Ecole Doctorale des Sciences Economiques, Juridiques, Politiques et de gestion Centre d'Etudes et de Recherche sur le Développement International (CERDI)

Université Clermont Auvergne, CNRS, IRD, CERDI, F-63000 Clermont-Ferrand, France

Developing Countries' Participation in Global Value Chains: Determinants and consequences.

Thèse présentée et soutenue publiquement le 07 Décembre 2022 pour l'obtention du titre de Docteur en Sciences Economiques

Par

NANA Ibrahim

sous la direction de

Professeur Mary-Françoise Renard

Membres du Jury

Patricia Augier	Professeur, Aix-Marseille Université – AMSE, MEGA	Rapporteur
Camélia Turcu	Professeur, Université d'Orléans-LEO	Rapporteur
Jean-Louis COMBES	Professeur, Université Clermont Auvergne - LEO	Suffragant
Issa Faye	Directeur CDIDR-IFC, World Bank	Suffragant
Mary-Françoise Renard	Professeur, Université Clermont Auvergne, CERDI	Directrice de thèse

L’Université Clermont Auvergne et le CERDI n’entendent donner aucune approbation ou improbation aux opinions émises dans cette thèse. Ces opinions doivent être considérées comme propres à leur auteur.

Remerciements

La réalisation de cette thèse a été possible grâce à l'aide, au soutien, et aux conseils d'un certain nombre personnes. Je remercie particulièrement ma directrice de thèse Professeur Mary-Françoise Renard pour l'encadrement et l'attention dont j'ai bénéficié tout au long de ce travail ainsi que les membres de Jury pour leur disponibilité. Mes remerciements s'adressent aussi à toute l'équipe du CERDI, tant au personnel enseignant, chercheur, administratif, ou étudiant aussi bien qu'à mes amis à Clermont-Ferrand, au Burkina Faso et ailleurs. Pour la réalisation de cette thèse et de mes études universitaires en général, j'ai bénéficié du financement de l'Etat Burkinabé à travers son ministère de l'Enseignement Supérieur, de la Recherche Scientifique et de l'Innovation. Cette thèse doit également beaucoup à mon expérience au sein de l'OCDE, de la BOAD, de l'ONUDI ainsi qu'au programme de Fellowship de la Banque Mondiale. Mes remerciements vont à l'encontre de toutes les personnes qui mon accueilli au sein de ces institutions. J'ai très sincèrement une pensée spéciale à mes très sympathiques promotionnaires de thèse. Je remercie profondément tous les membres de l'Association des Burkinabès de Clermont-Ferrand (ABUC). Enfin, j'aimerais rendre un vibrant hommage à toute ma famille qui m'a supporté tout au long de ce processus.

Summary

The current thesis discusses the "determinants and the consequences of Global Value Chains (GVCs) participation. The topic has been motivated by changes in the production process observed during the past years. These changes in how countries produce, and trade have increased the interconnectedness between countries/firms, making it necessary to study the phenomenon. The COVID-19 pandemic and the Russia-Ukraine war raised the necessity of having solid supply chains, but they also raised the problem of the dependence created by GVCs participation. The current dissertation studies two distinct phenomena around the concept of GVCs, following the well-known framework of Koopman et al. (2014) to compute country level as well as sectoral level GVCs participation indexes (chapter 1).

First, this thesis acknowledges the low participation of developing countries in high value-added trade and their high participation in commodity based GVCs and provides evidence on factors that can improve their participation in GVCs. Chapter 2 studies the relationship between education public expenditures and GVCs participation. It relies on a Bayesian Model Average estimator to identify key determinants. It also uses a panel fixed effects approach to provide evidence on the positive and significant impact of education public expenditures on GVCs participation. While the fixed effects and the IV estimates suggest the existence of this positive relationship, the local projections' method highlights that the response of GVCs participation to an increase in education public expenditures is not instantaneous. These findings highlight the importance of investing in human capital but also show that the return on investment may not be instantaneous. While the public action is necessary to promote GVCs participation, external support can also help developing countries upgrade the value chains. Chapter 3 provides evidence on how Aid for Trade (AfT) can help promote GVCs participation. Using a simple fixed effects approach, the findings suggest that AfT, by improving domestic infrastructures and the private sector's capacity, has a positive impact on GVCs participation in recipient countries. However, findings also suggest that AfT allocated to economic infrastructures performs better than the rest of the categories. Loans were found to perform better than grants. The first part this dissertation provides evidence that both public action and external assistance are key determinants of GVCs participation.

Once developing countries are integrated into GVCs, the gains and risks associated with such integration are critical and need to be understood. Chapters 4 and 5, show that uncertainty-related shocks can have ripple effects along the value chains. Using a gravity model, chapter 4 highlights that uncertainty in both the exporter and importer countries negatively impacts bilateral trade. Moreover, uncertainty in the top GVCs production hubs negatively impacts their bilateral trade with the rest of the world. Chapter 5 further relies on an event study approach to prove that uncertainty generated by the trade war between China and the US as well as the uncertainty created by the COVID-19 crisis led to a sudden drop in international trade. These findings confirm to which extent GVCs can be spread economic shocks. While trade is a channel through which economic crisis spreads worldwide, it is also an essential component of survival and post-crisis recovery and GVCs participation can have positive impacts.

Chapter 6 shows that trade and interaction through GVCs between Africa and China positively improve African economies level of technology. Chapter 6 proposes an innovative approach of exports sophistication based on value-added exports, that allows measuring domestic technology created and exported. Using panel data of 49 African countries from 1995 to 2016, the empirical findings suggest the existence of direct technology transfer from China to African countries on the condition that they have adequate absorptive capacity. Depth analysis using a PSTR model shows the existence of a threshold of absorptive capacity of African countries (human capital level and institutional concerns) above which direct technology transfer is effective. Moreover, the results reveal the existence of indirect technology transfer. While the findings from chapter 6 suggest that African countries can benefit from their interaction with important GVCs actors, it is important to provide evidence through proper analysis

of the impact of GVCs participation on economic growth of African countries and establish whether GVCs participation improves or decreases inequalities.

Chapter 7 uses panel data of 48 countries over a period of 27 years (1990-2016) and employs different empirical strategies such as a panel fixed effect estimator and an instrumental variable estimator with innovative instruments. It also examines the response of GDP per capita to an increase in the level of GVCs participation using the local projections approach. The findings suggest that GVCs participation is associated with increasing GDP per capita. Deep diving into the relationship between GVCs and GDP per capita, find evidence that this relationship may be driven by trade in knowledge-intensive goods and services. However, GVCs also exhibit a positive association with income inequality, implying that GVCs have the potential to increase income inequality.

Résumé

Cette thèse étudie les déterminants et les conséquences de la participation des pays en développement aux chaînes de valeur mondiales (CVM). Le sujet a été motivé par les différentes évolutions du processus de production observés au cours des dernières années qui ont accru l'interconnexion entre les pays/entreprises. Le chapitre 1 de cette thèse, en plus d'être un chapitre introductif, s'inspire de la méthodologie développée par Koopman et al. (2014) en vue d'estimer les indicateurs de participation aux CVM au niveau national et sectoriel. Le chapitre 2 étudie la relation entre les dépenses publiques d'éducation et la participation aux CVM. Il identifie les déterminants clés de l'intégration des pays en développement au sein des CVM à l'aide d'un estimateur BMA puis se base sur un modèle à effets fixes pour mettre en évidence l'effet positif des dépenses publiques d'éducation sur la participation aux CVM. Cet effet positif a été confirmé par la méthode des projections locales. Cependant cette dernière met en évidence l'effet retardé de la réponse de la participation aux CVM à une hausse des dépenses publiques d'éducation. Ces résultats montrent l'importance d'investir dans le capital humain, même si le retour sur investissement n'est pas instantané. Le chapitre 3 se focalise sur l'aide au commerce comme déterminant de l'intégration au sein des CVM. En utilisant une approche simple basé sur un modèle à effets fixes, les résultats montrent que l'aide au commerce a un impact positif sur la participation aux CVM dans les pays bénéficiaires. Cependant, les résultats suggèrent également que l'aide au commerce allouée aux infrastructures économiques obtient de meilleurs résultats que le reste des catégories. Les résultats confirment également que les prêts sont plus performants que les subventions.

La seconde partie de la thèse se focalise sur les conséquences de l'intégration au sein des CVM. Le chapitre 4 se base sur un modèle de gravité, pour étudier les effets de l'incertitude sur le commerce. Les résultats des estimations montrent que l'incertitude a un impact négatif sur le commerce bilatéral. De plus, l'incertitude au sein des principaux centres de production des CVM a un impact négatif sur leur commerce bilatéral avec le reste du monde. Le chapitre 5 suit une approche d'étude d'événements (repondue en finance), en vue d'étudier les effets de l'incertitude générée par la guerre commerciale entre la Chine et les États-Unis, ainsi que l'incertitude générée par la crise du COVID-19 sur le commerce. Les résultats montrent que ces évènements ont entraîné une chute soudaine du commerce international. Malgré le rôle des CVM dans l'expansion des chocs, une intégration savamment orchestrée peut avoir des effets positifs. Le chapitre 6 propose une approche innovante de l'indice de sophistication des exportations, en utilisant les exportations en valeur ajoutée domestique. Cette approche permet de mesurer le niveau de technologie créée à l'échelle nationale. En utilisant des données de panel de 49 pays africains sur 22 ans, et un modèle PSTR, le chapitre montre l'existence d'un seuil de capacité d'absorption des pays africains au-dessus duquel il y a un transfert de technologie. Le chapitre 7 utilise des données de panel de 48 pays sur 27 ans et emploie la méthode des variables instrumentale avec des instruments innovants. Il examine également la réponse du PIB par habitant à une hausse du niveau de participation aux CVM en utilisant l'approche des projections locales. Les résultats suggèrent que la participation aux CVM est associée à l'augmentation du PIB par habitant, surtout pour les pays spécialisés dans le commerce de biens et de services à forte intensité de connaissances. Toutefois ces gains associés à l'intégration des CVM sont très mal reparti car les résultats suggèrent également une hausse des inégalités de revenus.

Table of contents

List of figures

List of tables

List of acronyms

AEs: Advanced Economies

AfT: Aid for Trade

BMA: Bayesian Model Average

BPC : Building Productive Capacity

CEPII : Centre d'Etudes Prospectives et d'informations internationales

COVID-19: Coronavirus disease or SARS-CoV-2 virus.

DAC: Development Assistance Committee

DVA: Domestic Value Added

DVX: Domestic Value Added embodied in the exports of other countries. Forward GVCs .

EDI: Export Dissimilarity Index

EI: Economic Infrastructure

EIU: Economist Intelligence Unit

EMDEs: Emerging Markets and Developing Economies

EMEs: Emerging Market Economies

EMs: Emerging Markets

FDI: Foreign Direct Investment

FVA: Foreign Value Added

GARCH: generalized autoregressive conditional heteroskedasticity

GDP per capita: Gross Domestic Product per capita

GDP: Gross Domestic Product

IFPRI: International Food Policy Research Institute.

IMF: International Monetary Fund

IO: Input-Output

ITC: International Trade Commission

IV: Instrumental Variables

LDCs: Landlocked Developing Countries

LICs: Low Income Countries

MRIO: Multi-Region Input-Output

NTM: non-tariff measures

ODA: Official development Assistance

OECD: Organization for Economic Co-operation and Development

OLS: Ordinary Least Squares

GVCs: Global Value Chains

PIIE: Peterson Institute for International Economics

PPML: Poisson Pseudo-Maximum Likelihood

PSTR: Panel Smooth Transition Regression

PTAs: Preferential Trade Agreements

PTR: Panel Threshold Regression

R&D: Research and Development

RCA: Revealed Comparative Advantages

SDGs: Sustainable Development Goals

SITC: Standard International Trade Classification system.

SMEs: Small Medium Enterprises

TFP: total factors productivity

TPR: Trade Policy and Regulation

TRA: Trade Related Adjustment

TRAINS: Trade Analysis Information System

UN : United Nations

UN: United Nations

UNCTAD: United Nations Conference on Trade and Development

UNU-WIDER: United Nations University World Institute for Development Economics Research

VAR: Vector Autoregressive

VAX: Ratio of an economy's domestic value added to gross exports.

WDI: World Development Indicators.

WGI: World Governance Indicators

WHO: World Health Organization

WIID: World Income Inequality Database

WITS: World Integrated Trade Solution

WTO: World Trade Organization

WTO: World Trade Organization

WTU: World Trade Uncertainty

WUI: World Uncertainty Index

Chapter 1. General Introduction

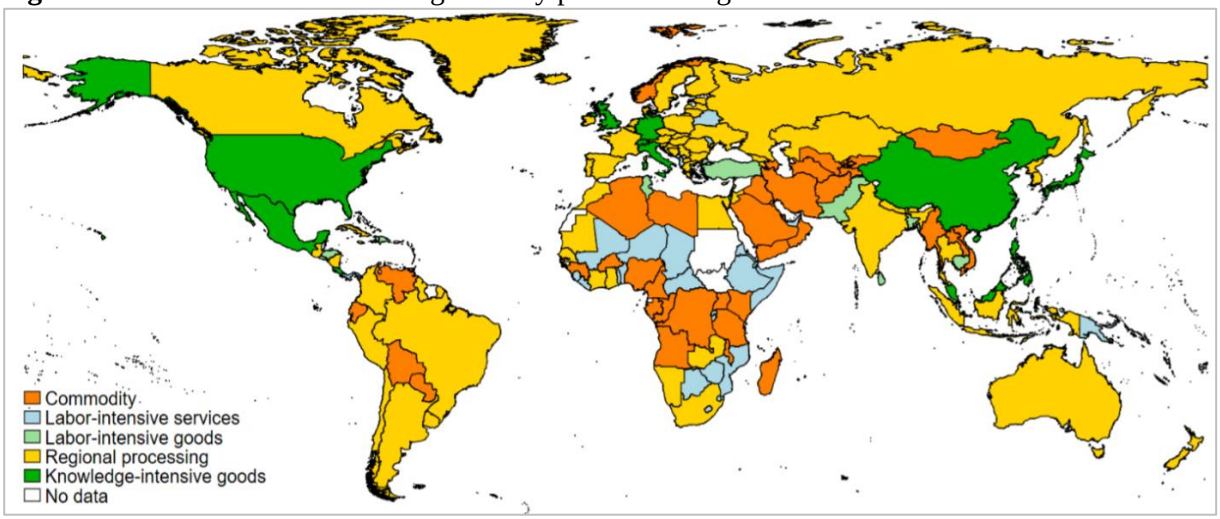
International economic activity has been reshaped. The production process has changed since the 90s because of global improvements in technology and reduced transaction costs, easing delocalization and outsourcing. Increasingly, production processes are taking place across different countries. International trade has not been spared from this change and is now slightly different from the initial comparative advantages pattern.[1] Countries have shifted from specializing in the production of a whole good or service to specializing in tasks or specific production stages. Thus, the production process involves multiple countries, each adding value to the production of a whole good, constituting a value chain. Therefore, the production process has increasingly involved global supply chains spanning multiple countries. This phenomenon, also called vertical specialization (Hummels et al., 2001) or global value chains (GVCs), has brought new opportunities and difficulties, making it interesting to study.

A GVC is defined as a series of stages involved in producing a good or service, with each stage adding value and with at least two stages taking place in different countries (World Bank, 2020). It refers to a configuration of coordinated activities that are divided among firms and that have a geographical scale (Keane, 2014; Ponte & Gibbon, 2005). The quick expansion of GVCs has been favored by multinational corporations that have undertaken to dominate international markets and optimize production. This move of multinational corporations to the global arena through production fragmentation, offshoring, and outsourcing has paved the way for smaller firms to engage in GVCs. Such engagement has pushed firms to make efforts to balance efficiency and risks associated with GVCs participation. Several sectors and production segments are involved in GVCs. As presented in Figure 1.1, Qiang et al., (2021) classified these sectors, based on several GVC components, focusing on their tradability (e.g., labor intensity and knowledge intensity). These components include commodities, regional processing, labor-intensive goods, knowledge-intensive goods, labor-intensive services, and knowledge-intensive services. As shown in Figure 1.1, commodities exporters are most often located in Sub-Saharan Africa and the Middle East, with a few in Latin America and Asia. However, regional processing countries are mostly located in South America and Eastern Europe. Labor-intensive goods are produced around the world, involving countries like Bangladesh, Pakistan, Turkey, Honduras, and the Dominican Republic. Several countries from North America, Western Europe, East Asia, and the Pacific region are involved in knowledge-intensive goods value chains. On the contrary, African, Caribbean, and Pacific countries are involved in labor-intensive services. Knowledge intensive services, usually only next to knowledge-

[1] David Ricardo :Countries should specialize in the production of the good they produce more efficiently compared to their partners.

intensive goods are GVCs segments that are located in many advanced countries such as the United States, Singapore and the United Kingdom.

Figure 1.1: Global value chains integration by production segment



Source: The World Bank Group (Qiang et al., 2021).

The increasing interest in GVCs since the 90s has pushed economists and policymakers further explore them and has generated a large volume of literature on the topic. According to Caraballo and Jiang (2016), this literature revolves around three main categories and is driven by both theoretical and empirical studies. The first category views the prevalence of GVCs as the solution to increasing productivity and efficiency. It is the extension of Adam Smith's well-known theory of the division of labor. According to this theory, GVCs are the internationalization of Adam Smith's theory — the international division of work (Ali & Dadush, 2011; Baldwin, 2009, 2012; Grossman & Rossi-Hansberg, 2008).[2] Studies in this category argue in favor of GVCs participation and estimate that it would allow developing countries to specialize in specific segments and help increase their productivity. However, this potential outcome from GVCs integration raises two different questions: the determinants of countries' participation — how they can climb the chains to capture more value — and the potential positive effects of GVCs participation. The second category is less optimistic and converges toward the theories of asymmetric international relations and the drawbacks of openness to depict a potentially harmful outcome from GVCs participation.[3] According to these theories, GVCs require the coordination of many firms and agents across the world. These agents operate under asymmetric power relations, and the result is an unfair income distribution across the participants (Milberg & Winkler, 2013; Neilson, 2014; Nolan & Zhang, 2010), with some participants being highly exposed to economic shocks. The second category also sheds light on two important questions. The first question relates to countries'

[2] This concept refers to the specialization of the labor force. It consists of splitting large jobs into many tiny components, each worker specializing in one isolated production area, thus increasing their efficiency. Focused laborers on specific tasks save time and money.
[3] In asymmetric relationships, actor A wins at the expense of actor B. The unequal allocation of power resources can lead to a point where the most powerful party makes threats and exerts pressure (Pfetsch, 2011)

exposure to economic shocks and uncertainty, while the second is about gains from GVCs and wealth distribution. The third category is more empirical and technical. Indeed, working on GVCs requires decomposed data on trade, which is different than the classic data on gross exports. Therefore, the third category groups a wide range of studies that tried to provide appropriate measures of GVCs participation (Johnson & Noguera, 2012; Koopman et al., 2014; Z. Wang et al., 2017b). Thus, three questions emerge from this literature. How does one quantify participation in GVCs? What are the drivers of GVCs participation in developing countries? Is integration into a GVC always safe and beneficial for countries?

This dissertation answers these questions and improves knowledge about the GVCs' phenomenon. This dissertation is divided into two main parts. The first part that comprises 0 and 0, explains how national policies and foreign assistance can foster the level of GVCs participation. The second part, comprising four chapters (Chapter 4, Chapter 5, 0, and Chapter 7), sheds light on the consequences of GVCs participation, including both positive and negative consequences. The second part shows that the interconnectedness between countries created by GVCs can negatively affect countries and create economic shocks. It also investigates how GVCs participation can benefit developing countries through technology transfer (using a case study). Part II concludes by investigation the potential impact of GVCs participation on African countries' economic growth.

1.1. Global value chains increase productivity and create opportunities

GVCs expanded rapidly in the 90s, driven mostly by the increase in multinational activities. This period marks the beginning of an increasing hyper-globalization, accompanied by an increase in global investment and the share of GVCs trade in total trade. In 2019, global trade share (as a percentage of GDP) reached 60%, up from 39% in 1990. GVCs trade grew rapidly in the 90s but stagnated (or even declined by some measures) during and after the 2008 global financial crisis. Nevertheless, about half of world trade is still related to GVCs (Timmer et al., 2016; World Bank, 2020).

GVCs involve cross-border flows of all production factors (e.g., funds, goods, services, people, information, and knowledge). The benefits of GVC integration have been largely documented in the literature (Constantinescu et al., 2017; Rocha & Winkler, 2019; World Bank, 2020). The emergence of GVCs has provided new opportunities for several developing countries to industrialize through multiple partnerships, including in trade and investment. Until recently, many developing economies have long been excluded from the industrialization game because of the required capital investments and technological knowledge. GVCs offer such countries a unique opportunity to specialize in a narrow stage of the production focus, allowing them to participate in the production of complex products. Indeed, the entry into manufacturing requires fixed costs, constituting a significant challenge for developing countries. To produce a good, countries previously had to be proficient in all the stages of the production process. However, given the new structure of international trade and global production

as well as the rise of intermediate goods exports, developing countries can skip those initial steps. As a result, countries can foster industrialization, improve their productivity, and create better jobs with less resources. In particular, Asian countries constitute a success story in GVCs, which propelled some of them from low- to middle-income status (K. Cheng et al., 2015).

While GVCs create opportunities, improve jobs, and reduce poverty, several countries (especially developing countries) are at the bottom of the chains or specialize in resource-based activities, with limited prospects of upgrading. Therefore, it is interesting to consider what determines countries' participation in GVCs. This new pattern of international trade and global production has involved many debates among policymakers, business leaders, and trade economists regarding the consequences of GVCs participation and the sensitivity to shocks of countries that are well integrated into GVCs. Before addressing these questions, it is important to understand how GVCs integration indices are measured and how those measurements may impact future studies.

1.2. GVCs participation: decomposition of gross exports into value-added exports

Recent empirical studies have made many efforts to decompose data on gross exports into domestic and foreign value added export (Hummels et al., 2001; Johnson & Noguera, 2012; Koopman et al., 2010, 2014; Stehrer et al., 2010; Xing & Detert, 2010). The current section relies on Koopman et al., (2014) who implemented a recent exports decomposition framework, to obtain GVCs integration measures. However some authors have proposed measures of GVC integration before the measures of Koopman et al. (2014). For example, ***(i)*** Hummels, Ishii, and Yi (2001) proposed a vertical integration index labeled VS, obtained by computing direct and indirect imported input contents in exports. $VS = A^M(I - A^D)^{-1}E$. ***(ii)*** Hummels, Ishii, and Yi (2001) proposed a second definition of *vertical specialization*—namely, the value of intermediate exports sent indirectly by another country to a destination. ***(iii)*** In addition, Daudin, Rifflart, and Schweisguth (2011) used exported goods that returned home as imports to determine proxy GVCs participation because such goods are used as intermediates by third countries and are reshipped back home. ***(iv)*** Finally, Johnson and Noguera (2012) used the VAX ratio as a proxy of GVC integration. It represents the value-added exports ratio — namely the value-added content of trade.

To compute GVCs participation indexes, we used world input output (IO) tables from the Eora multi-region input-output tables (MRIOs), following the export decomposition framework of Koopman et al. (2014). This framework makes it possible to track the evolution of countries' integration into GVCs by country/sector (see Annex 1 for the detailed decomposition). The methodology goes from raw IO tables

(Table A 1.1) to sophisticated indexes obtained through decomposition of gross exports (see Annex 1 for more details).[4]

According to the framework developed by Koopman et al. (2014), gross exports are composed of nine elements: domestic value added embodied in "direct final goods exports" (VAEFD); domestic value added in intermediate exports absorbed by direct importers (VAEI1); and domestic value added in intermediate exports re-exported to third countries (VAEI2). These three elements are value-added exports (VATRD). The other elements are value-added intermediates that return via final imports (VARHF); domestic value added intermediates that return via intermediate imports (VARHI); foreign value added in final goods and intermediate goods exports (FVA); and pure double-counted elements (two terms) (Figure A 1.1). We use these elements to compute GVCs indexes. It exists two types of indexes. Relative GVCs participation index (GVCs intensity) and absolute GVCs participation index (measuring the level of GVCs participation). The idea behind GVCs participation indexes is to know how much the value-added created at home is used in the world by third countries and to what extent domestic countries use foreign value-added to produce their exports.

Backward GVCs participation is the amount of foreign value-added embodied in the country's exports. In contrast, forward GVCs participation represents the domestic value-added exported goods or intermediates used by third countries as intermediates goods to compute final or intermediates goods. GVCs participation is the sum of "backward" and "forward" GVCs participation in value added (in absolute terms). GVCs intensity is the sum of domestic value-added and foreign value-added, embedded in domestic exports divided by gross exports — GVCs participation divided by gross exports. Backward and forward GVCs intensity are also expressed relative to gross exports.

Table 1.1: Different types of measurement of global value chains participation

Measure	Description
Backward GVCs participation	**Backward GVCs** participation involves importing foreign inputs to produce goods and services for export. It is measured as the foreign content of exports (foreign value added, or FVA).
Forward GVCs participation	**Forward GVCs** participation involves exporting goods and services that become inputs in the exports of other countries. It comprises transactions in which a country's exports are reexported by that country as part of a good or service (indirect value added, or DVX) to a third country.
GVCs participation (integration)	**Total GVCs participation** is the sum of the foreign value added and the domestic value added in an export to a third country. (FVA + DVX)

[4] Global and aggregated data on GVCs is obtained in the UNCTAD-Eora Global Value Chain (GVC) database that offers global coverage (189 countries and a "Rest of World" region) and a time series from 1990 to 2018 of the key GVCs indicators: foreign value added (FVA), domestic value added (DVA) and indirect value added (DVX) **(**see Casella et al., 2019**)**.

Backward GVCs intensity	**Backward GVCs intensity** is foreign content of a country's exports as a share of its total trade. Backward GVCs intensity = FVA/(Exports + Imports)
Forward GVCs intensity	**Forward GVCs intensity** is domestic exports used as inputs in the exports of third countries or reexported, expressed as a share of its total trade. Forward GVCs intensity = DVX/(Exports + Imports)
GVCs intensity	**GVCs intensity** is a country's total GVCs participation as a share of its total trade. GVCs intensity = (FVA + DVX)/(Exports + Imports)
GVCs position	**GVCs position** measures the relative position of sector j in country n within the GVCs, calculated as the log-difference between the upstream (IVA) and the downstream components (FVA) of the GVC participation index

Source: Author's organization base different sources

$$\text{GVCs participation}_s = DVX_s + FVA_s \tag{1.1}$$

$$\text{GVCs Intensity}_s = \frac{DVX_s + FVA_s}{E_s} \tag{1.2}$$

$$\text{Forward GVCs Intensity}_s = \frac{DVX_s}{E_s} \tag{1.3}$$

$$\text{Backward GVCs Intensity}_s = \frac{FVA_s}{E_s} \tag{1.4}$$

DVX_s represents forward GVCs participation**, while** FVA_s represents backward GVCs participation.

In addition to GVCs intensity and GVCs participation, one can calculate GVCs position, derived from different measures of GVCs (GVCs participation and GVCs intensity), to investigate whether countries are mostly involved in forward or backward integration. These various measurements are shown in **Table *1.1***.

$$\text{GVCs position1}_s = \ln\left(1 + \frac{DVX_s}{E_s}\right) - \ln\left(1 + \frac{FVA_s}{E_s}\right) \tag{1.5}$$

Or

$$\text{GVCs position2}_s = \ln(DVX_s) - \ln(FVA_s) \tag{1.6}$$

Each measure helps address a specific research question. First, the level of GVCs participation — the most used in the current dissertation — allows the identification of top GVC production hubs. It provides cross-country comparison and gives an idea of which country captures more value-added from GVCs. Second, GVCs intensity measures countries' integration relative to gross exports. It provides a view of countries' percentage trade that occurs through GVCs. According to this measure, smaller countries with

a significant share of commodities exports have a high position. It underestimates the level of integration of large countries into GVCs and overestimates that of small countries. Therefore, using this measure can sometimes be misleading. Finally, "GVCs position" allows the identification of countries' locations along the chains. It informs whether a country's position is upstream or downstream. Identifying the correct measurement of GVCs participation is the first step in studying its determinants. The literature has already identified a lot of determinants of GVCs participation.

1.3. The drivers of global value chains participation and upgrading

While the split in production units allows some developing countries to specialize in simpler parts and tasks, their ability to participate in GVCs is not guaranteed or predetermined. The literature on GVCs participation and GVCs upgrades is extensive. Several factors drive GVCs participation and upgrades—namely, factor endowments, geography, market size, institutions, the level of industrial development, and access to credit. However, these determinants require intervention (policies or foreign assistance) to be effective. Therefore, national policies, international cooperation, and official development assistance (ODA) also constitute key drivers of GVCs participation and upgrade.

1.3.1. Factor endowments

In the same way, factor endowments determine the path of countries' specialization in traditional trade theories (e.g., the Heckscher-Ohlin-Samuelson model).[5] They also drive the path of specialization in tasks and shape the positioning of countries in various GVCs. All types of initial endowments are important and useful according to the position in the value chain. Different types of engagement in GVCs require different types of workers (Braun, 2005; Felbermayr et al., 2019; A. M. Fernandes et al., 2019; Nunn, 2007).

Low-skilled workers matter for GVCs participation as such labor is an entry channel for joining manufacturing GVCs.[6,7] Several studies have evidenced that the abundance of low-skilled labor in a country is positively correlated to the extent of their backward integration in GVCs (World Bank, 2020). However higher skills matter for upgrading value chains and capturing more value added. High-skilled workers involve another level of integration. As countries with low skill continue their involvement in GVCs, the level of technological sophistication evolves, and improved technological skills contribute to

[5] Factor endowments represent the amount of land, labor, capital, and entrepreneurship that a country can exploit for manufacturing.

[6] The definition of low-skilled worker or low-skilled labor is based on International Standard Classification of Occupations (ISCO) categories, and it covers "elementary occupations," labeled skill level 1 by the International Labor Organization (ILO).

[7] When Samsung decided to invest in Vietnam, it was attracted to the young, cheap, and abundant workforce.2 On average, Vietnamese workers could be hired at half the cost of their Chinese counterparts and were seven years younger. This cheap labor lowers costs in Samsung's factories, giving the smartphone maker an edge over Apple in the less expensive handsets. Likewise, Bangladesh's success in apparel exports after conclusion of the Multifiber Arrangement's quota regime in 2004 is linked to its large pool of low-skilled.

a declining share of low-skilled workers. Improving workforce skills becomes necessary to export more advanced manufacturing goods and services.

Natural resources matter in forward GVCs integration. With regard to global integration in GVCs, African countries that are well endowed in natural resources appear to be well integrated. However, when we focus on the type of GVCs integration, the finding is that natural resources are a key driver of forward GVC participation. Higher relative endowments of land or natural resources are both strongly and positively correlated with forward GVC participation (World Bank, 2020). For example, extractive resource-based countries — with an abundance of resources such as of copper, iron ore, and other minerals — have higher shares of domestic value-added embodied in their partner countries' exports downstream. The 2020 World Development Report said that Sub-Saharan countries rich in non-oil natural resources exhibit greater forward linkages to manufacturing GVCs than other countries. This conclusion is also proper for other countries that have the same characteristics. The reason is that agricultural products and commodities are often used in a variety of downstream production processes that typically cross several borders.

Factors endowment matters in shaping countries' participation in GVCs, but the free movement of products through GVCs also depends on policy measures such as tariffs decrease.

1.3.2. Tariffs

Governments implement tariffs to protect domestic producers, consumers, and infant industries and preserve national security from overdependence on imports. However, tariffs increase can negatively impact domestic firms' competitiveness and "GVCs participation". In GVCs trade, imposing tariffs, even on imports, can hamper a country's exports. GVCs involve products (final or intermediate products) crossing many countries as well as input sometimes crossing many countries and used to compute exports. Imposing import tariffs can increase production costs through an increase in input costs, increasing the entry cost into GVCs for developing countries that would like to engage in basic industrialization.

Tariff escalation can also hamper the move of developing countries from commodity-based exports to manufactured exports. *Tariff escalation* is defined by F. Cheng (2007) as a common practice in international commodity trade that refers to a situation where tariffs are zero or low on primary products, while tariffs increase, or escalate, as products undergo processing. The consequence is an increase in value-added imports relative to the price of raw products. This increase negatively affects the demand for processed products in the importing country. Through tariff escalation, one country can effectively protect its domestic processing industries while limiting the scope of trade-related industrialization in foreign countries. Tariff escalation significantly impedes market access for developing countries (F.

Cheng, 2007). According to the WTO,[8] tariff escalation refers to higher import duties on semi-processed products than on raw materials, and higher still on finished products. This practice protects domestic processing industries and discourages the development of processing activity in the countries where raw materials originate. However, tariffs increase negatively impact GVCs participation as imported semi-processed and processed products are used as inputs. The implementation of non-tariff measures (NTMs) can also be harmful for developing countries' GVCs participation.

NTMs are legitimated by the need to protect domestic consumers' health, safety, animal health, environmental quality, and so on from a potential foreign imported product. In the case of potential harm, countries are allowed to restrict or regulate the importation of that product. Countries have non-discriminatory standards, regulated across trading partners by qualitative NTMs, such as sanitary and phytosanitary (SPS) measures, and technical barriers to trade (TBTs) to ensure certain standards and characteristics of imported products. The consequence of these measures is their potential negative effect on trade flows and their potential positive impact on products prices at different stages of production. In GVCs where countries are interconnected and rely on each other for intermediate inputs, these restrictions can positively affect the cost of production for downstream products—and therefore affect some countries' evolution through GVCs. However, according to the literature, implementing NTMs does not necessarily lead to negative effects; instead, the effects depend on the objective behind putting these NTMs in place. When they are used to substitute formal tariffs (Ghodsi, 2015, p. 20; Moore & Zanardi, 2011; Tudela-Marco et al., 2014) or to engage in policy retaliation (de Almeida et al., 2012; Vandenbussche & Zanardi, 2008), NTMs are more likely to lead to negative effects (Disdier et al., 2008; Looi Kee et al., 2009). But when their implementation is legitimate, they reduce informational asymmetries, enhance consumer trust, and decrease transaction costs. Such effects, in turn, have a positive effect on trade flows (Beghin et al., 2015; Blind et al., 2013; Bratt, 2014). Generally, a wide access to larger markets can help diversify trade partners, including export partners as well as input providers. However, it is crucial to notice the importance of the relative distance of each country to largest markets.

1.3.3. Distances: Lower transaction costs help reshape physical distances

The physical distance between two countries informs about transportation and transaction costs. A longer distance implies that the two countries are far away, increasing transport costs and negatively impacting bilateral trade flows. However, physical proximity decreases transportation costs. This analysis is valid for regular trade.

GVCs have initially been possible because of improved technology that has reduced transaction costs. Thus, the technological advances of a country as well as the availability of necessary infrastructure can

[8] See here: https://www.wto.org/english/thewto_e/glossary_e/tariff_escalation_e.htm

reduce distance-related costs and foster GVCs participation and upgrades. The efficiency of GVCs depends on smooth logistics and transport, which make it possible to avoid extra costs related to delays and difficulties in reaching the supplier or buyer. To be competitive in GVCs, firms need to be responsive in demand variation and cost efficient. According to the World Bank (2020), remoteness can be overcome by improving connectivity and lowering trade costs. Trade costs can be reduced by introducing custom reforms and competition in transport services and by improving port structure and governance.

While government policies can overcome frictions associated with distance (Clark, 2007), distance is still determinant. Physical distance matters in both regular and GVCs trade. With the decline in trade costs, one can estimate that the importance of distance has declined. However, some gravity models find that the importance of distance in bilateral trade is still valid (Carrère & Schiff, 2005; Mehl et al., 2019). In addition to bilateral distance, another aspect of distance is the "distance to the largest GVC production hubs" that play a critical role in regular and GVCs trade. The closer a country is to a GVC production hub, the more it trades.

1.3.4. Strong institutions help coordinate the process and make investors confident

There is a growing body of literature assessing the importance of institutional quality in determining trade through GVCs. Many factors explain this importance of institutions: political stability, a good rule of law (which promotes contract enforcement and favors a good investment climate), and regulatory compliance. Levchenko (2007), for example, suggested that institutional aspects can significantly influence trade flows, especially in products characterized by significant complexity—in particular, those characterized by the level of dispersion of intermediate inputs. Similarly, Costinot (2009) found that in complex industries characterized by high levels of job task complexity, strong institutions can determine trade performances.

Political stability matters in promoting GVCs trade: Political stability is a key determinant in attracting investment, ensuring good economic health, and enabling the shipment of intermediates and final goods through countries. Political stability, therefore, is key to GVCs integration. Given that GVCs involve products crossing multiple borders (at least two times), instability in a country or its partners can limit a product's circulation. This can increase transaction costs, increasing the prices of both intermediates and final products. The direct consequence is an increase in inputs and transaction costs, which can lead to a disruption of GVCs, pushing some countries to look for additional trade partners as one of their partners is subject to instability.

Rule of law matters in attracting investors: Rule of law improves contract enforcement as well as the respect for intellectual property. Nunn (2007) found that good contract enforcement is especially important for the export performance of relationship-specific sectors and can be an important source of comparative advantage.

.

1.3.5. Domestic Industrial Capacity and foreign direct investments

While former studies have evidenced the impact of industrial development on traditional trade through gravity models (Arkolakis et al., 2012), the impact for GVCs trade is not clear. Three cases appear when considering the impact of industrial development on GVCs participation (A. Fernandes et al., 2020). First, countries with an important level of industrial development may have a larger set of contiguous stages, reducing the use of imported inputs relative to domestic inputs in their exports.[9] Reduction in imported inputs may negatively impact backward GVCs participation (i.e., the use of foreign value added in domestic exports). Second, countries with an important level of industrial development may increase imports of final goods for domestic consumption, improving their specialization in downstream stages of production and therefore their backward GVCs participation. Finally, a higher level of industrial development implies a higher capacity to supply. As a result, domestic value added may increase, improving forward GVCs participation (Kee, 2015). Thus, the overall effect of industrial development on GVCs participation is ambiguous

The case of FDIs is clearer. FDIs are important for traditional trade but they may play even larger roles for GVCs trade, as they involve lead firms with high potential of exports, including intermediates and semi-finished products that cross international borders multiple times. Countries can attract FDIs to face the lack of capital, technology, and knowledge. All these elements are key determinants of GVCs participation. Therefore, FDIs may improve GVCs participation (A. Fernandes et al., 2020). Empirical evidences suggest that openness to FDI is positively associated with backward GVC participation (Buelens & Tirpák, 2017; K. Cheng et al., 2015; Kowalski et al., 2015). FDIs have also been identified as important factors for moving up GVCs, based on firm-level evidence for China and Bangladesh (Kee, 2015; Kee & Tang, 2016).

1.3.6. Access to clean credit lines and trade finance can support GVCs participation

Access to finance has been established as an important determinant of trade and specialization (Chor, 2010; Kowalski, 2011), and it is likely to play an important role in GVCs participation.

In many cases, goods cannot cross borders without trade finance. Two counterparts engage in cross-border trade: an exporter that requires payment for goods or services and an importer that requires the correct and timely arrival of those goods or services. Given the many complexities involved with cross-border payments and receipt of goods, cross-border trade has a unique set of risks. Trade finance instruments, intermediated by commercial banks, are designed to address the risks associated with cross-border payments and timing, which are amplified by jurisdictional and operational differences among trade counterparties. Trade finance instruments are premised on an existing credit relationship between

[9] To minimize cross-hauling of semi-processed goods in deferent stages, countries often specialize in contiguous stages of production in GVCs (A. Fernandes et al., 2020)

counterparty banks (Nana & Starnes, 2020). For example, a cross-border correspondent bank is often required to "confirm" the payment to the exporter, subject to performance required by a letter of credit. By doing so, the correspondent bank takes on the reimbursement risk related to the respondent bank, which in turn agrees to pay for the imported goods on behalf of its importer-customer. Thus, in order for goods to be shipped, a cross-border correspondent bank must be willing to take the payment risk of the respondent bank. In many cases, this process is heavily reliant on a correspondent relationship business model.[10] As such, trade finance is essential to cross-border payments, and therefore essential for trade and GVCs participation. Given 80% of world trade occurs through trade finance (WTO, 2016), it is necessary for countries to improve business access to trade finance in order to improve GVCs participation.

All these determinants of GVCs participation need additional support to be effective. This support can be either national policy or international cooperation or assistance. Such support fosters quick GVCs participation and rapid upgrades through these value chains.

1.3.7. National policies can help overcome limitations and accelerate GVCs participation

Several national policies are necessary to fostering GVCs participation and GVCs upgrades. They include policies to attract foreign direct investment (FDI), policies to foster trade liberation, policies to improve infrastructure, and policies to boost human capital and increase the share of skilled workers in the country (e.g., educational public spending and R&D expenditures). ***(i)*** Policies to attract FDIs can remedy the scarcity of capital, technology, and management skills. The public action helps attract more FDI to fill the gaps in capital, technology, and management skills. FDIs are important for GVC integration especially for developing countries. In fact, FDIs have several ripple effects—namely, technology, managerial expertise, and established market relationships. This is especially true for countries that have special economic zones. Thus, as discussed in the World Bank (2020) report on GVCs, attracting and retaining FDIs in a GVCs context requires a well-formulated investment policy. ***(ii)*** Trade liberalization opens access to foreign markets, increasing the demand domestic firms and farms are faced with. Market size is important for GVC integration. In fact, the larger the market, the higher the benefit. Firms can benefit from scaling production and technology returns if they have access to large markets (both domestic and foreign markets). ***(iii)*** Policies to improve transportation and communications infrastructure and to introduce competition in these services can improve the opening up of regions and physically link all stakeholders of international trade, including local and foreign suppliers or clients. ***(iv)*** Policies to increase human capital are important for GVC integration. As previously discussed, both levels of skills (low and high) are important for GVC integration and shape

[10] Correspondent banking can be defined, in general terms, as "an arrangement under which one bank (correspondent) holds deposits owned by other banks (respondents) and provides payment and other services to those respondent banks." It is an essential component of the global payment system, especially for cross-border transactions. Banks can access financial services in different jurisdictions and provide cross-border payment services to their customers through correspondent banking relationships, supporting international trade.

countries' specialization. However, the level of integration differs depending on the type of labor available. Countries need to improve the quality of labor, moving from low- to high-skilled labor in order to move up in GVCs.

The impact of national policies on GVC integration has been widely documented across the literature. However interesting research lines remain and need to be studied deeply, as mentioned in Costinot et al., (2013). 0 of the present dissertation focuses on the impact of national policies, mainly the impact of educational public expenditures on GVCs upgrade. In fact, regarding the importance of human capital on GVC integration, some developing countries have undertaken drastic increases in educational public expenditures to foster GVCs participation. Thus, it is important to understand whether the countries that increased educational public expenditures more than the average benefited in terms of GVCs upgrade. While deep analysis is still required in assessing the determinants of GVCs, some empirical studies have already investigated the effect of government expenditures on foreign trade, trade balances, and GVCs. In fact, these studies have discussed the impact of public action on trade (Brülhart & Trionfetti, 2004; Müller, 2008; Yashiro et al., 2017). However, they have not clearly responded to the question of whether educational public expenditures help developing countries upgrade GVCs. Müller (2008) studied the effect of fiscal policy on foreign trade using a vector autoregressive (VAR) model on US time series. He shows that an increase in government expenditures can have positive effects on net exports.[11] Brülhart & Trionfetti (2004) evaluated the effect of public expenditures on international specialization, considering the preference of governments for domestic suppliers over foreign suppliers (home-biased procurement) before considering the location of manufacturers (international specialization). Using the extended model of Helpman & Krugman (1985), they found that home-based procurement of a good is a strong indicator of a country's specialization in the production of that good. However, their finding does not shed light on the importance of educational public expenditures. Nevertheless, Yashiro et al., (2017) hold that improving access to higher education (increasing educational public expenditures) may help in moving up the GVCs because skills are a prerequisite for innovation and competitiveness. Moreover, increasing the level of education can foster the appropriation of technology obtained through intermediate goods imported from advanced countries. The authors also call for better governance and institutions in order to foster GVCs participation and moving up the chains. Finally, the World Bank (2018) has pointed to the importance of investing in technological and physical capital through efficient increases of public investment.

Improving GVCs participation can be challenging to countries, even for those with the strongest national policies, but external implication can help achieve the goal through development assistance.

[11] The mechanism behind this positive effect is that public spending depreciates nominal exchange rate. This depreciation translates into an appreciation of the terms of trade and therefore increases net exports.

1.3.8. Trade agreements also matter in conquering new markets

Trade integration agreements effects are twofold. While they contribute to an increase in markets, they also can improve the quality of countries' institutional and policy reforms, This is especially true when technical and financial assistance are included in agreements. Thus, developing countries have already benefited from the rules-based trade system, with its guarantees against trade discrimination, incentives to reform, assured market access, and dispute settlement. The international trade system is especially valuable in a GVC world. Policy action or inaction in one country can affect producers and consumers in other countries. To sustain beneficial trade openness, countries need to deepen traditional trade cooperation to address remaining barriers to trade in goods and services, as well as other measures that distort trade, such as subsidies and the activities of state-owned enterprises. Meaningful outcomes may be possible if a few conditions are met: traders in major developing countries engage as equal partners and even leaders instead of seeking special treatment; large, advanced countries continue to place their faith in rules-based negotiations instead of resorting to unilateral protection; and countries together define a negotiating agenda that reflects both development and business priorities.

Considering preferential trade agreements (PTAs), their number increased since the 1990s reaching the number of 700. PTAs have become the main instrument used by countries to deepen trade policy cooperation. A consequence is that deeper integration of markets is piecemeal, pertaining only to subsets of countries that have made reciprocal commitments to open their respective markets to two-way flows on trade and investment on a preferential basis (Baccini et al., 2021). Deep PTAs represent more than traditional market access issues and consider policy areas such as movement of capital, investment, visas, and intellectual property rights (World Bank, 2020). While some have argued that deep PTAs support GVCs, others underlined that GVCs have expanded in periods and regions where the main countries involved did not have deep PTAs. The two views are relevant (Baccini et al., 2021). However, other studies shown that deep PTAs improve GVCs participation (Johnson & Noguera, 2017; Kowalski et al., 2015; Laget et al., 2018; Orefice & Rocha, 2014).

1.3.9. Development assistance is also important in fostering GVCs participation

Many emerging markets and developing economies (EMDEs) have managed to overcome exclusionary barriers because of their own efforts and because of foreign support. In addition to national policies, foreign assistance can affect and shape the direction of the key drivers of GVCs participation. Support of the international community through ODA and aid for trade (AfT) is important for modeling developing countries' trade policies and creating the necessary infrastructure (Aggarwal, 2013; Redden, 2017). This topic has been theoretically studied, but few empirical studies have investigated it. In response to that research gap, chapter 3 focuses on furnishing elements of evidence regarding how AfT programs implemented by developed countries have shaped developing countries' position in GVCs.

AfT was developed as an instrument to assist countries in addressing supply-side constraints, as discussed in detail by Basnett et al. (2014). This program offers direct assistance to the trade sector through different areas or categories: building productive capacity, economic infrastructure, trade policy regulation, and trade-related adjustment

Table 1.2 provides examples about how AfT can help improve failures (market and governance failures), in order to improve international trade and GVCs participation. The table links failures to AfT categories that can help address them, providing evidence that AfT can help promote GVCs participation. For example, skills are mandatory in upgrading GVCs participation and since a substantial part of AfT is allocated to building productive capacity, it may help fix the problem of skills in some countries.

Table 1.2: How can Aid for Trade help promote GVCs integration?

