	18.8	1.5	5.5
Austria	19.3	69.9	1.8	7.4	1.2	0.5
Azerbaijan	37.8	50.9	1.8	7.5	1.2	0.8
Bahamas	11.6	10.0	1.5	73.9	2.4	0.6
Bahrain	46.2	36.6	2.4	9.6	3.3	2.0
Bangladesh	84.5	9.6	1.5	2.6	1.0	0.8
Barbados	21.2	22.5	2.9	41.9	9.5	2.0
Belarus	52.3	16.2	18.3	7.0	3.1	3.2
Belgium	23.6	60.8	3.6	8.9	2.2	0.8
Belize	24.3	17.4	5.0	45.5	5.7	2.1
Benin	35.6	35.7	17.8	5.6	3.3	1.9
Bermuda	34.3	26.0	5.1	28.9	3.3	2.3
Bhutan	45.6	25.3	10.3	7.9	6.4	4.5
Bolivia	26.4	19.8	2.3	13.6	36.9	0.9
Bosnia and Herzegovina	22.2	69.3	2.3	4.3	1.3	0.7
Botswana	28.3	18.9	43.1	5.6	2.4	1.8
Brazil	34.5	33.0	4.1	12.9	14.5	0.9
British Virgin Islands	42.7	29.5	10.5	9.8	4.5	3.0
Brunei	69.9	16.4	2.3	6.6	1.5	3.2
Bulgaria	31.0	61.1	1.5	3.9	2.0	0.5
Burkina Faso	36.3	36.0	11.5	6.5	6.2	3.5
Burundi	39.8	26.8	14.4	7.5	6.7	4.9
Cambodia	79.3	11.4	1.9	4.8	1.5	1.1
Cameroon	31.4	43.3	15.5	7.2	1.7	0.8
Canada	35.5	18.0	0.9	42.6	2.0	1.0
Cape Verde	30.7	45.6	7.5	9.0	4.6	2.7
Cayman Islands	28.1	29.5	5.4	22.9	11.6	2.4

Central African Republic	33.1	35.4	12.7	8.5	5.8	4.5
Chad	45.7	29.9	11.2	6.5	4.4	2.3
Chile	34.0	19.1	2.8	13.2	30.0	0.8
China	48.9	30.3	2.5	11.2	3.0	4.1
Colombia	27.5	24.9	1.4	29.2	16.3	0.7
Congo	34.6	39.1	6.9	14.7	2.9	1.7
Costa Rica	26.1	19.7	1.2	42.2	10.2	0.7
Croatia	20.6	64.7	2.2	10.5	1.4	0.5
Cuba	32.4	42.7	1.6	17.7	5.0	0.5
Cyprus	29.1	58.6	2.3	7.7	1.4	1.0
Czech Republic	20.3	71.0	1.3	5.8	1.1	0.5
Cote dIvoire	34.3	38.3	20.2	4.6	1.8	0.8
North Korea	82.6	10.5	2.4	2.4	1.3	0.8
DR Congo	39.0	25.9	26.1	6.0	1.9	1.1
Denmark	27.6	64.1	1.1	5.1	1.2	0.8
Djibouti	45.8	27.3	10.3	7.3	5.3	4.0
Dominican Republic	28.9	27.1	1.4	32.0	10.0	0.6
Ecuador	37.3	14.2	1.4	11.0	35.5	0.5
Egypt	50.4	34.8	1.5	10.5	1.7	1.1
El Salvador	16.6	12.8	1.0	60.5	8.6	0.5
Eritrea	43.4	25.9	15.0	6.6	6.1	2.9
Estonia	30.1	63.0	1.2	4.3	0.9	0.5
Ethiopia	45.4	33.2	6.7	9.7	3.0	2.0
Fiji	41.2	11.0	3.9	5.5	2.0	36.4
Finland	32.8	56.5	1.5	7.0	1.4	0.9
France	24.9	57.3	4.6	10.5	2.1	0.7
French Polynesia	27.6	29.5	2.8	26.5	2.9	10.6
Gabon	18.9	54.7	7.4	15.5	2.1	1.3
Gambia	34.0	35.6	11.0	8.2	6.7	4.5
Georgia	39.0	48.1	3.3	6.0	2.1	1.5
Germany	25.2	60.2	2.6	8.9	2.2	0.8
Ghana	51.9	27.8	13.0	4.4	1.4	1.5
Greece	31.9	58.0	3.0	5.1	1.3	0.6
Greenland	15.1	75.1	3.7	3.7	1.5	0.9
Guatemala	24.7	19.1	1.3	47.0	7.2	0.7
Guinea	49.2	22.5	18.3	5.2	2.5	2.3
Guyana	18.0	12.6	1.5	46.4	19.7	1.8
Haiti	28.4	24.3	4.5	33.4	7.3	2.2
Honduras	16.3	12.0	1.4	62.1	7.4	0.7