Area of failure	Examples	Responses	AfT category
Coordination	Externalities, complementarities ignored; linkages not exploited; no policy coherence	Capacity building for industrial policy	Trade development; trade related infrastructure; building productive capacity
Technology: developing, adapting and adopting	Incomplete and imperfect information; network externalities	Promotion of technology transfer and adoption	Trade development and trade-related infrastructure
Skills formation	Externalities; imperfect information	Coordination and/or subsidies for training	Building productive capacity
Environnent : protection, conservation, cleaner technologies	Negative externalities not accounted for	Product and process standards and regulations	Trade policy and regulations

Source: Author's organization based on Calì & te Velde (2011)

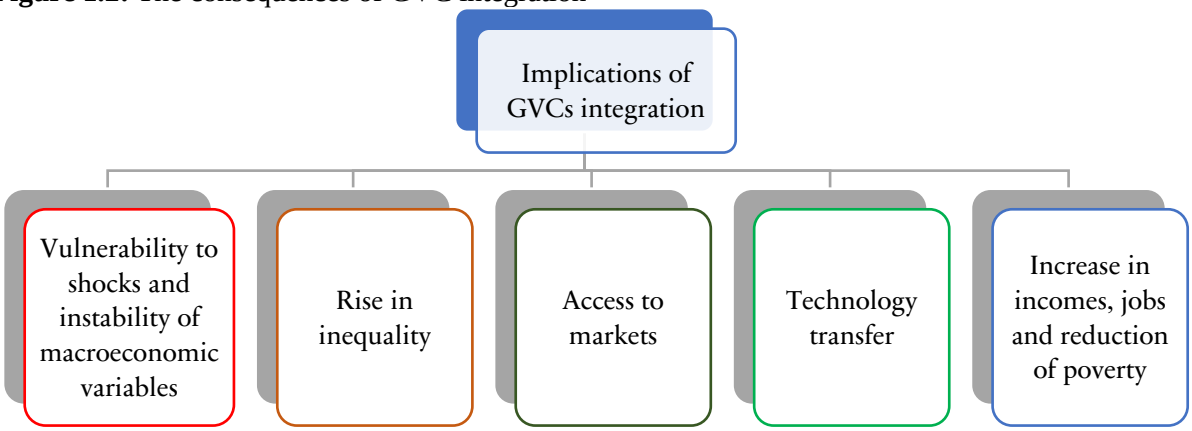
The literature has investigated the determinants of GVCs participation and found a wide range of factors determining positively or negatively countries integration and position in GVCs. Once integrated, countries belong to dynamic chains with trade and financial links, making them vulnerable to any shock. GVCs participation can involve several macroeconomic upheavals that quickly push policymakers to doubt the safety of deep integration for developing countries. Therefore, this raises the question of the consequences and the implications of deep integration into GVCs.

1.4. The consequences of GVCs participation

Integrating GVCs results in many consequences (positive and negative) that must be investigated (**Figure 1.2**). GVCs participation can increase income and wages in the long term but can also increase inequalities as incomes are not well distributed. In addition, because of the interconnectedness of countries, GVC integration can have some macroeconomic consequences—namely, vulnerability to

macroeconomic shocks (demand and supply shocks as well as uncertainty in countries). The second part of this dissertation focuses on these consequences and investigates their relevance in a developing world.

Figure 1.2: The consequences of GVC integration



Source: Author's organization based on the literature.

GVC integration can increase countries' vulnerability to economic negative shocks, including financial crises, instability, and uncertainty in partner countries. While being open to the world economy can help absorb economic shocks (Cavallo & Frankel, 2008; Rose, 2005), it can also be the channel through which these shocks can spread across other countries. The deeper a country is integrated into GVCs (i.e., the more it exports), the more vulnerable it is. According the World Development Report (2020) three main examples illustrate countries' vulnerabilities to shocks across the world when trading through GVCs. First, GVCs participation implies higher synchronization of economic activities with other countries. Though backward GVCs participation, a country can rely on inputs from another country for its exports, then economic activities in the two countries are linked and interconnected (Boehm et al., 2019; Giovanni et al., 2018; Johnson, 2014; Liao & Santacreu, 2015). Second, countries interaction through GVCs impact price formation and spread inflation along the chains. Thus, inflation in one country is more likely to spill over to its direct and indirect trading partners. In this sense, GVCs participation is associated with the rising synchrony in inflation across countries (Ha et al., 2019). Finally, GVCs amplify the costs of protectionism for trade and growth. The specialization in tasks for the production of a unique product and the cross-movement of products means that trade barriers are crossed multiple times. Protectionism is therefore costlier for growth and welfare along the value chain, even for the country implementing it (Vandenbussche et al., 2019). Generally, shocks that are likely to affect the economy of a country can spread easily to its partners located along the same chain.

Many authors have attempted to document this phenomenon, but most of them have focused on trade and liberalization. For example, Farhani et al. (2015) studied the effect of financial liberalization on the probability of the occurrence of banking crises. Using a Logit panel data model, they found a positive relation between financial liberalization and the probability of a banking crisis. Glick and Rose (Glick

& Rose, 1999) provide empirical evidence on the role of international trade on the propagation of a currency crisis. They estimated a binary Probit equation across countries via maximum likelihood. They found that a currency crisis tends to spread along regional lines and that trade seems to be an important channel. Therefore, strong trade linkages are associated with a high probability of a currency crisis. Furthermore, Wang et al. (2017a) directly analyzed the role of GVCs in transmitting economics shocks. Their findings suggest that the more a country is integrated into GVCs, the stronger the effects of financial crises. Using GVC participation indexes, they illustrated the impact of GVCs participation on the change of sectoral GDP between 2008 and 2009.

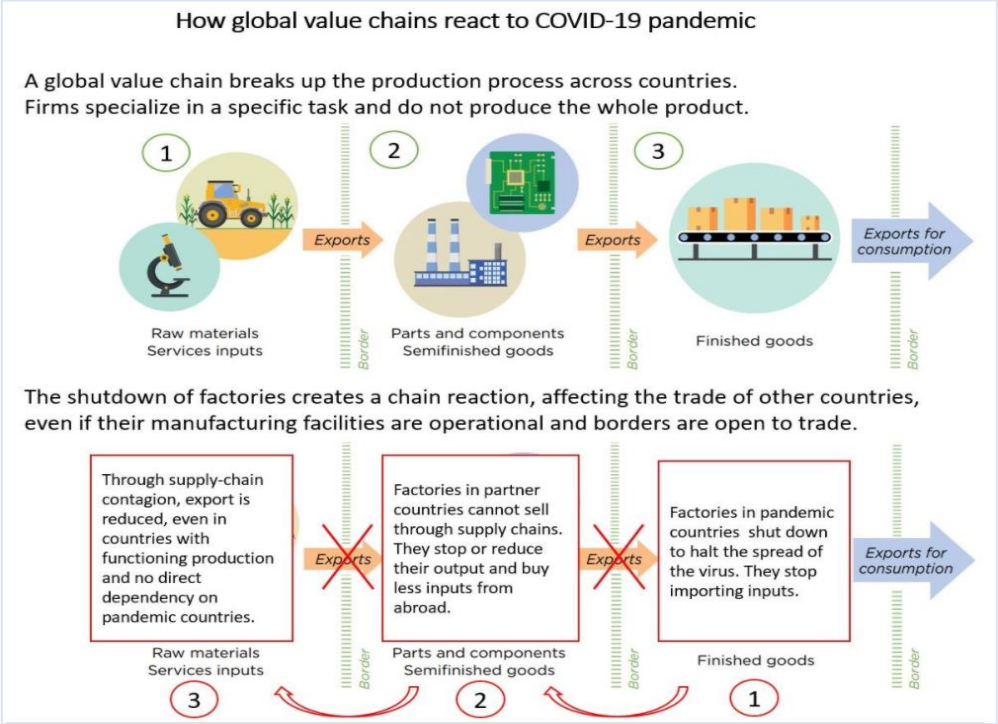
While some studies have tried to investigate the impact of GVCs participation on shocks transmission and the spread of crises, most of them have focused on traditional trade instead of GVCs trade. Thus, this topic offers room to play with and has been revived by the COVID-19 pandemic.

The COVID-19 pandemic has demonstrated how economic shocks and uncertainty can escalate and quickly spread through GVC linkages. While international trade connection brings a net benefit (Chang et al., 2009; Herzer, 2013; Jouini, 2015; D. H. Kim & Lin, 2009; Musila & Yiheyis, 2015; Newfarmer & Sztajerowska, 2012; Ulaşan, 2015), it also allows for economic contagion. The COVID-19 pandemic has affected global trade through both supply and demand shocks, which in turn travel to countries that are connected to each other in many ways, one of which is GVCs trade. COVID-19 has affected the ability of trade to supply goods in several ways. On the supply side, the pandemic has pushed authorities to adopt restrictive measures ranging from internal movement restrictions to international border closures to required closing (or work from home). While international border closures have reduced air freight capacity, internal movement restrictions and closures have affected businesses, halted industrial production, and limited port activities. As a result, many countries have found both their capacity to produce goods and to export them curtailed, thus reducing the movement of products across borders. Production limitations are exacerbated by the inability to source necessary production inputs from abroad. In addition, the reduction in aggregate demand among the world's largest importing countries has reduced the ability of many countries to successfully export the goods they do manage to produce. Figure 1.3 depicts the iterative effects of the COVID-19 crisis on supply and demand through magnified disruptions of supply chains.

The effects of COVID-19 are particularly pervasive, in part because of the emergence of the "large-hub-and-smaller-spoke" systems that have emerged with the rise of GVCs. Over two-thirds of world trade occurs through GVCs, in which production crosses at least one border before final assembly. The COVID-19 pandemic hit the three largest GVC hubs early, creating an unprecedented combination of supply and demand shocks (Figure 1.3). However, the spread of the virus lagged in several EMDEs. At the early stage of the pandemic, in many EMDEs, economic contagion spread prior to confirmation of actual COVID cases, as countries implemented measures to protect against transmission, which slowed production and output (this was also due to uncertainty and the economic shocks faced by EMDEs' trade

partners). This effect was exacerbated in many countries that rely on exports of commodities, many of which experienced severe price drops caused by reductions in global demand.

Figure 1.3: The economic effects of the pandemic spread through trade



Source: International Trade Center. Adapted from the World Development Report (2020).

The key takeaway from the pandemic is that while the virus was circulating only in China and in others advanced countries, the rest of the world started feeling economic impacts before being infected. This illustrates how the interconnectedness of countries through GVCs can contribute to the spread of economic shocks resulted from uncertainty. Chapter 4 and Chapter 5 of this dissertation focus on the consequences of countries' interconnectedness stemming from their integration in GVCs. To show how economic shocks in a country can transmit to other countries through GVCs linkages, Chapter 4 and Chapter 5 discusses how uncertainty generated in a given country can affect the economy of its partners through GVCs linkages.

GVCs participation opens new opportunities for firms and countries to access larger and more efficient markets. Being active in value chains allows countries to benefit from externalities, including wide market access. One of the problems faced by the industrialization of EMDEs is access to larger markets for their products. GVCs overcome this difficulty. GVCs participation opens access to efficient markets for developing countries, enabling them to source sophisticated inputs, but also to spread domestic products.

Vertical specialization and interaction between countries through GVCs can promote efficient production and the diffusion of technology as well as access to capital and inputs along value

chains. Indeed, technology upgrading can occur when local firms become suppliers of foreign firms evolving in a value chain. Since foreign firms produce products that embody high technology or require a level of sophistication to be produced, local suppliers have to meet the expectations of the foreign firm. Moreover, multinational firms and foreign firms can directly help their local suppliers in order to ensure that they are using quality inputs (Paus & Gallagher, 2008). Technology upgrades can also occur when foreign firms subcontract their activities through local firms (Farole & Winkler, 2014). Technology can also be transferred through diffusion effects. Indeed, the entry of a foreign firm in the local market increases competition between local suppliers and lowers the prices for the foreign firm. When prices become low, local suppliers compete to increase the quality of their products. Finally, imports of sophisticated intermediate goods can also help foster technology improvements (Goldberg et al., 2010). Few studies have focused on the question of technology transfer in the interactions between countries through GVCs and most of the studies are based on the spillover effects of FDIs and imports. This research area illustrates pending questions, offering research opportunities.

The problem faced by economists and policymakers in investigating the impact of GVCs participation on technology transfer is twofold: finding an appropriate metric for technology and relying on a better methodology. 0 of the current dissertation proposes a specific case—namely, whether interactions between China and African countries through GVCs leads to technology transfer. This approach also provides a revolutionary measure of a country-level technological sophistication index.

GVCs participation increases productivity and income growth. Such improvements outpace increase due to domestic production and traditional trade in finished goods. Participating in GVCs unlocks new opportunities but pursuing upgrades through these value chains gives even more value added to countries involved. The number of countries participating in GVCs also matters for the impact on development. Countries experience the biggest growth spurt during their transition out of commodities into basic manufacturing activities. This increase in productivity translates into an increase in countries' incomes (Antràs & de Gortari, 2017; CALIENDO & PARRO, 2015; Constantinescu et al., 2019; UNCTAD, 2013). According to the World Bank (2020), GVCs deliver more productive jobs, primarily through scale effects that result from increased productivity and expanded output. GVCs participation can have both positive and negative impacts on employment. While GVCs exports is expanding, exports are becoming less labor-intensive, leading some researchers to conclude that GVCs participation has a negative impact on employment (Cali et al., 2016; Rodrik, 2018; World Bank, 2020). However, given GVCs participation increases exports, their overall effects on employment have been positive. GVC firms tend to employ more workers than other firms (World Bank, 2020). For example, in Mozambique, despite adopting more mechanical technologies in the cashew value chain, employment increased alongside output in the sector (Costa & Delgado, 2019). Because they boost income and productive employment, participation in GVCs is associated with reduced poverty (e.g., Maertens & Swinnen, 2012).

Despite a positive impact of GVCs participation on growth, the gains are not distributed equally across or within countries. The source of inequality across countries is related to their position along value chains, as some countries are located at the bottom of the chains and therefore receive less value. However, even for countries that benefit from GVCs participation (through income increases), the gains are not equally distributed. According to the World Bank (2020), inequalities exist in the distribution of gains across countries, between labor and capital, skilled and unskilled workers, male and female workers, geographically within countries, etc. Inequalities arising from GVCs activities are multiple, but we will focus on some of them. ***(i)*** the growth of GVCs activities increased firms' benefits.[12] While consumers have benefited from lower prices, higher quality, and greater variety, they could have benefited more if firms had fully passed on those cost reductions.[13] There is an inequal repartition in gains between firms and consumers. ***(ii)*** Considering labor and capital remuneration, it is important to note that profits are rising, but labor's share of income is falling. We assist in a changing distribution of capital and labor in countries. While the observed global decline in labor share in some countries can be attributed to several causes (Karabarbounis & Neiman, 2013), the increase in GVCs activities is the key contributor. ***(iii)*** Inequality can also arise within the labor market when a growing wage premium is paid to skilled workers. It is widely agreed that vertical specialization increases wage inequality in countries at all income levels (Goldberg & Pavcnik, 2007). Three reasons explain this increase. First, the move of production processes from a higher income country to a lower income country increases the standard of tasks. Tasks considered low skilled and labor intensive in higher income countries are considered skilled and labor intensive in lower income countries (R. C. Feenstra & Hanson, 1997; R. Feenstra & Hanson, 1995). Therefore, offshoring increases the demand for skilled workers in low and middle income economies and puts upward pressure on wage inequality. Second GVCs are often more skill sensitive than traditional trade flows, thus setting off "a war for talent," with the price of particularly attractive producers or the wage of particularly skilled individuals increasing disproportionately (World Bank, 2020). Finally, GVCs produce more jobs for skilled workers (Hijzen et al., 2013; Javorcik, 2015; Markusen & Trofimenko, 2009; te Velde & Morrissey, 2003). Firms in GVCs tend to adopt more capital-intensive techniques (Bernard et al., 2018). As a result demand for skilled workers increases because of the capital-skill complementarity[14] (Becker et al., 2013; Bloom & Reenen, 2011; Dearden et al., 2006; Griliches, 1969, p. 196; B. Hansson, 2009; Krusell et al., 2000, p. 20; World Bank, 2020), pushing workers to move toward less routine and more interactive tasks.

The literature suggests that GVCs participation can positively impact growth and raise inequality. However, most studies realized in this area focused on developed countries and EMDEs. Less have paid

[12] Benefit increase is driven by lower costs of inputs for companies, the presence of economies of scale, and cost reductions not being fully passed on to consumers through lower prices

[13] After India's trade liberalization in the 1990s, when input tariffs on intermediate inputs fell, both costs and prices dropped, but markups went up by about 13% when the economy opened to trade (De Loecker et al., 2016)

[14] According to the World Bank (World Bank, 2020) physical capital (and especially capital equipment) is less substitutable with skilled labor than with unskilled labor

attention to the case of Africa, which seems to be highly integrated but remains at the bottom of the chain, with commodity-based participation. Chapter 7 of the current work investigates the impact of GVCs participation on GDP per capita and further shed lights on whether participation of African countries in GVCs has reduced or increased inequality.

1.5. Contributions and outlines of thesis

This thesis discusses the determinants and consequences of GVCs participation. It contributes to an extensive literature on the topic and other related topics. The contribution goes from innovative findings that reinforce the existing literature to the design and elaboration of innovative indicators and instruments in the trade and GVCs space.

0 and 0 contributed to the literature on the determinants of GVCs participation but also the impact of both public spending and development assistance. 0 shows that education public expenditures, when well-managed, constitutes a key determinant of GVCs. However, its high increase above the regional mean does not necessarily improve the level of GVCs participation. Thus, the chapter also raises the question of the quality of the public action. 0, which adds value to a large literature on development assistance, shows that AfT constitutes a powerful contributor to recipient countries' capacity to boost their exports and upgrade through GVCs. It sheds light on sectors and regions where AfT shows efficiency allowing donors to identify which type of AfT fits each region.

Chapter 4, Chapter 5, 0, and Chapter 7 discuss the consequences and implications of GVCs participation, with a large set of innovative contributions. Chapter 4 and Chapter 5, highlight the danger of integrating GVCs. It is an important contribution to the literature on GVCs participation that tends to forget the drawbacks of GVCs participation in favor of the benefits. The two chapter show that uncertainty in GVC production hubs has a spillover effect on the rest of the world and leads to trade contraction. It is a crucial contribution given the current events (COVID-19 and wars) that can raise uncertainty around the world.

0 discusses one of the positive implications of integrating GVCs, namely technology upgrade. Focusing on a case study, the chapter investigates whether the interaction between China and African countries has led to technology transfer. The chapter is innovative and contributes a lot to the existing literature. The innovation lies in creating a new value-added exports sophistication index approach that allows measuring domestic technology created and exported. This new approach of sophistication index based on forefathers' methods with an integration of the principle of GVCs, removes double counting and makes sure that export sophistication does not include foreign technology. Future studies that aim to use export sophistication indexes to measure technology at a country level should refer to domestic value-added export instead of gross exports. This contribution corrects for a higher bias in the measure of domestic technology in the literature and helps avoid misleading and biased results. The chapter also provide strategies for policymakers and road maps on how to build their partnerships.

Finally, Chapter 7 also discusses the implication of GVCs participation for African countries. It focuses on the Impact of GVCs on income per capita and inequality relying on an IV approach with innovative instruments that can replicated and used in the trade growth space. The chapter offers three novel contributions to the empirical literature on GVCs. First, it tracks and provide evidence on the evolution of African countries' along GVCs as well as their specialization patterns. Empirical literature has mostly focused on developed countries and emerging markets. This study is the first to document the evolution and position of African countries in GVCs. Until recently, many African countries have long been excluded from the industrialization game, because of the required capital investments and technological knowledge. GVCs offer these countries unique opportunities to specialize in different stages of the production focus, allowing them to participate in the production of complex products (AfDB et al., 2014; Inomata & Taglioni, 2019; Sommer et al., 2017). Thus, this contribution is important for decision mqking processes. Second, the chapter add empirical evidence on the importance of GVCs by going beyond economic growth to establish the relationship with income inequality. Empirical evidence on this relationship between GVCs participation and position is scarce in the literature. One exception is Carpa & Martínez-Zarzoso (2022) who examined the relationship between GVCs and income inequality, establishing a positive association between offshoring and income inequality in the short run which vanishes in the long run. However, their analysis mainly considers developed and advanced countries in Europe with a smaller number of observations which limits external validity. Chapter 7 therefore build on this, adding evidence on this relationship in the context of Africa, given the heavy involvement of African countries in GVCs. Finally, the chapter uncover what could be driving the relationship between GVCs and economic growth. Through sectoral GVCs participation indexes, it shows that trade in knowledge intensive goods and services could be playing a role here. In this regard, the analysis provides an improved understanding pertaining to GVCs which may be relevant in stirring economic development in Africa. In the face of growing inequality and poverty in many developing nations, the study provides some entry and leveraging points for policy in a bid to reduce inequality and poverty, boost shared prosperity and fast-track economic development in Africa.

Appendix: Exports decomposition framework and input-output tables' structure

Appendix 1: Decomposition of gross export: Koopman Wang and Wei (2014) framework

Let us consider as in Koopman et al.,(2014) the expression of total output that can be used as Final demand (Domestic use or abroad) or/and Intermediate Input (Domestic use or abroad) $X_s = Y + AX$; X is the total output; Y the Final Demand and AX intermediates good. Then,

$$X_s = Y + AX = (Y_{ss} + \sum_{r \neq s}^{G} Y_{sr}) + (A_{ss}X_s + \sum_{r \neq s}^{G} A_{sr}X_s) \quad \text{(A 1.1)}$$

$$X_s = (Y_{ss} + A_{ss}X_s\ ) + (\sum_{r \neq s}^{G} Y_{sr} + \sum_{r \neq s}^{G} A_{sr}X_s) \quad \text{(A 1.2)}$$

Total output can be divided into domestic contents (domestic demand of final goods and domestic demand of intermediates inputs) and Foreign contents (Exports) made of exports of final demand and exports of intermediates goods.

Using the first expression of total output, $X_s = Y + AX$ we have:

$$X - AX = Y \quad \text{(A 1.3)}$$

$$X(I - A) = Y \quad \text{(A 1.4)}$$

$$X = (I - A)^{-1}Y \quad \text{(A 1.5)}$$

With $(I - A)^{-1}$ the well-known Leontief Inverse Matrix. Let us call it B with $B = (I - A)^{-1}$. Therefore, total output can be rewrite as:

$$X = BY \quad \text{(A 1.6)}$$

Matrix expression
$$\begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ \vdots \\ X_G \end{bmatrix} = \begin{bmatrix} I - A_{11} & A_{12} & A_{13} & \cdots & A_{1G} \\ A_{21} & I - A_{22} & A_{23} & \cdots & AA_{1G} \\ A_{31} & A_{32} & I - A_{33} & \cdots & A_{1G} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ A_{G1} & A_{G2} & A_{G3} & \cdots & I - A_{GG} \end{bmatrix} \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ \vdots \\ Y_G \end{bmatrix}$$

Gross Exports are the sum of bilateral exports and can be divided into export of intermediates and exports of final good:

$$E_s = \sum_{r \neq s}^{G} E_{sr} = \sum_{r \neq s}^{G} (A_{sr}\, X_r + Y_{sr}\ ) \quad \text{(A 1.7)}$$

Koopman et al. (2014) made a decomposition of this gross export equation into different elements that allows computing data entering in the calculation of GVCs participation index (See the integral proof and demonstrations in Koopman et al. (2014)).

Let us consider a unit vector **u**. multiplying export by a unit vector does not change anything. Using the previous expressions in gross exports equation, the authors obtained a complete decomposition[15] of gross exports into:

$$\begin{aligned} uE_s = V_s \sum_{r\neq s}^{G} B_{ss}Y_{sr} + V_s \sum_{r\neq s}^{G} B_{sr}Y_{rr} + V_s \sum_{r\neq s}^{G}\sum_{t\neq s,r}^{G} B_{sr}Y_{rt} + V_s \sum_{r\neq s}^{G} B_{sr}Y_{rs} \\ + V_s \sum_{r\neq s}^{G} B_{sr}A_{rs}\ \ (I - A_{ss})^{-1}\ Y_{ss} + \sum_{t\neq s}^{G}\sum_{r\neq s}^{G} V_t B_{ts}Y_{sr} \\ + \sum_{t\neq s}^{G}\sum_{r\neq s}^{G} V_t B_{ts}Y_{sr}\,(I - A_{rr})^{-1}Y_{rr} + V_s \sum_{r\neq s}^{G} B_{sr}A_{rs}\ \ (I - A_{ss})^{-1}\ E_s \\ + \sum_{t\neq s}^{G} V_t B_{ts}A_{sr}\ \ (I - A_{rr})^{-1}\ E_s \end{aligned} \qquad \text{(A 1.8)}$$

Therefore, Gross Exports are decomposed in nine (9) elements: Domestic value-added in direct final goods exports (VAEFD), domestic value-added in intermediates exports absorbed by direct importers (VAEI1), domestic value-added in intermediates re-exported to third countries (VAEI2); these three elements are Value-added exports (VATRD). We also have domestic value-added in intermediates that returns via final imports (VARHF), domestic value-added in intermediates that returns via intermediates imports (VARHI), foreign value-added in final goods and intermediates goods exports (FVA) and Pure double counted (two terms).

$$VATRD = V_s \sum_{r\neq s}^{G} B_{ss}Y_{sr} + V_s \sum_{r\neq s}^{G} B_{sr}Y_{rr} + V_s \sum_{r\neq s}^{G}\sum_{t\neq s,r}^{G} B_{sr}Y_{rt} \qquad \text{(A 1.9)}$$

$$VARH = VARHI + VARHF = V_s \sum_{r\neq s}^{G} B_{sr}Y_{rs} + V_s \sum_{r\neq s}^{G} B_{sr}A_{rs}\ \ (I - A_{ss})^{-1}\ Y_{ss} \qquad \text{(A 1.10)}$$

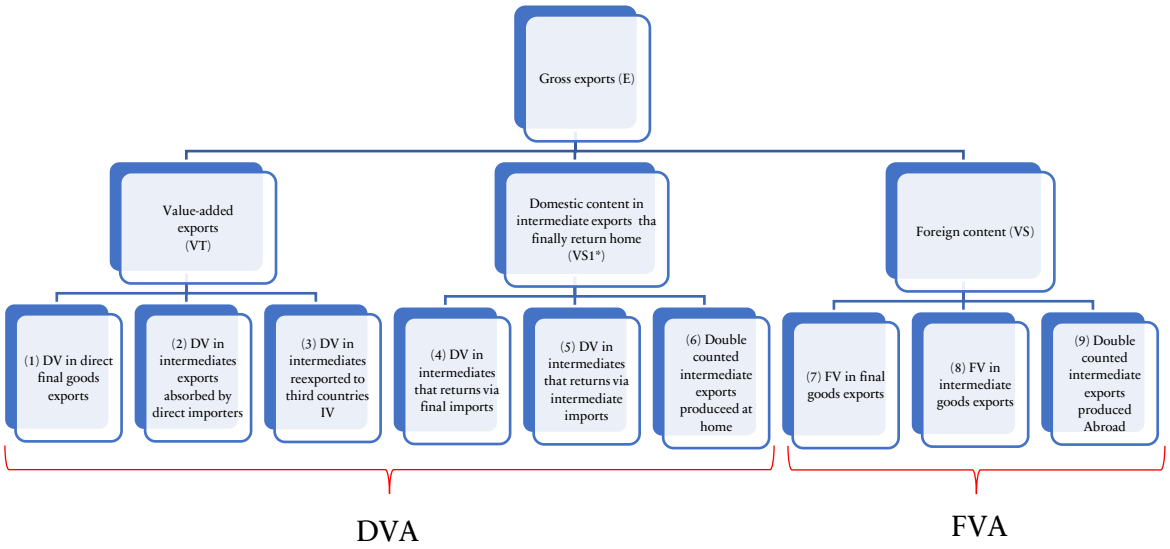
$$FVA = \sum_{t\neq s}^{G}\sum_{r\neq s}^{G} V_t B_{ts}Y_{sr} + \sum_{t\neq s}^{G}\sum_{r\neq s}^{G} V_t B_{ts}Y_{sr}\,(I - A_{rr})^{-1}Y_{rr} \qquad \text{(A 1.11)}$$

[15] Refer to Koopman et al (2014) for more details on the decomposition process

$$Pure\ DC = V_s \sum_{r \neq s}^{G} B_{sr} A_{rs} \ \ (I - A_{ss})^{-1} \ E_s + \sum_{t \neq s}^{G} V_t B_{ts} A_{sr} \ \ (I - A_{rr})^{-1} \ E_s \qquad \text{(A 1.12)}$$

Appendix 2 :Decomposition of gross exports.

Figure A 1.1- Decomposition of Gross Exports



Source : Koopman et al.(2014)

Appendix 3: Example of Eora MRIO Input-Output Table structure

Table A 1.1- Example of Eora MRIO Input-Output Table structure

Year : 20XX		T matrix												Final Demand (FD) Matrix				
		Country 1				Country 2				Country 3				Country 1	Country 2	Country 3		
		Sector 1	Sector 2	Sector 3	Sector 4	Sector 1	Sector 2	Sector 3	Sector 4	Sector 1	Sector 2	Sector 3	Sector 4	Households	Households	Households	Gross output	Gross Exports
Country 1	Sector 1	346	156	95	594	819	154	832	397	409	562	241	554	394	902	446	**6,901**	**5,316**
	Sector 2	354	443	7	908	42	92	561	839	470	770	83	368	514	694	512	**6,657**	**4,431**
	Sector 3	291	795	243	825	753	2	340	232	251	605	526	610	384	753	909	**7,518**	**4,980**
	Sector 4	637	259	289	813	500	716	947	645	856	221	898	41	91	653	301	**7,868**	**5,778**
Country 2	Sector 1	547	466	910	276	518	149	779	553	197	285	305	828	630	565	857	**7,864**	**5,300**
	Sector 2	752	936	822	638	611	496	98	924	608	689	872	972	847	209	37	**9,511**	**7,173**
	Sector 3	295	444	7	828	929	535	367	257	890	429	641	26	165	419	886	**7,117**	**4,610**
	Sector 4	113	518	791	459	79	748	254	218	586	673	424	157	800	355	501	**6,677**	**5,022**
Country 3	Sector 1	46	457	552	572	632	680	730	607	796	186	15	958	338	320	194	**7,082**	**4,934**
	Sector 2	962	96	544	96	675	113	711	337	787	571	241	211	479	14	608	**6,445**	**4,027**
	Sector 3	531	190	686	191	374	615	788	738	351	32	565	622	269	814	559	**7,326**	**5,197**
	Sector 4	857	776	897	18	915	482	308	458	253	145	982	270	700	822	729	**8,612**	**6,233**
																	89,578	
	VA matrix																	
Country 1	Value Added	1,172	1,120	1,676	1,648	-	-	-	-	-	-	-	-					
Country 2	Value Added	-	-	-	-	1,019	4,730	401	471	-	-	-	-					
Country 3	Value Added	-	-	-	-	-	-	-	-	626	1,278	1,532	2,995					
	Total input	**6,901**	**6,657**	**7,518**	**7,868**	**7,864**	**9,511**	**7,117**	**6,677**	**7,082**	**6,445**	**7,326**	**8,612**	**89,578**				

Source : EORA-MRIO - https://worldmrio.com/eora26/

Part I: Factors determining developing countries participation in GVCs.

This first part of the dissertation discusses the determinants of GVCs participation. Not all of those determinants have been the focus of researchers. Several factors explain GVCs participation and upgrades, such as factor endowments, geography, market size, and institutions. Most of these factors are affected by either policy choices or foreign assistance. Thus, national policies, international cooperation, and development assistance constitute key drivers of GVCs participation and upgrade. This part of the dissertation focuses on national policies and development assistance.

GVC actors, researchers, and policymakers agree that human capital is a critical determinant of upgrading GVCs (e.g., Ignatenko et al., 2019; Kowalski et al., 2015). Massively investing in human capital can help capture more value added from GVCs' trade, and national policies can be used to improve the stock of human capital available. In fact, the benefits associated with human capital accumulation are one of the key rationales for government intervention. Education is a public good in LDCs, and it needs government involvement to function effectively. Well-targeted patterns of education expenditure can be effective for human capital accumulation and generate positive externalities (Edeme et al., 2017; Jung & Thorbecke, 2003; Patel & Annapoorna, 2019), including GVCs participation. However, the well-known spillover effects of human capital may encourage some countries to irrationally increase their expenses. The impact of engaging in a competition to increase education expenditure on GVCs is unclear. While human capital can be a key determinant of GVCs participation, it is not certain that increasing public educational expenditures directly leads to an increase in the level of GVCs participation. This aspect of the drivers of GVCs participation will be seriously investigated in this part. Another aspect of the determinants of GVCs participation omitted by the literature is the contribution of external support. Foreign aid offered to developing countries fills an existing resources gap. Advanced economies have committed to support developing countries' trade through AfT, that supports several aspects of trade, raising the question of its importance in promoting GVCs participation.

The first two chapters after the introduction contribute to an existing gap in the literature of the determinant of GVCs participation. Chapter 2 presents evidence of a significant positive effect of education expenditure on the level of GVCs participation. However, the study also highlights that competition between countries in increasing public expenditure does not necessarily promote GVCs participation. Chapter 3 investigates the capacity of AfT in helping developing countries upgrade GVCs. The chapter highlights the existence of a positive effect of AfT on the level of GVCs participation and domestic value-added embodied in gross exports. Further estimations give more details, show that loans perform better than grants and suggest that the positive effect depends on the type of provider.

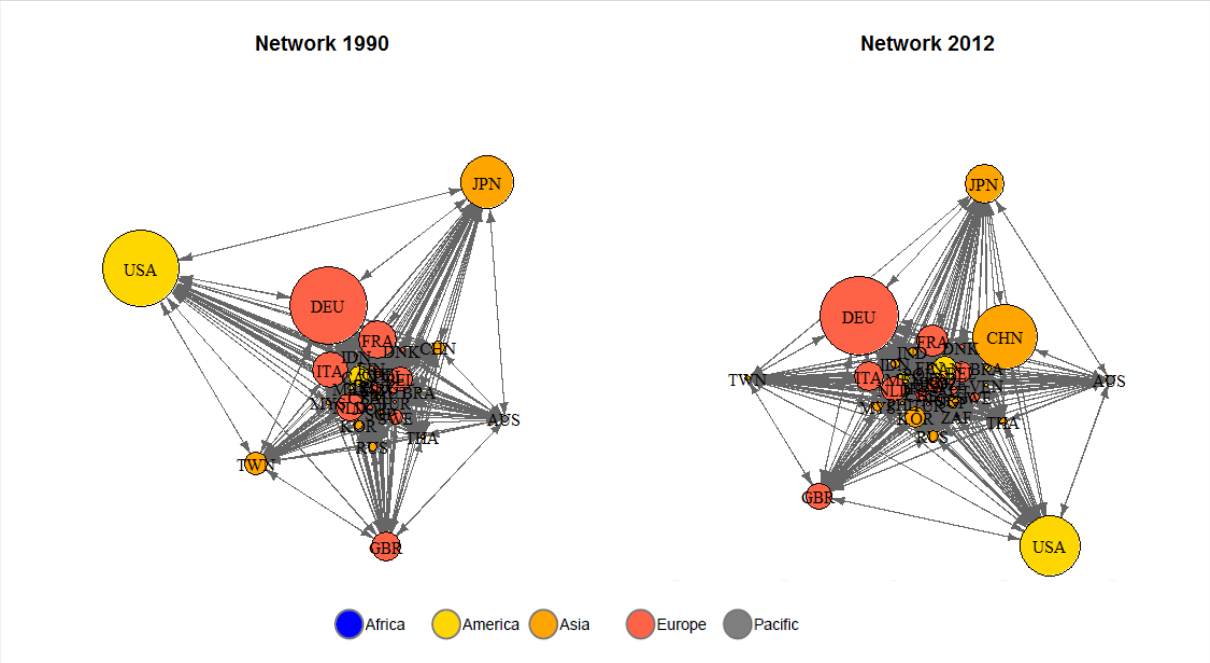
Chapter 2. Education Public Expenditure and Global Value Chains Integration

2.1. Introduction

International trade has evolved toward vertical specialization (Hummels et al., 2001) —namely specialization in tasks or specific production stages (Irwin, 2015, 2020; McCulloch, 1846). The production process spans multiple interconnected countries (Figure 2.1), each country specializing in a stage of a good's production sequence. In recent decades, Asian countries, especially China, have benefited more from this new phenomenon of vertical specialization. GVCs participation has helped some Asian countries transition from low to middle-income status. After integrating themselves into GVCs, their new challenge was to reposition themselves (upgrade) toward higher value-added production to capture a larger slice of value from their GVCs trade (K. Cheng et al., 2015). This new pattern of international trade has generated several debates among policymakers, business leaders, and trade economists. The changes in the production process are likely to change the nature of industrialization in the world. Indeed, entry into manufacturing used to be a major challenge for developing economies because of entry costs. However, GVCs have dramatically increased opportunities for firms to participate in formerly capital-intensive industries through reducing entry costs (Inomata & Taglioni, 2019). Several studies (AfDB et al., 2014; Sommer et al., 2017) have shown that developing countries would develop their industrial tissue quickly, without following the same steps as developed countries, if they were well integrated into GVCs. Thus, developing countries can skip the formerly mandatory initial industrialization steps that had prevented them from industrializing.

Given the importance of GVCs participation, it is crucial to analyze its determinants and learn more about public actions that can help countries upgrade within these chains and capture more value-added. The motivation of this chapter comes from the necessity to learn more about how developing countries can act to promote integration into GVCs. As human capital is critical to GVCs participation (Ignatenko et al., 2019; Kowalski et al., 2015) and technology transfer (Nana, 2021), the temptation for developing countries to increase their education expenditure to benefit GVCs is high. Costinot et al. (2013) suggested investigating whether a high increase in education expenditures (which often leads to competition between developing countries) significantly impacts GVCs participation. Thus, in addition to studying the impact of education expenditure on GVCs participation, the current chapter also focusses on the difference of a country’s education public expenditure from the regional mean and estimates its effect on GVCs participation, a way to account for competition in increasing education public expenditures.

Figure 2.1: Evolution of the world network in terms of value-added exports from 1990 to 2012



Source: Author's calculation using UNCTAD-MRIO GVCs data

Note: To avoid having an overload graph, countries with a low value of "value-added exported" have been removed from the chart. It allows the clear identification of production hubs.

This chapter is structured around two main topics: the determinants of GVCs participation and the impact of the public action on trade and GVCs. Regarding the first topic, several studies have been conducted to determine factors that promote GVCs participation. The mains determinants of GVCs discussed in the literature can be organized into three categories of determinants. ***(i)*** factors aiming to reduce transaction costs (Bruhn, 2014; Cattaneo et al., 2013; K. Cheng et al., 2015; A. Fernandes et al., 2020; Petersburg, 2013) ; ***(ii)*** fundamentals such as infrastructure, human capital, research and development, great institutions (K. Cheng et al., 2015; A. Fernandes et al., 2020; Nakazawa et al., 2007; Saslavsky & Shepherd, 2012; Yashiro et al., 2017) and ***(iii)*** policies aiming to improve the two previous determinants (Orefice & Rocha, 2014; Yashiro et al., 2017). The second topic addressed in this chapter is the effect of government expenditures on both foreign trade and trade balances, which is also well discussed in the literature (Brülhart & Trionfetti, 2004; Helpman & Krugman, 1985; Müller, 2008; Yashiro et al., 2017). While several studies have shown the importance of human capital and education on GVCs participation or discussed the effect of public expenditure on trade, a few studies have focused directly on public action's effect on GVCs participation. Those that investigated the topic, only provided theoretical foundation or implemented firm level analyses. Yashiro et al., (2017) mentioned in a policy paper that improving access to higher education may allow moving up GVCs because skills are a prerequisite for innovation and competitiveness. Thus, the contribution of this dissertation is unique

given it highlights the implications of public policy—through an increase in educational public expenditure — on the level of GVCs participation.

This chapter uses a sample of 60 countries from 1995 to 2017 to identify the effects of education expenditure on GVCs integration. It complements the literature on the determinants of GVCs upgrading. It uses recent local projections to estimate impulse response of GVCs to increased education public expenditures. We also used a new concept of distance called the "distance to the nearest production hub" that allows us to control our estimations for the geographical position of countries in a model that is not a gravity one.[16] The findings suggest that education public expenditures positively impact GVCs participation in the medium-term. However, there is a non-significant impact of the absolute deviation of education public expenditures from the regional mean, suggesting that increasing education expenditure higher than the regional mean to upgrade GVCs is not efficient. The rest of the chapter is the follow: Section 2.2 presents a simple theoretical model from Costinot et al., (2013), section 2.3 gives a brief description of the data, section 2.4 discusses the empirical approach and the results, and section 2.5 concludes.

2.2. Exports, global value chains, and public spending: A simple model

In this section, we replicated the model developed by Costinot et al. (2013), in which we included public expenditures as determinants of total factors productivity (TFP) to quantify the effect of education spending on the level of GVCs participation.

2.2.1. Initial model: Costinot et al.(2013)

Let us consider a world with multiple countries $c \in C \equiv \{1, \dots, C\}$ that are producing a final good q with one factor of production, labor, that is inelastically supplied and immobile across countries. L_c and w_c represent the endowment of labor and wage, respectively. The production of the final good requires performing sequentially a continuum of stages $s \in S \equiv (0, S]$. The production of a unit of an intermediate good requires one unit of labor and one unit of the previous stage's intermediate good. Production at any level (stage) is subject to a country-specific mistake rate. Mistakes occur at a Poisson rate $\lambda_c > 0$, and countries are ordered so that λ_c strictly decreases in *c*. The occurrence of a mistake on a unit of intermediate good at any stage leads to the destruction of the good. Let us consider two consecutive stages, s and $s + ds$, with ds infinitesimal. If a country c uses $q(s)$ units of intermediates goods and $q(s)ds$ units of labor, its output of intermediate goods $s + ds$ will be given by the following:

$$q(s + ds) = (1 - \lambda_c ds)q(s) \qquad (2.1)$$

[16] The gravity model of international trade in international economics is a model that, in its traditional form, predicts bilateral trade flows based on the economic sizes and distance between two units. Bilateral distance is a good predictor of trade. Since the current chapter is not using bilateral data, considering distance in a country-level specification can improve the relevance of the empirical model.

$$\frac{q'(s)}{q(s)} = -\lambda_c \quad (2.2)$$

Mistakes may occur along the supply chain in country c, and the destruction rate of the final good is noted λ_c. The term λ_c can be considered as a measure of TFP, and since it is decreasing, countries with a higher index c are more productive because the higher λ_c, the lower $q(s + ds)$.

In a free trade equilibrium (Annex 1), the model of Costinot et al. (2013) gives birth to two lemmas on free trade equilibrium, and we focus on the first lemma. Let us refer to the vector $(S_1, \dots, S_C)$ as the pattern of vertical specialization and $Q_c = Q_c(S_c)$ as the total amount of intermediate goods S_c produced and exported by country c. The pattern of vertical specialization and export levels can be jointly characterized as follows.

$$S_c = S_{c-1} - \left(\frac{1}{\lambda_c}\right) \ln\left(1 - \frac{\lambda_c L_c}{Q_{c-1}}\right), for\ all\ c \in C, \quad (2.3)$$

$$Q_c = e^{-\lambda_c (S_c - S_{c-1})} Q_{c-1}, for\ all\ c \in C, \quad (2.4)$$

With $S_0 = 0\ and\ S_C = S$

2.2.2. Introduction of public spending

To introduce public expenditure, the current study refers to P. Hansson & Henrekson (1994). Indeed, the authors consider TFP growth as a function of government spending. Filip (2016) also studied the determinants of TFP growth in a group of developed European countries. His findings suggest that knowledge and technology, infrastructure development, education quality, health level, the intensity of capital use, and the manifestation of the financial crisis constitute the determinants of TFP.

$$\frac{\Delta TFP}{TFP} = -\lambda_c = \gamma + \alpha Z_c + \beta gov_c \quad (2.5)$$

With gov_c measuring government spending, Z_c TFP determinants listed above and γ a constant.

Combining equation (4) and equation (5), we obtain the following specification:

$$Q_c = e^{-\lambda_c (S_c - S_{c-1})} Q_{c-1}, for\ all\ c \in C, \text{ With } -\lambda_c = \gamma + \alpha Z_c + \beta gov_c \quad (2.6)$$

$$lnQ_c = -\lambda_c (S_c - S_{c-1}) + \ln(Q_{c-1}) \quad (2.7)$$

$$\frac{dlnQ_c}{ds} = -\lambda_c + \frac{dlnQ_{c-1}}{ds} \quad (2.8)$$

$$\frac{dlnQ_c}{ds} = (\gamma + \alpha Z_c + \beta gov_c) + \frac{dlnQ_{c-1}}{ds} \quad (2.9)$$

Including government educational expenditures into Costinot et al.'s free trade equilibrium allows us to determine the growth rate of total exports. This growth rate in the initial model at the equilibrium is proportional to the level of TFP growth rate and partners' past exports of quantities. As we assume that TFP is proportional to government educational expenditures rate, export growth rate becomes a function of education public expenditures, country-specific factors, and imports of intermediate goods.

2.3. Variables and data sources

This section provides a brief description of the data used in this chapter. The sample is composed of 60 countries from 1990 to 2017. In our empirical estimation, the dependent variables are GVCs participation indexes: GVCs participation, backward GVCs participation and forward GVCs participation. The calculation of these indexes followed the framework of Koopman et al. (2014) as discussed in section 1.2 of Chapter 1. The independent variable of interest, education public expenditure, was obtained from the international food policy research institute (IFPRI).

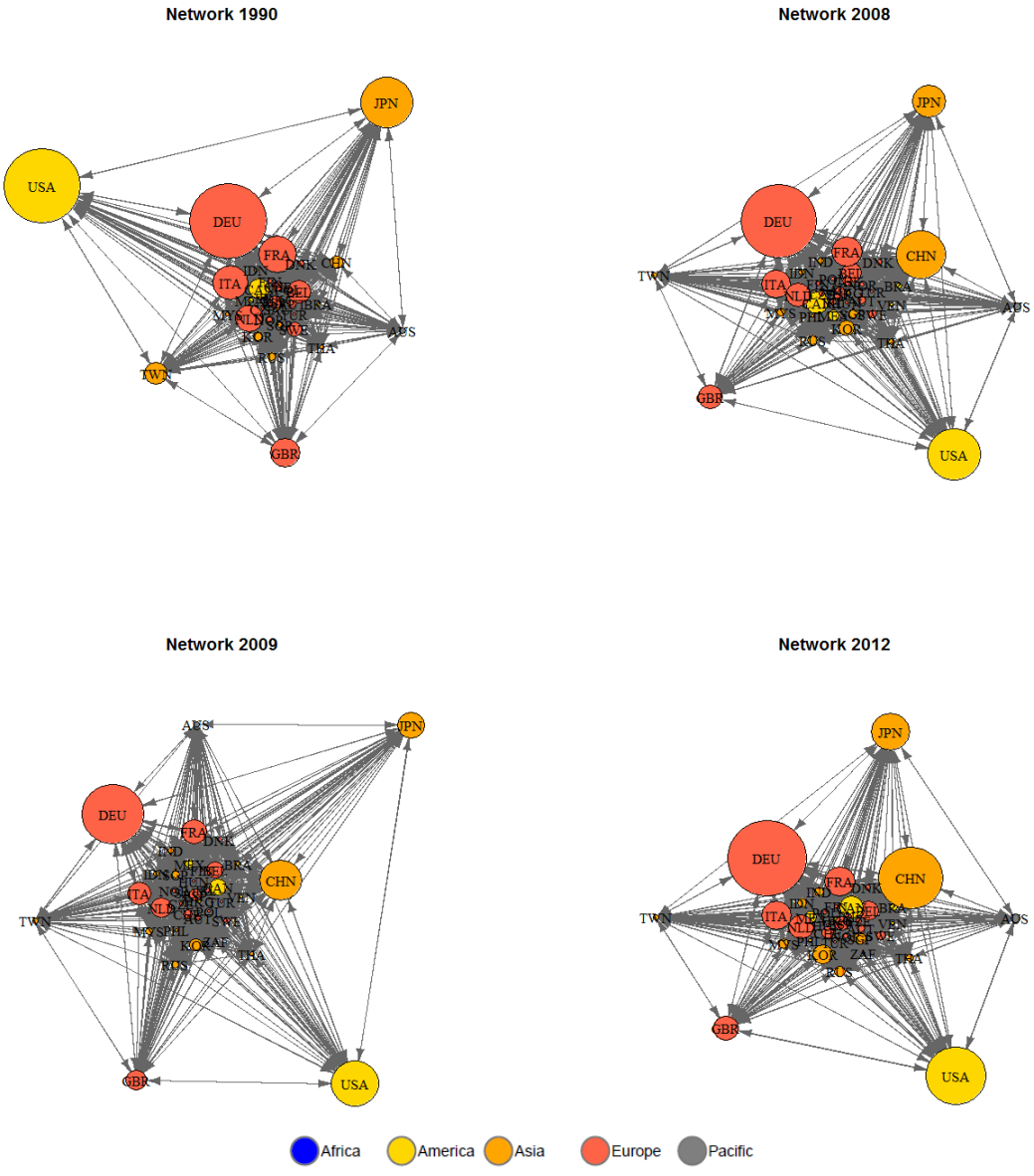
2.3.1. Control variables

The empirical model also considered additional variables to control for countries' development level and trade costs. The model controls for "real GDP per capita" and "natural resources rents" measuring respectively the country's level of development and the country's endowment in natural resources. The level of development is also a measure of the size of the country, which matters in traditional trade but also in GVCs trade (Allard et al., 2016; J. E. Anderson & van Wincoop, 2003; Tinbergen, 1962). The level of factor endowment is a key determinant for GVCs. In fact natural resources naturally leads to high forward GVCs participation since raw material and commodities are inputs in the production process, and the products usually cross several borders (Abreha et al., 2020; World Bank, 2020). Both variables are sourced from the World Bank World Development Indicators (WDI). The model controls for tariffs. Similar studies have used tariffs on intermediate goods as control variables (Bas & Strauss-Kahn, 2015; Pierola et al., 2018). We decided to use global tariffs on all types of products because GVCs trade involves final goods that cross borders several times as well as capital goods involved in the production process. Thus, an increase in tariffs on final goods can affect GVCs participation, given that some final goods are used to produce other final goods for other countries or are re-exported to third countries. Tariffs data are obtained from the UNCTAD TRAINS database. The model further considered institutional quality, which matters in implementing the necessary institutional framework for the promotion and governance of GVCs. Institutional quality variables used include the level of government effectiveness, property rights, investment freedom, and trade freedom. These variables also help control for the ease of doing business and exchanging freely. For example strong contract enforcement is crucial for both traditional and GVCs trade (Kowalski et al., 2015; Levchenko, 2007; Nunn, 2007). Government

effectiveness data come from worldwide governance indicators, while trade freedom index, investment freedom index, and property rights come from the Heritage Index of Economic Freedom.[17] Finally, the model controls for distance to the nearest GVCs production hub, calculated using bilateral distance data from CEPII and network theories to identify production hubs.

2.3.2. Geographical distance to the nearest regional hubs

Figure 2.2: Network of top GVCs production bubs



Source: Author's calculation using R Studio and UNCTAD-MRIO GVCs database

[17] The Economic Freedom is an annual guide published by the Heritage Foundation, Washington's No. 1 think tank

Note: To avoid having an overload graph, countries with a low value of "value-added exported" have been removed from the chart. This allows clear visual identification of production hubs.

Figure 2.2 presents the network of GVCs largest production hubs. The global trade network has changed since 1990. Indeed, in 1990 the top five GVC production hubs were the US, Germany, Japan, Italia, and France but this distribution has changed towards years. In 2008, China became the third value-added exporter after the US, and Germany and is now among the top five value-added exporters globally. Previous studies on international trade have been based on gravity models, using bilateral distance (Bergstrand, 1985; Chaney, 2018) to explain export dynamics. However, the notion of distance is less used when the model is not a gravity one. Thus, we introduced an innovative concept of distance—namely, the distance from the country to the nearest GVC production hubs among the top five. This new variable allowed us to use distance despite not using a gravity model. However, some economists like Richard Baldwin think that instead of talking about GVCs, we should refer to regional value chains because value chains are regional. We thus considered distance to regional GVC production hubs for robustness checks.

Whether value chains are regional or global, countries located near GVC production hubs can benefit from the neighborhood through technology transfers and can increase their level of integration. We computed both concepts of distance as follows:

Distance to regional production hub: For the distance of a given country to regional hubs, a country *i* will be considered a production hub in a region if it has the highest value-added exported in the region. Thus, each regional production hub is identified for each year. For each country we calculate the distance to it regional production hub for a specific year (since regional production hubs can vary from a year to another). The outcome et distance variable that vary overtime (slightly).

$$Country_{i,t} = Hub_{reg1,t} \; if \; Max[va\_exp]_{reg,t} = va\_exp_{i,t} \tag{2.10}$$

$$DistRegHubs_{j,reg1,t} = Dist(Country_{j,t} \; and \; Hub_{reg1,t}) \tag{2.11}$$

Distance to the nearest production hub (among the top five): We computed distance from a country to the nearest production hub (among the top five production hubs). A country will be listed among the top five production hubs in the world if it is among the top five countries with the highest value-added export. Distance to the nearest production hub is the minimal distance between a country *i* and the production hubs. Proximity with a production hub can boost upgrading within GVCs. This concept of distance is computed as follows:

$$DistHubs = Min\left[Distance_{i,j}\right] \tag{2.12}$$

With i the domestic country and j the top 5 production hubs j = {1,2,3,4,5}.

This new concept of distance allows us to use the notion of distance in a simple panel (country-year) model without using bilateral data or a gravity model. This new variable is supposed to affect GVCs participation negatively. The more distance between countries and their regional hubs, the less they export compared to those with close proximity to regional hubs. Moreover, a country will be more likely to integrate and upgrade value chains if it is close to the highest-integrated countries. However, we can also expect a positive effect because the farther countries are from production hubs, the more they are encouraged to produce their own intermediate goods, thus increasing the forward GVCs participation.

2.3.3. Descriptive statistics

Table 2.1: Descriptive statistics

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
va_exp	5,365	61	200	0	2310
dvx	5,365	17	59	0	683
fva	5,365	17	59	0	875
gvc	5,365	35	113	0	1470
dva	5,365	44	149	0	1880
educ_exp	2,865	11.85	28.15	0.000140	360.0
GDP	4,885	333200	1267000	122	17860000
Inflation	4,913	39.16	501.3	-29.69	26,766
Property Rights	3,725	48.51	23.89	0	98.40
Trade Freedom	3,723	68.96	16.35	0	95
Investment Freedom	3,730	53.82	21.26	0	95
ECI	3,210	0.0106	1.006	-2.791	2.625
NR Rents (% GDP)	4,786	7.384	11.25	0%	86%
Tariff	3,234	8.490	6.937	0	87.19
educ_exp (% GDP)	2,890	1.210	0.763	-4.6%	5.4%
gvc (% va_exp)	4,760	49.81	13.65	18%	100%
dvx (% va_exp)	4,760	27.02	10.39	0%	82%
Fva (% va_exp)	4,760	22.80	14.01	0%	100%

Notes: va-exp is value-added exported; dvx is domestic value added exported that cross at least two borders; dva is domestic value-added embodied in exports; fva is foreign value-added embodied in exports; ECI is an economic complexity index; educ_exp represents education expenditure and NR Rents represent natural resource rents.
Note: When using the level of GVCs in percentage of value-added exported countries such as Democratic Republic of Congo and South Sudan has the highest share of GVCs integration index. This situation conduced us to rely on absolute values of GVCs integration index for our regressions and analysis.

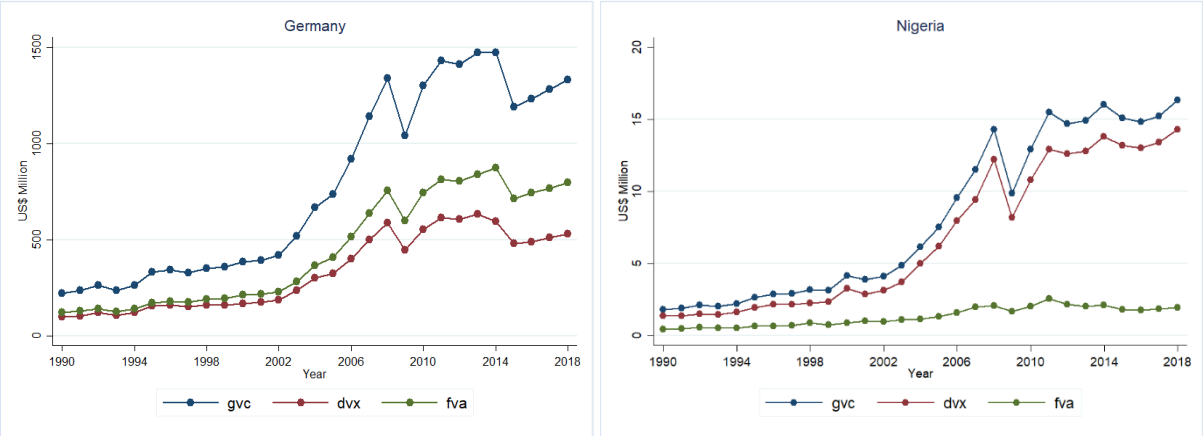
Table 2.1 presents descriptive statistics of the main variables involved in our study. The mean of GVCs intensity (in percentage of value-added exported)[18] is around 50%. In absolute terms, this value is around US$ 35 million. Analyzing both absolute and relative GVCs integration allows us to determine which measure was the most suitable for our analysis and future analyses. Regarding GVCs intensity, the highest value is around 100%. This value is for South Sudan, a country known as not much integrated into GVCs in absolute value. The Democratic Republic of Congo holds the second place as the most

[18] While GVCs intensity is GVCs participation expressed as a percentage of gross exports it can also be expressed relative to value added exports (total value added exported).

GVCs integrated country (when using GVCs intensity), a country well-endowed in natural resources but not as integrated into GVCs as suggested by the data. This observation means that using GVCs participation as a percentage of value-added exported or gross exports is misleading and does not capture the proper level of countries' integration into GVCs. Therefore, the current study relies on GVCs participation in absolute terms (US$). Table 2.1 shows that the highest value of GVCs participation is around US$ 1.5 billion (Germany 2013). In the 2018 ranking of GVCs participation, Germany had first place, followed by China and the US. Thus, the absolute measure of the GVCs participation is a good measure of countries' integration into GVCs. This analysis is accurate for both forward and backward GVCs participation — as the highest value of the forward GVCs participation is US$ 875 million, reported in 2018 for China and the highest value of backward GVCs participation is US$ 683 million, reported in 2014 for Germany.

The evolution of GVCs participation follows stylized facts. Indeed, analyzing Germany and Nigeria's GVCs participation indexes (Figure 2.3),[19] the first observation is that GVCs participation has been increasing since 1990. However, this evolution was not linear. For both countries, backward and forward GVCs participation experienced an important collapse in 2008-2009 following the financial crisis.

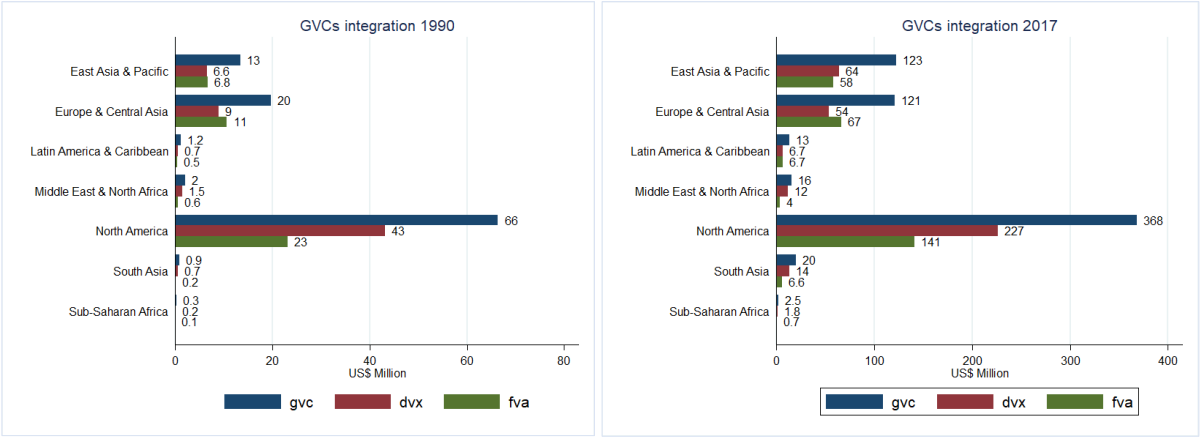
Figure 2.3: GVCs participation index of Germany and Nigeria (backward and forward participation)



Source: Author's calculation based on UNCTAD-MRIO GVCs database

[19] Germany and Nigeria are both leaders in their regional value chains, and Germany reported the highest GVCs participation index in 2018

Figure 2.4: Representation of backward and forward GVCs participation by region



Source: Author's calculation based on UNCTAD-MRIO GVCs database

While both countries are regional leaders, there is a difference in the composition of their GVCs participation. Germany relies on both forward and backward GVCs participation. The country creates value added used by other third countries (domestic value-added) as intermediate or final goods, but it also relies on foreign suppliers to process its exports (foreign value-added). However, Nigeria is far below Germany in terms of GVCs participation but also shows a different composition of its GVCs participation. The country has a lower level of foreign value-added compared to its domestic value-added. Nearly all its involvement is forward GVCs participation (domestic value-added). Thus, past increases in Nigeria's GVCs participation were due to increased forward GVCs participation, which also tends to be natural resource based. At the same time, the country's backward GVCs participation remained almost constant since 1990. For both Germany and Nigeria, we noted a drop of GVCs participation in 2009, a signal of the shock caused by the global financial crisis. For Germany, both forward and backward indexes were affected by the crisis. The contraction of the Nigerian GVCs participation in 2009 resulted most from a contraction in forward GVCs participation. The two countries also reported a drop in GVCs participation in 2015. Nigeria and Germany are both important actors in their regions, but these exhibit different levels of participation.

Figure 2.4 represents GVCs integration across regions. In 1990, North America had the highest level of GVCs participation (US$ 66 million). The two other regions that make the top three highest integrated regions are Europe and Central Asia (US$ 20 million) and East Asia and Pacific (US$ 13 million). They are followed by the Middle East and North Africa, Latin America and North Caribbean, South Asia, and Sub-Saharan Africa. This ranking has not changed much over time. In 2017, North America remained the region with the highest level of GVCs participation. However, East Asia and Pacific now holds the second place, followed by Europe & Central Asia, South Asia, Middle East and North Africa, Latin America and North Caribbean, and Sub-Saharan Africa. The level of Sub-Saharan Africa's GVCs participation has not changed over the period compared to other regions, but the data highlighted an increase between 1990 (US$ 300 million) and 2017 (US$ 2.5 billion). In light of the evolution of GVCs

participation in recent decades, it is relevant to investigate the joint evolution of GVCs participation and education public expenditures.

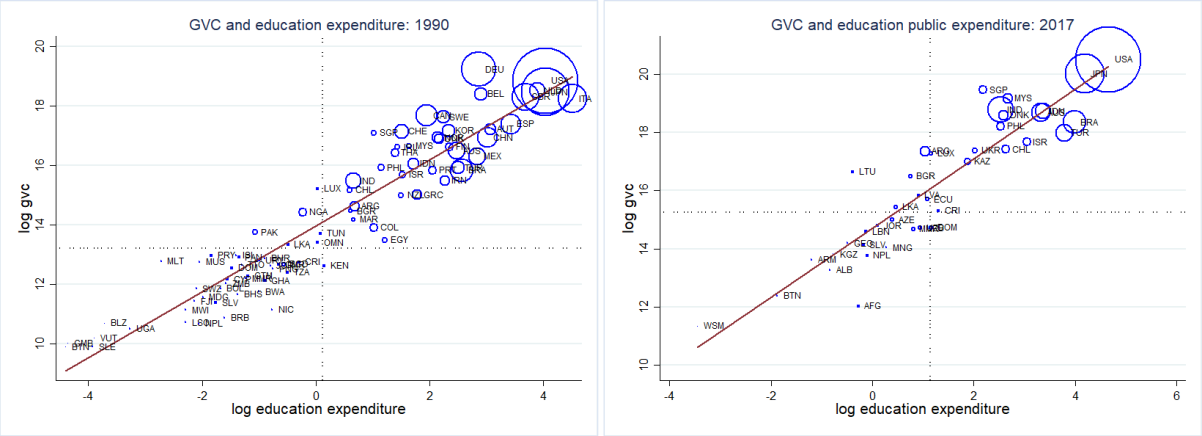
Figure 2.5 shows the evolution of both the GVCs participation and education public expenditures of China and the US from 1990 to 2017. Despite GVCs participation and education public expenditures increasing since 1990, there is no clear relation between the two for both China and the US. However, one can identify some episodes of positive correlation between the two variables. For example, in the US in 2009 and 2010 we can identify episodes of positive correlation (**Figure 2.5**), but this correlation is probably the result of the collapse caused by the global financial crisis, which affected almost all macroeconomic variables and economic recovery.

Figure 2.5: GVC participation and education public expenditure (US vs. China: 1990–2017)

Source: Author's calculation based on UNCTAD-MRIO GVCs database

An initial analysis of GVCs integration and education expenditure can be done through simple correlation analysis or scatter plots. **Figure 2.6** represents a scatter plot of GVCs participation and education expenditure in 1990 and 2017, weighted by the level of GDP. It shows a positive correlation between GVCs participation and education expenditure in 1990 and 2017. It also shows that the wealthiest countries have the highest GVCs participation index and the highest amount of educational expenditure. While our scatter plots seem to support a positive relation between education expenditure and GVCs participation, more analysis considering the full time range with control variables and appropriate regressors would help confirm our thoughts. More analysis would also provide more information about the causality and give better results.

Figure 2.6: Scatter plot of GVCs and education public expenditure weighted by the level of real GDP.



Source: Author's calculation based on UNCTAD-MRIO GVCs database and International Food Policy Research Institute (IFPRI) data.
Note: We have weighted by the level of GDP. The size of blue circles represents the level of countries GDP. The largest the size, the highest the level of GDP. Dash-dote lines represent the average value of both GVCs integration index and education expenditure.

2.4. Empirical analysis

The empirical analysis follows three main steps and uses three different methods to address different challenges unique to the current study. First, as discussed in the general introduction there is a wide range of GVCs determinants, rising the problem of model uncertainty. The current study relies on a Bayesian Model Average (BMA) approach to estimate and test for the relevance of variables included in our empirical model. This first step is a way to reduce model uncertainty and legitimate the variables and measurements used in our model. Second the current study exploits the panel aspect of the sample to estimate the effect of educational public expenditures on GVCs participation, considering unobserved fixed-effect and relying on instrumental variables approach to handle endogeneity. Finally, the study followed a local projection approach (Jordà, 2005; Jordà et al., 2011, 2020) to estimate the medium and long-term effect of GVCs participation response to increased educational public expenditure.

2.4.1. Empirical specification

Section 2.2 provided a theoretical foundation to the empirical model. The model expresses intermediate goods exports' growth rate as a function of government expenditure and other determinants. Equation (2.9) presents exports as follows:

$$\frac{dlnQ_c}{ds} = dlnE_c = (\gamma + \alpha Z_c + \beta gov_c) + \frac{dlnE_{c-1}}{ds}$$

However, exports of intermediate goods can be considered as a proxy for GVCs participation. Focusing on equation (13), we can implement our empirical model, explaining GVCs participation by public policy and a set of control variables from the literature (for a given period t, and country i).

$$\begin{aligned}\ln[GVC]_{i,t} = \; & \delta + \eta_i + \varphi_t + \emptyset \ln(Educ\_Exp)_{i,t} + \beta_1 \ln(Rents)_{i,t} \\ & + \beta_2 \ln(DistHubs)_{i,t} + \beta_3 \ln(Tariffs)_{i,t} + \beta_4 \ln(GDP)_{i,t} \\ & + \beta_5 Inflation_{i,t} + \beta_6 \ln(ECI)_{i,t} + \beta_7 GE_{i,t} + \beta_8 \ln(PRights)_{i,t} \\ & + \beta_9 \ln(Inv\_Free)_{i,t} + \beta_{10} \ln(Trd\_Free)_{i,t} + \varepsilon_{i,t}\end{aligned} \tag{2.13}$$

Here, $\eta_i \; and \; \varphi_t$ represent unobserved individual and time-specific effects and δ a constant. $\ln(Educ\_Exp)_{i,t}$ represents the logarithm of education public expenditure (in US$); $\ln(Rents)_{i,t}$ is the logarithm of natural resources rents; $\ln(DistHubs)_{i,t}$ is the logarithm of physical distance of country i to the nearest world production hub among the five largest;[20] $\ln(Tariffs)_{i,t}$ represents the logarithm of tariff rates; $\ln(GDP)_{i,t}$ is the logarithm of GDP; $\ln(ECI)_{i,t}$ represents the logarithm of economic complexity index; $GE_{i,t}$ represents government effectiveness, $\ln(PRights)_{i,t}$ is a measure of property rights; $\ln(Inv\_Free)_{i,t}$ is the logarithm of investment freedom index; $\ln(Trd\_Free)_{i,t}$ represents the logarithm of trade freedom index, and $\varepsilon_{i,t}$ represents the error term.

We can estimate equation (2.13) using the fixed effects estimator. This choice was also motivated by the Hausman test, which shows that the unique errors are correlated with regressors, confirming that the fixed effects model is preferred to the random effect model. Equation (2.13) can also be estimated using instrumental variables. However, the study's next step focused on a bayesian estimation to investigate the relevance of control variables included in the model.

2.4.2. Model uncertainty: Bayesian approach

This section identifies the critical determinants of GVCs participation among a set of determinants explored in the literature. It follows a Bayesian approach that allows us to estimate the probabilities of the inclusion of variables used in the empirical model. The BMA estimator was developed by Magnus et al. (2010). It helps determine which variables are good regressors for the model (variables with the highest probability of inclusion).

In empirical studies, model uncertainty is a critical issue and can impact the statistical properties of the outcome (Danilov & Magnus, 2004; Magnus & Durbin, 1999). Therefore, this approach deals with model uncertainty in the context of linear regressions, focusing on uncertainty about the choice of the explanatory variables. Unlike Danilov & Magnus (2004) who distinguished between focus regressors

[20] We calculated the minimal distance among the two, three and five largest production hubs.

(i.e., variables always included in the model) and auxiliary regressors (variables of which we are less confident), we considered all independent and control variables as auxiliary regressors to test their efficiency. BMA estimations provide estimated coefficients, standard errors, student ratios, posterior inclusion probabilities, and one-standard error bands, the outcome of interest being the posterior inclusion probability. The higher the posterior inclusion probability, the more relevant the variable for the model.

Table 2.2 presents the results of the BMA estimates. The level of education public expenditure, has a high posterior inclusion probability (100%), making it a relevant determent of GVCs participation in the current empirical model. Moreover, almost all of our variables of interest have high posterior inclusion probabilities (greater than 90%). Only the inflation rate and the logarithm of the trade freedom index have lower posterior inclusion probabilities (46% and 8%). The low probability of the logarithm of trade freedom is likely due to its high correlation with investment freedom and property rights. In a second estimation, we considered the same model, replacing education public expenditure by the absolute deviation of education public expenditure (measuring competition and captured with the deviation of the logarithm of education public expenditure from the regional mean). The result highlights a low posterior inclusion probability for the absolute deviation of education public expenditure (25%). We can also, as a first step, look at the sign in front of coefficients. This initial attempt gives us a better idea about the relevance of the determinants of GVCs participation. However, model uncertainty is not a unique problem that can happen in the estimation of equation (2.13).

Table 2.2: Results of initial Bayesian estimates (posterior inclusion probability)

	(1)	(2)	(3)
	BMA1	BMA2	BMA3
VARIABLES	Log GVCs	Log GVCs	Log GVCs
Log Educ_Exp	1.00		0.99
Diff Educ_Exp.		0.25	
Log Rents	1.00	1.00	1.00
Log DistHubs	1.00	1.00	1.00
Log Tariffs	1.00	1.00	1.00
Log GDP (Cst US$)	1.00	1.00	0.10
Inflation	0.46	0.53	0.10
Log ECI	1.00	1.00	1.00
GE	1.00	1.00	1.00
Log PRights	0.98	0.98	0.89
Log Inv_Free	1.00	1.00	0.97
Log Trd_Free	0.08	0.31	0.20
Log GFCF			1.00

Note: Log Educ_Exp represents the logarithm of education public expenditure (in US$); Log Rents is the logarithm of natural resources rents (% GDP); Log DistHubs is the logarithm of physical distance of

country i to the nearest world production hubs among the two largest; Log Tariffs represents the logarithm of tariff rates; Log GDP is the logarithm of the gross domestic product; Log ECI represents the logarithm of economic complexity index; GE represents government effectiveness, Log PRights is a measure of property right; Log Inv_Free is the logarithm of investment freedom index; Log Trd_Free represents the logarithm of trade freedom index, and log GFCF represents the logarithm of gross fixed capital formation.

2.4.3. Identification concerns

Endogeneity is a significant concern in several empirical studies and our empirical model is not spared from this. The sources of this endogeneity are multiple. It can be reverse causation or measurement errors and selection bias. At a first view, there seems to be no reverse causation between our variable of interest and GVCs participation, especially backward GVCs participation. Indeed, backward GVCs participation is the amount of foreign value-added embodied in domestic exports. Therefore, foreign value-added cannot affect the government's decision to invest more in education. Next, backward GVCs integration does not affect domestic public expenditures on education, reducing endogeneity due to reverse causation. However, this analysis does not work for forward GVCs participation. Moreover, given the existence of several sources of endogeneity, it is legitimate to consider and solve the potential endogeneity issue surrounding the empirical model. A potential solution is to use lagged education public expenditure to avoid reverse causation, but this practice can generate biases. To overcome the endogeneity issue, we can follow the method proposed by Arthur Lewbel (2012). This method serves to identify structural parameters in regression models with endogenous or mismeasured regressors in the absence of traditional identifying information, such as external instruments or repeated measurements. We, therefore, rely on an instrumental variable (IV) model with internal instruments made of lagged independent variables.

2.4.4. Results

Table *2.3* shows the results of estimations using the fixed-effects estimator (columns 1 and 2) and the IV estimator (column 3). Initial results highlight a positive relationship between education expenditure and GVCs integration (column 1).

Table 2.3: Results - Impact of education public expenditure on GVCs participation

	GVCs participation		
	(1)	(2)	(3)
VARIABLES	Ctr FE	Ctr-Year FE	IV
Log Educ_Exp	0.149***	0.0598***	0.0754***
	(0.0408)	(0.0172)	(0.0232)
Log Rents	0.0984***	-0.0335***	-0.0307***
	(0.0166)	(0.00755)	(0.00741)
Log DistHubs	-0.0539	-0.0135	-0.0154
	(0.0383)	(0.0162)	(0.0158)

Log Tariffs	-0.227***	-0.0224	-0.0183
	(0.0430)	(0.0197)	(0.0193)
Log GDP	1.696***	0.411***	0.381***
	(0.0840)	(0.0460)	(0.0475)
Inflation	-0.000945	0.000845	0.00102*
	(0.00123)	(0.000530)	(0.000526)
Log ECI	-0.0857***	-0.0108	-0.00965
	(0.0163)	(0.00706)	(0.00692)
GE	9.657***	-0.0241	0.441
	(0.664)	(0.722)	(0.743)
Log PRights	-0.286***	0.0184	0.00873
	(0.0756)	(0.0328)	(0.0323)
Log Inv_Free	0.116*	-0.0911***	-0.0912***
	(0.0628)	(0.0272)	(0.0273)
Log Trd_Free	0.262***	0.323***	0.333***
	(0.0923)	(0.0394)	(0.0387)
Observations	729	729	717
R-squared	0.852	0.975	0.975
Number of id	60	60	56
Country FE	Yes	Yes	Yes
Time FE	No	Yes	Yes

Note: Log Educ_Exp represents the logarithm of education public expenditure (in US$); Log Rents is the logarithm of natural resources rents (% GDP); Log DistHubs is the logarithm of physical distance of country i to the nearest world production hubs among the two largest; Log Tariffs represents the logarithm of tariff rates; Log GDP is the logarithm of the gross domestic product; Log ECI represents the logarithm of economic complexity index; GE represents government effectiveness, Log PRights is a measure of property right; Log Inv_Free is the logarithm of investment freedom index; Log Trd_Free represents the logarithm of trade freedom index. IV estimation used two lags of independent variable as instruments. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Corrected for heteroscedasticity.

The first observation is that natural resource rents appear to impact positively GVCs participation, but when including both country and time fixed effects, the impact of natural resources becomes negative. While allowing developing countries to enter into GVCs at the bottom of the chain, natural resources do not allow for upgrading within GVCs and capturing higher value-added. If they are not well managed, natural resource rents can maintain developing countries in low value-added or sometimes hamper their upgrading process within GVCs (a manifestation of Dutch disease[21]). The second variable representing the distance to the nearest production hub is negative even if it is not significant. This negative coefficient is logical as the more countries are far from production hubs, the lower the probability of exchanging with these influential actors. However, this argument can be misleading given that the most common argument for increasing GVCs trade is the reduction in transaction costs (including transportation costs), which allows countries to source from any other country and allows firms to relocate to any other location. Regarding the rest of the control variables, as expected, an increase in tariff rates harms GVCs participation, given that it can generate tariff escalation and even hamper a

[21] Dutch disease describes an economic phenomenon where the rapid boon in natural resources results in a negative impact on the country's overall economy. The term was originally mentioned in 1977 by The Economist to describe the unfavorable repercussions of natural gas discoveries in the late 1950s on the Dutch manufacturing sector.

country's exports. In GVCs trade, imposing tariffs, even on imports, can hamper the country's exports. GVCs involve products (final or intermediate products) crossing many countries, with input also crossing many countries and being reused to compute exports. Imposing import tariffs can increase production costs by increasing input costs— thus increasing GVCs entry costs for developing countries that would like to enter basic industrialization. The level of GDP also positively affects GVCs participation. This positive impact also holds for our institutional variables.

Focusing now on our variable of interest—namely education expenditure—all the models show a positive effect on GVCs integration. The initial result is presented in column 1. While it is coherent, the outcome presents a high coefficient. However, other results with both country and time fixed effects provide better results with rational coefficients. Column 2 shows that a 1% increase in education expenditure is associated with a 0.0598% increase in the level of GVCs participation. This value increases (0.0754%) when using an IV estimator with two lagged independent variables as instruments, including both country and time fixed effects.

Table *2.4* presents response elements on the impact of education public expenditure on both backward and forward GVCs participation. The results show that education public expenditures positively impacts backward and forward GVCs participation. Education public expenditures can indirectly improve labor productivity and increase domestic value-added through their positive impact on human capital and technological upgrade. Thus, education expenditure can impact forward GVCs participation through the productivity channel. The scheme is similar for backward GVCs participation. Given that backward GVCs participation refers to foreign inputs embodied in domestic exports, most of the backward GVCs' activities focus on product assembly or reexports. Despite this, countries specializing in such activities need educated labor—at least a small amount—to achieve this goal, explaining the positive effect of education public expenditure on backward GVCs participation. However, trade barriers should be at their lowest value in this case. While our model highlights a positive relationship between education public expenditures and GVCs participation, it is relevant to argue that education public expenditure's effect on human capital and therefore GVCs participation may not be instantaneous. Education public expenditure may have a medium long-term impact on GVCs participation. Thus, it may be interesting to estimate the response of GVCs participation to an increase in education public expenditure over a longer time period.

Table 2.4: Results - Impact of education public expenditure on backward, forward GVCs participation

	Forward GVCs participation			Backward GVCs participation		
	(1)	(2)	(3)	(1)	(2)	(3)
VARIABLES	Ctr FE	Ctr-Year FE	IV	Ctr FE	Ctr-Year FE	IV
Log Educ_Exp	0.144***	0.0568***	0.0789***	0.158***	0.0664***	0.0728**
	(0.0400)	(0.0177)	(0.0239)	(0.0436)	(0.0210)	(0.0284)
Log Rents	0.0993***	-0.0308***	-0.0278***	0.102***	-0.0310***	-0.0281***

	(0.0162)	(0.00778)	(0.00764)	(0.0177)	(0.00921)	(0.00905)
Log DistHubs	-0.0254	0.00843	0.00634	-0.0999**	-0.0546***	-0.0566***
	(0.0376)	(0.0167)	(0.0163)	(0.0410)	(0.0198)	(0.0193)
Log Tariffs	-0.203***	-0.000421	0.00358	-0.247***	-0.0271	-0.0232
	(0.0422)	(0.0203)	(0.0199)	(0.0460)	(0.0241)	(0.0236)
Log GDP (Cst US$)	1.849***	0.597***	0.558***	1.578***	0.229***	0.208***
	(0.0824)	(0.0474)	(0.0489)	(0.0898)	(0.0561)	(0.0580)
Inflation	-0.000913	0.000936*	0.00123**	-0.000938	0.000932	0.00102
	(0.00121)	(0.000546)	(0.000542)	(0.00132)	(0.000646)	(0.000643)
Log ECI	-0.0948***	-0.0230***	-0.0219***	-0.0726***	0.00706	0.00811
	(0.0160)	(0.00727)	(0.00712)	(0.0174)	(0.00860)	(0.00845)
GE	9.453***	-0.360	0.0266	9.813***	0.122	0.693
	(0.652)	(0.745)	(0.765)	(0.711)	(0.881)	(0.907)
Log PRights	-0.195***	0.0964***	0.0866***	-0.385***	-0.0600	-0.0706*
	(0.0741)	(0.0338)	(0.0333)	(0.0809)	(0.0400)	(0.0395)
Log Inv_Free	0.102*	-0.0873***	-0.0898***	0.126*	-0.0989***	-0.0995***
	(0.0616)	(0.0281)	(0.0282)	(0.0672)	(0.0332)	(0.0334)
Log Trd_Free	0.164*	0.219***	0.226***	0.333***	0.408***	0.420***
	(0.0906)	(0.0406)	(0.0399)	(0.0988)	(0.0480)	(0.0473)
Observations	729	729	717	729	729	717
R-squared	0.860	0.974	0.974	0.834	0.964	0.963
Number of id	60	60	56	60	60	56
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	No	Yes	Yes

Note: Log Educ_Exp represents the logarithm of education public expenditure (in US$); Log Rents is the logarithm of natural resources rents (% GDP); Log DistHubs is the logarithm of physical distance of country i to the nearest world production hubs among the two largest; Log Tariffs represents the logarithm of tariff rates; Log GDP is the logarithm of gross domestic product; Log ECI represents the logarithm of economic complexity index; GE represents government effectiveness, Log PRights is a measure of property right; Log Inv_Free is the logarithm of investment freedom index; Log Trd_Free represents the logarithm of trade freedom index. IV estimation used two lags of independent variable as instruments. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Corrected for heteroscedasticity.

2.4.5. Estimating impulse response functions, following a local projection approach

2.4.5.1. Presentation of local projection

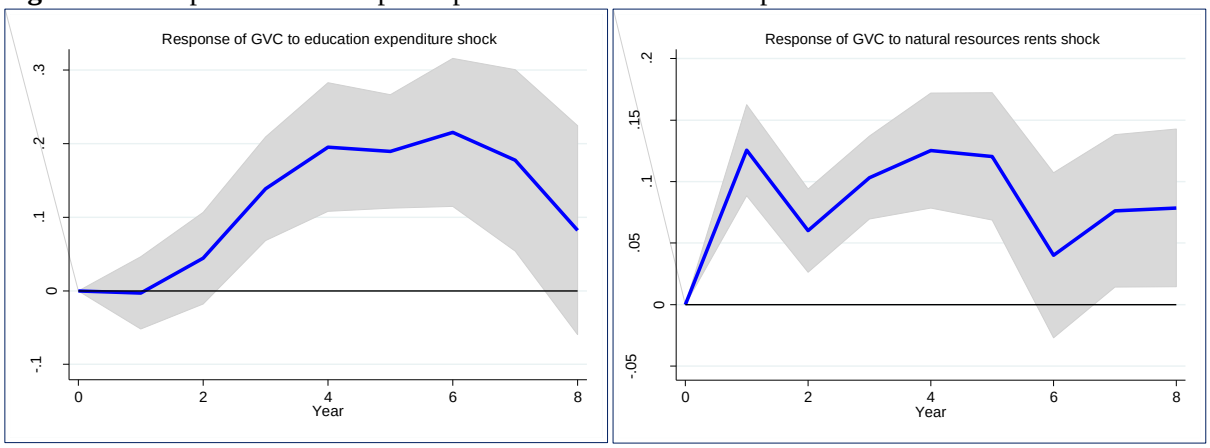
To estimate the medium and long-term effects of education public expenditure on GVCs integration, we followed Jordà (2005), using the same sample to estimate impulse responses through the local projections method. It is an alternative to VAR models and has several advantages: simple least squares can estimate them, they provide appropriate inference (individual or joint) that does not require asymptotic delta-method approximations nor of numerical techniques for its calculation, they are robust to misspecification of the DGP, and they easily accommodate experimentation with highly nonlinear specifications that are often impractical or infeasible in a multivariate context. The model is presented as follow for each future period k:

$$\Delta_k y_{i,t-1} = \propto_{i,k} + \delta_{t,k} + \theta_k \Delta\, Educ\_Exp_{i,t-1} + \sum_{j=1}^{l} \gamma_{j,k}\, \Delta Y_{i,t-j} + \sum_{j=0}^{l} \beta_{j,k} X_{i,t-j} + \varepsilon_{i,t,k} \qquad (2.14)$$

Where $\Delta_k y_{i,t-1} = y_{i,t+k} - y_{i,t-1}$ and corresponds to change in the logarithm of GVCs participation from the base year $t-1$ up to year $t+k$ with k= 0,1, …,8; $\propto_{i,k}$ and $\delta_{t,k}$ are the country and time fixed effects; the coefficient $\gamma_{j,k}$ captures the persistence of the logarithm of GVCs integration and $\beta_{j,k}$ captures the effect of a change in control variables. The impulse response is obtained by plotting the estimated coefficient θ_k for $k = 1, \dots, 8$. The number of lags chosen is equal to two.[22]

2.4.5.2. Response of GVCs participation

Figure 2.7: Response of GVCs participation to increase an in expenditures and natural resources rents



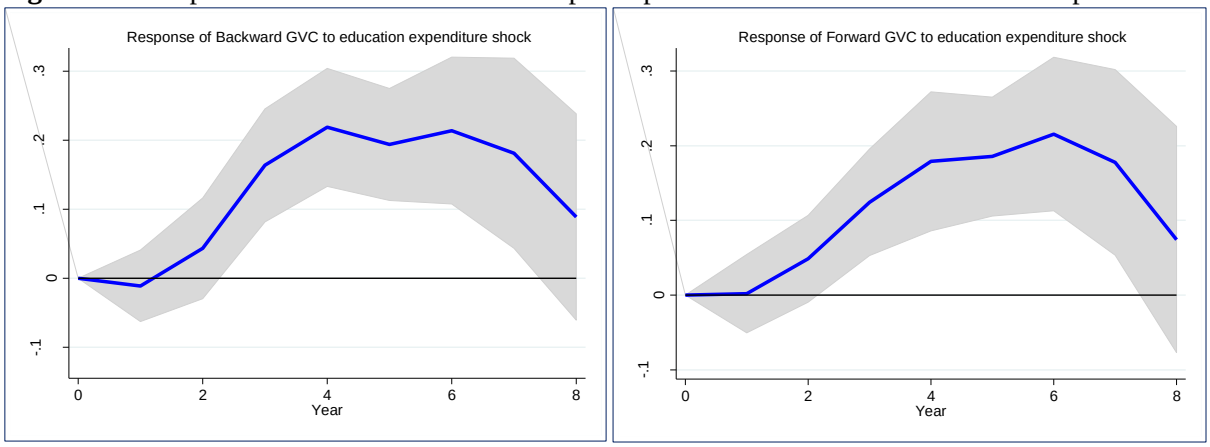
Source: Author's calculation from the results of local projection estimates
Note: The response of GVCs participation is a cumulative response. Country fixed effects considered.

The results of the local projections estimation highlight that GVCs participation has a significant and positive response to an increase in education public expenditures (**Figure 2.7**). Indeed, an increase in education public expenditures leads to an increase in GVCs participation—as well as GVCs upgrading. This positive effect starts in the third year after the increase until the seventh year. The coefficient of the response increases from the third to the sixth year before decreasing. However, it remains significant until the seventh year. This result shows that education public expenditures have a medium-term effect on GVCs upgrading. For robustness checks, we considered, in addition to the country fixed effects, time fixed effects. The results highlight a positive response of the GVCs participation that starts later in the sixth year after the increase and continues increasing until the eighth year, with lower coefficients than those obtained with only country fixed effects (**Figure A *2.2***). We also analyzed the impact of an increase in natural resource rents on GVCs upgrading. The results show a positive response of GVCs participation. However, this positive effect becomes non-significant when considering time-fixed

[22] We chose this number of lags following Jordà et al. (2011) and Furceri & Zdzienicka, (2012). This number is the maximum number of lags found to be statistically significant over the k periods in our case.

effects.

Figure 2.8: Response of forward and backward participation to an increase in education expenditures



Source: Author's calculation from the results of local projection estimates
Note: The response of GVCs participation is a cumulative response. Country fixed effects considered.

Further analysis separately considering forward and backward GVCs participation shows similar results. The estimates highlight a positive response of backward and forward GVCs participation to increased education public expenditures. The positive response of both forward and backward GVCs participation starts in the third year after the increase until the seventh year (**Figure *2.8***). When including time fixed effects, GVCs participation still responds positively to an increase in education public expenditures. However, the occurrence of this positive response and its significance are different. When considering both country and time fixed effects, forward GVCs participation responds positively to increased education public expenditures. However, this effect is only significant in the seventh year (Figure A 2.3), which means that the results are mitigated for forward GVCs participation. In contrast, backward GVCs participation responds positively to an increase in education public expenditures, and this effect is significant from the sixth year until the eighth year.

2.4.6. Robustness

For robustness purposes, we relied on GVCs participation indexes from EORA MRIO input-output tables. We also used data on GVCs integration computed by UNCTAD-EORA. Our findings suggest the same results since there is no critical difference between the two GVCs participation measures (both are using the same data source and method). Moreover, in our robustness checks, we included public expenditures other than education public expenditures (Table A 2.1). Given the collinearity between public expenditures and GDP, we removed GDP from the equation to account for other public expenditures that may impact GVCs integration. The results of the fixed effects estimator show that education public expenditures have a positive impact on GVCs participation. We also controlled for FDI inflows. The choice of controlling for FDI was motivated by its critical role in GVCs integration.

An increase in FDI inflows likely affects domestic capacities and increases domestic value-added exports if a large number of foreign firms are located in the country, which can positively affect forward GVCs participation.

Moreover, if those foreign firms located in the domestic country specialize in product assembly, the amount of foreign value-added embodied in domestic exports will also increase, positively affecting backward GVCs participation. Therefore, both backward and forward GVCs participation can be positively affected by FDI inflows. Controlling for FDI confirms these predictions. In addition, we controlled for a set of variables including foreign aid, domestic credit to the private sector (to control for financial development), air transport freight capacity (to control for distances and for improvements in shipment capacities and delivery time), and population aged between 15 and 64 to account for the labor force. The results confirm the positive impact of education public expenditures on GVCs participation. Thus, our estimation's results are robust to the measure of GVCs participation and the addition of control variables (Table A 2.1).

2.5. Conclusion

The interest in GVCs participation is not new and has been the subject of several debates and several studies, both theoretical and empirical, which have increased in recent years. This chapter provides an empirical assessment of the determinants of GVCs participation, with a particular focus on public policy. It discusses the impact of public policies—namely, education public expenditures on GVCs integration, based on a sample of 60 countries over 27 years (from 1990 to 2017). In doing so, the chapter relies on constructed measures of GVCs participation based on the well-known framework of Koopman et al. (2014), using recently developed methodologies consistent with the theoretical literature (well developed in the general introduction).

The results of the fixed effects and IV estimates suggest the existence of a positive relationship between education public expenditures and GVCs integration. This positive effect is also valid for both backward and forward GVCs participation. The chapter also discusses the response of GVCs participation to an increase in education public expenditures through the recent local projections' method, constructing impulse response functions. The result suggests a positive response of GVCs participation to an increase of education public expenditures that is only significant from the third year onward (the sixth year when considering time fixed effects). The effect of public expenditures on GVCs participation is therefore positive but not instantaneous. This lagged effect is intuitive, given that education public expenditures is composed of expenditures on all the steps, including primary, secondary, and tertiary education. Thus, increases in education public expenditures, even when well managed can take time before impacting the level of domestic human capital. However, increasing education public expenditures more than the regional mean does not necessarily increase GVCs participation. Thus, the quality and implementation of these expenditures also matter.

In terms of policy, in order to upgrade within GVCs and capture more value-added, it is effective for policymakers and developing countries' leaders to invest in education and in research and development. In addition, when implementing policies, policymakers should consider the domestic context: Investing in human capital is necessary for upgrading in GVCs, but such investments may require a baseline of at least some industrial development. While we have focused on the determinants of GVCs participation and upgrading, one can also study the effects of research and development directly to strengthen our findings or to investigate whether the positive effect of education public expenditures is conditioned by a threshold of industrial development.

Appendix: Theoretical model, descriptive statistics and results of estimates.

Appendix 1: trade equilibrium : Costinot et al. (2013)

Output of intermediate good $s + ds$ is given by:

$$q(s + ds) = (1 - \lambda_c ds)q(s) \quad (1)$$

$$\frac{q'(s)}{q(s)} = -\lambda_c \quad (2)$$

In this model, Costinot et al. (2013) consider that all markets are perfectly competitive, and all goods are freely traded. They assume that "intermediate good zero (0)" is in infinite supply and has zero (0) price $p(0) = 0$. However, "intermediate good S" correspond to the unique final good produced and we use it as a numeraire $p(S) = 1$. For technical reasons they assumed that: if a firm produce intermediate good $s + ds$, then it necessarily produces a measure $\Delta > 0$ of intermediate goods around this stage. Formally for any intermediate good $s + ds$, they assume the existence of $s_\Delta < s + ds < s_\Delta + \Delta$ such that $q(s + ds) > 0$, then $q'(s) > 0$ for all $s' \in (s_\Delta, s_\Delta + \Delta]$. This assumption implies for Cortinot et al. (2013) that each unit of q is produced by a finite number of firms.

In a free trade equilibrium, firm maximize their profits taking world prices as given and all market clear. Maximizing profit implies that for all countries $c \in C$ the intermediate good $s + ds$ price should be weakly less than its unit cost of production with equality if the intermediate good is is actually produced by a firm from c. The production of one unit intermediate good $s + ds$ requires $1/(1 - \lambda_c ds)$ units of intermediate good s as well as labor for all intermediate stages in $(s + ds]$. Therefore, the unit cost of production of the intermediate good $s + ds$ is given by $[p(s) + w_c ds]/(1 - \lambda_c ds)$. Since ds is infinitesimal, that is equal to $(1 + \lambda_c ds)p(s) + w_c$.

Good market clear condition requires that the change in world supply of intermediate goods between stages *s1* and *s2* must be equal to amount of intermediate goods lost due to mistakes in all countries between these two stages. Labor market clear condition states that total amount of labor used across all stages must be equal to the total supply of labor in country c.

Profit maximization:

$$p(s + ds) \leq (1 + \lambda_c ds)p(s) + w_c ds, \quad (A1)$$

$$p(s + ds) = (1 + \lambda_c ds)p(s) + w_c ds \; if \; Q_c(s') > 0 \; for \; all \; s' \in (s, s + ds], \quad (A2)$$

Good Market clearing

$$\sum_{c=1}^{C} Q_c(s2) - \sum_{c=1}^{C} Q_c(s1) = -\int_{s1}^{s2} \sum_{c=1}^{C} \lambda_c Q_c(s)\, ds\,, for\ all\ s1 \leq s2, \tag{A3}$$

$$\int_{0}^{S} Q_c(s)\, ds = L_c, for\ all\ c \in C, \tag{A3}$$

The model of Costinot et al. (2013) gives birth to two lemmas on free trade equilibrium. Let us refer to the vector $(S_1, \ldots, S_C)$ as the pattern of vertical specialization and denote by $Q_c = Q_c(S_c)$ the total amount of intermediate good S_c produced and exported by country c. The pattern of vertical specialization and export levels can be jointly characterized as follows.