Hong Kong	82.3	11.9	0.7	3.2	0.8	1.1
Hungary	34.3	58.7	0.9	4.8	0.9	0.4
Iceland	32.8	58.2	1.4	5.3	1.3	0.9
India	54.6	30.1	3.5	5.7	2.5	3.6
Indonesia	60.2	19.2	1.7	11.0	1.8	6.2
Iran	56.9	32.5	1.3	4.9	2.6	1.8
Iraq	82.2	11.8	2.0	2.2	1.3	0.6
Ireland	35.7	52.3	1.0	9.4	0.9	0.6
Israel	25.4	60.8	2.2	9.3	1.6	0.6
Italy	26.5	53.9	3.2	12.8	2.8	0.8
Jamaica	17.6	14.2	2.1	56.7	7.7	1.7
Japan	53.9	19.2	2.3	15.1	3.2	6.3
Jordan	58.5	35.0	1.8	2.9	0.9	0.8
Kazakhstan	20.4	68.1	1.9	6.9	1.8	0.9
Kenya	63.6	20.9	7.3	4.8	1.7	1.5
Kuwait	53.9	28.7	2.5	10.5	2.4	2.0
Kyrgyzstan	44.9	32.2	7.6	8.4	3.9	3.0
Laos	80.8	8.0	6.2	2.8	0.9	1.2
Latvia	21.8	71.5	1.5	3.8	0.9	0.6
Lebanon	44.8	43.3	4.7	4.9	1.5	0.8
Lesotho	64.9	11.3	13.6	5.5	2.9	1.8
Liberia	42.4	21.7	15.5	9.6	6.3	4.4
Libya	27.9	54.4	6.2	6.7	3.7	1.1
Liechtenstein	36.6	27.4	11.8	9.4	8.1	6.8
Lithuania	14.9	78.9	1.0	3.8	1.0	0.4
Luxembourg	14.6	74.1	1.4	8.1	1.2	0.5
Macao SAR	90.5	5.6	0.6	2.0	0.5	0.7
Madagascar	52.0	29.7	8.9	5.6	2.1	1.6
Malawi	35.6	17.1	38.3	5.0	2.3	1.8
Malaysia	61.4	19.9	1.2	12.1	1.5	4.0
Maldives	63.6	17.2	4.7	6.6	3.0	4.9
Mali	38.2	28.4	21.3	5.9	3.8	2.4
Malta	36.4	49.7	2.4	8.6	1.8	1.1
Mauritania	24.7	47.9	12.5	9.1	3.3	2.4
Mauritius	67.2	18.8	6.0	4.7	1.3	2.0
Mexico	34.4	21.8	0.9	38.1	4.1	0.7
Monaco	42.8	19.0	19.8	8.0	6.0	4.4
Mongolia	59.9	30.4	3.1	3.6	1.5	1.5
Montenegro	47.6	17.2	19.6	5.7	6.7	3.3
Morocco	23.1	64.7	2.5	7.0	2.0	0.6