Lemma 1.

$$S_c = S_{c-1} - \left(\frac{1}{\lambda_c}\right) \ln\left(1 - \frac{\lambda_c L_c}{Q_{c-1}}\right), for\ all\ c \in C, \tag{A4}$$

$$Q_c = e^{-\lambda_c (S_c - S_{c-1})} Q_{c-1}, for\ all\ c \in C, \tag{A5}$$

With $S_0 = 0\ and\ S_C = S$

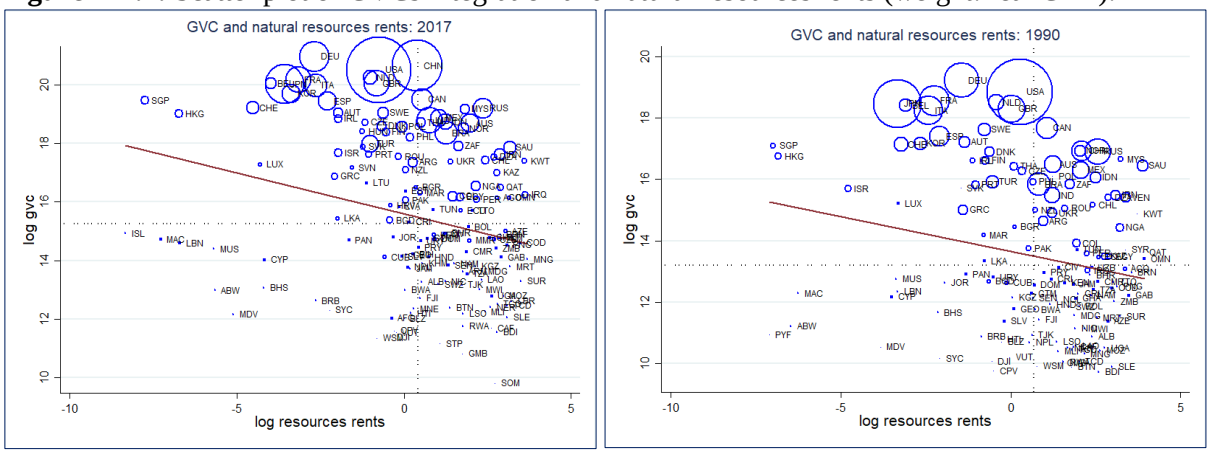
Lemma 2.

$$w_{c-1} = w_c + (\lambda_c - \lambda_{c-1}) p_c\,, for\ all\ c < C, \tag{A6}$$

$$p_c = e^{\lambda_c N_c} p_{c-1} + (e^{\lambda_c N_c} - 1)(w_c/\lambda_c)\,, for\ all\ c \in C, \tag{A73}$$

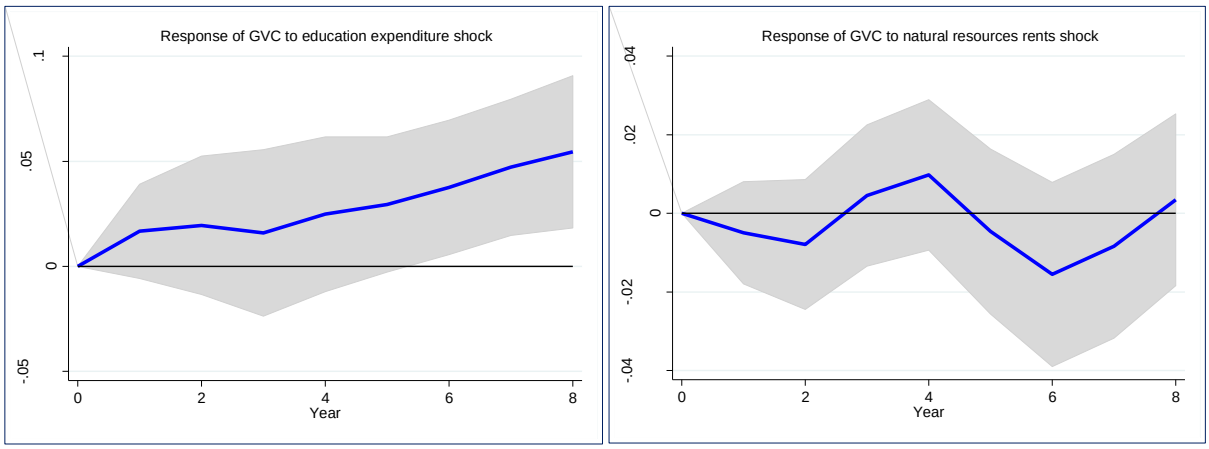
Appendix 2: Descriptive statistics and results

Figure A 2.1: Scatter plot of GVCs integration and natural resources rents (weight: real GDP).



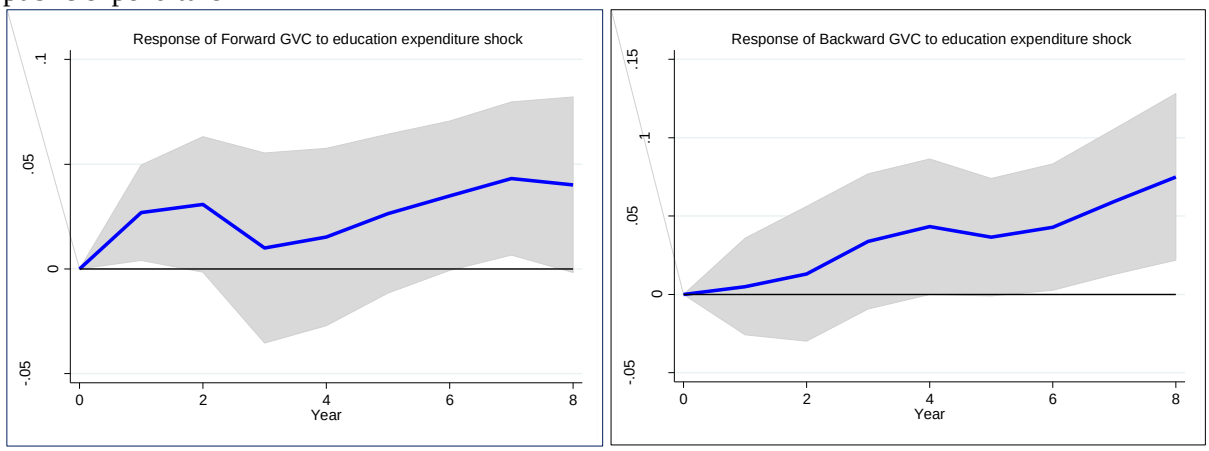
Note: The graphic is weighted by the level of GDP. The size of blue circles represents the level of countries GDP. The largest the size, the highest the level of GDP. Dash-dote lines represent the average value of both GVCs integration index and education expenditure.

Figure A 2.2: Response of GVCs participation to an increase in education public expenditure and natural resources rents



Source: Author's calculation from the results of local projection estimates
Note: The response of GVCs participation is a cumulative response. Country and time fixed effects were considered.

Figure A 2.3: Response of forward and backward GVCs participation to an increase in education public expenditure



Source: Author's calculation from the results of local projection estimates
Note: The response of GVCs participation is a cumulative response. Country and time fixed effects were considered.

Table A 2.1: Impact of education public expenditure on GVCs participation with control variables

	Additional variables (Fixed-Effects)							All
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Educ_Exp	0.149**	0.291***	0.0855*	0.0994**	0.148*	0.157**	0.137*	0.108***
	(0.0654)	(0.0944)	(0.0427)	(0.0392)	(0.0743)	(0.0659)	(0.0773)	(0.0286)
Log Rents	0.0984**	0.108***	0.106**	0.119**	0.115***	0.0873**	0.118***	0.108*
	(0.0415)	(0.0327)	(0.0456)	(0.0492)	(0.0399)	(0.0406)	(0.0384)	(0.0564)
Log DistHubs	-0.0539	-0.0399	-0.0524	-0.0800	-0.0807*	-0.0590	-0.0563	-0.0834
	(0.0586)	(0.0488)	(0.0607)	(0.0875)	(0.0417)	(0.0581)	(0.0513)	(0.0654)
Log Tariffs	-0.227***	-0.297**	-0.231***	-0.203*	-0.154***	-0.227***	-0.213***	-0.153
	(0.0487)	(0.112)	(0.0515)	(0.101)	(0.0394)	(0.0473)	(0.0560)	(0.0939)
Log GDP	1.696***		1.761***	1.593***	1.419***	1.723***	1.937***	0.978***
	(0.173)		(0.171)	(0.220)	(0.142)	(0.169)	(0.193)	(0.221)
Inflation	-0.000945	0.00250	-0.00150	0.00103	-0.000957	-0.000797	-0.000870	0.00210**
	(0.00122)	(0.00229)	(0.00126)	(0.00107)	(0.00106)	(0.00115)	(0.00124)	(0.00102)
Log ECI	-0.0857***	-0.0475**	-0.0853***	-0.0565**	-0.0880***	-0.0794***	-0.0815***	-0.0520**
	(0.0177)	(0.0229)	(0.0180)	(0.0257)	(0.0177)	(0.0178)	(0.0199)	(0.0226)
GEStdE	9.657***	10.95***	9.566***	3.957***	10.49***	9.210***	9.304***	4.679***
	(0.828)	(0.804)	(0.880)	(1.174)	(0.908)	(0.846)	(0.771)	(1.263)
Log PRights	-0.286*	-0.399**	-0.289*	-0.109	-0.404***	-0.283*	-0.318**	-0.159
	(0.151)	(0.167)	(0.152)	(0.140)	(0.122)	(0.150)	(0.145)	(0.150)
Log Inv_Free	0.116	0.225*	0.0766	-0.282**	-0.0348	0.0705	0.109	-0.394**
	(0.119)	(0.125)	(0.118)	(0.137)	(0.112)	(0.124)	(0.114)	(0.151)
Log Trd_Free	0.262	0.589**	0.249	0.0911	0.263*	0.234	0.253	0.112
	(0.215)	(0.252)	(0.206)	(0.109)	(0.153)	(0.202)	(0.192)	(0.0902)
Log Exp		0.873***						0.101
		(0.155)						(0.0890)
Log FDI			-0.00822					0.0470**
			(0.0113)					(0.0231)
Log Aid				0.0368				0.0122
				(0.0309)				(0.0239)
Log credit					0.109**			0.132
					(0.0480)			(0.0946)
Log freight						-0.0312		-0.0556*
						(0.0289)		(0.0320)
Log Pop							-0.961***	1.048**
							(0.313)	(0.386)
Observations	729	729	682	264	657	683	729	232
R-squared	0.852	0.811	0.851	0.883	0.856	0.849	0.859	0.908
Number of id	60	60	59	38	60	60	60	35

Note: Log Educ_Exp represents the logarithm of education public expenditure (in US$); Log Rents is the logarithm of natural resources rents (% GDP); Log DistHubs is the logarithm of physical distance of country i to the nearest world production hubs among the two largest; Log Tariffs represents the logarithm of tariff rates; Log GDP is the logarithm of the gross domestic product; Log ECI represents the logarithm of economic complexity index; GE represents government effectiveness, Log PRights is a measure of property right; Log Inv_Free is the logarithm of investment freedom index; Log Trd_Free represents the logarithm of trade freedom index; Log Exp represents the logarithm of public expenditure except education expenditure; Log FDI represents the logarithm of FDI flows; Log of Aid represents the logarithm of net ODA and Aid; Log credit represents the logarithm of domestic credit to private sector; Log freight represents the logarithm of air transport freight capacity and Log pop represent the logarithm of population aged from 15 to 64. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Corrected for heteroscedasticity.

Chapter 3. Aid for Trade and Global Value Chains: An Investigation of 15 Years of Trade Assistance.

3.1. Introduction

The United Nations' Sustainable Development Goals (SDGs) are a continuity of the millennium development goals. SDGs seek to build a better world for people and our planet by 2030. Goal 17, which aims to "strengthen the means of implementation and revitalize the global partnership for sustainable development," considers trade improvement a critical target. The objective of trade improvement embodied in Goal 17 is to decrease worldwide trade restrictions, to provide broader access to goods, contribute to a more open trading system, and favor exports growth from developing countries. This goal can have spillover effects on the other goals and help achieve the SDGs—through an increase in productivity, job creation, and then reduction of poverty. In practice, achieving goal 17 will help increase the level of exports from least developed and developing countries, their GVCs trade, as well as the domestic value added embodied in their exports. The logical consequence would be an increase in growth and well-being. Moreover, depending on how efficiently wealth is distributed, it would reduce poverty and inequality. Developed countries are engaged in this fight to implement SDGs through their aid programs. While the final objective is to increase exports' performances, preferential tariffs applied to imports from least developed countries and developing countries in developed markets remained unchanged. In addition, despite the efforts made by the international community to improve trade dynamics, the share of least developed countries in world merchandise exports remains just above 1% in 2018 (United Nations, 2020). Therefore, this slow growth affects the achievement of the trade target set by the Istanbul Program of Action (i.e., doubling the least developed countries' share of global exports by 2020 and achieving the SDGs by 2030). The COVID-19 pandemic has worsened the situation. Developed countries have set up a framework to support developing countries' trade. This framework is called AfT—i.e., Aid for Trade. It is an instrument used by developed countries and multilateral providers to help developing countries improve their export capabilities. After the Paris declaration of 2006, calling for an expansion of AFT funding to reduce trade costs, a WTO AfT task force was set up to implement this "positive agenda" to enhance competitiveness. This resulted in the adoption of multiple goals, without clear guidelines on conducting evaluations (Cadot et al., 2014). Trade increased around the world, and enhanced international cooperation is needed to ensure that sufficient means of implementation exist to provide developing countries the opportunity to achieve the SDGs. Since the implementation of the AfT initiative in 2006, donors have disbursed US$ 409 billion in official development assistance and US$ 346 billion in low concessional loans to help developing countries build their trade capacities (OECD, 2019).

Donors allocate AfT in four main domains: building productive capacity (BPC), economic infrastructure (EI), trade policy regulation (TPR), and trade related adjustment (TRA). Empirical studies and program evaluations have found that AfT improves countries' competitiveness, expands and diversifies their trade, attracts FDI, and creates employment (OECD, 2019). The literature has demonstrated the impact of AfT on trade, but few studies have focused on the effect on GVCs participation. While the literature on the determinants of GVCs participation is recent, all factors that reduce trade costs, improve economic infrastructure, advance industrialization, and improve market share constitute important determinants to GVCs participation.

The literature on AfT is highly correlated to the literature on aid and development assistance. First, past studies have investigated the effects of aid on growth based on the neoclassical growth model, where aid provides a boost to capital accumulation and thus to growth (Burnside & Dollar, 2000; Prasad et al., 2007). However, existing studies do not show any consensus on the direction of the effects. While some authors have found a positive effect (Arndt et al., 2015; Gomanee et al., 2005; H. Hansen & Tarp, 2001, p. 2001; Malcolm F. McPherson & Tzvetana Rakovski, 2001; Moolio & Kong, 2016), others claim the absence of a significant effect or a negative effect of aid (Burnside & Dollar, 2000; Doucouliagos & Paldam, 2007; Prasad et al., 2007; Rajan & Subramanian, 2005). Second, most of the studies that have investigated AfT effectiveness report a positive impact of AfT on recipient countries' export performance[23] and development indicators (Bearce et al., 2013; Brazys, 2013; Brenton & von Uexkull, 2009; Cirera & Winters, 2015; Durowah, 2017; Ferro et al., 2014; Ghimire et al., 2016; Gnangnon, 2019a, 2019b; Helble et al., 2012; Hühne et al., 2014a, 2014b; Hynes & Holden, 2016; H.-H. Lee & Ries, 2016; S. L. Lee, 2018; Martínez-Zarzoso et al., 2017; Razzaque & te Velde, 2013; Roy, 2017; Vijil & Wagner, 2012; Winters & Martuscelli, 2014). Among recent studies, Ghimire et al., (2016) found a positive and significant effect of AfT on multiple measures of export performance, but with diminishing returns. Roy (2017) found that AfT can play a supportive role in improving the policy environment and help attract the FDI required to meet the SDGs and develop the ICT infrastructure. Martínez-Zarzoso et al. (2017) confirmed the assistance effect of AfT for vulnerable countries and said that "countries that export less in volume are those benefitting most from aid for trade." This statement has further been confirmed by S. L. Lee (2018). Gnangnon (2019a) shows that AfT has a positive and significant effect on total (male and female) employment, and the share of female employment, but no significant effect on the share of male employment. He also found that AfT inflows exert a positive and significant impact on recipient countries' export ratios. However, some findings suggest different effects depending on the region or the type of AfT. In fact, Brazys (2013) shows that differences in program design and implementation may account for differences in AfT export effects. Cirera & Winters (2015) provide

[23] Exports performance was mostly measure by export to GDP ratio.

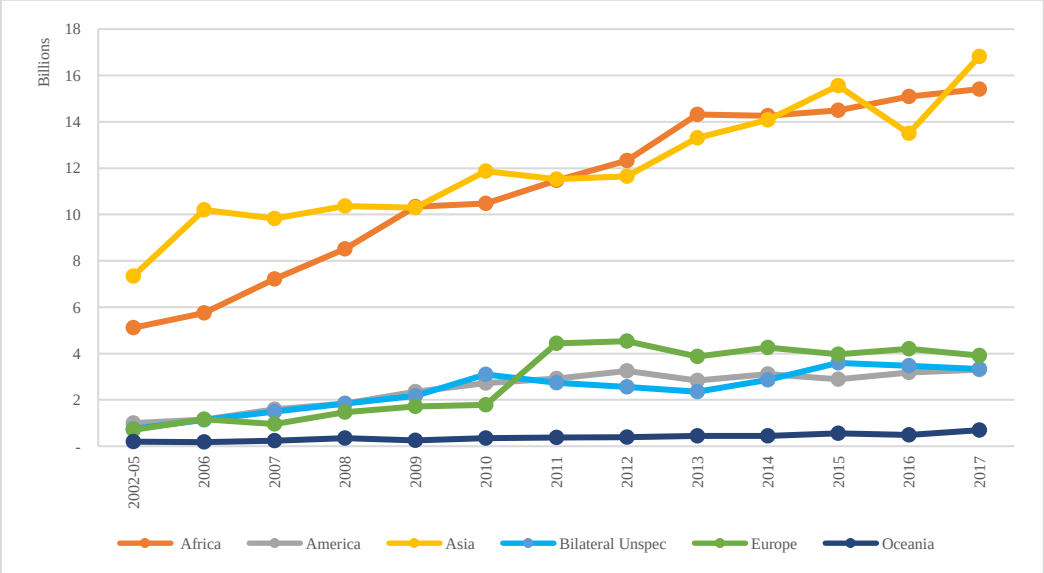
evidence that AfT flows appear to have had a statistically significant impact in reducing the time of exporting and importing in Sub-Saharan Africa. Evaluations from AfT programs and projects and the case stories submitted in the context of earlier AfT monitoring exercises have corroborated these empirical findings (OECD & WTO, 2017).

While many researchers have shown the effect of AfT on exports, none of them have focused on the capacity of developing countries to create value (i.e., domestic value-added embodied in exports). The present chapter investigates the effect of AfT on GVCs participation, separating the effect on both forward and backward GVCs participation (domestic value-added exports and foreign value-added embodied in domestic exports). It builds on previous studies to expand the coverage and depth of the AfT analysis to shed light on the long-term implications of AfT on developing countries' trade performance. Using panel data of a unique database on AfT disbursement of 96 recipients over 15 years (2002–2017), this chapter uses panel fixed effects and instrumental variable (IV) estimators with internal instruments to investigate the capacity of AfT in helping developing countries upgrade within GVCs. The results show evidence of a positive effect of AfT on domestic value-added. Heterogenous studies give more detail and show that loans perform better than grants. Results also suggest that the need of the recipient country should be considered in AfT's allocation in order to have a better impact.

The rest of the chapter is organized as follow. Section 3.2 provides stylized facts on the AfT trend. Section 3.3 discusses the methodology, section 3.4 discusses the results and findings, and section 3.5 concludes.

3.2. Stylized facts: An evaluation of 15 years of Aid for Trade

Figure 3.1: AfT by continent from 2002 to 2017 (USD Millions)



Source: Author's calculation based on OECD data

The evolution of the AfT from 2002 to 2017 by region gives information on the highest recipients. AfT is most directed to African and Asian countries (Figure 3.1). From 2002 to 2011, Asia was the highest recipient of AfT, followed by Africa. Africa took first place from 2011 to 2014. After 2014, the AfT received by Asia fluctuated, but the region remained the top recipient in 2017. Globally, Asia and Africa received approximately 74% of the total disbursement from 2002 to 2017. Thus, AfT disbursements dedicated to the other regions are far below the amounts received by Asia and Africa.

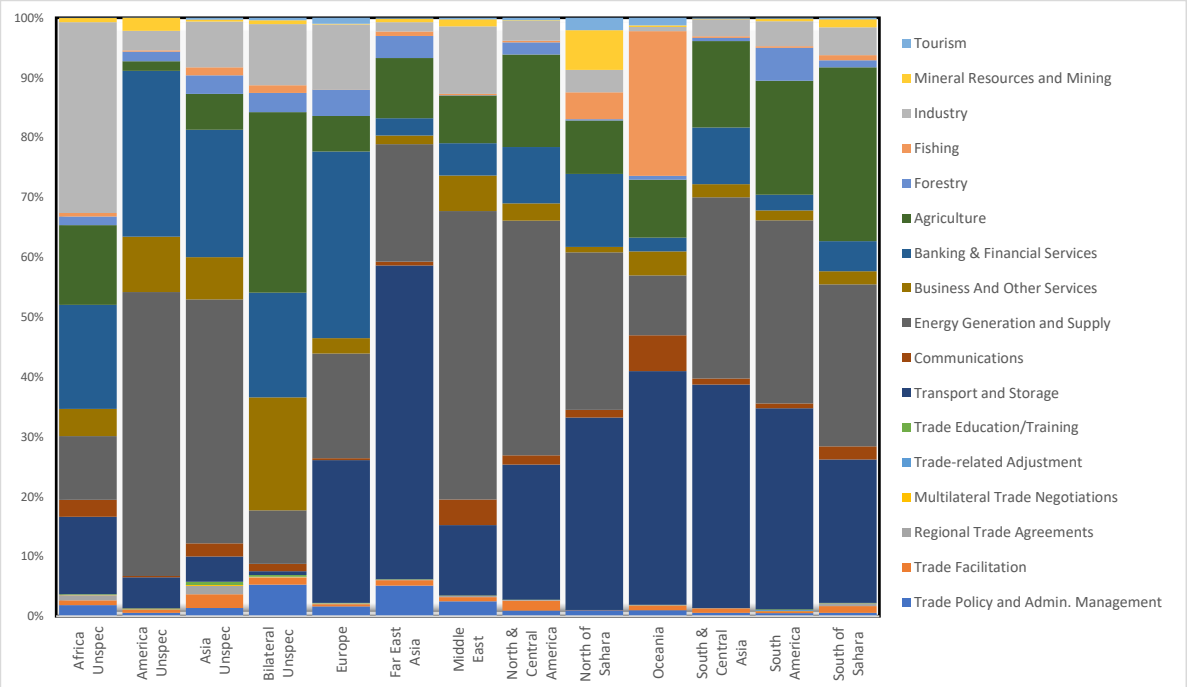
Figure 3.2: Aid for Trade by region and category (percentage 2017, 2010, 2008, 2002–05)

Source: Author's calculation based on OECD data

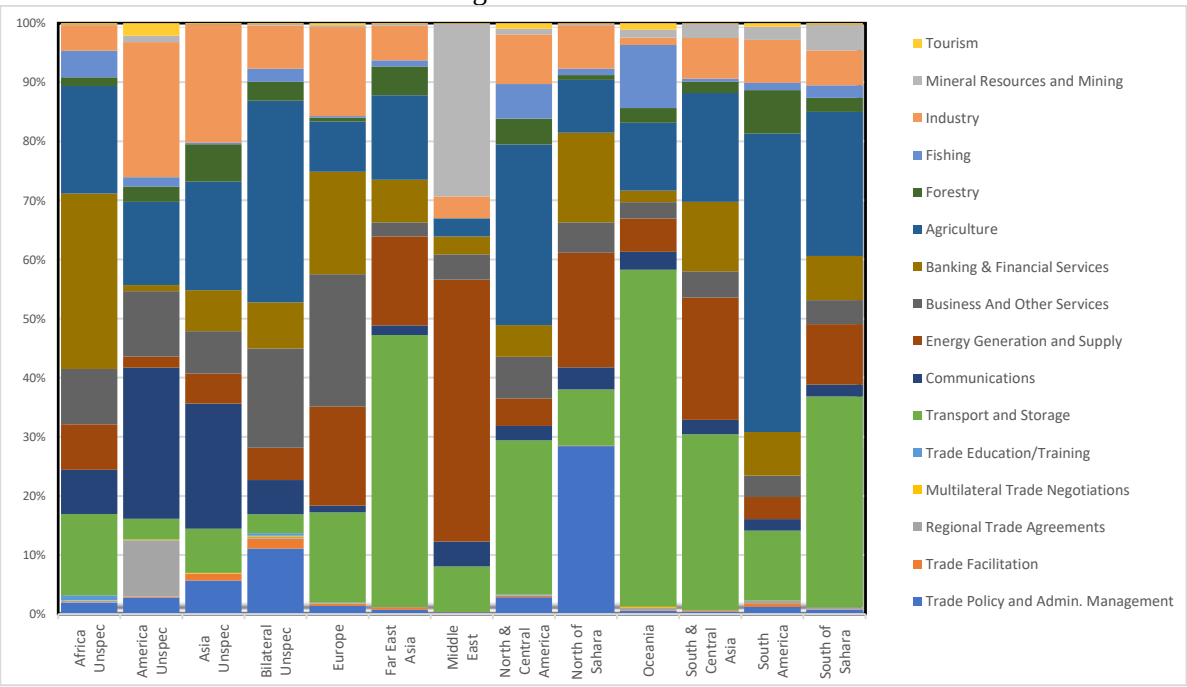
AfT is composed of different categories, namely BPC, EI, TPR, and TRA. During the years mentioned in Figure 3.2 (2002–05, 2008, 2010, and 2017), the repartition of AfT across the different categories shows that for almost all the continents, AfT was most concentrated in the BPC and EI categories (Figure 3.2). The two other categories are less represented. In 2002–05, the two continents with the highest share of BPC over total AfT were America (72%) and Europe (65%), followed by Africa (49%), Asia (42%), and Oceania (33%). In 2002–05, Africa was the continent with the highest share of trade policy regulation over total AfT (except bilateral unspecified). In 2008, at the beginning of the crisis, America still had the highest share of BPC (67%), followed by Africa (48%). However, in 2017, the configuration changed, with Europe holding the largest share of AfT in the BPC category (57%). In absolute terms, among all the continents, Asia had the highest volume of BPC in 2002–05, followed by Africa, while in 2017, Africa had the highest volume of AfT allocated to the BPC category.

Figure 3.3: Aid for Trade by region and sub-Category in average 2002–05 and 2017

A- Aid for Trade 2017



B- Aid for Trade average 2002–05



Source: Author's calculation based on OECD data

Note: Africa Unspec, America Unspec and Asia Unspec refer to AfT allocated globally to a continent without any specification of the region or country. Bilateral Unspec refers to AfT allocated by a specific donor (country) to another unspecified country.

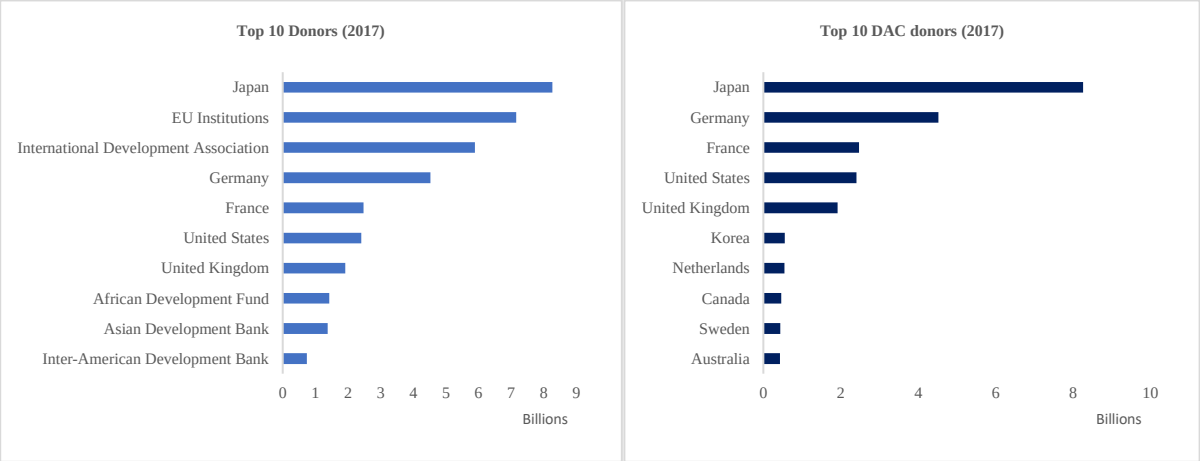
To deepen our analysis, we focused on more disaggregated AfT data and analyzed AfT sub-categories by region (Figure 3.3). The sectoral allocation and repartitioning of AfT are differ across regions. In

2017, in Europe, the two most important sectors of AfT allocation were “banking and financial services” and “transport and storage.” In Oceania, the two most important sectors of AfT allocation were “transport and storage” and “fishing.” The configuration is different in Sub-Saharan Africa, where “energy generation and supply” and “agriculture” were the two largest sectors of AfT allocation. Finally, in the Far East Asia, the Middle East, North and Central America, North of Sahara, South and Central Asia, and South America, “energy generation and supply” and “transport and storage” sectors were identified as the two largest sectors of AfT allocation. Global observation shows that AfT allocation depends on the region’s needs. Sub-Saharan Africa’s case confirms this observation, given that an important share of AfT is mainly allocated to the “agriculture” sector. This figure is understandable given that more than 60% of the population of sub-Saharan Africa is smallholder farmers, and that about 23% of sub-Saharan Africa’s GDP comes from agriculture. The case of Oceania is also specific, as the fishery was the second largest sector of AfT allocation.

Comparing AfT allocation in 2002–05 and 2017 shows that in sub-Saharan Africa, AfT sectoral allocation did not vary significantly as the three main sectors of AfT remained the sectors of “agriculture,” “transport and storage,” and “energy generation and supply.” However, in South America, AfT moved from the “agriculture” sector, which had an important share in 2002–05, to “transport and storage” and “energy generation and supply” sectors in 2017, which can illustrate an evolution in priorities and upgrade through value chains. Another significant change is the reduction in the share of AfT allocated to “mineral resources and mining” in the Middle East. All these changes illustrate the evolution in trade-related priorities. In addition to the difference in AfT allocated to sectors across regions, there are differences in donors (the type of donors and their importance in global AfT volume).

Japan was the highest provider of AfT in 2017. With US$ 8 billion of AfT disbursement, Japan is ahead of essential donors such as EU institutions (US$ 7 billion), the International Development Association (US$ 6 billion), and the African Development Bank (US$1 billion). In 2017, five of the top 10 AfT providers were DAC countries. This substantial share of DAC providers in AfT shows that DAC members provide more AfT than other countries to promote developing countries’ trade development (Figure 3.4). In 2017, the top provider among DAC countries was Japan, with the highest disbursement of AfT in absolute terms. The other highest providers of AfT in 2017 were Germany (US$ 4 billion), France (US$ 2 billion), the USA (US$ 2 billion), and the UK (US$ 1.9 billion). The contributions of DAC members remain important, and it is legitimate to evaluate this contribution compared to the rest of the providers. This initiative follows the EU’s objective of increasing its amount of AfT to developing countries. The analyses presented below, focus on investigating the impact depending on the type of donor, the category of AfT, and the type of flows (grants vs loans). However, before reaching this level of disaggregation, it is important to understand to present the methodology followed to quantify the impact of AfT on recipient countries’ macroeconomic indicators.

Figure 3.4: Top 10 providers of AfT (2017)



Source: Author's calculation based on OECD data

3.3. Methodology and data

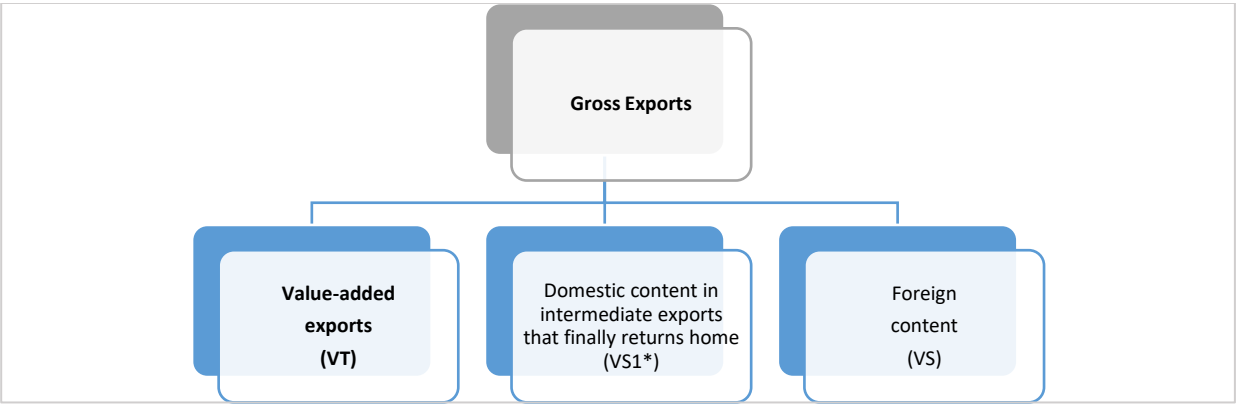
The study aims to investigate the impact of AfT on recipients' level of GVCs participation—especially domestic value-added embodied in gross exports. Indeed, many studies have already investigated the effects of AfT on aggregated or bilateral gross exports. However, with vertical specialization, countries' gross exports no longer reflect domestic value-added but include foreign value-added embodied in exports. That is why we found it necessary to look at the effects of AfT on GVCs participation and to emphasize domestic value-added exports over gross exports. Our sample comprised 96 recipient countries from 2002 to 2017. The model is presented as follows:

$$\begin{aligned} \ln(GVCs)_{it} = {} & \alpha + \mu_i + \theta_t + \beta_1 \ln(AfT)_{i,t} + \beta_2 \ln(FDI)_{i,t} + \beta_3 \ln(Tariffs)_{i,t} \\ & + \beta_4 \ln(DEBT)_{i,t} + \beta_5 \ln(GDP)_{i,t} + \beta_7 \ln(GDPPC)_{i,t} + \beta_8 \ln(RER)_{i,t} \\ & + \beta_9 \mathrm{INFL}_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{3.1}$$

With μ_i representing country-specific effects; θ_t representing time fixed effects; and *AfT* representing the disbursement of AfT. *FDI* is foreign direct investments, *Tariffs* is the tariff rate, *DEBT* represents central government debt, RER is real exchange rates, GDP represents the level of real GDP, GDPPC represents the level of GDP per capita, and INFL represents the inflation rate measured proxied by the GDP deflator.

GVCs is GVCs participation as measured in Chapter 1.[24] As a reminder, it represents the sum of domestic value-added exported goods or intermediates used by third countries as intermediate goods to compute final or intermediate goods and foreign value-added embodied in domestic exports. The idea behind this index is to know how much the value-added created at home is used toward the world as intermediate goods (forward GVCs participation) and to what extent domestic country uses foreign value-added to produce its exports (backward GVCs participation). Indeed, gross exports comprise domestic value-added exports, domestic content in intermediate exports that finally return home, and foreign value-added (contents). Domestic value-added exports estimate value-added created by an economy — that is domestic contents embodied in gross exports (*Figure 3.5*). Data on GVCs and domestic value-added exports data came from our calculation (Chapter 1).

Figure 3.5: Decomposition of gross exports



Source : Koopman et al.(2014)

AfT data come from the OECD CRS database. The control variables come from the World Bank World Development Indicators (WDI) database, the IMF, and the WITS. Gross debt, FDI, credit to the private sector, inflation rate, Real GDP per capita that measures the wealth of nations, Real GDP, used as a proxy of the size of the economy, natural resources rent, real effective exchange rate, are all obtained from the WDI. Tariffs data come from the UNCTAD TRAINS database and were obtained through the World Integrated Trade Solution (WITS) website.

The study seeks to investigate the causal impact of AfT on GVCs participation. Estimating equation (*3.1*) can be challenging if the independent variable either presents measurement errors or is in a reverse causation link with the dependent variable (endogeneity). The value of AfT commitment does not depend on the recent country's level of GVCs participation, this observation leads to the conclusion of a lack of endogeneity. However, equation (3.1) still raises the question of endogeneity, since model uncertainty can generate endogeneity caused by missing variables. Therefore, the current study needs

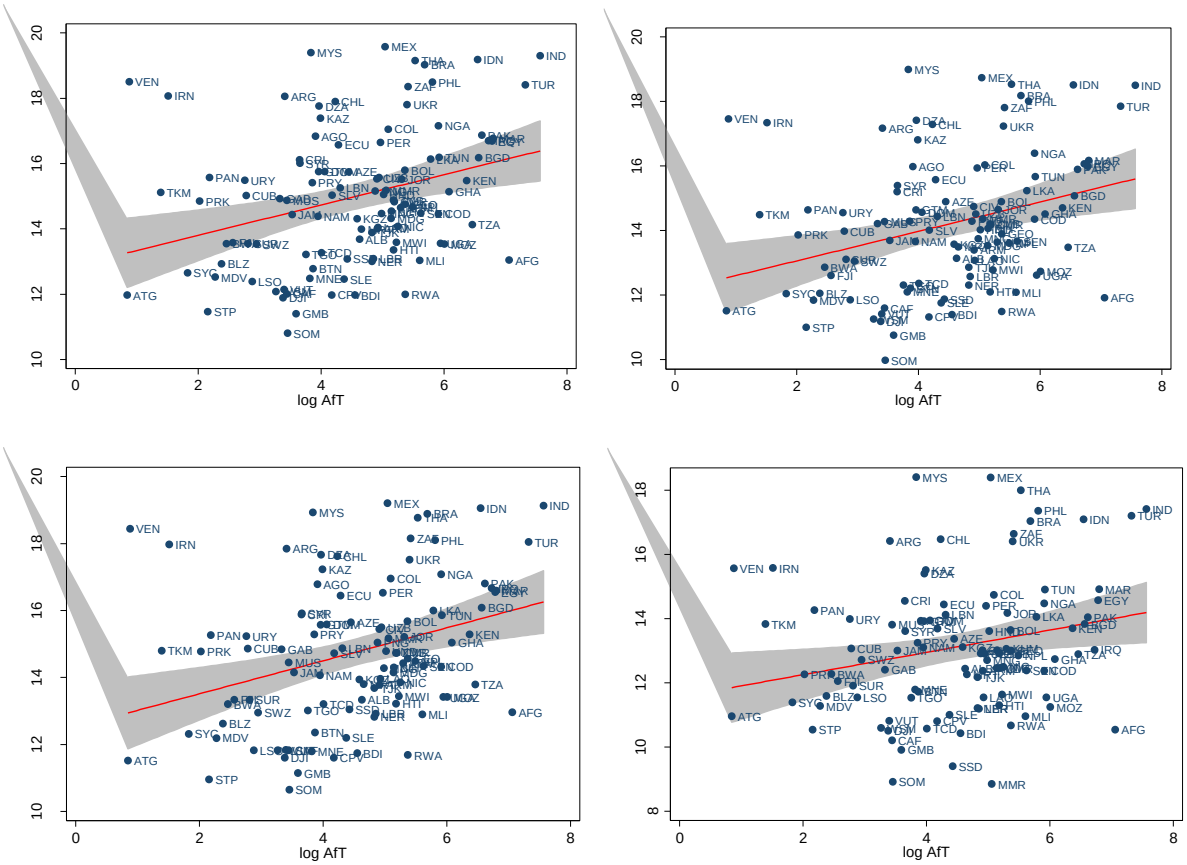
[24] Reliable GVCs participation indexes can be obtained from the UNCTAD MRIO index of Global Value Chains integration

an appropriate estimator to estimate equation (*3.1*). To overcome this endogeneity issue, we followed the method proposed by Lewbel (2012). It is an IV method used for the identification of structural parameters in regression models with endogenous or mismeasured regressors in the absence of traditional identifying information, such as external instruments or repeated measurements.

3.4. Results

The link between AfT and trade seems intuitive and direct given the initial aim of the program. However, the impact of AfT on GVCs participation is less evident and has been less documented. Figure 3.6 shows the link (i.e., correlation) between AfT and GVCs participation (backward and forward GVCs participation).

Figure 3.6: Scatter – value added exports, GVCs participation and AfT (Av. 2002-2017)



Source: Author's calculation based on OECD data

There is a positive correlation between AfT and GVCs participation, domestic value added exported and foreign value added exported. The determinants of GVCs participation include regional trade agreements, investment, quality of infrastructure, the flexibility of movement of goods and information, institutions, and transport logistics (Kowalski et al., 2015). AfT programs are already dealing with a number of GVCs-related determinants— namely, border administration, market access, trade

facilitation, and business environment— which implies that AfT can generate new trade opportunities and is likely to accelerate GVCs participation.[25] In fact, AfT has four main subcategories that illustrate how AfT affects trade and GVCs integration. By improving infrastructure, AfT can unlock the necessary logistics to improve the shipment of goods and products across and within countries. In addition, AfT also aims to build developing countries' productive capacity, improving production capacity and the private sector's efficiency. Finally, trade policy regulation and trade-related adjustment directly affect receiving countries' trade and allow for the implementation of relevant trade policies.

Table 3.1: The impact of AfT on value added exports, and GVCs participation.

	Panel Fixed-Effects				IV heteroskedasticity-based instruments			
VARIABLES	Va-exp	dva	fva	gvc	Va-exp	dva	fva	gvc
Log AfT	0.0471***	0.0457***	0.0465***	0.0483***	0.0590***	0.0470**	0.0970***	0.0588***
	(0.0112)	(0.0122)	(0.0129)	(0.0114)	(0.0211)	(0.0214)	(0.0256)	(0.0207)
Log FDI	0.00669	0.00238	0.0223	0.0132	0.00720	0.00422	0.0143	0.0136
	(0.0113)	(0.0111)	(0.0157)	(0.0117)	(0.00841)	(0.00844)	(0.0102)	(0.00832)
Log Gross Debt	-0.116***	-0.115***	-0.125***	-0.132***	-0.0120	-0.0186	-0.00261	-0.0225
	(0.0367)	(0.0371)	(0.0415)	(0.0377)	(0.0295)	(0.0286)	(0.0372)	(0.0283)
Log GDP	1.677***	1.724***	1.673***	1.525***	1.211***	1.354***	0.758***	0.953***
	(0.190)	(0.219)	(0.210)	(0.165)	(0.132)	(0.135)	(0.151)	(0.124)
Log GDP PC	-0.387	-0.471*	-0.418	-0.230	-0.329*	-0.492***	0.0712	-0.0995
	(0.253)	(0.273)	(0.335)	(0.238)	(0.170)	(0.177)	(0.189)	(0.158)
Inflation Rate	0.00396**	0.00347**	0.00747***	0.00634***	0.00490***	0.00449***	0.00616***	0.00632***
	(0.00153)	(0.00150)	(0.00204)	(0.00178)	(0.00119)	(0.00117)	(0.00143)	(0.00123)
Log Tariff Rate	-0.0329	-0.0176	-0.0815*	-0.0568	-0.0208	-0.00528	-0.0645**	-0.0257
	(0.0386)	(0.0408)	(0.0443)	(0.0390)	(0.0236)	(0.0251)	(0.0281)	(0.0243)
Log RER	-0.0400	-0.0449	-0.0691***	-0.0633**	0.00954	0.0101	-0.00477	-0.0159
	(0.0259)	(0.0317)	(0.0178)	(0.0260)	(0.0187)	(0.0187)	(0.0223)	(0.0195)
Observations	782	782	782	782	733	733	733	733
R-squared	0.722	0.695	0.665	0.699	0.526	0.532	0.352	0.452
Number of id	91	91	91	91	85	85	85	85
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Log AfT is the logarithm of Aid for Trade; Log FDI represents the logarithm of Foreign Direct Investment; Log Gross Debt measures the logarithm of Gross Debt; Log GDP is the logarithm of Gross Domestic Product; Log GDP PC represents the logarithm of Gross Domestic Product per capita; Inflation Rate measures the rate of inflation proxied by the GDP deflator; Log Tariff Rate is the logarithm of trade tariffs; Log RER represents the logarithm of Real Effective Exchange rate. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Corrected for heteroscedasticity.

Furthermore, the AfT program can help improve compliance with standards in order to improve developing countries' GVCs participation and assist directly with south-south GVCs participation. It also enhances workers' technical skills, both inside and outside the value chain. AfT, through increased investment and improved capacity of the private and public sectors, makes it possible to capture the benefits of existing and future market access. It helps facilitate, implement and adjust to trade reform and liberalization. AfT also improves regional integration and integration into the world trading system, and it assists in implementing trade agreements. Building the capacity of the private sector through technical support, capacity building, and trade-related infrastructure are central AfT objectives that align closely with the needs of SMEs in meeting sustainability compliance. AfT can play a strategic role in assisting those SMEs incorporate themselves into relevant global or regional value chains (Redden,

[25] https://www.wto.org/english/res_e/booksp_e/aid4trade13_chap5_e.pdf

2017). The initial results of our estimations indicate that AfT has a positive impact on value added exports and GVCs participation. A 1% increase in AfT leads to a 0.047% increase in value added exports (Table 3.1). The coefficients in front of domestic and foreign value added are also significant and positive, illustrating the positive impact of AfT on both backward and forward GVCs participation. These initial results were confirmed when controlling for additional variables such as natural resources, institutions, and the level of financial development. As mentioned above, we also conduced IV regressions using lagged independent variables as instruments. These estimations support our initial model's results: AfT positively affects GVCs participation (Table 3.2).

Table 3.2: The impact of AfT on value added exports, and GVCs participation (additional variables)

	Panel Fixed-Effects				IV heteroskedasticity-based instruments			
VARIABLES	Va-exp	dva	fva	gvc	Va-exp	dva	fva	gvc
Log AfT	0.0298**	0.0297**	0.0285*	0.0271*	0.0484**	0.0394*	0.0834***	0.0506**
	(0.0133)	(0.0139)	(0.0161)	(0.0137)	(0.0202)	(0.0201)	(0.0248)	(0.0203)
Log Nat Resources	0.0807***	0.0741***	0.116***	0.0875***	0.0617***	0.0548***	0.0979***	0.0724***
	(0.0214)	(0.0208)	(0.0296)	(0.0217)	(0.0176)	(0.0172)	(0.0222)	(0.0175)
Log Credit	0.101*	0.0815	0.151*	0.0912*	0.0555	0.0422	0.0787	0.0264
	(0.0563)	(0.0557)	(0.0764)	(0.0539)	(0.0420)	(0.0403)	(0.0534)	(0.0417)
Log Institutions	-0.479**	-0.380*	-0.617**	-0.594***	-0.220	-0.145	-0.313	-0.314**
	(0.205)	(0.216)	(0.307)	(0.216)	(0.156)	(0.154)	(0.202)	(0.157)
Log FDI	0.00509	0.000892	0.0202	0.0130	0.00607	0.00374	0.0116	0.0121
	(0.0102)	(0.00990)	(0.0148)	(0.00990)	(0.00874)	(0.00866)	(0.0107)	(0.00874)
Log Gross Debt	-0.0868**	-0.0831**	-0.0809	-0.104**	-0.0166	-0.0170	-0.0124	-0.0294
	(0.0427)	(0.0411)	(0.0563)	(0.0426)	(0.0309)	(0.0297)	(0.0399)	(0.0302)
Log GDP	1.416***	1.524***	1.135***	1.241***	1.144***	1.263***	0.742***	0.946***
	(0.183)	(0.194)	(0.216)	(0.165)	(0.136)	(0.139)	(0.164)	(0.131)
Log GDP PC	-0.120	-0.240	0.0547	0.0537	-0.170	-0.297*	0.150	0.0156
	(0.239)	(0.255)	(0.278)	(0.206)	(0.176)	(0.179)	(0.207)	(0.170)
Inflation Rate	0.00502***	0.00462***	0.00689***	0.00584***	0.00512***	0.00474***	0.00607***	0.00622***
	(0.00120)	(0.00124)	(0.00149)	(0.00115)	(0.00124)	(0.00123)	(0.00150)	(0.00126)
Log Tariff Rate	-0.0303	-0.00568	-0.0990**	-0.0514	-0.0127	0.00773	-0.0679**	-0.0219
	(0.0357)	(0.0384)	(0.0420)	(0.0374)	(0.0234)	(0.0248)	(0.0285)	(0.0245)
Log RER	-0.00570	-0.0102	-0.0255	-0.0274	0.00732	0.00737	-0.00294	-0.0147
	(0.0261)	(0.0250)	(0.0394)	(0.0257)	(0.0192)	(0.0192)	(0.0236)	(0.0195)
Observations	827	827	827	827	709	709	709	709
R-squared	0.727	0.718	0.632	0.694	0.548	0.548	0.397	0.482
Number of id	83	83	83	83	82	82	82	82
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Log AfT is the logarithm of Aid for Trade; Log FDI represents the logarithm of Foreign Direct Investment; Log Gross Debt measures the logarithm of Gross Debt; Log GDP is the logarithm of Gross Domestic Product; Log GDP PC represents the logarithm of Gross Domestic Product per capita; Inflation Rate measures the rate of inflation proxied by the GDP deflator; Log Tariff Rate is the logarithm of trade tariffs; Log RER represents the logarithm of Real Effective Exchange rate. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Corrected for heteroscedasticity.

3.4.1. Heterogeneity in the impact: Which category and type of AfT works

As discussed above, AfT has four main subcategories: BPC, EI, TPR and TRA. We investigated the impact of each AfT category on domestic value-added exports. Our results indicate that among these subcategories, AfT allocated to economic infrastructures has a positive impact on countries' domestic

value-added exports.[26] The impact of AfT allocated to the categories BPC and TPR is not significant. The category TI presents better results: a 1% increase in AfT dedicated to TI leads to a 0.022% significant increase in domestic value added (Table 3.3, column 4). However, this effect may change depending on the region. In fact, regional results show that AfT dedicated to BPC has a positive and significant impact on domestic value added exported in American countries (Table A 3.1). In the case of AfT dedicated to improving EI, the findings suggest a positive and significant impact in both Africa and America (Table A 3.2), while AfT dedicated to TPR only shows positive and significant results in Asia (Table A 3.3). These results may reflect each region's need in terms of aid and give an overview of where AfT can make an impact depending on its allocation.

AfT composition also matters. The analysis can also be subdivided into the type of AfT provided. We can distinguish between loans and grants. A deeper and more disaggregated analysis of the impact of AfT shows differences between loans and grants. In fact, our results suggest that loans perform better than grants. A 1% increase in AfT loan leads to a 0.18% significant increase in the beneficiary country's domestic value-added exports. In contrast, the effect of grants is not significant (although it is positive) (Table 3.4).

Table 3.3: The impact of AfT subcategories on domestic value-added exports

VARIABLES	(1) BPC	(2) EI	(3) TPR	(4) All
Log AfT BPC	0.0138			0.0112
	(0.0274)			(0.0292)
Log AfT EI		0.0235**		0.0223**
		(0.0106)		(0.0109)
Log AfT TPR			-0.00111	-0.00211
			(0.01000)	(0.00993)
Log FDI	-0.00529	-0.00532	-0.00499	-0.00459
	(0.0174)	(0.0171)	(0.0179)	(0.0178)
Log Gross Debt	-0.153***	-0.158***	-0.140***	-0.146***
	(0.0374)	(0.0376)	(0.0399)	(0.0373)
Log GDP	2.121***	2.041***	2.083***	1.992***
	(0.293)	(0.295)	(0.318)	(0.330)
Log GDP PC	-1.300***	-1.251***	-1.167**	-1.170**
	(0.410)	(0.397)	(0.449)	(0.465)
Inflation Rate	0.00378*	0.00371*	0.00375*	0.00311
	(0.00193)	(0.00201)	(0.00213)	(0.00196)
Log Tariff Rate	-0.0895	-0.0830	-0.0715	-0.0588
	(0.0695)	(0.0696)	(0.0700)	(0.0672)
Log RER	-0.146	-0.137	-0.171*	-0.142
	(0.0957)	(0.0920)	(0.101)	(0.103)

[26] There is no result for Trade related Adjustment (TRA) because of lack of data.

Observations	332	330	324	323
R-squared	0.632	0.637	0.612	0.617
Number of id	38	38	38	38
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Note: Log AfT is the logarithm of Aid for Trade; Log FDI represents the logarithm of Foreign Direct Investment; Log Gross Debt measures the logarithm of Gross Debt; Log GDP is the logarithm of Gross Domestic Product; Log GDP PC represents the logarithm of Gross Domestic Product per capita; Inflation Rate measures the rate of inflation proxied by the GDP deflator; Log Tariff Rate is the logarithm of trade tariffs; Log RER represents the logarithm of Real Effective Exchange rate. BP: Building Productive capacity; EI: Economic Infrastructure; TPR: Trade policy regulation; Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Corrected for heteroscedasticity.

Table 3.4: The impact of the type of AfT (loan vs grants) on domestic value-added exports

VARIABLES	(1) Fixed Effects	(2) Fixed Effects	(3) Fixed Effects
Log AfT loan	0.0183***		0.0181***
	(0.00625)		(0.00629)
Log AfT grants		0.0249	0.0174
		(0.0185)	(0.0230)
Log FDI	0.00197	0.00334	0.00250
	(0.0123)	(0.0114)	(0.0123)
Log Gross Debt	-0.111***	-0.111***	-0.104**
	(0.0416)	(0.0367)	(0.0413)
Log GDP	1.782***	1.789***	1.742***
	(0.228)	(0.228)	(0.236)
Log GDP PC	-0.496*	-0.485*	-0.456
	(0.283)	(0.285)	(0.287)
Inflation Rate	0.00455**	0.00335**	0.00430**
	(0.00175)	(0.00145)	(0.00173)
Log Tariff Rate	-0.00877	-0.0219	-0.00892
	(0.0433)	(0.0414)	(0.0428)
Log RER (USD)	-0.0890**	-0.0401	-0.0920**
	(0.0393)	(0.0322)	(0.0389)
Observations	712	782	712
R-squared	0.676	0.690	0.677
Number of id	88	91	88
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Note: Log AfT is the logarithm of Aid for Trade; Log FDI represents the logarithm of Foreign Direct Investment; Log Gross Debt measures the logarithm of Gross Debt; Log GDP is the logarithm of Gross Domestic Product; Log GDP PC represents the logarithm of Gross Domestic Product per capita; Inflation Rate measures the rate of inflation proxied by the GDP deflator; Log Tariff Rate is the logarithm of trade tariffs; Log RER represents the logarithm of Real Effective Exchange rate. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Corrected for heteroscedasticity.

3.4.2. Performance depends on donors - AfT from DAC and multilaterals donors is impactful.

AfT is provided by DAC members, other bilateral providers, and multilateral institutions. The fixed-effect model shows that AfT has a positive and significant effect on domestic value-added exports. However, this positive effect is only significant for DAC members and multilateral institutions (**Error! Not a valid bookmark self-reference.**). The channel through which AfT impacts domestic value-added exports, is factors productivity, and infrastructures that make a more straightforward production process, and export capabilities. AfT also directly impacts some areas of recipient countries that are related to trade.

Table 3.5: The fixed effects model results of AfT by type of donors

Variables	(All) Fixed-Effects	(DAC) Fixed-Effects	(Other Bilateral) Fixed-Effects	(Multilateral) Fixed-Effects
Log AfT Total	0.0457***			
	(0.0122)			
Log AfT from DAC		0.0228**		
		(0.0108)		
Log AfT from Other bilateral			0.0131	
			(0.00904)	
Log AfT from Multilateral				0.0253***
				(0.00849)
Log FDI	0.00238	0.00132	-0.00871	0.00470
	(0.0111)	(0.0114)	(0.0364)	(0.0109)
Log Gross Debt	-0.115***	-0.119***	-0.0383	-0.115***
	(0.0371)	(0.0376)	(0.114)	(0.0361)
Log GDP	1.724***	1.808***	0.202	1.763***
	(0.219)	(0.216)	(0.561)	(0.222)
Log GDP PC	-0.471*	-0.521*	0.400	-0.533*
	(0.273)	(0.277)	(0.704)	(0.276)
Inflation Rate	0.00347**	0.00365**	0.00599	0.00361**
	(0.00150)	(0.00149)	(0.00424)	(0.00143)
Log Tariff Rate	-0.0176	-0.0231	0.103	-0.0195
	(0.0408)	(0.0424)	(0.0684)	(0.0400)
Log RER	-0.0449	-0.0385	0.101	-0.0397
	(0.0317)	(0.0324)	(0.159)	(0.0308)
Observations	782	781	197	782
R-squared	0.695	0.690	0.131	0.695
Number of id	91	91	58	91
Country FE	Yes	Yes	Yes	Yes
Time	Yes	Yes	Yes	Yes

Note: Log AfT is the logarithm of Aid for Trade; Log FDI represents the logarithm of Foreign Direct Investment; Log Gross Debt measures the logarithm of Gross Debt; Log GDP is the logarithm of Gross Domestic Product; Log GDP PC represents the logarithm of Gross Domestic Product per capita; Inflation Rate measures the rate of inflation proxied by the GDP deflator; Log Tariff Rate is the logarithm of trade tariffs; Log RER represents the logarithm of Real Effective Exchange rate. Robust

standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Corrected for heteroscedasticity.

3.5. Conclusion

The current study complements existing literature on both GVC integration determinants and the impact of AfT. While it is not a complete investigation of AfT effectiveness, it gives an idea of how AfT has affected countries' GVC participation. The current study focused on the capacity of AfT to leverage domestic capacity and to create value-added destined for export. The results show that AfT, by impacting domestic infrastructures and by improving the capacity of the private sector, has a positive impact on GVCs participation of recipient countries, with the existence of heterogeneity in the impact. AfT injected in economic infrastructures seems to perform better than the rest of the categories, and loans also seem to perform better than grants.

AfT constitutes a powerful instrument used by developed nations and institutions to help developing countries foster their trade. Given its positive effects on recipient countries' capacity to boost their exports and upgrade through GVCs, the AfT program should be maintained, reinforced, and improved in the allocation process. AfT is thus relevant in helping developing countries integrate GVCs, but this relevance remains dependent on its allocation modalities. AfT can also consider funding trade finance, given that some 80% to 90% of world trade relies on trade finance (trade credit and insurance/guarantees). Moreover, in 2019, the Asian Development Bank estimated the global trade finance gap at a staggering US$ 1.5 trillion, and what is more, amid the fallout from COVID-19, the trade finance gap has skyrocketed. New research from the International Chamber of Commerce (ICC) estimates that an additional US$ 1.9 to US$ 5 trillion of trade finance is necessary to return to the 2019 levels. AfT can help develop private sector capacity to export by funding financial institutions.

Appendix: Results of estimates by region and AfT subcategories

Table A 3.1: The impact of AfT (Building productive capacity) on GVCs participation

VARIABLES	(1) Africa	(2) America	(3) Asia	(4) Europe
Log AfT BPC	0.0138	0.0422**	0.0116	-0.0308
	(0.0274)	(0.0150)	(0.0172)	(0.0286)
Log FDI	-0.00529	0.0607*	0.0165	-0.0213
	(0.0174)	(0.0314)	(0.0142)	(0.0513)
Log Gross Debt	-0.153***	-0.0807	-0.0521	0.481**
	(0.0374)	(0.0680)	(0.127)	(0.0918)
Log GDP	2.121***	2.210***	2.322***	1.830
	(0.293)	(0.348)	(0.384)	(0.953)
Log GDP PC	-1.300***	-0.807	-1.007**	1.154
	(0.410)	(0.540)	(0.450)	(1.324)
Inflation Rate	0.00378*	0.00789***	0.00447	-0.000847
	(0.00193)	(0.00204)	(0.00409)	(0.0123)
Log Tariff Rate	-0.0895	0.0242	0.225*	0.215*
	(0.0695)	(0.0578)	(0.115)	(0.0868)
Log RER	-0.146	-0.110	-0.0185	-0.743*
	(0.0957)	(0.157)	(0.0170)	(0.253)
Observations	332	208	192	38
R-squared	0.632	0.825	0.788	0.679
Number of id	38	23	23	4
Country FE	YES	YES	YES	YES

Note: Log AfT is the logarithm of Aid for Trade; Log FDI represents the logarithm of Foreign Direct Investment; Log Gross Debt measures the logarithm of Gross Debt; Log GDP is the logarithm of Gross Domestic Product; Log GDP PC represents the logarithm of Gross Domestic Product per capita; Inflation Rate measures the rate of inflation proxied by the GDP deflator; Log Tariff Rate is the logarithm of trade tariffs; Log RER represents the logarithm of Real Effective Exchange rate. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Corrected for heteroscedasticity.

Table A 3.2: The impact of AfT (Economic infrastructure) on GVCs participation

VARIABLES	(1) Africa	(2) America	(3) Asia	(4) Europe
Log AfT EI	0.0235**	0.0281***	0.0240	0.0464
	(0.0106)	(0.00821)	(0.0196)	(0.0633)
Log FDI	-0.00532	0.0578*	0.0173	0.00320
	(0.0171)	(0.0324)	(0.0146)	(0.0601)
Log Gross Debt	-0.158***	-0.0992	-0.0432	0.395**
	(0.0376)	(0.0662)	(0.126)	(0.106)
Log GDP	2.041***	2.194***	2.160***	1.099
	(0.295)	(0.352)	(0.416)	(0.747)
Log GDP PC	-1.251***	-0.943*	-0.849*	1.456
	(0.397)	(0.489)	(0.482)	(1.313)
Inflation Rate	0.00371*	0.00902***	0.00463	-0.00401
	(0.00201)	(0.00209)	(0.00421)	(0.0112)
Log Tariff Rate	-0.0830	-0.000966	0.193	0.179
	(0.0696)	(0.0522)	(0.127)	(0.0965)
Log RER (USD)	-0.137	-0.120	-0.0212	-0.740**
	(0.0920)	(0.157)	(0.0163)	(0.171)
Observations	330	208	192	38
R-squared	0.637	0.833	0.791	0.687
Number of id	38	23	23	4
Country FE	YES	YES	YES	YES

Note: Log AfT is the logarithm of Aid for Trade; Log FDI represents the logarithm of Foreign Direct Investment; Log Gross Debt measures the logarithm of Gross Debt; Log GDP is the logarithm of Gross Domestic Product; Log GDP PC represents the logarithm of Gross Domestic Product per capita; Inflation Rate measures the rate of inflation proxied by the GDP deflator; Log Tariff Rate is the logarithm of trade tariffs;

Log RER represents the logarithm of Real Effective Exchange rate. .Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Corrected for heteroscedasticity.

Table A 3.3: The impact of AfT (Trade policy regulation) on GVCs participation

VARIABLES	(1) Africa	(2) America	(3) Asia	(4) Europe
Log AfT TPR	-0.00111	-0.00499	0.0297**	0.0259
	(0.01000)	(0.00997)	(0.0140)	(0.0167)
Log FDI	-0.00499	0.0633*	0.0131	0.00795
	(0.0179)	(0.0355)	(0.0127)	(0.0613)
Log Gross Debt	-0.140***	-0.105	-0.0377	0.481***
	(0.0399)	(0.0643)	(0.121)	(0.0719)
Log GDP	2.083***	2.447***	2.315***	1.203
	(0.318)	(0.426)	(0.298)	(0.950)
Log GDP PC	-1.167**	-1.157*	-1.059***	1.301
	(0.449)	(0.638)	(0.352)	(1.219)
Inflation Rate	0.00375*	0.00911***	0.00330	0.00103
	(0.00213)	(0.00214)	(0.00393)	(0.0119)
Log Tariff Rate	-0.0715	0.0139	0.205*	0.177*
	(0.0700)	(0.0570)	(0.112)	(0.0713)
Log RER (USD)	-0.171*	-0.132	-0.0285	-0.576
	(0.101)	(0.150)	(0.0183)	(0.316)
Observations	324	201	191	38
R-squared	0.612	0.817	0.797	0.688
Number of id	38	22	23	4
Country FE	YES	YES	YES	YES

Note: Log AfT is the logarithm of Aid for Trade; Log FDI represents the logarithm of Foreign Direct Investment; Log Gross Debt measures the logarithm of Gross Debt; Log GDP is the logarithm of Gross Domestic Product; Log GDP PC represents the logarithm of Gross Domestic Product per capita; Inflation Rate measures the rate of inflation proxied by the GDP deflator; Log Tariff Rate is the logarithm of trade tariffs; Log RER represents the logarithm of Real Effective Exchange rate. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Corrected for heteroscedasticity.

Part II: Negative and positive implications of developing countries integration into GVCs

One thing is to be aware of the drivers of GVCs integration, but another is to understand the implications and benefits of integrating GVCs. The second part of this dissertation focuses on the consequences of GVCs participation. While GVCs participation can help increase revenues, it can also increase inequalities. The interconnectedness of countries generated by trade and investment through GVCs integration can have some macroeconomics consequences—namely, the vulnerability to macroeconomic shocks (demand and supply shocks and uncertainty in countries). This second part of the dissertation assesses the consequences of GVCs participation, focusing on negative and positive impacts. It comprises four chapters (Chapter 4, Chapter 5, 0 and Chapter 7), each assessing a specific question. First, Chapter 4 and Chapter 5 discusses the impact and spillover effects of economic shocks generated by uncertainty. Second, 0 shows how interacting through GVCs can benefit developing countries using a specific case study involving China and African countries. Finally, Chapter 7 focuses on Africa and investigates whether GVCs participation has helped African countries grow and whether it impacted inequality.

Chapter 4 focuses on the impact of uncertainty in both importer and exporter countries on bilateral trade. It also examines the impact of uncertainty in advanced economies on trade flows in the rest of the world. In the same view, Chapter 5 also discusses through an event study how economic shocks or uncertainty can spread through GVCs. It analyzes the effect of three main events—President Donald Trump's election, the US-China trade war, and the current COVID-19 crisis—on trade and GDP. These first two chapters show why it is important to study the consequences of GVCs participation and question the relevance of helping developing countries integrate a system with a high potential of spreading chocks in their economies. However, in the same way that shocks and uncertainty can spread through GVCs, the dynamics and benefits behind GVCs trade can spread and positively impact developing countries. Chapter 6 discusses the positive impacts of GVCs participation. It investigates the effect of interactions through GVCs on technology transfer. Considering China's growing but criticized presence in Africa over the last decades, it investigates the effect of the presence of China in Africa through GVCs regarding the level of technological sophistication of African countries' exports, independently of the determinants of this presence. Chapter 7 goes further and examines the relationship between GVCs, economic growth and income inequality. It also tracks the evolution of African countries along GVCs, identify specialization patterns and generate sector/task level GVCs participation and position indices. Based on sectoral indices Chapter 7 investigates the relationship between GVCs participation and position with growth and inequality, exploring which sectors explain these relationships.

Chapter 4. Uncertainty in Global Value Chains' Production Hubs and Trade Instability in Developing Countries.

4.1. Introduction

GVCs have fostered international trade since the 90s and now account for almost half of all trade (World Bank, 2020). According to the OECD, approximately 70% of international trade involves GVCs given goods and services cross borders often several times. The increased reliance on GVCs has enabled some emerging countries to takeoff. This pattern of GVCs can help developing countries to catch up with wealthier nations. GVCs allow for the circulation of new technologies, which could draw production closer to the consumer and reduce labor demand, increasing the productivity of developing countries. However, the 2008 global financial crisis, the US-China trade conflict, and the 2020 "great lockdown" generated by the COVID-19 pandemic have shed light on severe threats about GVCs participation. In fact, because countries are highly linked and connected through international trade, a shock or uncertainty in a given country is likely to spread to other countries.

In recent decades, several episodes of uncertainty have been reported, and economists have studied the impact of each phenomenon on the economy. As presented in **Figure *4.1*** below, world uncertainty spikes occurred near the September 11th attacks, the SARS outbreak, the Gulf War II, the Euro debt crisis, El Niño, Europe's border-control crisis, the UK's referendum vote in favor of Brexit, the US presidential election and now the COVID-19 pandemic (Ahir et al., 2022). Uncertainty has increased worldwide since the global financial crisis, and the COVID-19 crisis and the Ukraine war have exacerbated it. The COVID-19 pandemic has generated twin demand and supply shock, pushing most countries into downward pressure inactivity not experienced since the global financial crisis of 2008–09. While most countries have implemented restrictive measures to fight the pandemic, economists have found no consensus about the trend of post-pandemic recovery. Uncertainty surrounds all the aspects of the COVID-19 pandemic: on the sanitary and epidemiological side, this uncertainty was related to the infectiousness and lethality of the virus (Fauci et al., 2020; Li et al., 2020), the time needed to develop and deploy vaccines (Koirala et al., 2020), and the duration and effectiveness of lockdown measures (R. M. Anderson et al., 2020; Atkeson, 2020; Eichenbaum et al., 2021). On the economic side, uncertainty is related to the economic impacts of COVID-19, policy responses (Baqaee et al., 2020), the speed of recovery, and uncertainty in countries' capacity to supply—because of travel bans, closures and working from home. Therefore, the complete recovery from the COVID-19 crisis depends on how long the virus will last, how long uncertainty will remain, and how effective the vaccine will be against new COVID variants. The economic impacts of both COVID-19 and the global financial crises quickly spread because countries were well-integrated into GVCs. The interconnectedness of countries through GVCs

has spread the virus's economic effects throughout the world. A clear but simple example was the shortage in the supply of face masks, which can mainly be explained by a surge in demand. This high demand caused trouble for importing countries that relied on China for face masks and medical equipment imports. We heard stories about face masks from China intended for France 'hijacked' by the US at the last minute. Nevertheless, trade remains the cornerstone of the post-pandemic recovery, but it will need to face global uncertainty generated by the crisis. Thus, uncertainty is a significant issue that can cause economic losses even out of the origin country.

Given the deep integration of countries into GVCs and given that uncertainty spikes tend to be more synchronized within economies with tighter trade and financial linkages, the current chapter investigates the effect of uncertainty on bilateral trade flows. We also examined how uncertainty in GVC production hubs can affect global trade.[27] In the past measures of economic and political uncertainty were only available for few countries specially advanced economies. However, with the improvement of uncertainty measurement undertaken by Ahir et al. (2018)[28] (Figure 4.1), uncertainty measures have been provided for larger samples, allowing for the evaluation of the impact of uncertainty on developing economies.

The current chapter relies on bilateral data of 80 countries over 29 years (from 1990 to 2018) and focuses on the impact of uncertainty in both importer and exporter's countries on bilateral trade. It also examines the impact of uncertainty in advanced economies on trade flows in the rest of the world. The findings suggest that uncertainty—in exporter and importer's countries—harms bilateral exports. The impact of trade uncertainty varies depending on the case. In addition, results indicate that uncertainty in the world's top three GVC hubs (the US, China, and Germany) has a spillover impact on the trade of the rest of the world. A focus on African countries shows that global uncertainty in GVC production hubs negatively and significantly affects African country's trade. The current chapter sheds lights on how uncertainty in an economy can be harmful for the rest of the world belonging to the same value chain. This chapter contributes to a literature gap regarding uncertainty with less coverage by focusing on African countries that were not considered in previous studies on uncertainty.

The rest of the chapter is structured as follows. Section 4.2 describes the way uncertainty issues have been addressed in the past. Section 4.3 presents the methodology and data. Sections 4.4 and 4.5 build on the econometric results. Section 4.4 relies on a gravity model and investigates the impact of uncertainty in one or both bilateral trade partners on bilateral trade, while Section 4.5 uses a simple model to study the spillover impact of uncertainty in top GVC production hubs. Section 4.6 concludes.

[27] IMF country reports suggest that uncertainty has recently been a key factor of weaker economic performance in many economies (2017 country reports for Nigeria, South Africa, the United Kingdom and the United States).

[28] IMF build a new uncertainty index, World Uncertainty Index (WUI), for 143 countries from the first quarter of 1996 onward using the Economist Intelligence Unit (EIU) country reports.

4.2. Past studies have addressed uncertainty issues in a different way

Policymakers, development banks, and institutions often consider an increase in uncertainty in advanced countries and global uncertainty as a critical reason for an increase in the volatility of international capital and trade flows in developing countries. This chapter is related to several strands of the literature. Several authors (Bloom, 2009; Kusi, 2002; Sharma, 2000) have pioneered studies on uncertainty. They have assessed the macroeconomic implications of fluctuations in uncertainty, especially changes in the expected volatility in the US stock market. Bloom (2009) found uncertainty to be a driver of business cycle fluctuation, while Bloom et al. (2012) show that uncertainty is strongly countercyclical, with positive shocks to uncertainty causing a temporary drop in output and investment. Rey (2013) focuses on the spillover effects of uncertainty. He shows how uncertainty's fluctuations in US financial markets drive a global financial cycle and significantly affect global asset prices and financial flows. Rey (2015) provides further econometric evidence for the global financial cycle emphasized by Rey (2013). Most of the literature has focused on financial volatility, commodity prices' volatility, and the balance of payment implications. The literature has either concentrated on the spillover impacts of uncertainty or its direct effects. While some authors have focused on the transmission of uncertainty from advanced economies to EMDEs (Aizenman et al., 2016; Bhattarai et al., 2020; Canova, 2005; Fink & Schüler, 2015; Maćkowiak, 2007), others have focused on the impact of global uncertainty as well as domestic uncertainty on the economy (Akıncı, 2013; Carrière-Swallow & Céspedes, 2013; Grier & Smallwood, 2007; Kusi, 2002, 2002; Matsumoto, 2011; Raulatu et al., 2019; Sly, 2016; Taglioni & Zavacka, 2013; Uribe & Yue, 2006).

The first group of authors' investigations have shown that the spillover impact of uncertainty in developed countries affects the performances of EMDEs. Canova (2005) studied the transmission of US shocks to Latin American countries, and Maćkowiak (2007) investigated the effects of US monetary policy shocks on emerging market economies (EMEs). Aizenman et al., (2016) provide evidence of the correlation between the policy rates and exchange rates in EMEs with policy rates in four developed countries: the US, Euro area, Japan, and China. Fink & Schüler (2015) also provide evidence for how systemic financial stress shocks in the US transmit to EMEs. Moreover, Bhattarai et al. (2020) studied how unconventional monetary policy shocks in the US were transferred to EMEs. Recently, Graziano et al. (2018) found that uncertainty generated by increases in the probability of Britain's exit from the European Union (Brexit) reduced bilateral export values and trade participation affecting UK and EU exporters. In addition, Bhattarai et al. (2020) studied the spillover effects of US uncertainty fluctuations using panel data from 15 EMEs. Their findings highlight that US uncertainty shock negatively affects EME stock prices and increases exchange rates, leading to capital outflows. In addition, the US uncertainty shock decreases EME output while increasing consumer prices and net exports.

The second group of authors have widely addressed the impact of global uncertainty on EMDEs. Sharma (2000) investigated export determinants in India from 1970 to 1998. Using simultaneous equations and export prices as a proxy macroeconomic uncertainty, Sharma (2000) shows that demand for Indian exports increases when export prices fall relative to world prices and that an appreciating rupee adversely affects Indian exports. Kusi (2002) investigated the impact of global uncertainty in South Africa and found that uncertainty positively affects export performance. Using a time series of South Africa from 1976 to 1999, the study revealed that external demand mattered in determining export earnings in all sectors within the period of observation. Uribe & Yue (2006) estimated the effects of foreign interest and/or interest spread shock on EMEs using an empirical VAR model. Furthermore, Grier & Smallwood (2007) examined the relationship between uncertainty and exports using a GARCH model with a sample of nine developed and nine developing countries. They studied the impact of uncertainty in exchange rates and income on countries' export earnings. The result shows that developing countries' trade flows are more likely to be affected by uncertainty, demonstrating a negative relationship between real exchange rate uncertainty and growth in export in six out of the nine developing countries. There was no evidence of a positive relationship among the other countries. Results also show that export growth was significantly influenced by uncertainty about foreign income. In addition, Taglioni & Zavacka (2013) investigated the impact of uncertainty on international trade using a VAR model with United States data from June, 1962, to June, 2008. The findings highlighted that uncertainty in the importer country has a strong negative effect on countries' exports. They also found non-linear effects in uncertainty shocks. Thus, uncertainty shocks are directly transmitted and must reach a particular level before they can exert significant aggregate effects on trade. Matsumoto (2011), Akinci (2013), and Carrière-Swallow & Céspedes (2013) also studied the impact of global and US financial uncertainty on EMEs. More recently, Sly (2016) estimated the effects of global uncertainty on external demand for US exports. He used quarterly data of 26 countries from 2002 to 2015, representing about 85% of US total exports. The result highlights a reduction of foreign demand for US exports during episodes of greater uncertainty. Results demonstrate that a 2.8% fall in US export activity on an annualized basis results in a one percentage point surge in the spread between reported high and low foreign GDP growth forecasts. Also, Raulatu et al. (2019) studied the effect of global economic policy uncertainty on Nigeria's export earnings, using Nigerian data from 1997 to 2016. Their findings reveal the adverse impact of global economic policy uncertainty on Nigeria's export earnings, affirming the vulnerability of Nigeria's export earnings to external shocks.

The literature has revealed several studies focusing on developed economies, with a few on developing economies. Most studies used various proxies for uncertainty (fluctuations in commodity prices, inflation expectations, interest rates, output, and exchange rates). In addition, a few of these studies have focused on how uncertainty in developed economies can have ripple effects on EMDEs.

4.3. Methodology and Data

This chapter follows two approaches. To estimate the impact of uncertainty, it relies first on a gravity model with bilateral data of 80 countries over 29 years (from 1990 to 2018), to assess how uncertainty in both importer and exporter countries can affect bilateral exports. Future investigations using a fixed-effects estimator on panel data over the same period, will help investigate spillover effects of uncertainty in world GVC production hubs on other countries' trade values.

4.3.1. Conceptual framework of the gravity model

Several trade studies have relied on gravity models for their empirical specifications. The basic model explains trade flows between two countries ("*i*" and "*j*") by their size or wealth (GDP) and, inversely, the geographic distance between the two counties. The concept of distance and proximity includes physical distances, historical proximity, and cultural distance (common language, common border, and other factors affecting trade barriers). The model was used in the 1960s by Hasson (1964) and Pöyhönen (1963) to study trends in global trade. It was first introduced in the economics world by Isard & Peck (1954). The gravity model of trade is defined most simply as:

$$X_{ij} = \frac{KY_i^{\alpha} Y_j^{\theta}}{Dist_{ij}^{\beta}} \tag{4.1}$$

Where X_{ij} stands for the transaction volume between countries i and j; Y stands for the value of nominal GDP of the trading partners; D_{ij} is the physical distance between the trading partners and K is a constant.

Following the traditional approach of the gravity model of trade, this chapter relied on an augmented gravity model with additional variables, such as control of corruption, air transport freight capacity, and dummy variables measuring common official language, common colonizer, common borders, landlocked, and trade agreements. These variables were added to better depict the transaction environment and explain trade. Thus, the augmented gravity model is presented as follows:

$$X_{ijt} = \frac{KY_{it}^{\beta_1} Y_{jt}^{\beta_2} \, Lang_{ij}^{\beta_3} Col_{ij}^{\beta_4} Geo_{it}^{\beta_5} Geo_{jt}^{\beta_6} \, TA_{ijt}^{\beta_7}}{Dist_{ij}^{\beta_8} Cost_{it}^{\beta_9} Cost_{jt}^{\beta_{10}}} \tag{4.2}$$

Where $\boldsymbol{X_{ijt}}$ stands for bilateral trade value between i and j during the period t; Y stands for the value of nominal GDP of the trading partners; $\boldsymbol{Dist_{ij}}$ is the absolute physical distance between the trading partners; $\boldsymbol{Lang_{ij}}$ represents common official language; $\boldsymbol{Col_{ij}}$ represents colonial links (if the two trade partners have had a common colonizer in the past and if they have ever been in colonial links); **Geo** is composed of geographical variables representing the area of countries and a dummy identifying landlocked countries; $\boldsymbol{TA_{ij}}$ represents trade agreement between *i* and *j*, including regional trade agreements and currency unions; $\boldsymbol{Cost_{it}}$ and $\boldsymbol{Cost_{jt}}$ represents potential trade costs that may affect

each trade partner. In the current study, $\boldsymbol{Cost_{it}}$ and $\boldsymbol{Cost_{jt}}$ will be presented by uncertainty that constitutes a cost for international trade. K is a constant.

To estimate the gravity equation (4.2), the model is employed in its log-linear form. Using natural logarithms, the model becomes as follows:

$$\begin{aligned}\ln(X_{ijt}) = lnK + \beta_1 \ln(Y_{it}^{\beta_1}) + \beta_1 \ln\left(Y_{jt}^{\beta_2}\right) + \beta_1 \ln\left(Lang_{ij}^{\beta_3}\right) + \beta_1 ln(Col_{ij}^{\beta_4}) \\ + \beta_1 \ln\left(Geo_{it}^{\beta_5}\right) + \beta_1 \ln\left(Geo_{jt}^{\beta_6}\right) + \beta_1 \ln\left(TA_{ijt}^{\beta_7}\right) - \beta_1 \ln\left(Dist_{ij}^{\beta_8}\right) \\ - \beta_1 \ln\left(Cost_{it}^{\beta_9}\right) - \beta_1 \ln\left(Cost_{jt}^{\beta_{10}}\right) + \varepsilon_{ij}\end{aligned} \quad (4.3)$$

Equation (4.3) is estimated using OLS and Poisson Pseudo-Maximum Likelihood (PPML) estimators. PPML estimators are often used in estimating gravity equations. They require positive values for dependent variables.

4.3.2. Model: A panel fixed effect approach

We used a panel fixed effects model with aggregated trade data from 80 countries over 29 year (1990-2018), to estimate the impact of the world top traders' uncertainty on the trade of the rest of the world. The model is presented as follows:

$$\ln(Trade_{i,t}) = \alpha + \mu_i + \beta_1 \ln(Un_{H,t}) + \sum_n \beta_n X_{i,t}^n + \ln(Dist_{i,hubs}) + \varepsilon_{ij} \quad (4.4)$$

Where μ_i represents country fixed effects. $\ln(Un_{H,t})$ separately represents the logarithm of uncertainty in the three GVC production hubs—namely, *H= China, US, and Germany*. $X_{i,t}^n$ represents a set of n control variables that are subject to impact international trade. These variables are: real GDP, inflation, real effective exchange rate, FDIs, gross fixed capital formation, population, domestic credit to private sector, secondary school enrolment ratio, life expectancy, and air transport freight capacity. $\ln(Dist_{i,hubs})$ represents the distance of country i to the nearest GVC production hub among the top five GVC production hubs. We included this last variable, given the relevance of bilateral distance in explaining trade in the gravity model. This distance is time varying and country specific.[29]

Equation (4.4) can be estimated using an OLS estimator. In terms of identification, the independent variable—namely, uncertainty in top traders (China, the US, and Germany)—can be considered as an exogenous variable. There is no doubt that uncertainty in the world's top traders does not depend on developing countries' trade flows. Therefore, reverse causation issues are minimal because trade flow in developing countries is less likely to affect high-income countries' level of uncertainty.[30]

[29] The distance to the nearest GVC production hub is time varying because the top world traders vary sometimes (the ranking may vary yearly). It is country specific because each country has a different location and distances to the nearest GVC production hub are different.

[30] There may have exception especially for oil exporters.

4.3.3. Data

4.3.3.1. Variables

Most of the variables used in our estimations come from the World Bank World Development Indicators (WDI) and the IMF data (**Table *4.1***). The dependent variable comes from CEPII and IMF databases on bilateral trade. The independent variable that captures uncertainty comes from Ahir et al. (2018). The control variables include GDP from WDI, sea distance from the CERDI database, air transport freight capacity from WDI, institutional variable from the world governance indicators, geographic and gravity models' control variables (colonial links, cultural links) from CEPII, and trade agreement data from Mario Larch's Regional Trade Agreements Database. Control variables included in the fixed effects model include, inflation, real effective exchange rate, FDIs, gross fixed capital formation, population, domestic credit to private sector, secondary school enrolment ratio and life expectancy. These variables are all from the World Bank WDI.

Table 4.1: Variables and data sources

Variable	Sources
Gross Domestic Product (GDP)	World Bank Group (WDI)
Geographic variables	CEPII and CERDI-sea distance database
Air transport freight capacity	World Bank Group (WDI)
Export series	World Bank Group (WDI), IMF, CEPII-BACI
Uncertainty	Ahir et al. (2018)[31]
Institutions	World Governance Indicators (WGI)[32]
Trade agreements	Mario Larch's Regional Trade Agreements Database[33]
Inflation,	World Bank Group (WDI)
Real effective exchange rate,	World Bank Group (WDI)
FDIs	World Bank Group (WDI)
Gross fixed capital formation,	World Bank Group (WDI)
Population	World Bank Group (WDI)
Domestic credit to private sector	World Bank Group (WDI)
Secondary school enrolment ratio	World Bank Group (WDI)
Life expectancy	World Bank Group (WDI)

Focusing on the control variables, their potential impact on trade is presented as follows: ***(i)*** GDP captures the country's economic size and wealth. It also gives information on the ability of governments to manufacture export-oriented products and on their capacity to import. It is a proxy of economic development. Thus, this variable should have a positive effect on bilateral exports. ***(ii)*** The distance variable represents bilateral physical distance. Our study relied on sea distance. We used sea distance to account for the change in shipment capacities and technologies that a significant share of products

[31] https://worlduncertaintyindex.com/data/

[32] WGI: https://info.worldbank.org/governance/wgi/

[33] Trade agreements data: https://www.ewf.uni-bayreuth.de/en/research/RTA-data/index.html

exchanged are shipped through the sea. A higher physical distance affects transportation costs, raising the unit price of the final product for sale and reducing its demand. Therefore, distance should negatively impact bilateral exports. ***(iii)*** For the same reason that sea distance was considered, air transport freight capacity was also included in the model to account for air shipment capacity that has improved over the years. This variable is complementary to the sea distance variable. An increase in air freight capacity reduces transportation costs. Therefore, air transport freight capacity in both exporter and importer countries should positively impact bilateral trade. ***(iv)*** Colonial and cultural links also matter in explaining bilateral trade. We, therefore, expect a positive impact of some of these variables. ***(v)*** Finally, trade agreements (regional agreements and currency unions) should help increase trade volume. Thus, partner countries that are in the same regional trade agreement or currency union should trade more.

4.3.3.2. Distance to production hubs

The current study computed time-varying distance to include distance in the panel fixed effects model. In fact, distance is usually used in bilateral data for gravity models. Years of research have proved the importance of distance in bilateral trade (J. E. Anderson & van Wincoop, 2003; Bergstrand, 1985; Chaney, 2018; Tenreyro & Silva, 2006). The chapter applies the concept of distance to a simple non-gravity model by considering the distance of each country to the nearest world GVC production hub. World production hubs are represented by countries with the largest level of GVCs participation.

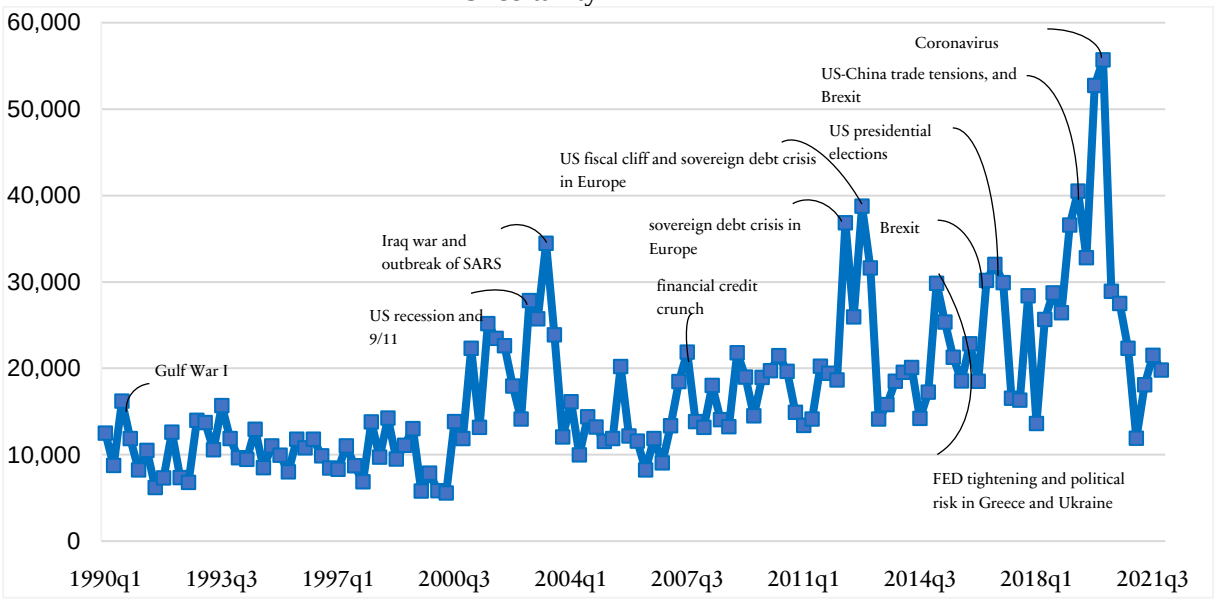
Given that the rankings of countries with the largest GVCs participation vary yearly according to countries' trade performances, the distance to the nearest GVC production hub may also vary over time and is specific to each country. This new variable is expected to negatively affect trade. The principle is that the further a country is from the GVC production hubs, the less it will trade with these important partners and the lower its trade volume will be.

4.3.3.3. Measure of uncertainty

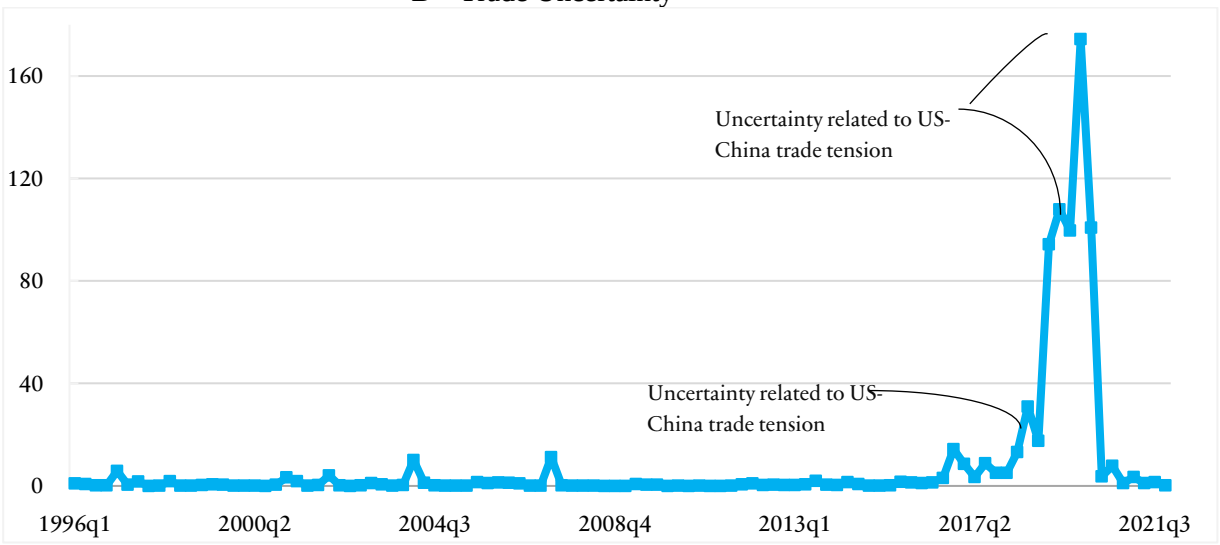
As previously discussed, uncertainty data comes from the IMF. The database has been constructed for 143 individual countries quarterly from 1996 onwards. Ahir et al. (2018) built the uncertainty variable using the frequency of the “word uncertainty” in the quarterly Economist Intelligence Unit (EIU) country reports. The current study used global uncertainty measured as the three-quarter weighted moving average of the World Uncertainty Index (WUI) for 143 countries from the 1995s to 2021. Ahir et al. (2018) determined World Trade Uncertainty (WTU) by counting the number of times “uncertainty” is mentioned within proximity to a word related to trade in the EIU country reports. The index is an equally weighted average and scaled by the number of words in the EIU country reports.

Figure 4.1 : World uncertainty index and world trade uncertainty (1960Q1 to 2020Q2)

A- Uncertainty



B- Trade Uncertainty



Source: Ahir et al. (2018), "World Uncertainty Index".

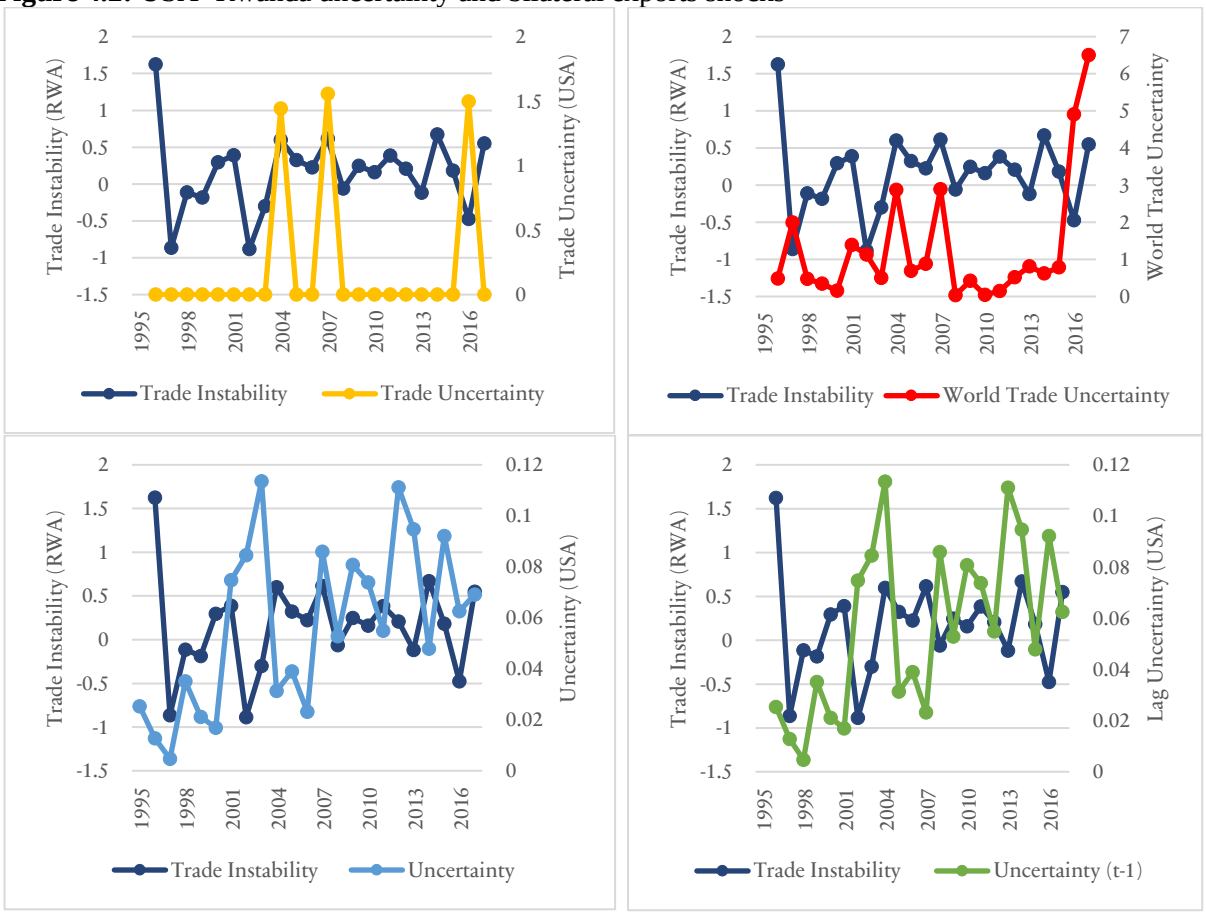
4.4. Results

4.4.1. Relation between trade shock and uncertainty

This chapter answers two main questions. First, does uncertainty in one or both bilateral trade partners' economy impacts bilateral trade? Second, does uncertainty in the economies of GVC production hubs harm the trade of the rest of the world, mainly African countries? **Figure *4.2*** analyzes the relation between uncertainty and trade shocks using a specific case with a developed economy represented by the US, the third largest GVC production hub, and a developing economy represented by Rwanda – an important actor of GVCs in Africa – from 1995 to 2017. First, the US did not report many episodes of trade uncertainties. Episodes of high trade uncertainty were reported only in 2004, 2007, and 2016

(**Figure *4.2***). The last two episodes of trade uncertainty represent the beginning of the global financial crisis (2008) and trade tensions between the US and China (2016). There is no clear correlation between Rwanda's trade shocks and trade uncertainty episodes in the US. The first two spikes (increase in the US trade uncertainty) in 2004 and 2007 are positively correlated with Rwanda's positive trade shocks. However, the last pic in US trade uncertainty (2016) is associated with negative trade. The low occurrence of trade uncertainty does not make it possible to conclude a positive or a negative correlation. However, **Figure *4.2*** identifies a negative correlation between world trade uncertainty and Rwanda's trade shocks. Unlike the US trade uncertainty, there are several episodes of US global uncertainty. Episodes of US global uncertainty are associated with negative trade shocks in Rwanda. In the case of global uncertainty, the occurrence of spikes is enough to identify a negative correlation between US global uncertainty and Rwanda export shocks (Figure 4.2).