Mozambique	44.6	17.4	30.6	3.7	2.0	1.7
Myanmar	40.4	21.9	21.7	10.2	3.8	1.9
Namibia	14.6	16.7	61.2	4.5	1.7	1.3
Nepal	73.0	15.1	2.1	6.3	1.6	1.9
Netherlands	39.1	49.1	2.4	6.6	2.0	0.8
Netherlands Antilles	27.0	26.4	2.2	30.1	12.7	1.5
New Caledonia	25.0	38.6	3.4	6.3	2.2	24.4
New Zealand	42.3	18.4	1.2	16.1	1.4	20.6
Nicaragua	19.3	13.9	2.5	55.5	8.0	0.9
Niger	33.1	21.1	34.9	6.1	2.7	2.1
Nigeria	48.0	40.9	1.9	3.6	4.9	0.7
Norway	21.8	59.6	1.4	14.8	1.7	0.6
Gaza Strip	66.0	22.4	5.8	3.5	1.3	0.9
Oman	69.6	18.0	2.0	7.3	1.7	1.4
Pakistan	60.0	23.6	5.9	6.9	1.8	1.7
Panama	37.3	15.9	2.1	25.4	18.8	0.6
Papua New Guinea	54.9	12.3	2.7	5.8	1.8	22.5
Paraguay	29.3	19.2	2.2	7.4	41.1	0.8
Peru	24.2	18.5	1.6	29.9	25.0	0.8
Philippines	69.2	15.7	0.8	11.0	1.0	2.3
Poland	36.2	55.8	1.3	5.0	1.2	0.6
Portugal	23.6	65.5	3.1	4.9	2.3	0.6
Qatar	69.4	18.0	1.9	8.5	1.1	1.2
South Korea	73.3	15.5	1.5	5.4	2.5	1.9
Moldova	37.7	22.8	12.4	14.1	6.9	6.0
Romania	30.9	61.3	1.1	4.6	1.3	0.8
Russia	24.9	49.8	1.7	20.3	2.5	0.7
Rwanda	38.7	24.6	21.0	7.0	5.7	3.1
Samoa	34.6	22.2	10.3	11.3	6.4	15.2
San Marino	28.5	4.8	60.8	4.4	0.9	0.6
Sao Tome and Principe	39.4	31.5	12.8	6.0	6.2	4.2
Saudi Arabia	45.3	31.7	5.2	13.2	2.5	2.1
Senegal	34.3	35.5	14.9	10.5	3.7	1.1
Serbia	40.1	23.0	17.2	8.3	6.0	5.3
Seychelles	49.9	21.6	12.5	9.1	3.1	3.8
Sierra Leone	40.2	32.2	11.3	9.0	4.4	3.0
Singapore	70.2	14.7	1.6	10.2	1.2	2.2
Slovakia	24.4	69.6	0.9	4.0	0.8	0.4
Slovenia	16.2	75.6	1.6	4.9	1.1	0.5
Somalia	40.1	25.0	12.6	9.8	7.2	5.3