Figure 4.2: USA- Rwanda uncertainty and bilateral exports shocks



Source : Author's calculations based on Ahir et al. (2018) database and IMF data

4.4.2. Results of our first step estimations

The gravity model generally suggests that trade is proportional to the size of countries' economies and level of development (GDP) and inversely proportional to the distance between trade partners. The

results presented in **Table *4.2*** support the predictions of the gravity model. The coefficients in front of both exporter and importer's GDP are positive and significant, indicating that GDP impacts bilateral export value positively. On the demand side, the importer's GDP growth increases demand for partners' exports. The result is an increase in bilateral trade. However, on the supply side, an increase in exporter's GDP growth increases productivity. The result is an increase in export capacities.

As expected, the coefficient in front of the logarithm of sea distance is negative in all the cases, highlighting a negative relation between bilateral distance and bilateral trade. The farther a country is from its trade partner, the lower is their bilateral trade. This negative impact of distance is due to transaction costs, transport costs, and the lack of trustworthy relations between countries far from each other. Air transport freight capacity is positively related to trade. Air transport freight capacity is a variable that measures improvement in shipment capacity by air. An improvement in shipment capacity is associated with low prices or short delivery times. Thus, an increase in air transport freight capacity positively affects bilateral trade (Table 4.2).

The results of the first step estimation show that the coefficients in front of global uncertainty (both exporters and importers' uncertainty) are negative, which means that an increase of uncertainty in both the importer and exporter's countries decreases bilateral trade. This result is also valid for trade uncertainty (Table 4.2). However, it is essential to note that the coefficient of global uncertainty is higher than the coefficient in front of trade uncertainty (pair fixed-effect models). Therefore, the effect of global uncertainty on trade flows is higher than trade uncertainty, which is logical as trade uncertainty is an aspect of global uncertainty (**Table *4.2***).

In African countries, the results are similar but highlight the dependence of those countries on imports. We identified three different cases in the analysis. First, when the exporter is from an African country, the results are similar to the previous results. Both global uncertainty and trade uncertainty in the exporter and importer countries negatively impact bilateral trade (**Table A *4.1***). Second, when the importer is from an African country, both global and trade uncertainty in the exporter's country negatively impact bilateral trade. However, the impact of uncertainty in the importer's country, when it is an African country, is either insignificant or positive (Table A 4.2). This result means that an increase in African countries' uncertainty increases their imports. This result likely highlights the dependence of African countries on imports for their basic needs, obliging them to continue importing in a period of uncertainty. Finally, for intra-African trade (when both the exporter and importer are African countries), the results corroborate the previous cases. Uncertainty in the exporter's country hurts bilateral trade, while uncertainty in the importer's country does not have any significant and clear impact on trade (Table A 4.3).

A possible way of estimating our gravity model and obtaining more robust results is to use the PPML estimator. The use of the PPML for our robustness checks is a strategic choice that responds to a common problem generally faced by gravity models. In bilateral trade data, pair countries that did not trade in a given period reported values of zero. So, if bilateral trade between nations is zero and if we estimate them using a conventional log-linear model, these zero observations are dropped from the sample as undefined. Consequently, the number of observations decreases, causing a loss of information and misleading results. An alternative approach is to use the PPML estimator, estimated using the quasi-poison distribution and a log-link (Tenreyro & Silva, 2006). This estimator has many benefits for gravity model estimations. Tenreyro & Silva (2006) state that, in addition to being a solution to the zero-trade problem, the PPML is a robust approach in the presence of heteroskedasticity. This method can be applied to the levels of trade, thus estimating the non-linear form of the gravity model directly.[34] The results of our PPML estimation are consistent with our baseline estimations. Uncertainty in both importer and exporter country harms bilateral trade. Results also highlight that the impact of trade uncertainty varies according to the econometric specification (Table A 4.4). There are several channels through which uncertainty can impact bilateral trade.

In fact, in addition to the direct impact of uncertainty on productivity and income, countries tend to be less confident in their trade partners in a period of uncertainty. Their risk aversion increases, and they tend to adopt restrictive measures that can lower bilateral trade. This fear generated by uncertainty in the importer's country can negatively impact its economy, reducing income and demand for its partners' products. Second, uncertainty in the importer's country can push the exporter to diversify its partners (clients) to prepare for any risk related to orders being cancelled by its partners. Similarly, uncertainty in the exporter's country directly affects bilateral trade by reducing economic activity and production. Uncertainty can also impact bilateral trade as it can push governments to adopt restrictive measures: the COVID-19 crisis has illustrated this effect (Nana & Starnes, 2021). In addition to these transmission channels, uncertainty can affect trade by reducing trade finance availability and supply. In fact, some 80% to 90% of world trade relies on trade finance (trade credit and insurance/guarantees), mostly of a short-term nature. A reduction in trade finance supply can widen the existing trade finance gap and lead to a trade contraction. When risk aversion increases sharply, trade finance is subject to de-investing (banks retrench from such products) given its short tenors, dollar denomination, and cross-border country risk profiles. Even though trade finance is a low-risk asset class, crises and uncertainty put downward pressure on this unique and necessary offering, contributing to trade contraction.

[34] In a PPML specification, the dependent variable is trade, not the logarithm of trade, whereas the explanatory variables can still be in log forms. A major requirement of PPML estimation is that the variable should have only positive values.

The results are in favor of a negative impact of uncertainty and highlight the dependence of African countries on imports. Results are also robust to estimation procedures. However, further specifications are necessary to investigate the spillover effects of uncertainty in top GVC production hubs.

Table 4.2: Results of the gravity model (OLS)

	Global Uncertainty				Trade Uncertainty			
VARIABLES	OLS	Exp-Imp FE	Pair FE	Pair-Year FE	OLS	Exp-Imp FE	Pair FE	Pair-Year FE
Exp Un	-1.858***	-0.989***	-1.018***	-0.652***	-0.0127**	0.00253	-0.00928***	0.00437
	‘(0.192)	‘(0.108)	‘(0.0980)	‘(0.0992)	‘(0.00570)	‘(0.00357)	‘(0.00325)	‘(0.00338)
Imp Un	-0.620***	-0.472***	-0.404***	-0.143	-0.00184	7.79E-05	-0.00547*	0.00695**
	‘(0.183)	‘(0.108)	‘(0.0949)	‘(0.0963)	‘(0.00566)	‘(0.00369)	‘(0.00304)	‘(0.00310)
Log sea dist	-0.849***	-0.931***			-0.851***	-0.931***		
	‘(0.0235)	‘(0.0242)			‘(0.0235)	‘(0.0242)		
Log Exp Area	-0.214***	-2.180***			-0.217***	-2.219***		
	‘(0.00881)	‘(0.654)			‘(0.00883)	‘(0.654)		
Log Imp Area	-0.121***	2.601***			-0.122***	2.565***		
	‘(0.00935)	‘(0.525)			‘(0.00936)	‘(0.524)		
Exp Cor	-9.979***	-0.0223	-1.253***	-1.212***	-9.360***	0.348	-0.911***	-0.995**
	‘(0.531)	‘(0.385)	‘(0.354)	‘(0.441)	‘(0.530)	‘(0.384)	‘(0.352)	‘(0.440)
Imp Cor	3.845***	-1.240***	-1.240***	-1.241***	4.107***	-1.123***	-1.140***	-1.189***
	‘(0.472)	‘(0.346)	‘(0.312)	‘(0.380)	‘(0.473)	‘(0.346)	‘(0.312)	‘(0.380)
Log Exp RGDP	1.244***	1.197***	1.291***	1.208***	1.241***	1.196***	1.293***	1.230***
	‘(0.0142)	‘(0.0433)	‘(0.0402)	‘(0.0470)	‘(0.0142)	‘(0.0431)	‘(0.0401)	‘(0.0468)
Log Imp RGDP	0.883***	1.108***	1.212***	1.142***	0.882***	1.095***	1.201***	1.151***
	‘(0.0144)	‘(0.0382)	‘(0.0349)	‘(0.0414)	‘(0.0144)	‘(0.0381)	‘(0.0349)	‘(0.0414)
Exp landl	-0.234***	-4.304***			-0.243***	-4.279***		
	‘(0.0481)	‘(0.700)			‘(0.0481)	‘(0.701)		
Imp landl	-0.513***	1.760***			-0.517***	1.716***		
	‘(0.0474)	‘(0.565)			‘(0.0474)	‘(0.564)		
Log Exp AirTF	0.0946***	0.0557***	0.0381***	0.0353***	0.0966***	0.0565***	0.0391***	0.0350***
	‘(0.00774)	‘(0.00774)	‘(0.00735)	‘(0.00731)	‘(0.00775)	‘(0.00776)	‘(0.00737)	‘(0.00731)
Log Imp AirTF	0.105***	0.0191***	0.0125**	0.00874	0.106***	0.0200***	0.0136**	0.00851
	‘(0.00738)	‘(0.00593)	‘(0.00534)	‘(0.00534)	‘(0.00738)	‘(0.00592)	‘(0.00534)	‘(0.00534)
Colony	0.671***	0.648***			0.647***	0.649***		
	‘(0.111)	‘(0.113)			‘(0.112)	‘(0.113)		
Com col	0.798***	0.985***			0.814***	0.985***		
	‘(0.0843)	‘(0.0764)			‘(0.0844)	‘(0.0764)		
contiguity	1.542***	1.330***			1.548***	1.330***		
	‘(0.120)	‘(0.125)			‘(0.119)	‘(0.125)		
Com off lang	0.625***	1.081***			0.613***	1.081***		
	‘(0.0504)	‘(0.0519)			‘(0.0503)	‘(0.0519)		
RTA	0.883***	0.812***	0.131***	0.105***	0.883***	0.811***	0.122***	0.105***
	‘(0.0438)	‘(0.0421)	‘(0.0220)	‘(0.0230)	‘(0.0439)	‘(0.0422)	‘(0.0223)	‘(0.0230)
CU	1.275***	0.885***	0.448***	0.344***	1.258***	0.885***	0.439***	0.344***
	‘(0.0681)	‘(0.0695)	‘(0.0330)	‘(0.0348)	‘(0.0684)	‘(0.0696)	‘(0.0331)	‘(0.0348)
Observations	185,784	185,784	184,885	184,885	185,784	185,784	184,885	184,885
R-squared	0.674	0.752	0.902	0.903	0.673	0.752	0.901	0.903

Exp Un represents the level of uncertainty in the exporter country; **Imp Un** is the level of uncertainty in the exporter country; **Log sea dist** is the logarithm of sea distance; **Log Exp Area** is the logarithm of the exporter country's area; **Log Imp Area** is the logarithm of the Importer country's area; **Exp Cor** measures the level of corruption in the exporter country; **Imp Cor** measures the level of corruption in the exporter country; **Log Exp RGDP** is the logarithm of Real Gross Domestic Product of the exporter country; **Log Imp RGDP** is the logarithm of Real Gross Domestic Product of the importer country; **Exp landl** is a dummy variable that takes the value of 1 if the exporter is a landlocked country; **Imp landl** is a dummy variable that takes the value of 1 if the importer is a landlocked country; **Log Exp AirTF** is the logarithm of Air Transport Freight Capacity of the exporter country; **Log Imp AirTF** is the logarithm of Air transport freight capacity of the importer country; **Colony** takes the value of 1 if pairs ever in colonial relationship; **Com col** equal to 1 if pair countries had a common colonizer post-1945; **contiguity** is a dummy variable that takes the value of 1 if pair of countries share the same borders; **Com off lang** equal 1 if pair countries have the same official language; **RTA** is a dummy variable that takes the value of 1 if pair countries are in the same regional trade agreement; **CU** equals 1 if pair of countries are in the same currency union.

4.4.3. The impact of uncertainty on bilateral trade by sector or industry

We also investigated the impact of uncertainty on bilateral trade by type of products (sectors), following the Standard International Trade Classification system (SITC). The United Nations recommends the SITC classification that provides international comparability of trade statistics. Using this classification, known as SITC, Revision 3, (which groups all commodities into categories suitable for economic analysis), we classified products into two categories: primary products and manufactured/industrialized products. Our results show that global uncertainty in both exporter and importer countries has a negative impact on the bilateral trade of primary products (Annex 3 - **Table A 4.5**). However, the effect of trade uncertainty is not explicit. While trade uncertainty in the importer country negatively impacts the bilateral trade of primary products (in all models), trade uncertainty in the exporter country positively impacts the bilateral trade of primary products. Most of the best commodity exporters are developing countries that significantly rely on their exports of primary products. Thus, even in a period of uncertainty, these countries continue to export to maintain their revenue. The results also highlight that uncertainty in exporter and importer countries negatively impacts the bilateral exports of manufacturing products (Table A 4.6). This result is also valid for trade uncertainty in both importer and exporter countries, unlike the previous case where trade uncertainty in the exporter country positively impacts the bilateral trade of primary goods. In fact, the productivity of manufacture and industrialized products is associated with stability in the domestic country. This may explain why trade uncertainty in an exporter country hurts the bilateral trade of manufactured/industrialized products. The study also looks at the impact of uncertainty on bilateral trade in oil exports, which is sensitive to economic shocks, including uncertainty. The results follow our initial estimations and highlight the negative impact of global uncertainty from all sides of borders on the bilateral trade of mineral fuel. However, the effect of trade uncertainty is unclear (Table A 4.7).

4.4.4. Uncertainty in GVC production hubs

To understand more how uncertainty is transmitted and the role of GVCs in this transmission, we studied the impact of uncertainty on bilateral trade when exporters or importers are among the top GVC production hubs — from the highest to among the top 10 GVC production hubs. Appendix 4 provides the results on the impact of uncertainty in the world's top 10 traders. The basic gravity variables follow the expectations. The coefficient in front of distance is negative. The coefficients in front of both importer and exporter's GDP are positive and significant. In addition, the results confirm the negative link between uncertainty and trade flows. Two cases appeared in the results depending on whether GVC production hubs are the exports or the importers. ***(i)*** **First case :** When importers are among the top 10 GVC production hubs (Table A 4.8 and Table A 4.9), uncertainty in both the importer and the exporter countries has a negative impact on bilateral trade. For trade uncertainty, only uncertainty in the importer's country negatively impacts bilateral trade. The effect of trade uncertainty in the exporter

country is not significant and varies with the model used. ***(ii)*** **Second case :** When exporters are among the top 10 GVC production hubs (Table A 4.10 and Table A 4.11), both global and trade uncertainty in the importer and export countries have a negative and significant impact on bilateral trade. The results confirm the initial findings and show that uncertainty in GVC production hubs negatively impacts their bilateral trade with other countries.

4.5. Spillover effects of uncertainty through GVCs: A panel fixed effects approach

The second part of this chapter investigates the spillover impact of uncertainty in the top 3 GVC production hubs (Germany, China, and the US) on other countries' global trade. First, when focusing on all countries, the results suggest that global uncertainty in the US, China, and Germany negatively impact other countries' trade flows. The coefficient in front of the US and China's uncertainty is negative but not significant, but the coefficient in front of Germany's[35] uncertainty is negative and significant (Table 4.3). When considering the impact of these top three GVC production hubs on countries with a high GVCs integration, we can see that uncertainty in the US has a negative effect on the trade of the rest of the world (Table 4.4).

Table 4.3: Results of panel fixed effects all countries

	Trade (Export plus Import)					
VARIABLES	Model (1)	Model (2)	Model (3)	Model (4)	Model (4)	Model (5)
Log RGDP	1.803***	1.793***	1.819***	1.828***	1.821***	1.941***
	(0.212)	(0.213)	(0.211)	(0.213)	(0.216)	(0.223)
Price	-0.000217	-0.000206	-0.000202	-0.00021	-0.00017	-0.000201
	(0.000184)	(0.000182)	(0.000187)	(0.000185)	(0.000184)	(0.000200)
Log Pop (15-64)	-0.0174	-0.0153	-0.0221	-0.0361	-0.0423	-0.495
	(0.312)	(0.312)	(0.318)	(0.312)	(0.319)	(0.396)
Log Credit	0.220***	0.217***	0.214***	0.210***	0.205***	0.171**
	(0.0689)	(0.0691)	(0.0693)	(0.0694)	(0.0703)	(0.0720)
Log Dist_hubs	-0.000346**	-0.000334**	-0.000337**	-0.000321**	-0.000328**	-0.000333*
	(0.000160)	(0.000155)	(0.000157)	(0.000156)	(0.000156)	(0.000180)
Log Air freight	0.0122	0.0122	0.0105	0.0134	0.0126	0.0226
	(0.0285)	(0.0285)	(0.0289)	(0.0281)	(0.0286)	(0.0330)
log RER	0.121	0.126	0.124	0.118	0.129	0.138
	(0.147)	(0.146)	(0.147)	(0.145)	(0.147)	(0.158)
log FDI	0.0189	0.0178	0.0161	0.0211	0.0193	0.0264*
	(0.0126)	(0.0125)	(0.0128)	(0.0127)	(0.0126)	(0.0145)
Log GFCF	-0.0248	-0.0309	-0.0361	-0.0201	-0.0262	-0.0592
	(0.130)	(0.130)	(0.130)	(0.129)	(0.132)	(0.151)
Log LE	1.846	1.903	1.959	1.851	1.922	2.218
	(1.736)	(1.760)	(1.811)	(1.734)	(1.767)	(1.666)
Log SSE	-0.162	-0.164	-0.16	-0.17	-0.16	0.0168
	(0.208)	(0.208)	(0.208)	(0.205)	(0.209)	(0.221)
USA Un	-0.312					
	(0.268)					
China Un		-0.508				
		(0.340)				
Germany Un			-0.687**			
			(0.342)			
USA TUn				-0.0321***		
				(0.00912)		
China TUn					-0.0338**	
					(0.0133)	
World TUn						-0.316***
						(0.0455)

[35] Germany was ranked in 2018 as the highest GVCs integrated country in the world.

Constant	-27.77***	-27.83***	-28.56***	-28.19***	-28.25***	-26.00***
	(5.592)	(5.626)	(5.907)	(5.644)	(5.761)	(6.743)
Observations	966	966	966	966	966	866
R-squared	0.803	0.803	0.804	0.804	0.804	0.823
Number of id	70	70	70	70	70	62

The study also focused on trade uncertainty in the US and China as well as on world trade uncertainty.[36] First trade uncertainty has a negative and significant impact on global trade, which is logical. Second, our results suggest that trade uncertainty in the US and China has spillover effects on other countries' trade. This result confirms our initial expectation that economic shocks resulting from uncertainty can spread through GVCs. The results are similar when looking at the effect of uncertainty in these GVC production hubs on countries that are highly integrated into GVCs (Table 4.4), confirming the findings of the gravity model.

Table 4.4: Results of panel fixed effects—countries that are highly integrated into GVCs

	Trade (Export plus Import)					
VARIABLES	Model (1)	Model (2)	Model (3)	Model (4)	Model (4)	Model (5)
Log RGDP	1.299***	1.268***	1.264***	1.295***	1.283***	1.434***
	(0.349)	(0.350)	(0.346)	(0.346)	(0.339)	(0.311)
Price	0.00762	0.00801	0.00614	0.00761	0.00841	0.00564
	(0.00993)	(0.00968)	(0.00925)	(0.0102)	(0.00973)	(0.0104)
Log Pop (15-64)	0.635	0.656	0.685	0.636	0.642	0.481
	(0.856)	(0.856)	(0.854)	(0.855)	(0.855)	(0.879)
Log Credit	0.200*	0.193*	0.189*	0.193*	0.18	0.159
	(0.101)	(0.105)	(0.105)	(0.106)	(0.107)	(0.0997)
Log Dist_hubs	6.25E-05	3.35E-05	2.31E-05	5.58E-06	3.24E-05	-0.000165
	(0.000305)	(0.000288)	(0.000281)	(0.000287)	(0.000283)	(0.000255)
Log Air freight	0.015	0.0213	0.0127	0.0195	0.0236	0.0184
	(0.0486)	(0.0474)	(0.0461)	(0.0465)	(0.0458)	(0.0391)
log RER	0.452**	0.460**	0.445**	0.466**	0.461**	0.473**
	(0.212)	(0.208)	(0.204)	(0.199)	(0.200)	(0.185)
log FDI	0.0116	0.0113	0.00569	0.0155	0.0131	0.0114
	(0.0135)	(0.0136)	(0.0137)	(0.0140)	(0.0130)	(0.0132)
Log GFCF	-0.0867	-0.0871	-0.0746	-0.0773	-0.0837	-0.225
	(0.188)	(0.193)	(0.192)	(0.190)	(0.191)	(0.172)
Log LE	4.276	4.389	4.757	4.253	4.566	4.051
	(2.786)	(2.871)	(2.929)	(2.774)	(2.830)	(2.474)
Log SSE	-0.0281	-0.0163	0.0377	-0.0454	-0.00697	0.052
	(0.304)	(0.306)	(0.307)	(0.304)	(0.298)	(0.290)
USA Un	-0.513*					
	(0.298)					
China Un		-0.563				
		(0.338)				
Germany Un			-0.944***			
			(0.278)			
USA TUn				-0.0205*		
				(0.0121)		
China TUn					-0.0331***	
					(0.00912)	
World TUn						-0.359***
						(0.0513)
Constant	-40.57***	-40.57***	-42.59***	-40.19***	-41.54***	-39.62***
	(12.57)	(12.64)	(12.75)	(12.41)	(12.38)	(11.87)
Observations	365	365	365	365	365	362
R-squared	0.769	0.768	0.772	0.768	0.771	0.792
Number of id	32	32	32	32	32	31

[36] Germany trade uncertainty was not considered because of lack of data.

4.6. Conclusion

In the wake of the COVID-19 pandemic and the surrounding uncertainty, this research investigated the impact of past episodes of uncertainty in GVC production hubs on trade. Using a gravity model and a panel fixed effect specification, the chapter concludes with the following results. Uncertainty in both the exporter and importer countries affects its bilateral exports. The impact of global uncertainty was found to be more stable and painful than trade uncertainty (partly explained by the low quality of trade uncertainty data). The results also highlight that GVCs play an essential role in transmitting economic shocks resulting from uncertainty. In fact, according to the gravity model, global and trade uncertainty in the world's top 10 GVC production hubs (whether they are importers or exporters) negatively affects their bilateral trade. This is also true when their partners are African countries. This study has also focused on the spillover effects of uncertainty in the three most-integrated countries into GVCs: the US, China, and Germany. The results also show that uncertainty in these GVC production hubs spreads to the rest of the world and leads to trade contraction. All these findings are consistent with the literature about financial uncertainty.

Regarding policy, the topic of uncertainty and transmission of economic shocks through GVCs is increasingly topical, given the current uncertainty and downturn generated by the COVID-19 pandemic. This uncertainty may remain after the pandemic and may harm economic recovery, especially for developing countries. The results depicted in this study suggest that despite the economic benefit from GVCs integration, countries that are well integrated can quickly become vulnerable to shocks. Thus, policymakers, by promoting GVCs integration, should at the same time promote measures and protocols to reduce economic losses in case a shock occurs along the chain.

Appendix – Charts and result tables

Appendix 1: Exports shocks

How to measure exports Instability (shocks)

In the literature, a wide range of methods are used to measures of instability, with each variable having its own strength and weakness (Cariolle & Goujon, 2015). Going from simple measures such as deviation from the trend to more sophisticated measures, the debate on measuring macroeconomics variables' instability/volatility remains a tricky issue in economy. Instability is often measured as the short term or yearly fluctuation of exports proceeds around the growth trend of exports (Seiji Naya, 2020). The well-known measures of instability are: The coefficient of variation, the mean squared deviation which depends on the choice of the form of the trend. The literature has long discussed the different ways in modelling trends. We have two categories of trend namely stochastic and deterministic trend that can be mixed. In our study we rely on a "mixed trend" regression, as shown in the following equation:

$$\ln(Exp_t) = \alpha + \beta_1 \ln(Exp_{t-1}) + \beta_2 T + \varepsilon_t \quad (6)$$

Where, Exp is the value of exports of goods and services at constant US dollars in year t; T is the time variable; ε is the error term in year t; α, β_1 and β_2 are the regression coefficients.

The residual that represents the deviation from the trend are used as a proxy of trade shocks. (Figure 2)

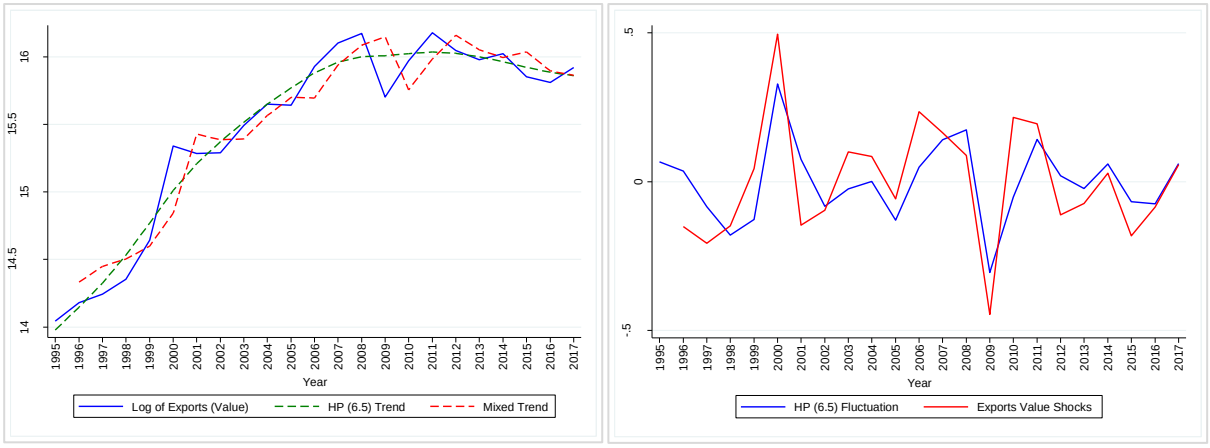
Statistical filters can also be used to isolate the deviations as a cyclical component by removing the trend components of series. In difference to the parametric approach, the filter approach does not require a priori assumptions on the form of the trend and is sensitive to structural breaks. We relied on the Hodrick-Prescott (HP) filter (Hodrick-Prescott, 1997), that is amongst the most popular (another example is the Band Pass filter of Baxter and King, 1999) and breaks down the change in a series into a trend component , and a cyclical component. The HP filter isolates the cyclical component by optimizing the following program:

$$\min_{\{HP_t^*\}} \left[\sum_{t-1}^{T} (y_t - HP_t)^z + \lambda \left(\sum_{t=2}^{T-1} \Delta^2 HP_t \right)^2 \right] \quad with \ T = 1,2,3,\dots t \quad (7)$$

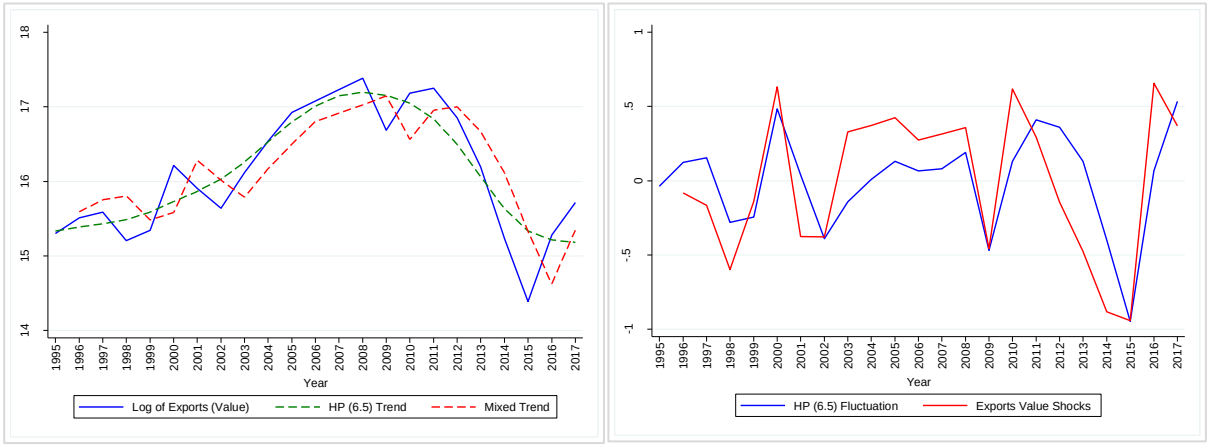
giving the deviation. $\widehat{\varepsilon_t} = y_t - HP_t^*$. This method is close to a symmetrical moving average filter with an infinite time horizon. λ is a smoothing parameter which can be either estimated or determined ad hoc.

Figure A 4.1: Bilateral Export Revenue, Mixed Trends, HP and Residuals trend (Shocks).

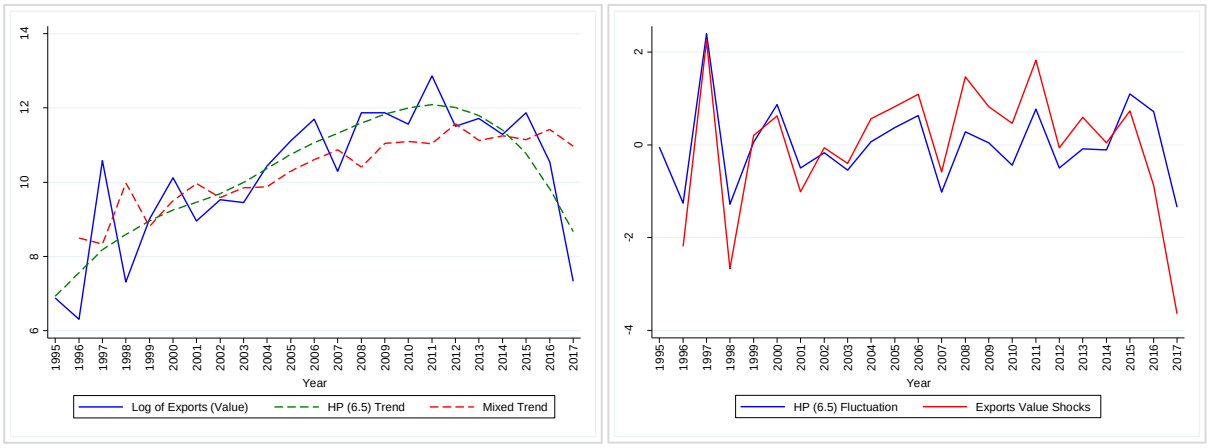
(a) South-Africa Exports to The United States of America



(b) Nigeria Exports to The United States of America

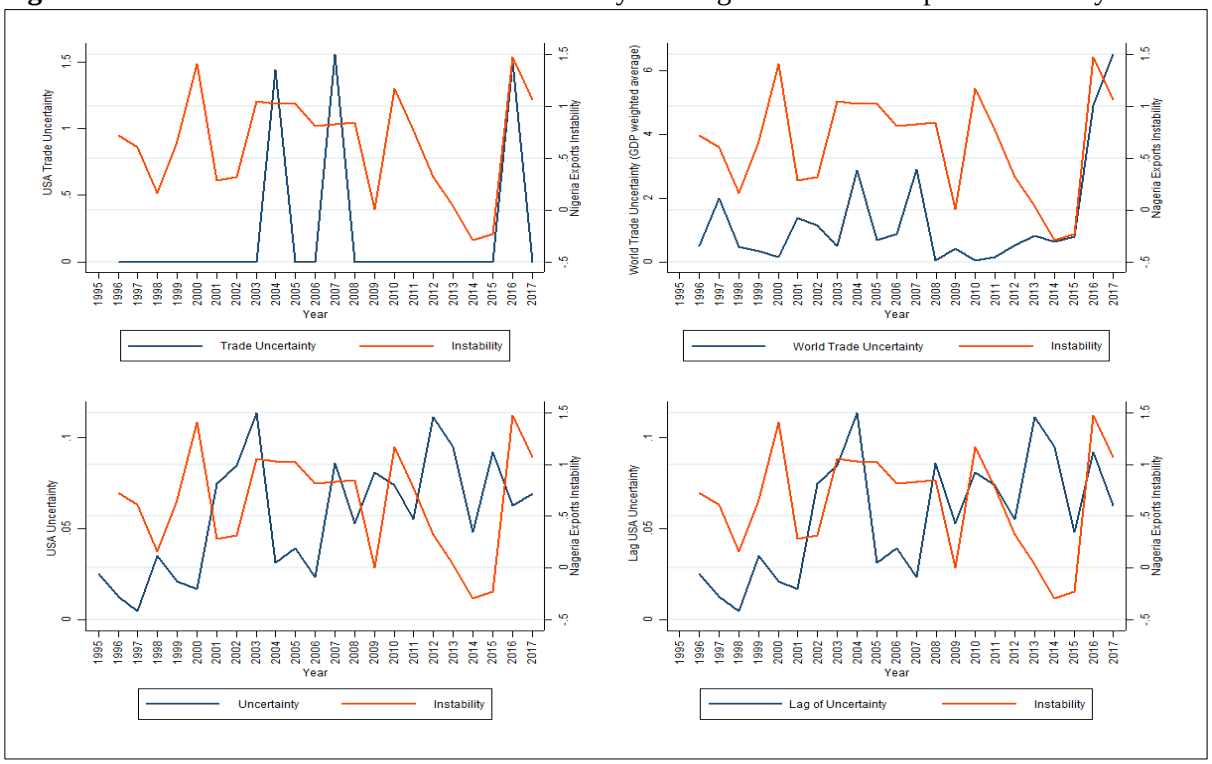


(c) Niger Exports to The United States of America



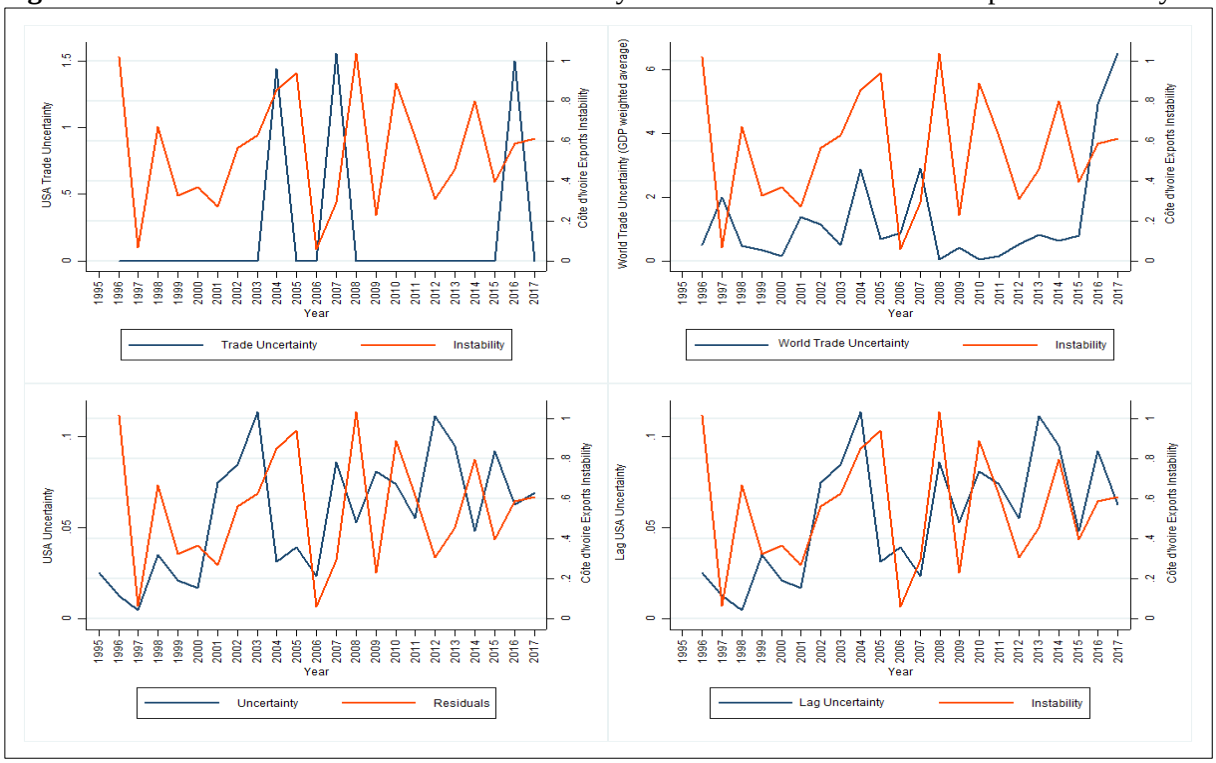
Source : Author's calculation

Figure A 4.2: The US Trade and Global Uncertainty and Nigeria Bilateral Exports Instability



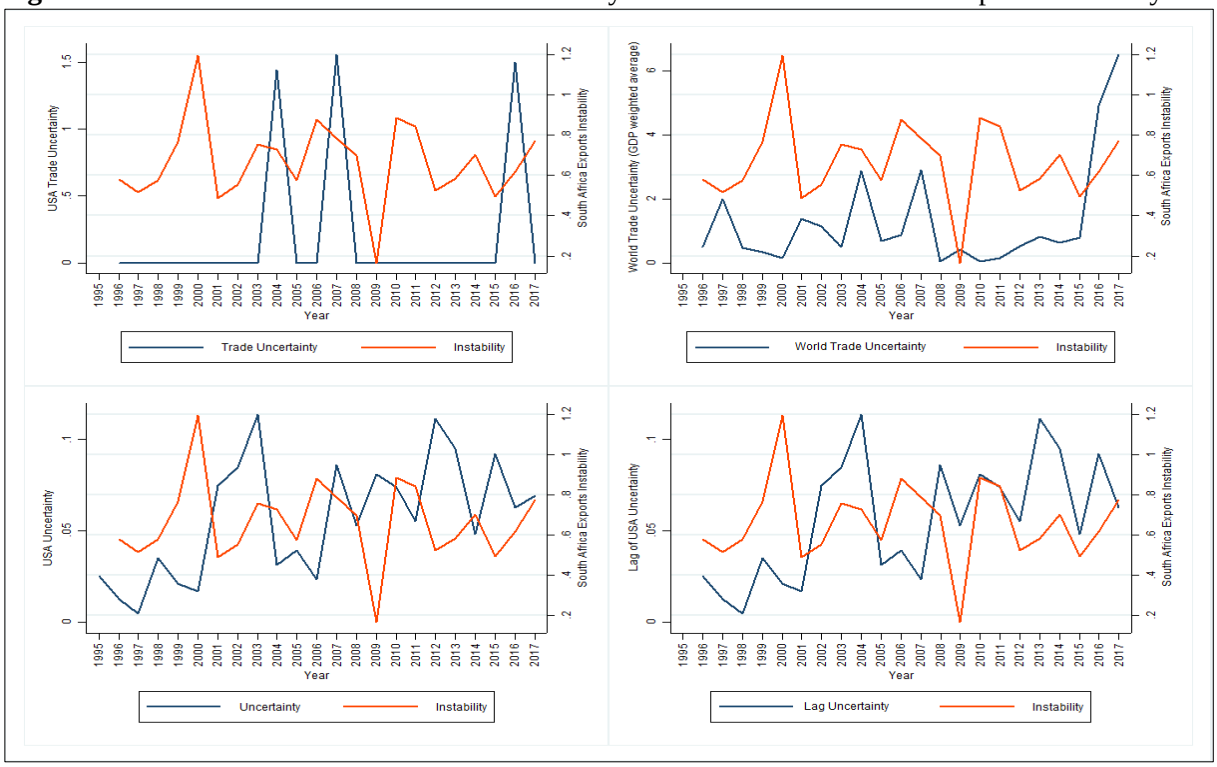
Source : Author's calculation

Figure A 4.3 : The US Trade and Global Uncertainty and Côte d'Ivoire Bilateral Exports Instability



Source : Author's calculation

Figure A 4.4: The US Trade and Global Uncertainty and South Africa Bilateral Exports Instability



Source : Author's calculations

Annex 2: Base line estimation results: focus on African countries

Table A 4.1: Results of the Gravity model (The Exporter is an African country)

	Uncertainty				Trade Uncertainty			
	1	2	3	4	5	6	7	8
VARIABLES	OLS	Imp-Exp FE	Pair FE	Pair-Year FE	OLS	Imp-Exp FE	Pair FE	Pair-Year FE
Log sea dist	-1.100***	-0.883***			-1.090***	-0.885***		
	(0.0591)	(0.0626)			(0.0590)	(0.0626)		
Log Exp Area	-0.279***	-0.709*			-0.278***	-0.885**		
	(0.0496)	(0.384)			(0.0495)	(0.384)		
Log Imp Area	-0.136***	-1.757			-0.135***	-1.874		
	(0.0221)	(1.446)			(0.0221)	(1.439)		
Exp Cor	-4.593***	-0.223	0.0756	-1.913	-4.621***	-0.297	-0.0343	-2.546
	(1.160)	(1.006)	(0.968)	(1.650)	(1.169)	(1.006)	(0.967)	(1.641)
Imp Cor	3.628***	0.465	-0.731	-1.612	3.816***	1.276	0.0265	-1.503
	(1.394)	(1.228)	(1.168)	(1.296)	(1.383)	(1.223)	(1.160)	(1.292)
Log Exp RGDP	1.021***	1.224***	1.366***	1.764***	1.023***	1.183***	1.326***	1.849***
	(0.0437)	(0.0992)	(0.0958)	(0.136)	(0.0435)	(0.0984)	(0.0951)	(0.135)
Log Imp RGDP	0.919***	1.271***	1.277***	1.501***	0.916***	1.207***	1.217***	1.503***
	(0.0351)	(0.125)	(0.118)	(0.130)	(0.0351)	(0.125)	(0.119)	(0.131)
Exp landl	-0.833***	-1.256**			-0.832***	-1.617***		
	(0.0927)	(0.516)			(0.0928)	(0.515)		
Imp landl	-0.767***	-3.082**			-0.776***	-3.363**		
	(0.120)	(1.492)			(0.120)	(1.482)		
Log Exp AirTF	0.0820***	0.0548***	0.0573***	0.0490***	0.0797***	0.0550***	0.0581***	0.0452***
	(0.0147)	(0.0135)	(0.0134)	(0.0132)	(0.0147)	(0.0135)	(0.0135)	(0.0132)
Log Imp AirTF	0.135***	0.0366**	0.0370**	0.0315*	0.137***	0.0396**	0.0403**	0.0321*
	(0.0177)	(0.0174)	(0.0164)	(0.0164)	(0.0177)	(0.0175)	(0.0165)	(0.0165)
Colony	1.291***	0.736***			1.268***	0.735***		
	(0.261)	(0.256)			(0.260)	(0.256)		
Com col	0.438***	0.218*			0.445***	0.215*		
	(0.133)	(0.124)			(0.133)	(0.124)		
contiguity	2.157***	2.294***			2.166***	2.299***		
	(0.298)	(0.250)			(0.297)	(0.251)		
Com off lang	0.832***	0.778***			0.829***	0.780***		
	(0.0987)	(0.103)			(0.0987)	(0.103)		
RTA	0.837***	0.519***	0.0149	-0.027	0.831***	0.508***	-0.0292	-0.0221
	(0.131)	(0.117)	(0.112)	(0.114)	(0.131)	(0.117)	(0.114)	(0.115)
CU	1.232***	0.989***	0.147	0.114	1.229***	0.977***	0.0921	0.101
	(0.179)	(0.170)	(0.167)	(0.163)	(0.178)	(0.170)	(0.166)	(0.163)
Exp Un	0.259	-1.567***	-1.492***	-1.045***				
	(0.383)	(0.245)	(0.229)	(0.238)				
Imp Un	-1.153**	-0.877***	-0.776***	-0.26				
	(0.486)	(0.327)	(0.293)	(0.301)				
Exp TUn					0.0925***	0.0137	-0.00989	0.0384***
					(0.0200)	(0.0144)	(0.0134)	(0.0149)
Imp TUn					-0.0807***	-0.0367***	-0.0333***	-0.00364
					(0.0163)	(0.0130)	(0.0109)	(0.0110)
Constant	-19.61***	-5.014	-51.60***	-65.71***	-19.78***	1.554	-49.33***	-67.65***
	(1.386)	(21.25)	(3.059)	(4.718)	(1.381)	(21.14)	(3.074)	(4.726)
Observations	34,814	34,814	34,390	34,390	34,814	34,814	34,390	34,390
R-squared	0.502	0.62	0.805	0.807	0.503	0.62	0.805	0.807

Note: Exp TUn represents the level of trade uncertainty in the exporter country; **Imp TUn** is the level of trade uncertainty in the exporter country; **Exp Un** represents the level of uncertainty in the exporter country; **Imp Un** is the level of uncertainty in the exporter country; **Log sea dist** is the logarithm of sea distance; **Log Exp Area** is the logarithm of the exporter country's area; **Log Imp Area** is the logarithm of the Importer country's area; **Exp Cor** measures the level of corruption in the exporter country; **Imp Cor** measures the level of corruption in the exporter country; **Log Exp RGDP** is the logarithm of Real Gross Domestic Product of the exporter country; **Log Imp RGDP** is the logarithm of Real Gross Domestic Product of the importer country; **Exp landl** is a dummy variable that takes the value of 1 if the exporter is a landlocked country; **Imp landl** is a dummy variable that takes the value of 1 if the importer is a landlocked country; **Log Exp AirTF** is the logarithm of Air Transport Freight Capacity of the exporter country; **Log Imp AirTF** is the logarithm of Air transport freight capacity of the importer country; **Colony** takes the value of 1 if pairs ever in colonial relationship; **Com col** equal to 1 if pair countries had a common colonizer post-1945; **contiguity** is a dummy variable that takes the value of 1 if pair of countries share the same borders; **Com off lang** equal 1 if pair countries have the same official language; **RTA** is a dummy variable that takes the value of 1 if pair countries are in the same regional trade agreement; **CU** equals 1 if pair of countries are in the same currency union.

Table A 4.2: Results of the Gravity model (The Importer is an African country)

	Uncertainty				Trade Uncertainty			
	1	2	4	5	1	2	4	5
VARIABLES	OLS	Imp-Exp FE	Pair FE	Pair-Year FE	OLS	Imp-Exp FE	Pair FE	Pair-Year FE
Log sea dist	-1.103***	-0.985***			-1.094***	-0.985***		
	(0.0549)	(0.0511)			(0.0548)	(0.0511)		
Log Exp Area	-0.209***	-6.320***			-0.210***	-6.380***		
	(0.0162)	(0.930)			(0.0162)	(0.937)		
Log Imp Area	-0.126***	0.0443			-0.128***	0.0767		
	(0.0349)	(0.269)			(0.0349)	(0.268)		
Exp Cor	-11.02***	0.654	-0.363	0.726	-10.87***	0.874	-0.222	0.881
	(1.127)	(0.849)	(0.831)	(0.928)	(1.117)	(0.842)	(0.824)	(0.923)
Imp Cor	2.561***	-4.440***	-3.910***	-0.988	2.444***	-4.455***	-3.898***	-0.847
	(0.829)	(0.652)	(0.623)	(0.998)	(0.836)	(0.652)	(0.623)	(0.998)
Log Exp RGDP	1.162***	1.258***	1.222***	1.128***	1.161***	1.279***	1.260***	1.141***
	(0.0268)	(0.0860)	(0.0836)	(0.0951)	(0.0269)	(0.0852)	(0.0828)	(0.0949)
Log Imp RGDP	0.772***	0.923***	1.021***	0.941***	0.777***	0.918***	1.018***	0.924***
	(0.0352)	(0.0716)	(0.0686)	(0.0879)	(0.0350)	(0.0717)	(0.0688)	(0.0878)
Exp landl	-0.704***	-9.444***			-0.711***	-9.394***		
	(0.0855)	(0.862)			(0.0854)	(0.870)		
Imp landl	-1.036***	-1.132***			-1.032***	-1.090***		
	(0.0718)	(0.284)			(0.0713)	(0.280)		
Log Exp AirTF	0.156***	0.0557***	0.0379***	0.0367***	0.157***	0.0568***	0.0386***	0.0367***
	(0.0143)	(0.0148)	(0.0140)	(0.0139)	(0.0143)	(0.0148)	(0.0141)	(0.0139)
Log Imp AirTF	0.0536***	0.000281	0.00697	-0.00286	0.0529***	0.000729	0.00765	-0.00279
	(0.0114)	(0.00900)	(0.00850)	(0.00865)	(0.0114)	(0.00900)	(0.00852)	(0.00865)
Colony	0.706***	0.899***			0.683***	0.899***		
	(0.222)	(0.222)			(0.222)	(0.222)		
Com col	0.573***	0.422***			0.581***	0.422***		
	(0.112)	(0.0929)			(0.112)	(0.0929)		
contiguity	1.676***	2.168***			1.686***	2.169***		
	(0.298)	(0.258)			(0.298)	(0.259)		
Com off lang	0.511***	0.685***			0.510***	0.685***		
	(0.0823)	(0.0751)			(0.0822)	(0.0751)		
RTA	0.840***	0.540***	0.240***	0.133**	0.833***	0.538***	0.235***	0.131**
	(0.107)	(0.0938)	(0.0561)	(0.0586)	(0.107)	(0.0938)	(0.0565)	(0.0587)
CU	1.139***	0.887***	0.142	0.0777	1.136***	0.889***	0.159	0.0882
	(0.179)	(0.157)	(0.163)	(0.161)	(0.178)	(0.157)	(0.163)	(0.161)
Exp Un	-1.157***	-0.855***	-0.942***	-0.517**				
	(0.378)	(0.229)	(0.212)	(0.213)				
Imp Un	0.501	0.291	0.542***	0.481**				
	(0.309)	(0.196)	(0.178)	(0.187)				
Exp TUn					-0.0576***	-0.0244***	-0.0307***	-0.00789
					(0.0136)	(0.00924)	(0.00878)	(0.00898)
Imp TUn					0.0538***	0.0236*	0.0193	0.0381***
					(0.0183)	(0.0136)	(0.0124)	(0.0127)
Constant	-18.78***	58.91***	-40.41***	-36.94***	-18.95***	58.72***	-41.35***	-36.96***
	(1.115)	(13.76)	(2.237)	(3.239)	(1.112)	(13.82)	(2.220)	(3.237)
Observations	40,329	40,329	40,034	40,034	40,329	40,329	40,034	40,034
R-squared	0.627	0.747	0.866	0.868	0.627	0.747	0.866	0.868

Note: Exp TUn represents the level of trade uncertainty in the exporter country; **Imp TUn** is the level of trade uncertainty in the exporter country; **Exp Un** represents the level of uncertainty in the exporter country; **Imp Un** is the level of uncertainty in the exporter country; **Log sea dist** is the logarithm of sea distance; **Log Exp Area** is the logarithm of the exporter country's area; **Log Imp Area** is the logarithm of the Importer country's area; **Exp Cor** measures the level of corruption in the exporter country; **Imp Cor** measures the level of corruption in the exporter country; **Log Exp RGDP** is the logarithm of Real Gross Domestic Product of the exporter country; **Log Imp RGDP** is the logarithm of Real Gross Domestic Product of the importer country; **Exp landl** is a dummy variable that takes the value of 1 if the exporter is a landlocked country; **Imp landl** is a dummy variable that takes the value of 1 if the importer is a landlocked country; **Log Exp AirTF** is the logarithm of Air Transport Freight Capacity of the exporter country; **Log Imp AirTF** is the logarithm of Air transport freight capacity of the importer country; **Colony** takes the value of 1 if pairs ever in colonial relationship; **Com col** equal to 1 if pair countries had a common colonizer post-1945; **contiguity** is a dummy variable that takes the value of 1 if pair of countries share the same borders; **Com off lang** equal 1 if pair countries have the same official language; **RTA** is a dummy variable that takes the value of 1 if pair countries are in the same regional trade agreement; **CU** equals 1 if pair of countries are in the same currency union.

Table A 4.3: Results of the Gravity model (Intra-African Trade)

	Uncertainty				Trade Uncertainty			
	1	2	4	5	1	2	4	5
VARIABLES	OLS	Imp-Exp FE	Pair FE	Pair-Year FE	OLS	Imp-Exp FE	Pair FE	Pair-Year FE
Log sea dist	-1.152***	-1.094***			-1.148***	-1.094***		
	(0.0839)	(0.0841)			(0.0838)	(0.0841)		
Log Exp Area	-0.459***	-0.0552			-0.457***	-0.213		
	(0.0795)	(0.719)			(0.0789)	(0.717)		
Log Imp Area	-0.255***	0.441			-0.259***	0.469		
	(0.0759)	(0.752)			(0.0755)	(0.752)		
Exp Cor	-8.771***	-0.271	-0.0925	2.16	-8.851***	-0.549	-0.482	1.582
	(2.455)	(2.192)	(2.239)	(2.985)	(2.441)	(2.202)	(2.256)	(2.978)
Imp Cor	4.891**	-1.155	-2.223	0.239	4.821**	-0.629	-1.746	0.618
	(2.396)	(2.065)	(2.066)	(2.460)	(2.394)	(2.069)	(2.074)	(2.469)
Log Exp RGDP	1.130***	1.539***	1.562***	1.889***	1.130***	1.515***	1.607***	1.964***
	(0.0793)	(0.196)	(0.188)	(0.247)	(0.0790)	(0.192)	(0.184)	(0.247)
Log Imp RGDP	0.751***	0.953***	0.890***	1.098***	0.756***	0.872***	0.827***	1.052***
	(0.0772)	(0.194)	(0.180)	(0.192)	(0.0763)	(0.195)	(0.181)	(0.195)
Exp landl	-0.838***	1.107			-0.839***	0.779		
	(0.150)	(0.863)			(0.150)	(0.848)		
Imp landl	-0.803***	-0.716			-0.798***	-0.795		
	(0.173)	(0.743)			(0.171)	(0.738)		
Log Exp AirTF	0.109***	0.0490**	0.0528***	0.0474**	0.104***	0.0468**	0.0500**	0.0428**
	(0.0235)	(0.0211)	(0.0204)	(0.0206)	(0.0234)	(0.0212)	(0.0206)	(0.0206)
Log Imp AirTF	0.0841***	-0.0124	0.0112	0.000417	0.0812***	-0.0107	0.0133	0.00116
	(0.0247)	(0.0217)	(0.0202)	(0.0205)	(0.0246)	(0.0219)	(0.0204)	(0.0208)
Colony	1.027	-0.579			0.94	-0.634		
	(0.721)	(0.613)			(0.746)	(0.634)		
Com col	0.564***	0.413*			0.576***	0.411*		
	(0.201)	(0.218)			(0.200)	(0.218)		
contiguity	1.556***	1.675***			1.552***	1.677***		
	(0.285)	(0.255)			(0.284)	(0.255)		
Com off lang	0.433**	0.731***			0.416**	0.731***		
	(0.179)	(0.189)			(0.179)	(0.189)		
RTA	1.718***	1.617***	0.0682	-0.0521	1.735***	1.616***	0.0662	-0.0598
	(0.231)	(0.216)	(0.110)	(0.127)	(0.231)	(0.216)	(0.111)	(0.130)
CU	0.553***	0.921***	0.134	0.0556	0.585***	0.916***	0.138	0.0621
	(0.179)	(0.173)	(0.166)	(0.168)	(0.179)	(0.173)	(0.167)	(0.168)
Exp Un	0.326	-1.507***	-1.086***	-0.971**				
	(0.659)	(0.448)	(0.395)	(0.423)				
Imp Un	0.639	0.136	0.897**	1.091**				
	(0.721)	(0.512)	(0.446)	(0.460)				
Exp TUn					0.168***	0.0348	-0.00319	0.0492
					(0.0418)	(0.0341)	(0.0306)	(0.0325)
Imp TUn					0.107***	0.0449	0.0209	0.0671**
					(0.0401)	(0.0330)	(0.0302)	(0.0313)
Constant	-12.63***	-44.85***	-44.80***	-58.45***	-12.68***	-40.45***	-44.38***	-59.06***
	(2.373)	(15.70)	(4.639)	(7.019)	(2.362)	(15.45)	(4.536)	(7.104)
Observations	8,621	8,621	8,527	8,527	8,621	8,621	8,527	8,527
R-squared	0.542	0.644	0.82	0.823	0.543	0.643	0.819	0.822

Note: Exp TUn represents the level of trade uncertainty in the exporter country; **Imp TUn** is the level of trade uncertainty in the exporter country; **Exp Un** represents the level of uncertainty in the exporter country; **Imp Un** is the level of uncertainty in the exporter country; **Log sea dist** is the logarithm of sea distance; **Log Exp Area** is the logarithm of the exporter country's area; **Log Imp Area** is the logarithm of the Importer country's area; **Exp Cor** measures the level of corruption in the exporter country; **Imp Cor** measures the level of corruption in the exporter country; **Log Exp RGDP** is the logarithm of Real Gross Domestic Product of the exporter country; **Log Imp RGDP** is the logarithm of Real Gross Domestic Product of the importer country; **Exp landl** is a dummy variable that takes the value of 1 if the exporter is a landlocked country; **Imp landl** is a dummy variable that takes the value of 1 if the importer is a landlocked country; **Log Exp AirTF** is the logarithm of Air Transport Freight Capacity of the exporter country; **Log Imp AirTF** is the logarithm of Air transport freight capacity of the importer country; **Colony** takes the value of 1 if pairs ever in colonial relationship; **Com col** equal to 1 if pair countries had a common colonizer post-1945; **contiguity** is a dummy variable that takes the value of 1 if pair of countries share the same borders; **Com off lang** equal 1 if pair countries have the same official language; **RTA** is a dummy variable that takes the value of 1 if pair countries are in the same regional trade agreement; **CU** equals 1 if pair of countries are in the same currency union.

Table A 4.4: Results of the Gravity model using the PPML estimator.

	Uncertainty				Trade Uncertainty			
VARIABLES	1 PPML	2 PPML Imp-Exp FE	3 PPML Pair-FE	4 PPML Pair Year-FE	1 PPML	2 PPML Imp-Exp FE	3 PPML Pair-FE	4 PPML Pair Year-FE
Log sea dist	-0.386***	-0.379***			-0.389***	-0.379***		
	‘(0.0267)	‘(0.0259)			‘(0.0277)	‘(0.0258)		
Log Exp Area	-0.102***				-0.102***			
	‘(0.0188)				‘(0.0198)			
Log Imp Area	-0.0791***				-0.0797***			
	‘(0.0175)				‘(0.0186)			
Exp Cor	-10.00***	-2.071**	-2.017***	-2.249**	-9.081***	-1.940**	-1.829**	-2.356**
	‘(1.655)	‘(0.816)	‘(0.741)	‘(0.991)	‘(1.641)	‘(0.813)	‘(0.746)	‘(0.970)
Imp Cor	-0.721	-2.216***	-2.347***	-2.538***	0.151	-1.923***	-1.946***	-2.488***
	‘(1.384)	‘(0.734)	‘(0.636)	‘(0.526)	‘(1.409)	‘(0.741)	‘(0.657)	‘(0.523)
Log Exp RGDP	0.704***	0.765***	0.800***	0.909***	0.692***	0.761***	0.816***	0.910***
	‘(0.0342)	‘(0.0513)	‘(0.0508)	‘(0.0558)	‘(0.0354)	‘(0.0500)	‘(0.0509)	‘(0.0552)
Log Imp RGDP	0.677***	0.794***	0.814***	0.943***	0.671***	0.795***	0.837***	0.948***
	‘(0.0335)	‘(0.0720)	‘(0.0702)	‘(0.0809)	‘(0.0342)	‘(0.0719)	‘(0.0710)	‘(0.0812)
Exp landl	0.0331				0.00747			
	‘(0.113)				‘(0.121)			
Imp landl	-0.0656				-0.0943			
	‘(0.126)				‘(0.132)			
Log Exp AirTF	0.158***	0.0559***	0.0542***	0.0425***	0.168***	0.0554***	0.0581***	0.0415***
	‘(0.0242)	‘(0.0137)	‘(0.0132)	‘(0.0116)	‘(0.0256)	‘(0.0133)	‘(0.0132)	‘(0.0114)
Log Imp AirTF	0.159***	0.0496***	0.0498***	0.0322***	0.166***	0.0479***	0.0515***	0.0304***
	‘(0.0228)	‘(0.0100)	‘(0.00901)	‘(0.00810)	‘(0.0238)	‘(0.00962)	‘(0.00904)	‘(0.00764)
Colony	-0.0216	0.199**			-0.0757	0.200**		
	‘(0.0898)	‘(0.0853)			‘(0.0922)	‘(0.0851)		
Com col	0.201	0.510***			0.253	0.511***		
	‘(0.183)	‘(0.142)			‘(0.188)	‘(0.142)		
contiguity	1.000***	0.824***			1.019***	0.823***		
	‘(0.110)	‘(0.0831)			‘(0.109)	‘(0.0828)		
Com off lang	0.268***	0.178**			0.273***	0.177**		
	‘(0.0890)	‘(0.0810)			‘(0.0896)	‘(0.0812)		
RTA	0.503***	0.501***	0.0328	-0.00656	0.503***	0.507***	0.00644	-0.00199
	‘(0.0655)	‘(0.0482)	‘(0.0255)	‘(0.0226)	‘(0.0661)	‘(0.0496)	‘(0.0243)	‘(0.0222)
CU	0.461***	0.844***	0.191***	0.0632***	0.401***	0.848***	0.177***	0.0539**
	‘(0.0993)	‘(0.0816)	‘(0.0194)	‘(0.0222)	‘(0.0991)	‘(0.0814)	‘(0.0197)	‘(0.0231)
Exp Un	-2.284***	-0.0922	-0.284**	0.162				
	‘(0.506)	‘(0.134)	‘(0.121)	‘(0.109)				
Imp Un	-1.191***	-0.402***	-0.525***	-0.0788				
	‘(0.319)	‘(0.122)	‘(0.101)	‘(0.0892)				
Exp TUn					-0.00679	0.00324	-0.0119*	0.00555*
					‘(0.0163)	‘(0.00385)	‘(0.00624)	‘(0.00326)
Imp TUn					0.00305	0.0045	-0.0110**	0.00676**
					‘(0.00799)	‘(0.00379)	‘(0.00539)	‘(0.00295)
Constant	-5.743***	-6.380***	-9.105***	-10.56***	-6.182***	-6.442***	-9.557***	-10.57***
	‘(0.386)	‘(0.591)	‘(0.534)	‘(0.677)	‘(0.389)	‘(0.603)	‘(0.551)	‘(0.677)
Observations	185,795	185,795	184,897	184,897	185,795	185,795	184,897	184,897
R-squared	0.748				0.744			

Note: Exp TUn represents the level of trade uncertainty in the exporter country; **Imp TUn** is the level of trade uncertainty in the exporter country; **Exp Un** represents the level of uncertainty in the exporter country; **Imp Un** is the level of uncertainty in the exporter country; **Log sea dist** is the logarithm of sea distance; **Log Exp Area** is the logarithm of the exporter country's area; **Log Imp Area** is the logarithm of the Importer country's area; **Exp Cor** measures the level of corruption in the exporter country; **Imp Cor** measures the level of corruption in the exporter country; **Log Exp RGDP** is the logarithm of Real Gross Domestic Product of the exporter country; **Log Imp RGDP** is the logarithm of Real Gross Domestic Product of the importer country; **Exp landl** is a dummy variable that takes the value of 1 if the exporter is a landlocked country; **Imp landl** is a dummy variable that takes the value of 1 if the importer is a landlocked country; **Log Exp AirTF** is the logarithm of Air Transport Freight Capacity of the exporter country; **Log Imp AirTF** is the logarithm of Air transport freight capacity of the importer country; **Colony** takes the value of 1 if pairs ever in colonial relationship; **Com col** equal to 1 if pair countries had a common colonizer post-1945; **contiguity** is a dummy variable that takes the value of 1 if pair of countries share the same borders; **Com off lang** equal 1 if pair countries have the same official language; **RTA** is a dummy variable that takes the value of 1 if pair countries are in the same regional trade agreement; **CU** equals 1 if pair of countries are in the same currency union.

Annex 3: Gravity model-Regression by product type/Sector or Industry

Table A 4.5: Results of the Gravity model (trade in primary products)

	Uncertainty				Trade Uncertainty			
	1	2	3	4	5	6	7	8
VARIABLES	OLS	Imp-Exp FE	Pair FE	Pair-Year FE	OLS	Imp-Exp FE	Pair FE	Pair-Year FE
Log sea dist	-0.618***	-0.671***			-0.618***	-0.670***		
	(0.0228)	(0.0231)			(0.0228)	(0.0231)		
Log Exp Area	0.0990***	-4.124***			0.0968***	-4.114***		
	(0.0122)	(1.185)			(0.0122)	(1.187)		
Log Imp Area	-0.0882***	2.975***			-0.0887***	2.966***		
	(0.0114)	(0.766)			(0.0114)	(0.767)		
Exp Cor	-4.884***	0.246	-2.476***	1.336**	-4.640***	0.546	-2.229***	1.523**
	(0.800)	(0.590)	(0.492)	(0.681)	(0.790)	(0.586)	(0.491)	(0.681)
Imp Cor	-2.169***	-0.931*	-0.958**	0.656	-1.784***	-0.928*	-0.897**	0.748
	(0.674)	(0.479)	(0.419)	(0.507)	(0.670)	(0.478)	(0.417)	(0.505)
Log Exp RGDP	0.507***	0.676***	0.640***	0.313***	0.510***	0.674***	0.643***	0.326***
	(0.0218)	(0.0495)	(0.0435)	(0.0487)	(0.0218)	(0.0497)	(0.0437)	(0.0490)
Log Imp RGDP	0.650***	1.280***	1.368***	1.062***	0.646***	1.268***	1.364***	1.071***
	(0.0180)	(0.0485)	(0.0439)	(0.0507)	(0.0180)	(0.0483)	(0.0439)	(0.0506)
Exp landl	-0.270***	-4.960***			-0.274***	-4.937***		
	(0.0592)	(0.823)			(0.0593)	(0.825)		
Imp landl	-0.410***	3.762***			-0.416***	3.728***		
	(0.0623)	(0.730)			(0.0622)	(0.731)		
Log Exp AirTF	0.120***	0.0571***	0.0432***	0.0544***	0.119***	0.0561***	0.0433***	0.0537***
	(0.0121)	(0.0116)	(0.00971)	(0.00944)	(0.0122)	(0.0116)	(0.00970)	(0.00942)
Log Imp AirTF	0.0908***	0.0353***	0.0392***	0.0399***	0.0927***	0.0360***	0.0400***	0.0400***
	(0.00949)	(0.00777)	(0.00620)	(0.00614)	(0.00949)	(0.00776)	(0.00620)	(0.00614)
Colony	0.571***	0.746***			0.569***	0.747***		
	(0.0878)	(0.0850)			(0.0879)	(0.0849)		
Com col	0.463***	0.730***			0.475***	0.728***		
	(0.0963)	(0.0894)			(0.0963)	(0.0894)		
contiguity	1.229***	1.075***			1.230***	1.074***		
	(0.0869)	(0.0851)			(0.0868)	(0.0850)		
Com off lang	0.353***	0.534***			0.341***	0.533***		
	(0.0540)	(0.0558)			(0.0541)	(0.0558)		
RTA	0.440***	0.583***	0.0293	0.0199	0.444***	0.587***	0.03	0.02
	(0.0430)	(0.0369)	(0.0220)	(0.0236)	(0.0431)	(0.0371)	(0.0223)	(0.0236)
CU	0.972***	1.183***	0.437***	0.355***	0.972***	1.189***	0.440***	0.353***
	(0.0565)	(0.0539)	(0.0307)	(0.0327)	(0.0565)	(0.0541)	(0.0309)	(0.0327)
Exp Un	0.301	-0.176	-0.229**	-0.15				
	(0.220)	(0.111)	(0.0918)	(0.0965)				
Imp Un	-1.245***	-0.141	-0.259***	-0.250***				
	(0.229)	(0.119)	(0.0947)	(0.0957)				
Exp TUn					0.0625***	0.0275***	0.00947***	0.0187***
					(0.00646)	(0.00388)	(0.00330)	(0.00323)
Imp TUn					-0.0396***	-0.00104	-0.00864***	-0.00272
					(0.00614)	(0.00377)	(0.00312)	(0.00316)
Constant	-8.075***	-12.55	-35.24***	-19.37***	-8.170***	-12.31	-35.29***	-20.01***
	(0.707)	(19.89)	(1.343)	(1.814)	(0.707)	(19.91)	(1.343)	(1.809)
Observations	61,965	61,965	61,041	61,041	61,965	61,965	61,041	61,041
R-squared	0.606	0.735	0.929	0.932	0.607	0.735	0.929	0.932

Note: Exp TUn represents the level of trade uncertainty in the exporter country; **Imp TUn** is the level of trade uncertainty in the exporter country; **Exp Un** represents the level of uncertainty in the exporter country; **Imp Un** is the level of uncertainty in the exporter country; **Log sea dist** is the logarithm of sea distance; **Log Exp Area** is the logarithm of the exporter country's area; **Log Imp Area** is the logarithm of the Importer country's area; **Exp Cor** measures the level of corruption in the exporter country; **Imp Cor** measures the level of corruption in the exporter country; **Log Exp RGDP** is the logarithm of Real Gross Domestic Product of the exporter country; **Log Imp RGDP** is the logarithm of Real Gross Domestic Product of the importer country; **Exp landl** is a dummy variable that takes the value of 1 if the exporter is a landlocked country; **Imp landl** is a dummy variable that takes the value of 1 if the importer is a landlocked country; **Log Exp AirTF** is the logarithm of Air Transport Freight Capacity of the exporter country; **Log Imp AirTF** is the logarithm of Air transport freight capacity of the importer country; **Colony** takes the value of 1 if pairs ever in colonial relationship; **Com col** equal to 1 if pair countries had a common colonizer post-1945; **contiguity** is a dummy variable that takes the value of 1 if pair of countries share the same borders; **Com off lang** equal 1 if pair countries have the same official language; **RTA** is a dummy variable that takes the value of 1 if pair countries are in the same regional trade agreement; **CU** equals 1 if pair of countries are in the same currency union.

Table A 4.6: Results of the Gravity model (trade in manufacture/industrialized products)

	Uncertainty				Trade Uncertainty			
	1	2	3	4	5	6	7	8
VARIABLES	OLS	Imp-Exp FE	Pair FE	Pair-Year FE	OLS	Imp-Exp FE	Pair FE	Pair-Year FE
Log sea dist	-0.544***	-0.606***			-0.543***	-0.606***		
	(0.0215)	(0.0206)			(0.0215)	(0.0206)		
Log Exp Area	-0.152***	-0.0426			-0.155***	-0.127		
	(0.0105)	(0.868)			(0.0106)	(0.862)		
Log Imp Area	-0.0810***	2.331***			-0.0834***	2.307***		
	(0.0102)	(0.774)			(0.0102)	(0.773)		
Exp Cor	-12.49***	-1.149**	-2.896***	-3.080***	-11.59***	-0.727	-2.488***	-3.080***
	(0.711)	(0.514)	(0.409)	(0.532)	(0.706)	(0.509)	(0.405)	(0.531)
Imp Cor	1.476**	-1.631***	-1.152***	-1.187***	1.914***	-1.514***	-0.968***	-1.124***
	(0.581)	(0.394)	(0.323)	(0.372)	(0.581)	(0.394)	(0.323)	(0.372)
Log Exp RGDP	0.835***	0.907***	1.002***	1.033***	0.834***	0.905***	1.008***	1.032***
	(0.0212)	(0.0439)	(0.0386)	(0.0451)	(0.0213)	(0.0438)	(0.0385)	(0.0450)
Log Imp RGDP	0.652***	0.849***	1.002***	1.008***	0.652***	0.851***	1.012***	1.018***
	(0.0166)	(0.0386)	(0.0325)	(0.0374)	(0.0167)	(0.0385)	(0.0324)	(0.0373)
Exp landl	0.283***	-1.770*			0.282***	-1.868**		
	(0.0572)	(0.909)			(0.0574)	(0.905)		
Imp landl	-0.0803	2.069***			-0.0843	2.084***		
	(0.0546)	(0.791)			(0.0546)	(0.790)		
Log Exp AirTF	0.104***	0.0335***	0.0122	0.00875	0.107***	0.0346***	0.0143	0.00916
	(0.0121)	(0.0109)	(0.00884)	(0.00850)	(0.0121)	(0.0109)	(0.00889)	(0.00850)
Log Imp AirTF	0.0719***	0.0226***	0.0182***	0.0116**	0.0727***	0.0231***	0.0189***	0.0112**
	(0.00883)	(0.00644)	(0.00481)	(0.00474)	(0.00888)	(0.00645)	(0.00482)	(0.00473)
Colony	0.339***	0.533***			0.308***	0.533***		
	(0.0852)	(0.0768)			(0.0861)	(0.0767)		
Com col	0.547***	0.706***			0.586***	0.705***		
	(0.0928)	(0.0831)			(0.0928)	(0.0831)		
contiguity	1.258***	1.024***			1.269***	1.024***		
	(0.0792)	(0.0765)			(0.0795)	(0.0765)		
Com off lang	0.285***	0.558***			0.277***	0.559***		
	(0.0519)	(0.0526)			(0.0519)	(0.0526)		
RTA	0.467***	0.496***	0.0425***	0.0343*	0.466***	0.496***	0.0301*	0.0351**
	(0.0389)	(0.0347)	(0.0162)	(0.0179)	(0.0392)	(0.0349)	(0.0166)	(0.0179)
CU	0.835***	0.991***	0.312***	0.219***	0.817***	0.991***	0.293***	0.219***
	(0.0516)	(0.0467)	(0.0228)	(0.0253)	(0.0521)	(0.0469)	(0.0232)	(0.0252)
Exp Un	-2.233***	-0.497***	-0.590***	0.00152				
	(0.215)	(0.0991)	(0.0732)	(0.0746)				
Imp Un	-0.799***	-0.506***	-0.678***	-0.211***				
	(0.183)	(0.0974)	(0.0751)	(0.0738)				
Exp TUn					-0.0294***	-0.00584	-0.0242***	-0.0041
					(0.00620)	(0.00372)	(0.00284)	(0.00266)
Imp TUn					-0.0023	0.000785	-0.00764***	0.00509**
					(0.00546)	(0.00312)	(0.00227)	(0.00218)
Constant	-11.73***	-53.00***	-32.98***	-33.92***	-12.06***	-51.67***	-33.55***	-34.17***
	(0.655)	(16.30)	(1.096)	(1.554)	(0.659)	(16.23)	(1.101)	(1.546)
Observations	53,361	53,361	52,529	52,529	53,361	53,361	52,529	52,529
R-squared	0.704	0.799	0.956	0.96	0.702	0.798	0.955	0.96

Note: Exp TUn represents the level of trade uncertainty in the exporter country; **Imp TUn** is the level of trade uncertainty in the exporter country; **Exp Un** represents the level of uncertainty in the exporter country; **Imp Un** is the level of uncertainty in the exporter country; **Log sea dist** is the logarithm of sea distance; **Log Exp Area** is the logarithm of the exporter country's area; **Log Imp Area** is the logarithm of the Importer country's area; **Exp Cor** measures the level of corruption in the exporter country; **Imp Cor** measures the level of corruption in the exporter country; **Log Exp RGDP** is the logarithm of Real Gross Domestic Product of the exporter country; **Log Imp RGDP** is the logarithm of Real Gross Domestic Product of the importer country; **Exp landl** is a dummy variable that takes the value of 1 if the exporter is a landlocked country; **Imp landl** is a dummy variable that takes the value of 1 if the importer is a landlocked country; **Log Exp AirTF** is the logarithm of Air Transport Freight Capacity of the exporter country; **Log Imp AirTF** is the logarithm of Air transport freight capacity of the importer country; **Colony** takes the value of 1 if pairs ever in colonial relationship; **Com col** equal to 1 if pair countries had a common colonizer post-1945; **contiguity** is a dummy variable that takes the value of 1 if pair of countries share the same borders; **Com off lang** equal 1 if pair countries have the same official language; **RTA** is a dummy variable that takes the value of 1 if pair countries are in the same regional trade agreement; **CU** equals 1 if pair of countries are in the same currency union.

Table A 4.7: Results of the Gravity model (trade in mineral fuel)

	Uncertainty				Trade Uncertainty			
	1	2	3	4	5	6	7	8
VARIABLES	OLS	Imp-Exp FE	Pair FE	Pair-Year FE	OLS	Imp-Exp FE	Pair FE	Pair-Year FE
Log sea dist	-1.359***	-1.452***			-1.359***	-1.451***		
	(0.0473)	(0.0447)			(0.0473)	(0.0447)		
Log Exp Area	0.177***	-0.35			0.172***	-0.427		
	(0.0232)	(2.066)			(0.0234)	(2.064)		
Log Imp Area	-0.0980***	4.467***			-0.0994***	4.423***		
	(0.0226)	(1.210)			(0.0226)	(1.210)		
Exp Cor	-8.324***	-0.866	-2.052**	1.027	-7.175***	-0.463	-1.592	1.153
	(1.404)	(1.072)	(1.007)	(1.233)	(1.390)	(1.064)	(1.000)	(1.231)
Imp Cor	-5.065***	-1.896**	-2.954***	-0.989	-4.682***	-1.677*	-2.686***	-0.805
	(1.229)	(0.889)	(0.841)	(1.018)	(1.223)	(0.887)	(0.839)	(1.016)
Log Exp RGDP	0.632***	0.660***	0.950***	0.573***	0.631***	0.649***	0.943***	0.581***
	(0.0386)	(0.104)	(0.102)	(0.113)	(0.0386)	(0.104)	(0.102)	(0.113)
Log Imp RGDP	0.637***	1.261***	1.463***	1.085***	0.638***	1.249***	1.458***	1.110***
	(0.0350)	(0.0929)	(0.0890)	(0.107)	(0.0351)	(0.0925)	(0.0886)	(0.107)
Exp landl	-1.090***	-9.353***			-1.092***	-9.482***		
	(0.126)	(1.805)			(0.126)	(1.804)		
Imp landl	-0.810***	4.392***			-0.809***	4.363***		
	(0.109)	(1.255)			(0.109)	(1.255)		
Log Exp AirTF	0.0881***	0.0505**	0.0458**	0.0524***	0.0887***	0.0512**	0.0474**	0.0530***
	(0.0216)	(0.0210)	(0.0194)	(0.0193)	(0.0216)	(0.0210)	(0.0195)	(0.0193)
Log Imp AirTF	0.109***	0.0623***	0.0591***	0.0542***	0.110***	0.0634***	0.0603***	0.0537***
	(0.0169)	(0.0143)	(0.0133)	(0.0133)	(0.0169)	(0.0143)	(0.0133)	(0.0133)
Colony	0.997***	1.041***			0.963***	1.041***		
	(0.213)	(0.189)			(0.214)	(0.189)		
Com col	1.261***	1.089***			1.300***	1.088***		
	(0.176)	(0.156)			(0.176)	(0.156)		
contiguity	1.840***	1.808***			1.850***	1.807***		
	(0.187)	(0.178)			(0.187)	(0.178)		
Com off lang	-0.00199	0.367***			-0.0178	0.366***		
	(0.120)	(0.111)			(0.120)	(0.111)		
RTA	0.432***	0.786***	0.0789	0.0681	0.433***	0.789***	0.0763	0.0692
	(0.0894)	(0.0760)	(0.0540)	(0.0581)	(0.0896)	(0.0763)	(0.0544)	(0.0582)
CU	0.775***	1.146***	0.550***	0.383***	0.755***	1.151***	0.549***	0.383***
	(0.118)	(0.107)	(0.0814)	(0.0868)	(0.118)	(0.107)	(0.0821)	(0.0869)
Exp Un	-2.898***	-0.569**	-0.719***	-0.132				
	(0.478)	(0.280)	(0.259)	(0.271)				
Imp Un	-0.352	-0.805***	-0.974***	-0.666***				
	(0.449)	(0.281)	(0.253)	(0.257)				
Exp TUn					-0.0229	0.0245**	0.000165	0.0205*
					(0.0144)	(0.0115)	(0.0106)	(0.0110)
Imp TUn					0.00586	-0.00212	-0.00787	0.000879
					(0.0128)	(0.00916)	(0.00879)	(0.00899)
Constant	-7.451***	-75.59**	-48.95***	-30.02***	-7.821***	-73.53**	-48.89***	-30.96***
	(1.315)	(33.66)	(2.843)	(4.013)	(1.311)	(33.63)	(2.849)	(4.001)
Observations	83,135	83,135	81,734	81,734	83,135	83,135	81,734	81,734
R-squared	0.323	0.499	0.777	0.78	0.322	0.499	0.777	0.78

Note: Exp TUn represents the level of trade uncertainty in the exporter country; **Imp TUn** is the level of trade uncertainty in the exporter country; **Exp Un** represents the level of uncertainty in the exporter country; **Imp Un** is the level of uncertainty in the exporter country; **Log sea dist** is the logarithm of sea distance; **Log Exp Area** is the logarithm of the exporter country's area; **Log Imp Area** is the logarithm of the Importer country's area; **Exp Cor** measures the level of corruption in the exporter country; **Imp Cor** measures the level of corruption in the exporter country; **Log Exp RGDP** is the logarithm of Real Gross Domestic Product of the exporter country; **Log Imp RGDP** is the logarithm of Real Gross Domestic Product of the importer country; **Exp landl** is a dummy variable that takes the value of 1 if the exporter is a landlocked country; **Imp landl** is a dummy variable that takes the value of 1 if the importer is a landlocked country; **Log Exp AirTF** is the logarithm of Air Transport Freight Capacity of the exporter country; **Log Imp AirTF** is the logarithm of Air transport freight capacity of the importer country; **Colony** takes the value of 1 if pairs ever in colonial relationship; **Com col** equal to 1 if pair countries had a common colonizer post-1945; **contiguity** is a dummy variable that takes the value of 1 if pair of countries share the same borders; **Com off lang** equal 1 if pair countries have the same official language; **RTA** is a dummy variable that takes the value of 1 if pair countries are in the same regional trade agreement; **CU** equals 1 if pair of countries are in the same currency union.

Annex 4: Gravity model - Regression for the top 10 traders in the world.

Table A 4.8: Results- Importer is among the world top 10 traders' (Importer and Exporter FE; from the top 1 to 5)

	Importers: Top 1 trader		Importers: Top 2 traders		Importers: Top 3 traders		Importers: Top 4 traders		Importers: Top 5 traders	
VARIABLES	WU	TU	WU	TU	WU	TU	WU	TU	WU	TU
Log sea dist	-0.636***	-0.629***	-0.577***	-0.576***	-0.549***	-0.549***	-0.552***	-0.552***	-0.591***	-0.591***
	(0.160)	(0.160)	(0.104)	(0.104)	(0.0795)	(0.0794)	(0.0758)	(0.0757)	(0.0650)	(0.0650)
Log Exp Area	-2.945***	-2.930***	-4.410***	-4.414***	-3.636***	-3.644***	-4.596***	-4.614***	-4.652***	-4.666***
	(1.009)	(0.971)	(1.189)	(1.181)	(0.952)	(0.942)	(1.230)	(1.222)	(1.107)	(1.096)
Log Imp Area	-204.4***	-192.0***	69.16	69.21	144.8***	154.5***	185.0***	190.9***	0.511	0.52
	(66.06)	(65.67)	(49.48)	(50.56)	(42.78)	(42.80)	(43.90)	(43.51)		
Exp Cor	-10.26***	-10.89***	-2.566	-2.41	-3.392**	-3.402**	-2.128	-1.949	-2.724**	-2.530**
	(3.453)	(3.492)	(2.405)	(2.381)	(1.708)	(1.678)	(1.444)	(1.443)	(1.207)	(1.204)
Imp Cor	1.68	2.724	2.532	2.668	6.181***	6.953***	4.406**	4.664**	4.836***	5.251***
	(3.129)	(3.030)	(2.925)	(2.829)	(2.218)	(2.147)	(1.945)	(1.917)	(1.717)	(1.703)
Log Exp RGDP	1.508***	1.484***	1.091***	1.115***	1.219***	1.245***	1.100***	1.114***	1.145***	1.165***
	(0.384)	(0.376)	(0.253)	(0.253)	(0.180)	(0.179)	(0.132)	(0.131)	(0.123)	(0.123)
Log Imp RGDP	-0.992**	-0.855**	-0.0742	-0.113	0.453**	0.433*	0.955***	0.952***	1.007***	1.021***
	(0.429)	(0.421)	(0.304)	(0.305)	(0.223)	(0.224)	(0.193)	(0.198)	(0.179)	(0.178)
Exp landl	-3.531**	-3.658**	-6.602***	-6.499***	-5.416***	-5.312***	-7.164***	-7.104***	-6.955***	-6.867***
	(1.533)	(1.516)	(1.220)	(1.207)	(1.046)	(1.029)	(1.401)	(1.389)	(1.267)	(1.252)
Log Exp AirTF	0.0258	0.0267	0.0606*	0.0597*	0.0307	0.0308	0.0464*	0.0462*	0.0424*	0.0422*
	(0.0532)	(0.0541)	(0.0361)	(0.0360)	(0.0267)	(0.0266)	(0.0263)	(0.0262)	(0.0226)	(0.0225)
Log Imp AirTF	0.384	0.259	0.818***	0.866***	0.769***	0.810***	0.509***	0.539***	0.442***	0.455***
	(0.275)	(0.298)	(0.225)	(0.233)	(0.156)	(0.157)	(0.128)	(0.133)	(0.102)	(0.101)
Colony	0.301	0.31	0.564**	0.564**	0.463***	0.466***	0.616***	0.617***	0.921***	0.922***
	(0.302)	(0.312)	(0.228)	(0.227)	(0.175)	(0.175)	(0.179)	(0.179)	(0.181)	(0.181)
contiguity	0.447	0.475	0.564*	0.565*	0.546**	0.545**	0.512**	0.513**	0.380*	0.379*
	(0.401)	(0.402)	(0.295)	(0.294)	(0.250)	(0.250)	(0.245)	(0.245)	(0.214)	(0.214)
Com off lang	0.214	0.186	-0.0353	-0.0347	0.0287	0.0286	0.0596	0.0599	0.372**	0.373**
	(0.258)	(0.256)	(0.190)	(0.190)	(0.176)	(0.177)	(0.175)	(0.175)	(0.156)	(0.156)
RTA	0.124	0.139	0.586***	0.592***	0.501***	0.501***	0.532***	0.529***	0.469***	0.467***
	(0.217)	(0.215)	(0.169)	(0.171)	(0.148)	(0.149)	(0.129)	(0.130)	(0.110)	(0.110)
CU			1.053***	1.051***	1.358***	1.361***	1.274***	1.274***	1.278***	1.280***
			(0.263)	(0.263)	(0.214)	(0.214)	(0.227)	(0.226)	(0.161)	(0.161)
Exp Un	1.324*		-0.301		-0.29		-0.466		-0.552*	
	(0.754)		(0.497)		(0.388)		(0.336)		(0.309)	
Imp Un	-1.465**		0.156		-0.505		-0.0659		-0.338	
	(0.635)		(0.540)		(0.474)		(0.471)		(0.399)	
Exp TUn		0.0306		0.0284**		0.0196		0.0113		0.01
		(0.0252)		(0.0142)		(0.0127)		(0.0105)		(0.00907)
Imp TUn		0.0108		-0.0228		-0.0542***		-0.0574***		-0.0604***
		(0.0171)		(0.0155)		(0.0164)		(0.0171)		(0.0155)
Constant	3,342***	3,140***	-1,057	-1,058	-2,304***	-2,459***	-2,944***	-3,040***	19.93	18.78
	(1,064)	(1,057)	(799.5)	(817.0)	(690.6)	(690.9)	(708.5)	(702.4)		
Observations	1,981	1,981	3,957	3,957	5,917	5,917	7,888	7,888	9,857	9,857
R-squared	0.876	0.876	0.849	0.849	0.838	0.838	0.825	0.825	0.826	0.827

Table A 4.9: Results- Importer are among the world top 10 traders' (Importer and Exporter FE; from the top 6 to 10)

	Importers: Top 6 traders		Importers: Top 7 traders		Importers: Top 8 traders		Importers: Top 9 traders		Importers: Top 10 traders	
VARIABLES	WU	TU	WU	TU	WU	TU	WU	TU	WU	TU
Log sea dist	-0.579***	-0.580***	-0.596***	-0.597***	-0.600***	-0.601***	-0.616***	-0.617***	-0.609***	-0.609***
	(0.0593)	(0.0593)	(0.0572)	(0.0574)	(0.0532)	(0.0534)	(0.0521)	(0.0522)	(0.0498)	(0.0499)
Log Exp Area	-4.628***	-4.654***	-4.775***	-4.795***	-4.531***	-4.550***	-4.576***	-4.595***	-4.302***	-4.315***
	(0.975)	(0.964)	(0.875)	(0.866)	(1.032)	(1.025)	(0.973)	(0.966)	(0.932)	(0.928)
Log Imp Area	0.655	0.639	9.526	9.922	14.50**	14.06**	-0.567***	-0.580***	-0.538***	-0.546***
		(237,656)	(7.046)	(7.035)	(6.709)	(6.708)	(0.0738)	(0.0739)	(0.0704)	(0.0703)
Exp Cor	-3.311***	-3.024***	-3.058***	-2.822***	-4.252***	-4.121***	-3.918***	-3.808***	-3.963***	-3.852***
	(1.093)	(1.093)	(0.999)	(0.998)	(0.990)	(0.985)	(0.928)	(0.919)	(0.888)	(0.880)
Imp Cor	5.483***	6.009***	4.902***	5.483***	5.177***	6.480***	4.023***	5.338***	4.171***	5.570***
	(1.561)	(1.531)	(1.404)	(1.396)	(1.366)	(1.344)	(1.331)	(1.297)	(1.243)	(1.206)
Log Exp RGDP	1.192***	1.209***	1.206***	1.220***	1.185***	1.202***	1.198***	1.210***	1.184***	1.197***
	(0.114)	(0.113)	(0.111)	(0.110)	(0.106)	(0.106)	(0.0991)	(0.0990)	(0.0921)	(0.0923)
Log Imp RGDP	0.966***	0.932***	0.909***	0.860***	1.198***	1.190***	1.215***	1.238***	1.250***	1.258***
	(0.179)	(0.179)	(0.176)	(0.175)	(0.156)	(0.156)	(0.143)	(0.143)	(0.135)	(0.135)
Exp landl	-6.620***	-6.539***	-6.662***	-6.580***	-6.575***	-6.461***	-6.586***	-6.498***	-6.378***	-6.277***
	(1.093)	(1.077)	(0.996)	(0.982)	(1.046)	(1.033)	(0.978)	(0.966)	(0.923)	(0.915)
Log Exp AirTF	0.0403*	0.0407*	0.0342*	0.0348*	0.0383**	0.0394**	0.0418**	0.0429**	0.0394**	0.0404**
	(0.0213)	(0.0213)	(0.0191)	(0.0191)	(0.0188)	(0.0188)	(0.0176)	(0.0176)	(0.0169)	(0.0170)
Log Imp AirTF	0.549***	0.589***	0.581***	0.627***	0.310***	0.321***	0.273***	0.269***	0.235***	0.238***
	(0.100)	(0.1000)	(0.0981)	(0.0976)	(0.0713)	(0.0716)	(0.0661)	(0.0664)	(0.0602)	(0.0606)
Colony	0.722***	0.723***	0.639***	0.638***	0.671***	0.671***	0.682***	0.682***	0.711***	0.711***
	(0.144)	(0.144)	(0.130)	(0.130)	(0.127)	(0.127)	(0.126)	(0.126)	(0.123)	(0.123)
contiguity	0.440**	0.440**	0.402*	0.401*	0.347*	0.346*	0.299	0.296	0.332*	0.330*
	(0.213)	(0.213)	(0.210)	(0.210)	(0.204)	(0.204)	(0.203)	(0.203)	(0.196)	(0.196)
Com off lang	0.444***	0.445***	0.420***	0.421***	0.411***	0.413***	0.403***	0.405***	0.291***	0.292***
	(0.144)	(0.144)	(0.134)	(0.134)	(0.129)	(0.129)	(0.125)	(0.125)	(0.110)	(0.110)
RTA	0.436***	0.432***	0.410***	0.406***	0.446***	0.444***	0.418***	0.415***	0.416***	0.417***
	(0.0953)	(0.0957)	(0.0889)	(0.0900)	(0.0806)	(0.0820)	(0.0757)	(0.0768)	(0.0713)	(0.0724)
CU	0.963***	0.958***	0.810***	0.804***	0.792***	0.793***	0.752***	0.751***	0.722***	0.725***
	(0.140)	(0.140)	(0.128)	(0.129)	(0.121)	(0.122)	(0.112)	(0.113)	(0.105)	(0.105)
Exp Un	-0.764***		-0.755***		-1.009***		-0.894***		-0.914***	
	(0.281)		(0.261)		(0.261)		(0.243)		(0.235)	
Imp Un	-0.690**		-0.621**		-0.983***		-0.939***		-1.038***	
	(0.302)		(0.305)		(0.284)		(0.271)		(0.273)	
Exp TUn		0.0129		0.0118		0.0140*		0.0119*		0.0137**
		(0.00829)		(0.00748)		(0.00736)		(0.00661)		(0.00612)
Imp TUn		-0.0497***		-0.0306***		-0.0221**		-0.0251**		-0.0129
		(0.0126)		(0.0109)		(0.0106)		(0.0107)		(0.00847)
Constant	16.02	16.58	-124.2	-129.9	-212.8*	-206.2*	29.78**	28.86**	25.14*	24.38*
		(3.812e+06)	(116.7)	(116.5)	(111.9)	(111.9)	(13.96)	(13.88)	(13.40)	(13.36)
Observations	11,824	11,824	13,805	13,805	15,780	15,780	17,759	17,759	19,728	19,728
R-squared	0.824	0.824	0.825	0.825	0.82	0.82	0.82	0.82	0.819	0.818

Table A 4.10: Results- Exporter are among the world top 10 traders' (Importer and Exporter FE; from the top 1 to 5)