South Africa	34.9	42.9	3.5	12.6	3.1	2.9
South Sudan	38.3	25.1	11.2	12.6	7.0	5.7
Spain	29.6	55.0	4.9	7.1	2.7	0.7
Sri Lanka	70.3	19.3	1.8	5.2	1.2	2.2
Sudan	38.9	25.0	10.7	13.7	6.9	4.8
Suriname	36.0	27.3	7.0	19.9	7.6	2.2
Swaziland	20.5	14.9	52.1	8.4	2.5	1.6
Sweden	22.3	68.6	1.0	6.3	1.2	0.6
Switzerland	19.5	64.9	1.7	11.4	1.8	0.6
Syria	35.8	52.0	1.8	7.2	2.3	0.9
Taiwan	55.9	17.7	1.8	20.4	1.3	3.0
Tajikistan	55.9	26.8	7.6	4.8	3.1	2.0
Thailand	63.6	21.7	1.8	8.7	1.5	2.7
TFYR Macedonia	22.7	61.7	4.3	7.9	2.2	1.1
Togo	28.5	39.0	20.7	6.3	3.2	2.3
Trinidad and Tobago	20.2	19.0	2.4	46.3	10.7	1.4
Tunisia	21.9	66.2	3.4	6.5	1.4	0.6
Turkey	38.9	52.7	1.9	4.7	1.2	0.6
Turkmenistan	54.2	39.3	1.0	4.2	0.8	0.6
Former USSR	34.9	22.6	13.4	15.0	7.3	6.8
Uganda	39.4	21.1	32.7	4.2	1.5	1.2
Ukraine	17.7	75.6	1.1	4.0	1.0	0.5
UAE	61.7	21.0	1.9	12.4	1.7	1.3
UK	37.8	47.6	2.2	9.8	1.5	1.2
Tanzania	60.7	19.7	15.0	2.9	1.0	0.7
USA	45.9	19.8	3.0	20.8	9.3	1.1
Uruguay	22.4	21.0	2.9	7.3	45.6	0.9
Uzbekistan	37.3	40.6	6.0	8.3	4.2	3.5
Vanuatu	45.4	18.0	11.9	6.4	4.8	13.6
Venezuela	31.6	35.1	2.0	20.8	9.7	0.8
Viet Nam	79.0	11.9	0.8	5.6	0.8	1.8
Yemen	61.2	24.1	3.9	6.6	2.8	1.3
Zambia	40.5	20.9	28.1	6.8	2.0	1.8
Zimbabwe	30.4	14.1	50.9	2.8	1.1	0.8

Table C: Variable Sources

Variable	**Measure**	**Source**
Manufacturing Value-Added	Manufacturing Value Added (Current US$)	World Bank
Manufacturing Share of GDP	Manufacturing, value added (%of GDP)	World Bank
Tariffs on Intermediates	Tariffs on Intermediate Goods, AHS Weighted Average (%)	World Integrated Trade Solutions, World Bank
FDI Share of GDP	Foreign direct investment, net inflows (% of GDP)	World Bank
Distance to Manufacturing Hub	Minimum distance to either China, Germany, or the USA	CEPII
Distance to Economic Activity	Internal distance to the capital city of a country	CEPII
Resource Rents' Share of GDP	Total natural resources rents (% of GDP)	World Bank
Medium and High-Skill Share of Labour Force	Share of employment of skill levels 2, 3 and 4, according to the International Standard ILO Classification of Occupations in total employment	International Labour Organization (ILO)
Number of PTA Partners	Number of PTA partners of each country	Deep Trade Agreements Database, World Bank
Productive Capacity Index	Holistic index measuring the productive capacity of a country	UNCTAD
LNDIST WEIGHTED	Bilateral distance between the biggest cities of two countries, weighted by the share of the city in the respective country's population	CEPII

Contiguity	Dummy variable indicating presence of a common border between two countries	CEPII
COMLANG OFF	Dummy variable indicating presence of a common official language between two countries	CEPII
COMCOL	Dummy variable indicating presence of a common colonizer between two countries	CEPII
COL45	Dummy variable indicating colonial status after 1945	CEPII
RTA	Dummy variable indicating presence of a trade agreement be- tween two countries	CEPII
PTA Depth	Total number of provisions contained in a bilateral trade agreement between two countries, as described in Hofmann et al (2017)	Deep Trade Agreements Database, World Bank
LPI Rank	Rank of countries in the Logistics Performance Index	World Bank

For details on the construction of CEPII's distance measures, see Mayer and Zignago (2011). ILO estimates are taken from the November 2020 modelled estimates of Employment by Sex and Occupation; see ILO *documentation*. Medium-skill employment corresponds to skill level 2 and high-skill to skill levels 3 and 4. For information on the sources and construction of gravity variables and RTA dummies borrowed from CEPII, see Conte et al. (2020).

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Conte, M., Cotterlaz, P., and Mayer, T. (2020). The CEPII Gravity Database.

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