	Exporters: Top 1 trader		Exporters: Top 2 traders		Exporters: Top 3 traders		Exporters: Top 4 traders		Exporters: Top 5 traders	
VARIABLES	WU	TU	WU	TU	WU	TU	WU	TU	WU	TU
Log sea dist	-0.439***	-0.438***	-0.513***	-0.515***	-0.512***	-0.515***	-0.560***	-0.562***	-0.591***	-0.593***
	(0.106)	(0.107)	(0.0856)	(0.0858)	(0.0699)	(0.0700)	(0.0641)	(0.0642)	(0.0512)	(0.0513)
Log Exp Area	136.9***	170.5***	-0.0351	-0.0426	-0.0439	-0.0455	-0.371	-0.373	0.0979	0.101
	(36.68)	(38.17)	(116,117)		(51,462)				(78,683)	
Log Imp Area	-2.464***	-2.435***	2.152	2.131	2.094	2.069	1.66	1.612	1.499	1.456
	(0.653)	(0.662)	(2.362)	(2.365)	(1.549)	(1.558)	(1.189)	(1.197)	(1.002)	(1.008)
Exp Cor	1.96	3.192*	1.509	1.811	5.851***	6.845***	4.598***	4.629***	4.674***	4.529***
	(1.829)	(1.748)	(1.490)	(1.459)	(1.236)	(1.201)	(1.072)	(1.058)	(0.916)	(0.902)
Imp Cor	-8.562***	-8.706***	-4.823***	-4.723***	-5.235***	-5.299***	-2.640***	-2.423***	-2.242***	-2.006***
	(2.006)	(2.014)	(1.137)	(1.144)	(0.879)	(0.875)	(0.705)	(0.711)	(0.567)	(0.571)
Log Exp RGDP	0.416***	0.568***	0.733***	0.739***	0.923***	0.931***	1.233***	1.272***	1.034***	1.126***
	(0.155)	(0.154)	(0.148)	(0.147)	(0.117)	(0.118)	(0.103)	(0.106)	(0.0909)	(0.0906)
Log Imp RGDP	1.257***	1.221***	1.061***	1.082***	1.091***	1.117***	1.083***	1.102***	1.090***	1.110***
	(0.233)	(0.234)	(0.130)	(0.131)	(0.0857)	(0.0856)	(0.0704)	(0.0704)	(0.0604)	(0.0604)
Imp landl	-2.668***	-2.797***	1.857	1.916	1.735	1.815	1.116	1.163	0.939	0.982
	(0.960)	(0.955)	(2.666)	(2.674)	(1.746)	(1.760)	(1.348)	(1.359)	(1.137)	(1.145)
Log Exp AirTF	-0.668***	-0.689***	-0.277**	-0.216*	0.333***	0.373***	0.199***	0.222***	0.382***	0.364***
	(0.123)	(0.138)	(0.123)	(0.129)	(0.0909)	(0.0901)	(0.0747)	(0.0776)	(0.0579)	(0.0574)
Log Imp AirTF	-0.0412	-0.0391	0.0261	0.026	0.0247**	0.0255**	0.0354***	0.0353***	0.0308***	0.0301***
	(0.0260)	(0.0262)	(0.0194)	(0.0194)	(0.0117)	(0.0116)	(0.0103)	(0.0102)	(0.00850)	(0.00844)
Colony	0.449**	0.459**	0.228	0.228	0.17	0.172	0.427**	0.427**	0.699***	0.698***
	(0.195)	(0.200)	(0.214)	(0.213)	(0.177)	(0.177)	(0.186)	(0.185)	(0.135)	(0.135)
contiguity	1.580***	1.564***	0.829***	0.828***	0.759***	0.759***	0.658***	0.661***	0.593***	0.595***
	(0.244)	(0.245)	(0.238)	(0.238)	(0.218)	(0.218)	(0.222)	(0.223)	(0.201)	(0.201)
Com off lang	0.254	0.24	0.281**	0.282**	0.292**	0.293**	0.261**	0.263**	0.436***	0.438***
	(0.157)	(0.158)	(0.133)	(0.133)	(0.133)	(0.133)	(0.129)	(0.129)	(0.118)	(0.118)
RTA	-0.0223	-0.0223	0.525***	0.519***	0.458***	0.447***	0.482***	0.469***	0.409***	0.398***
	(0.129)	(0.128)	(0.116)	(0.117)	(0.0895)	(0.0903)	(0.0836)	(0.0843)	(0.0693)	(0.0698)
CU			0.766***	0.760***	0.954***	0.950***	0.875***	0.868***	0.830***	0.822***
			(0.241)	(0.241)	(0.182)	(0.182)	(0.185)	(0.185)	(0.116)	(0.116)
Exp Un	-1.420***		0.071		-0.812***		0.306		0.646***	
	(0.378)		(0.282)		(0.227)		(0.212)		(0.188)	
Imp Un	0.546		-0.262		-0.344		-0.620***		-0.568***	
	(0.375)		(0.281)		(0.209)		(0.177)		(0.152)	
Exp TUn		0.00446		-0.0336***		-0.0814***		-0.0936***		-0.0975***
		(0.00890)		(0.00849)		(0.00944)		(0.00995)		(0.00911)
Imp TUn		-0.0322**		0.000221		-0.00117		-0.00314		-0.0039
		(0.0130)		(0.00702)		(0.00577)		(0.00464)		(0.00487)
Constant	-2,177***	-2,722***	-48.47	-49.44	-60.24	-61.33	-56.27	-57.5	-57.43	-59.95
	(588.8)	(612.6)	(1.688e+06)		(640,160)	(204,782)			(757,566)	
Observations	2,186	2,186	4,370	4,370	6,548	6,548	8,740	8,740	10,919	10,919
R-squared	0.924	0.924	0.906	0.906	0.899	0.899	0.895	0.895	0.898	0.899

Table A 4.11: Results- Exporter are among the world top 10 traders' (Importer and Exporter FE; from the top 6 to 10)

	Exporters: Top 6 traders		Exporters: Top 7 traders		Exporters: Top 8 traders		Exporters: Top 9 traders		Exporters: Top 10 traders	
VARIABLES	WU	TU	WU	TU	WU	TU	WU	TU	WU	TU
Log sea dist	-0.587***	-0.590***	-0.597***	-0.600***	-0.613***	-0.617***	-0.617***	-0.620***	-0.606***	-0.608***
	(0.0445)	(0.0446)	(0.0423)	(0.0424)	(0.0387)	(0.0388)	(0.0375)	(0.0375)	(0.0360)	(0.0361)
Log Exp Area	462.5***	471.6***	12.52***	14.06***	15.34***	16.52***	-0.579***	-0.605***	-0.550***	-0.567***
	(24.85)	(24.77)	(3.623)	(3.632)	(3.554)	(3.565)	(0.0369)	(0.0371)	(0.0361)	(0.0362)
Log Imp Area	1.430*	1.382	1.557**	1.515**	1.521**	1.467**	1.211*	1.159*	1.342**	1.294**
	(0.862)	(0.865)	(0.754)	(0.756)	(0.668)	(0.670)	(0.661)	(0.663)	(0.608)	(0.610)
Exp Cor	3.294***	3.513***	3.131***	3.379***	3.574***	4.250***	1.714**	2.332***	2.275***	2.901***
	(0.816)	(0.795)	(0.733)	(0.723)	(0.725)	(0.718)	(0.690)	(0.678)	(0.637)	(0.624)
Imp Cor	-1.929***	-1.682***	-1.616***	-1.400***	-2.077***	-1.891***	-1.746***	-1.556***	-1.871***	-1.673***
	(0.510)	(0.512)	(0.462)	(0.463)	(0.457)	(0.460)	(0.423)	(0.425)	(0.406)	(0.409)
Log Exp RGDP	0.896***	0.900***	0.818***	0.815***	1.088***	1.129***	1.087***	1.145***	1.168***	1.182***
	(0.0874)	(0.0872)	(0.0851)	(0.0848)	(0.0762)	(0.0766)	(0.0693)	(0.0699)	(0.0662)	(0.0660)
Log Imp RGDP	1.058***	1.072***	1.106***	1.117***	1.148***	1.171***	1.132***	1.155***	1.131***	1.157***
	(0.0580)	(0.0581)	(0.0524)	(0.0524)	(0.0533)	(0.0536)	(0.0499)	(0.0501)	(0.0450)	(0.0453)
Imp landl	0.861	0.881	1.224	1.228	1.325*	1.370*	0.938	0.986	1.116	1.182*
	(0.977)	(0.982)	(0.855)	(0.857)	(0.761)	(0.764)	(0.751)	(0.755)	(0.689)	(0.692)
Log Exp AirTF	0.560***	0.581***	0.611***	0.636***	0.350***	0.345***	0.322***	0.310***	0.245***	0.259***
	(0.0517)	(0.0516)	(0.0502)	(0.0501)	(0.0392)	(0.0394)	(0.0365)	(0.0365)	(0.0331)	(0.0331)
Log Imp AirTF	0.0273***	0.0276***	0.0302***	0.0308***	0.0299***	0.0305***	0.0320***	0.0325***	0.0376***	0.0379***
	(0.00841)	(0.00841)	(0.00782)	(0.00780)	(0.00776)	(0.00775)	(0.00706)	(0.00703)	(0.00666)	(0.00665)
Colony	0.636***	0.635***	0.602***	0.600***	0.593***	0.591***	0.592***	0.590***	0.593***	0.591***
	(0.103)	(0.103)	(0.0907)	(0.0906)	(0.0882)	(0.0881)	(0.0870)	(0.0869)	(0.0835)	(0.0835)
contiguity	0.614***	0.616***	0.594***	0.596***	0.551***	0.553***	0.528***	0.530***	0.528***	0.528***
	(0.194)	(0.194)	(0.189)	(0.189)	(0.181)	(0.182)	(0.176)	(0.177)	(0.171)	(0.171)
Com off lang	0.427***	0.429***	0.413***	0.415***	0.437***	0.440***	0.433***	0.435***	0.418***	0.419***
	(0.105)	(0.105)	(0.0959)	(0.0959)	(0.0906)	(0.0906)	(0.0847)	(0.0847)	(0.0739)	(0.0739)
RTA	0.418***	0.408***	0.419***	0.405***	0.407***	0.389***	0.395***	0.380***	0.405***	0.394***
	(0.0588)	(0.0590)	(0.0544)	(0.0551)	(0.0498)	(0.0506)	(0.0468)	(0.0474)	(0.0453)	(0.0459)
CU	0.798***	0.786***	0.745***	0.727***	0.775***	0.757***	0.791***	0.775***	0.814***	0.804***
	(0.0957)	(0.0962)	(0.0868)	(0.0878)	(0.0823)	(0.0831)	(0.0775)	(0.0781)	(0.0732)	(0.0737)
Exp Un	-0.586***		-0.724***		-0.796***		-0.610***		-0.660***	
	(0.148)		(0.143)		(0.142)		(0.140)		(0.138)	
Imp Un	-0.464***		-0.314**		-0.548***		-0.568***		-0.600***	
	(0.135)		(0.124)		(0.126)		(0.122)		(0.112)	
Exp TUn		-0.0623***		-0.0516***		-0.0564***		-0.0593***		-0.0391***
		(0.00746)		(0.00657)		(0.00644)		(0.00649)		(0.00515)
Imp TUn		0.00105		-0.00153		-0.00185		-0.00142		-0.000706
		(0.00436)		(0.00365)		(0.00366)		(0.00340)		(0.00330)
Constant	-7,486***	-7,633***	-256.1***	-280.8***	-307.3***	-327.6***	-46.16***	-47.45***	-50.31***	-50.81***
	(400.2)	(398.9)	(60.33)	(60.47)	(59.01)	(59.20)	(9.398)	(9.446)	(8.656)	(8.692)
Observations	13,110	13,110	15,304	15,304	17,497	17,497	19,692	19,692	21,886	21,886
R-squared	0.9	0.901	0.904	0.904	0.904	0.904	0.905	0.905	0.905	0.905

Annex 5: Panel fixed effects model – Spillover effects of uncertainty in GVC production hubs.

Table A 4.12: Results of Panel Fixed Effects All countries (Imports and Exports)

	Export						Import					
VARIABLES	1 USA Uncertainty	2 China Uncertainty	3 Germany Uncertainty	4 USA Trade Uncertainty	5 China Trade Uncertainty	6 World Trade Uncertainty	7 USA Uncertainty	8 China Uncertainty	9 Germany Uncertainty	10 USA Trade Uncertainty	11 China Trade Uncertainty	12 World Trade Uncertainty
Log RGDP	1.911***	1.903***	1.928***	1.939***	1.934***	2.092***	1.709***	1.694***	1.711***	1.728***	1.719***	1.795***
	(0.218)	(0.220)	(0.218)	(0.219)	(0.220)	(0.215)	(0.208)	(0.209)	(0.207)	(0.211)	(0.214)	(0.232)
Price	-0.000202	-0.000196	-0.00019	-0.000199	-0.000156	-0.000209	-0.00024	-0.000218	-0.000216	-0.000224	-0.000188	-0.000214
	(0.000217)	(0.000218)	(0.000222)	(0.000220)	(0.000220)	(0.000235)	(0.000147)	(0.000143)	(0.000146)	(0.000146)	(0.000146)	(0.000158)
Log Pop (15-64)	-0.255	-0.249	-0.257	-0.272	-0.279	-0.888**	0.241	0.233	0.231	0.219	0.214	0.000593
	(0.363)	(0.363)	(0.367)	(0.358)	(0.367)	(0.403)	(0.280)	(0.280)	(0.284)	(0.284)	(0.289)	(0.395)
Log Credit	0.194**	0.193**	0.190**	0.186**	0.180**	0.128	0.273***	0.267***	0.265***	0.261***	0.257***	0.243***
	(0.0769)	(0.0768)	(0.0771)	(0.0772)	(0.0782)	(0.0806)	(0.0635)	(0.0641)	(0.0643)	(0.0643)	(0.0648)	(0.0664)
Log Dist_hubs	-0.000301*	-0.000292*	-0.000295*	-0.000279	-0.000285*	-0.000254	-0.000411***	-0.000392***	-0.000394***	-0.000380***	-0.000387***	-0.000402***
	(0.000174)	(0.000170)	(0.000172)	(0.000172)	(0.000171)	(0.000206)	(0.000145)	(0.000139)	(0.000141)	(0.000140)	(0.000141)	(0.000147)
Log Air freight	-0.0204	-0.0207	-0.0223	-0.0195	-0.0203	0.00459	0.0314	0.0324	0.031	0.0331	0.0323	0.0391
	(0.0363)	(0.0363)	(0.0367)	(0.0359)	(0.0368)	(0.0401)	(0.0250)	(0.0248)	(0.0250)	(0.0247)	(0.0249)	(0.0246)
log RER	0.0674	0.0725	0.0699	0.0644	0.0761	0.0729	0.197	0.202	0.201	0.196	0.207	0.214
	(0.153)	(0.152)	(0.153)	(0.151)	(0.153)	(0.166)	(0.146)	(0.146)	(0.147)	(0.145)	(0.147)	(0.155)
log FDI	0.0258*	0.0242*	0.0228	0.0277**	0.0258*	0.0251	0.0159	0.0167	0.0149	0.0186	0.0169	0.0260*
	(0.0132)	(0.0132)	(0.0138)	(0.0134)	(0.0134)	(0.0169)	(0.0131)	(0.0131)	(0.0131)	(0.0132)	(0.0130)	(0.0132)
Log GFCF	-0.202	-0.21	-0.213	-0.198	-0.204	-0.224	0.15	0.151	0.145	0.156	0.15	0.131
	(0.147)	(0.149)	(0.148)	(0.146)	(0.149)	(0.174)	(0.100)	(0.0989)	(0.0982)	(0.0988)	(0.101)	(0.114)
Log LE	1.807	1.866	1.914	1.809	1.885	2.481	1.6	1.635	1.686	1.612	1.675	1.696
	(1.946)	(1.976)	(2.024)	(1.947)	(1.986)	(1.803)	(1.490)	(1.495)	(1.541)	(1.482)	(1.509)	(1.442)
Log SSE	-0.295	-0.296	-0.292	-0.302	-0.291	-0.0972	-0.0328	-0.0409	-0.0368	-0.045	-0.0353	0.0877
	(0.216)	(0.218)	(0.217)	(0.214)	(0.218)	(0.223)	(0.201)	(0.201)	(0.201)	(0.199)	(0.202)	(0.212)
USA Un	-0.227						-0.487**					
	(0.309)						(0.241)					
China Un		-0.572						-0.195				
		(0.358)						(0.302)				
Germany Un			-0.668*						-0.46			
			(0.387)						(0.294)			
USA TUn				-0.0326***						-0.0313***		
				(0.0103)						(0.00846)		
China TUn					-0.0368**						-0.0302**	
					(0.0155)						(0.0117)	
World TUn						-0.325***						-0.308***
						(0.0515)						(0.0449)
Constant	-25.66***	-25.83***	-26.49***	-26.16***	-26.27***	-23.84***	-30.89***	-30.63***	-31.20***	-31.16***	-31.16***	-30.42***
	(6.626)	(6.667)	(6.942)	(6.665)	(6.812)	(7.688)	(4.465)	(4.439)	(4.718)	(4.498)	(4.568)	(5.372)
Observations	966	966	966	966	966	866	966	966	966	966	966	866
R-squared	0.761	0.761	0.762	0.762	0.763	0.785	0.831	0.83	0.831	0.832	0.832	0.854
Number of id	70	70	70	70	70	62	70	70	70	70	70	62

Table A 4.13: Results of Panel Fixed Effects: Countries that are well integrated into GVCs (dependent variables are Imports and Exports)

	Export						Import					
VARIABLES	1 USA Uncertainty	2 China Uncertainty	3 Germany Uncertainty	4 USA Trade Uncertainty	5 China Trade Uncertainty	6 World Trade Uncertainty	7 USA Uncertainty	8 China Uncertainty	9 Germany Uncertainty	10 USA Trade Uncertainty	11 China Trade Uncertainty	12 World Trade Uncertainty
Log RGDP	1.366***	1.338***	1.334***	1.364***	1.354***	1.522***	1.149***	1.111***	1.106***	1.141***	1.125***	1.243***
	(0.375)	(0.375)	(0.368)	(0.371)	(0.362)	(0.326)	(0.320)	(0.324)	(0.326)	(0.323)	(0.321)	(0.317)
Price	0.00413	0.00424	0.00235	0.00407	0.00479	0.00216	0.0145	0.0155	0.0137	0.0146	0.0155	0.0122
	(0.00980)	(0.00951)	(0.00902)	(0.0101)	(0.00960)	(0.0104)	(0.0111)	(0.0109)	(0.0107)	(0.0113)	(0.0109)	(0.0114)
Log Pop (15-64)	0.442	0.462	0.493	0.442	0.448	0.264	1.051	1.074	1.101	1.055	1.064	0.946
	(0.901)	(0.902)	(0.895)	(0.901)	(0.899)	(0.928)	(0.787)	(0.787)	(0.793)	(0.788)	(0.792)	(0.810)
Log Credit	0.182*	0.177	0.172	0.176	0.163	0.137	0.249**	0.238**	0.235**	0.240**	0.226**	0.215**
	(0.103)	(0.106)	(0.106)	(0.107)	(0.108)	(0.101)	(0.104)	(0.109)	(0.108)	(0.109)	(0.110)	(0.104)
Log Dist_hubs	1.62E-05	-1.58E-05	-2.34E-05	-3.49E-05	-1.17E-05	-0.0002	0.00013	0.000107	9.11E-05	6.06E-05	9.52E-05	-0.000124
	(0.000304)	(0.000285)	(0.000279)	(0.000286)	(0.000283)	(0.000254)	(0.000321)	(0.000307)	(0.000302)	(0.000306)	(0.000298)	(0.000281)
Log Air freight	0.0045	0.0102	0.000862	0.00841	0.0123	0.00816	0.0254	0.0332	0.0262	0.0314	0.0358	0.0288
	(0.0534)	(0.0519)	(0.0504)	(0.0513)	(0.0505)	(0.0454)	(0.0434)	(0.0427)	(0.0422)	(0.0417)	(0.0413)	(0.0340)
log RER	0.446*	0.448**	0.435*	0.458**	0.452**	0.470**	0.479**	0.500**	0.483**	0.499**	0.493**	0.491***
	(0.221)	(0.217)	(0.214)	(0.209)	(0.208)	(0.197)	(0.206)	(0.201)	(0.198)	(0.192)	(0.196)	(0.175)
log FDI	0.0149	0.0137	0.00817	0.0183	0.0162	0.0121	0.00642	0.00809	0.00243	0.0112	0.00849	0.0105
	(0.0147)	(0.0149)	(0.0149)	(0.0151)	(0.0142)	(0.0138)	(0.0129)	(0.0131)	(0.0134)	(0.0134)	(0.0125)	(0.0130)
Log GFCF	-0.182	-0.186	-0.171	-0.174	-0.18	-0.354*	0.111	0.119	0.125	0.123	0.116	0.04
	(0.210)	(0.216)	(0.214)	(0.212)	(0.214)	(0.179)	(0.160)	(0.163)	(0.165)	(0.161)	(0.163)	(0.176)
Log LE	4.111	4.247	4.623	4.089	4.39	3.776	4.642	4.707	5.053	4.617	4.949	4.628*
	(2.756)	(2.843)	(2.878)	(2.743)	(2.792)	(2.395)	(2.910)	(2.984)	(3.081)	(2.903)	(2.968)	(2.698)
Log SSE	0.00123	0.0181	0.0727	-0.0143	0.0221	0.074	-0.099	-0.0981	-0.0461	-0.12	-0.078	-0.011
	(0.323)	(0.327)	(0.326)	(0.324)	(0.317)	(0.306)	(0.285)	(0.283)	(0.287)	(0.284)	(0.280)	(0.278)
USA Un	-0.446						-0.664**					
	(0.321)						(0.267)					
China Un		-0.726*						-0.206				
		(0.357)						(0.355)				
Germany Un			-1.015***						-0.784**			
			(0.310)						(0.293)			
USA TUn				-0.0186						-0.0244*		
				(0.0123)						(0.0125)		
China TUn					-0.0321***						-0.0342***	
					(0.0104)						(0.00803)	
World TUn						-0.347***						-0.384***
						(0.0492)						(0.0639)
Constant	-38.29***	-38.42***	-40.53***	-37.96***	-39.27***	-36.93***	-47.21***	-46.91***	-48.74***	-46.73***	-48.14***	-47.03***
	(12.90)	(12.96)	(12.95)	(12.77)	(12.72)	(12.25)	(12.02)	(12.07)	(12.44)	(11.79)	(11.82)	(11.21)
Observations	365	365	365	365	365	362	365	365	365	365	365	362
R-squared	0.756	0.757	0.76	0.756	0.759	0.782	0.766	0.764	0.767	0.766	0.768	0.787
Number of id	32	32	32	32	32	31	32	32	32	32	32	31

Chapter 5. Global Value Chains and Transmission of Economic Shocks: An Event Study Approach - from the US-China Trade War to the COVID-19 Shock

5.1. Introduction

The phenomenon of GVCs has raised several concerns about countries' vulnerability to economic shocks and financial crises. While trade openness can help absorb economic shocks (Cavallo & Frankel, 2008; Rose, 2005), it can also be the channel through which these shocks spread across other countries. The deeper a country is integrated into GVCs, the more vulnerable it is. A number of arguments support the theory of countries' vulnerability to shocks when trading through GVCs: First, GVC integration means highly synchronized economic activities across countries. Because production in a country relies on inputs from partners, economic activities in countries are linked. Second, GVCs create strong linkages in price formation, so inflation in one country is likely to spill over to its direct and indirect trading partners. Third, in well-integrated countries, episodes of export growth are related to an increase in imports in their trade partners and in their partners' partners. Finally, GVCs amplify the costs of protectionism for trade and economic growth. The back-and-forth movement in goods and services across borders means that trade barriers occur multiple times. Protectionism is, therefore, costlier for businesses along the value chain, even for a country that implements it. These arguments are not recent, but the debate is ongoing. Generally, economic shocks that are likely to affect a country's economy can spread quickly to its partners located along the same chain. Many authors (Farhani et al., 2015; Glick & Rose, 1999; Z. Wang et al., 2017b) have attempted to document the role of GVCs in spreading economic shocks and have found evidence of the spillover effects of shocks through GVCs. Since the 90s, the world has known two major crises: the global financial crisis of 2008–2009 and the current COVID-19 crisis, also called the great lockdown. Furthermore, the world has known less severe shocks, such as the Soviet bloc collapse crisis in the early 1990s, the Asian financial crisis in the late 1990s, and the recent US-China trade war. These crises provided unique opportunities to analyze the consequences of GVCs and study the response of countries to an economic shock.

The COVID-19 pandemic represents an unprecedented challenge to the global economy and reminds us about the risk of being deeply integrated into GVCs. Because of the pandemic, trade, which is integral to economic growth and economic development, was under pressure in 2020 and 2021. Because of the pandemic, several countries implemented restrictive measures to protect their citizens from the virus. Thus, economies are suffering from resulting drops in production and consumption. This situation has been further exacerbated as each country's slowdown has also contributed to the decline in trade, amplifying the economic challenge with cross-border demand and supply shocks. The economic pain

from the virus is severe, especially in some emerging markets and developing economies (EMDEs) because many of them were already facing limitations and obstacles before the pandemic. These preexisting limitations mean that some countries' have limited capacity to address the pandemic's effects, putting their resilience at risk.

This chapter borrows the event study methodology, widely used in the finance literature, and relies on 192 countries over a precise event window (period) to estimate the impact of a given event on abnormal returns, to evaluate the effect of economic shocks on trade. According to Schmidheiny & Siegloch (2019), whether and how a given event affects financial markets is a relevant question that researchers and practitioners aim to answer. That is why the event study framework has become a statistical technique used in many areas, from economics to accounting, from finance to law.[37] Thus, this chapter relies on Schmidheiny & Siegloch (2019), who developed event studies and applied them to economics with generalized cases.

Considering three significant events—namely, President Trump's election, the US-China trade war, and the COVID-19 pandemic—the aim of this study is twofold. First, we seek to demonstrate that a shock in a country highly integrated into GVCs can have adverse spillover effects on the rest of the world. We also seek to show how such countries have been affected by the twin shocks generated by the COVID-19 pandemic[38] and which group of countries recovered more quickly. The findings suggest that uncertainty generated in a GVC production hub can have negative spillover effects on the rest of the world. Our findings also suggest that the COVID-19 pandemic has negatively impacted trade and growth. Countries that are well integrated into GVCs have been most affected.

The rest of the chapter is structured as follows: Section 1 discusses the first event—namely, what happened from President Trump's campaign to the trade war between the US and China. Section 5.2 discusses the second event—namely, tariffs escalation resulted from President Trump's election. Section 5.3 discusses the third event and shows how the COVID-19 pandemic has affected economies, especially trade. Section 5.4 presents the methodology. Sections 5.5 and 0 discuss the results of the event study with regard to both trade and GDP. Section 5.7 concludes.

5.2. Tariff escalation: From Trump's election to the US-China trade war.

Former US President Donald Trump's presidential campaign raised major economic and security questions (BBC News, 2017). During the campaign, President Trump and his economic team made big promises about boosting economic growth. Though official budget estimates assume growth will rise 3% a year, the president suggested growth could be much faster. To justify these claims, his team pointed to trade and immigration restrictions as the cornerstone. The Trump administration's policies

[37] According to Kothari & Warner (2007), between 1974 and 2000, almost 600 studies conducted in various fields employed such a technique.

[38] The COVID-19 pandemic as generated a supply and demand shock at the same time.

on trade and immigration constitute a break from Republican tradition. According to the Brooking institution, Democrats have been much more ambivalent about trade agreements than Republicans because of the opposition of labor leaders. As a candidate, President Trump denounced the trade relationship between the US and China: "If China does not stop its illegal activities, including its theft of American trade secrets, I will use every lawful presidential power to remedy trade disputes, including the application of tariffs consistent with Section 201 and 301 of the Trade Act of 1974 and Section 232 of the Trade Expansion Act of 1962."

During the 2016 election, economists worried about Trump's potential election given the measures he announced. Trump's trade policies were expected damage US trading partners, like Mexico and Canada, to undermine the standing of the US in the world, and to have little impact on US growth. Despite China was the target, it had many economic weapons to counter US policies. The last three years of the Trump administration were characterized by periods of tariff escalation with China, creating unprecedented uncertainty.

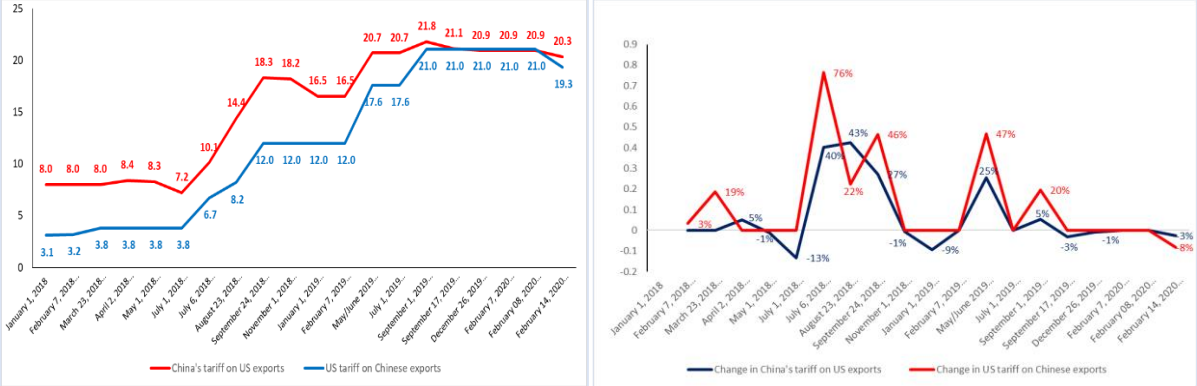
According to the Peterson Institute for International Economics (PIIE) (Bown & Kolb, 2018), President Trump administration's tariff escalation began slowly in 2018, with initial measures in line with WTO norms. China's response—while against norms—also initially followed its pre-Trump playbook. On January 22, Trump announced that safeguard tariffs on imports of washing machines and solar panels, together covering more than $10 billion of US imports, would come into force on February 7.

The announcement followed affirmations by the US International Trade Commission (ITC) in late 2017 that imports had injured the respective domestic industries, recommending that the president impose protection. On February 5, China telegraphed its initial retaliation plans. Similar to its 2009 response to an Obama administration safeguard tariff on tires, China announced self-initiating antidumping and countervailing duty investigations. This time, roughly $1 billion of US exports of sorghum were under threat. (In April, China would temporarily impose tariffs of 178.6% on those exports.) On March 22, President Trump announced that he was imposing tariffs on $60 billion of Chinese imports. That day, the USTR issued a report documenting various unfair trade practices the Chinese government had allegedly deployed since its integration of the WTO to forcibly transfer technology from the US to Chinese firms. These practices included mandating joint ventures with local firms (including state-owned enterprises), state-sponsored industrial espionage, cyber-hacking, and the predatory acquisition of foreign technology. The Trump administration formally announced 25% tariffs on $50 billion of imports from China on April 3, followed by an announcement of China that it would retaliate with 25% tariffs on $50 billion of US exports. The US-China tariff escalation continued throughout the summer of 2018 and 2019 (read the PIIE for all the details).

The waves of US and Chinese tariffs imposed throughout 2018 and 2019 affected distinct product categories. At the end of the tariff escalation, more than 80% of US imports from China of intermediate inputs faced new tariffs of 25%. However, China's tariff retaliation disproportionately focused on

agricultural and seafood products, including soybeans, sorghum, pork, and lobster. Despite imposing counter-tariffs over a relatively sizable share of its imports of US manufacturing, China mostly avoided placing tariffs on critical inputs such as semiconductors and semiconductor manufacturing equipment as well as imports of aircraft and medical supplies.

Figure 5.1: President Trump's election and tariffs escalation: Uncertainty due to tariff increase.



Source: PIIE; Trade Map and Market Access Map (ITC, marketanalysis.intracen.org), China's Ministry of Finance's announcements, and USTR announcements

The presidential campaign and the resulting trade war between the US and China generated uncertainty for the US and its partner economies. Moreover, that uncertainty affected the economies of the rest of the world. Indeed, several countries are involved in the same value chains as China and the US, which are the second and the third highest-integrated into GVCs (Germany being the country with the highest level of GVCs participation). Unfortunately for the rest of the world, this shock was nothing compared to the coming economic shock caused by the pandemic in 2020.

5.3. How has COVID-19 impacted trade?

The COVID-19 pandemic represents an unprecedented challenge to the global economy. Governments implemented several measures to contain the spread of the pandemic. These measures included social distancing, travel bans, trade restrictions, stay-at-home requirements, and movement restrictions. The combined effect of the pandemic and protective measures was a decrease in year-on-year world trade merchandise value in the first half of 2020.

Trade connects countries, driving growth but expediting contagion. Before assessing the spread of COVID-19's economic effects through trade, it is crucial to keep in mind the benefits from trade over time. While the debate over the exact relationship between trade and growth is still active, in general, countries that trade more have typically grown faster and have had more opportunities to advance their

development trajectories (Chang et al., 2009; Herzer, 2013; Jouini, 2015; D. H. Kim & Lin, 2009; D.-H. Kim, 2011; Musila & Yiheyis, 2015; Newfarmer & Sztajerowska, 2012; Ulaşan, 2015; World Bank, 2020). Nevertheless, while the trade-growth connection brings a net benefit, it also allows for economic contagion.

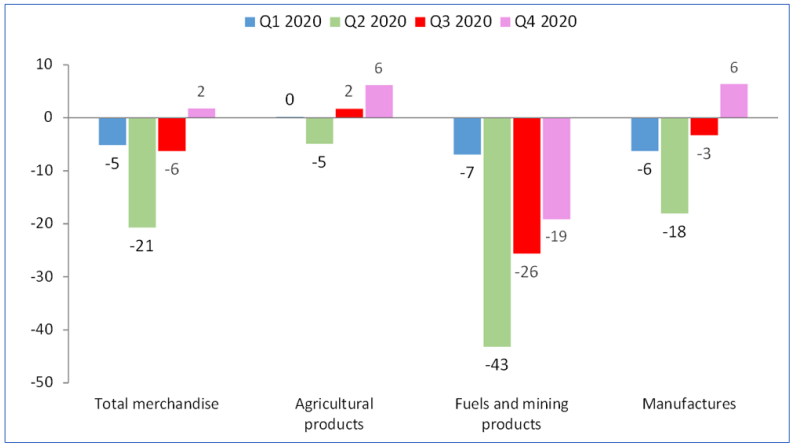
The COVID-19 pandemic has affected global trade through both supply and demand shocks, which have spread in many ways, one of which is trade. COVID-19 has affected goods supply in several ways. On the supply side, the pandemic has pushed authorities to adopt restrictive measures ranging from internal movement restrictions to international border closures to required closing (or work from home). While international border closures have reduced air freight capacity, internal movement restrictions and closures have affected businesses, halted industrial production, and limited port activities. As a result, many countries have found both their ability to produce goods and export them curtailed, thus reducing the movement of products across borders. Production limitations have been exacerbated by the inability to source necessary production inputs from abroad. In addition, the reduction in aggregate demand among the world's largest importing countries has reduced the ability of many countries to successfully export the goods they do manage to produce. COVID-related business closures across multiple industries were responsible for this situation, negatively affecting consumer demand. Indeed, the steep decline of many commodity prices quantitatively illustrates this phenomenon.

The effects of COVID-19 are particularly pervasive, in part because of the emergence of the "large-hub-and-smaller-spoke" systems that have emerged with the rise of GVCs. Over two-thirds of world trade occurs through GVCs (World Bank & WTO, 2019), in which production crosses at least one border before final assembly. The COVID-19 pandemic hit the three largest GVC production hubs early, creating an unprecedented combination of supply and demand shocks affecting global trade.

Global trade collapsed during the first two quarters of 2020 (Nana & Starnes, 2020). Additional data released since that publication indicates a moderate recovery in trade of some products and some countries. According to the WTO, for the whole of 2020, merchandise trade fell by 5.3%, less than the 9.2% decline foreseen in the WTO's previous forecast in October 2020, while merchandise trade in nominal dollar terms fell by 7%. This better-than-feared performance was partly due to the announcement of the new COVID-19 vaccines in November, which contributed to improved business and consumer confidence. The impact of the pandemic on merchandise trade volumes differed across regions in 2020. All regions of the world reported a decrease in trade volume in 2020. Asia was the sole exception, with export volumes up 0.3% and import volumes down a modest 1.3%. Natural-resource-based regions saw the most significant declines in imports, including Africa (-8.8%), South America (-9.3%), and the Middle East (-11.3%), likely because of reduced export revenues as oil prices fell around 35%. Compared to other regions, the decline in North American imports was relatively small (-6.1%).

There is no doubt that the pandemic has negatively impacted economies around the world. There are several ways to quantify the impact of the pandemic—from simple descriptive statistics to economic regression. However, considering the COVID-19 pandemic as an event, how can we quantify the impact of such event on international trade and economic growth?

Figure 5.2: Year-on-year growth in world merchandise trade, 2020Q1–2020Q4[39]



Source: WTO data portal

5.4. Presentation and methodology

The event study design is among the best practices in empirical methods in difference-in-differences family. The empirical specification usually relies on a simple two-way fixed effects panel data model, where the regressors of interest are a set of non-parametric event indicators defined relative to the event (Schmidheiny & Siegloch, 2019). Event study designs originate from the finance literature. They are now widely used in applied economics, primarily public and labor economics, where an event is a policy change whose effects are investigated. Several economic studies followed the event study methodology, and its use skyrocketed after 2010 (e.g., Baker & Fradkin, 2017). Two main steps are necessary to implement an event study. The first step is to identify the event and the event date, and the second step consists of setting up the event window.

5.4.1. Event and event date identification

The first step in an event study is to determine the event to examine and collect necessary data that have been affected by the event and data allowing to capture the period zero of the event.[40] Following the identification of an appropriate event, the next step involves selecting the event date. The event date

[39] https://www.wto.org/english/news_e/pres21_e/pr876_e.htm

[40] Period zero is the announcement date

is an essential feature of the study, because it forms the basis for evaluating the impact of the observed event (Brown & Warner, 1985; MacKinlay, 1997). The event date allows researchers to compare interest variables behaviors before and after the event to measure the extent to which the event has impacted countries and firms' performances (Armitage, 1995; Binder, 1998).

The aim of studying this event is to show how GVCs increase the spread of economic shocks related to uncertainty. In this study, we consider three main events. The first event in the second largest GVCs production hub, namely the US, is related to the President trump election. We refer to the event date, the announcement of Donald Trump's campaign for the presidency. The second event is "tariffs increase" caused by the trade war. The chapter investigated the impact of the US-China trade war on other countries' trade. The increases in tariffs by the US on Chinese products and vice versa constitute the event period in the second case. Finally, we consider COVID-19 as the third event and explore the economic impact of this event on international trade worldwide. We defined the first month of closures and internal movement restrictions as period zero of the core event day under examination. Information on the last event date was collected from the Our World in Data website (https://ourworldindata.org).

Table 5.1: President Trump's election has generated uncertainty.

Period	Event
June 2015	Donald Trump Announces 2016 Presidential Campaign
July 2015 - October 2016	Campaign period
November 2016	November 8, 2016: Donald Trump is elected as president
February 2018	The start of the US-China trade war
January 2020	The World Health Organization (WHO) announces mysterious Coronavirus-Related pneumonia in Wuhan, China
Variable across countries	The COVID-19-related restrictions (stay at home requirement)

Source: Author's organization based on the literature

5.4.2. Events windows

Depending on the sample size and the length of the event timeline, the event window may comprise a few days, weeks, or months before and after the event date. The event window is an essential feature of the event study methodology as it permits researchers to measure the impact of the analyzed event on firms' returns. While there exists no fixed number of days, weeks or months that should form the length of an event window, it should be relatively short to avoid including the impact of unrelated events on the post-event returns (Armitage, 1995; McWilliams & Siegel, 1997). Accordingly, researchers need to use good judgment in selecting a suitable event window.

We conducted an event study to analyze the impact of uncertainty in President Trump's election, tariff increases and the COVID-19 pandemic on trade. The first source of uncertainty is related to President

Trump's election (event 1). The event period goes from the announcement of President Trump's campaign to the final results of the elections (**Table *5.1***). The second source of uncertainty (event 2) focused on policy measures undertaken by President Trump after he was elected. The event period includes periods of tariffs increase by both the US and China (**Figure *5.1***). The third source of uncertainty (event 3), studied in the current chapter, is generated by the COVID-19 pandemic. It can be studied differently according to the aim of the study. First, the chapter considers the period (quarter) of the announcement of the existence of COVID-19 by the WHO in January 2020, as the event date. Second, the chapter also considers restrictive measures implemented by countries to fight the pandemic as an event period. It helps investigate the impact of COVID-19 restrictive measures on trade.

5.4.3. Model

We sought to estimate the dynamic effects of three shocks that occurred in different periods on our dependent variable, represented by trade (imports, exports, and trade as the sum of exports and imports), which we observed in a balanced panel of 192 countries at different periods $t = \underline{t}, \dots, \overline{t}$. We call $[\underline{t}, \dots, \overline{t}]$ the observation window for the dependent variable. The specification of the event study is presented as follows:

$$\ln (Trade)_{i,t} = \sum_{j=-3}^{4} \beta_j \, d_{i,t-j} + \delta W_{i,t} + \mu_i + \varepsilon_{i,t} \tag{5.1}$$

where $d_{i,t} = 1[e_i = t]$ is an event indicator that takes the value 1 in the year of the treatment, e_i, and 0 otherwise. Where Trade is the natural logarithm of trade (the sum of exports and imports) in country *i* and period *t* (month); $d_{i,t-j}$ is an indicator variable that indicates whether the country *i* implemented a "stay at home requirement" *j* month before or after *t* (j $\in [-3,4]$). Parameter μ_i captures country fixed effects. The vector $W_{i,t}$ captures control variables — namely, commodity prices that affected trade during the pandemic.

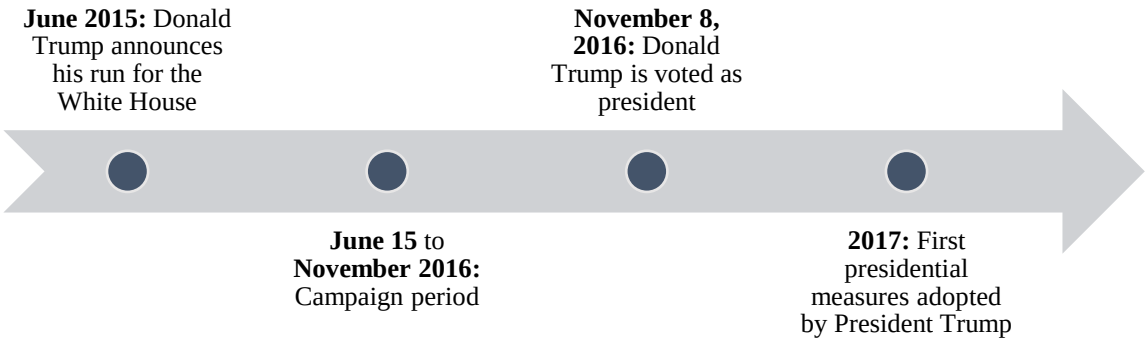
Schmidheiny & Siegloch (2019) in a recent attempt to improve the effectiveness of event study methods, raised the importance of restricting the effect window and the necessity of binning endpoints. In our case, we implicitly assume that treatment effects drop to 0 outside of the effect window. This is an assumption that is typically hard to defend, but in our case, we suppose that the surrounding uncertainty around President Trump's election or tariff increases will disappear out of the event window, even if the effect can remain. However, in the COVID-19 case, it is hard to defend because the effects of the pandemic remain after the lockdown and because the pandemic is still active despite vaccination.

5.5. Results on the impact of the three events on trade

5.5.1. Uncertainty related to President Trump's election (event 1)

Figure 5.4 presents the results of the impact of uncertainty related to President Trump's election on the global trade of the other countries (rest of the world) and on their bilateral trade with the US. The moment President Trump was elected is considered as the event date (Figure 5.3).[41] The results show a decrease in international trade two months after the event date. Uncertainty related to President Trump's election reduced countries' international trade with the US by 4.2% in the second month and then by 11% in the third month (Figure 5.4 - B). Moreover, considering countries' global trade, the event led to a decrease in trade by 3% in the second month and 7% in the third month (Figure 5.4 - A). However, these coefficients are lower, which means that countries trading more with the US (or belonging to the same value chains as the US) were most affected. The results also highlight that the uncertainty related to President Trump's election affected quickly high GVCs integrated countries compared to low/medium GVCs integrated countries. The negative impact started in the second month for high GVCs integrated countries, while it started in the third month for low/medium GVCs integrated countries (Figure 5.4 – C and D).

Figure 5.3: Chronology of President Trump's election

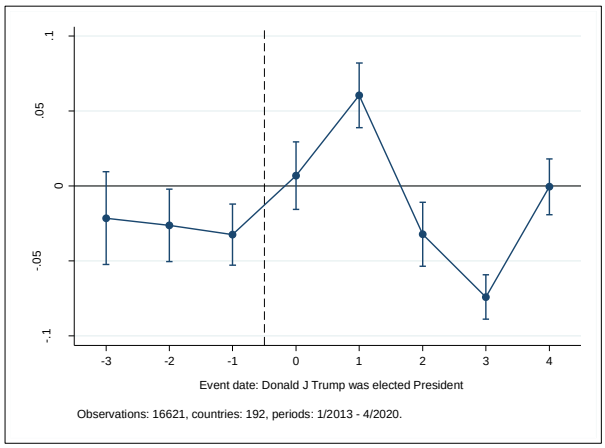


Source: Author's representation base on PIIE

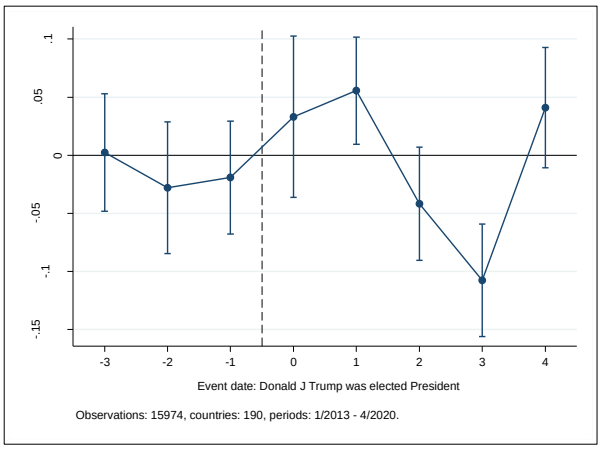
[41] The event comprises multiple events of identical sizes going from the start of the presidential campaign to Donald Trump's election

Figure 5.4: Results — The event date corresponds to President Trump's election

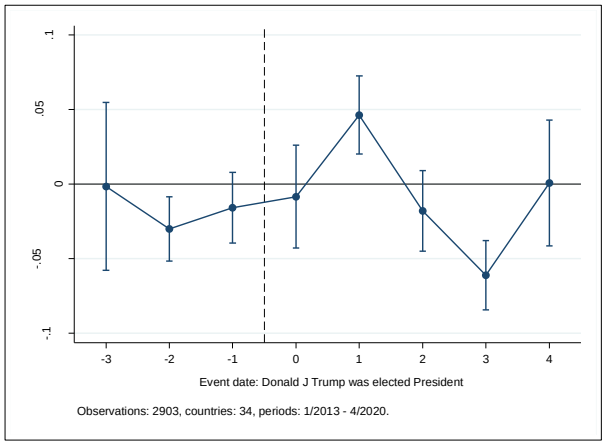
A- Effect on countries' trade



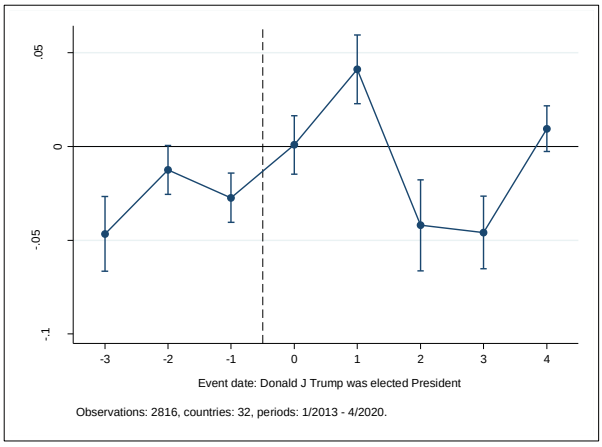
B- Effect on countries' trade with the US



C- Effect on low/medium GVCs countries' trade



D- Effect on high GVCs countries' trade



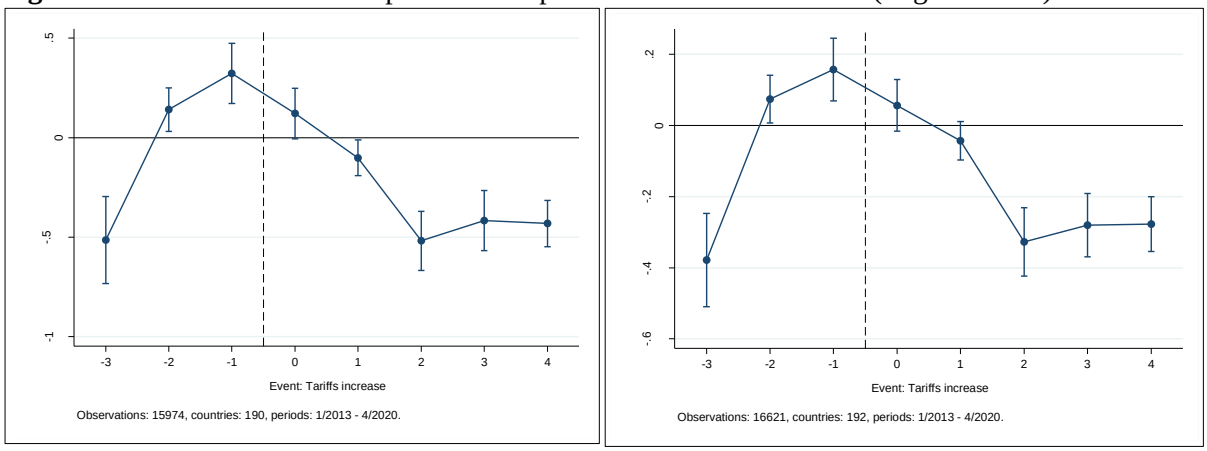
Note: No binning and no normalization at -1. The graphs show point estimates and 95%-confidence intervals based on standard errors clustered by country. The estimation window goes from 2013 to 2020. Control variables, including commodity prices and exchange rate were considered. Time fixed effects were included.

5.5.2. The events are episodes of tariff increases caused by the US-China trade war.

Figure 5.5 presents the event study results when the event corresponds to a positive change in tariffs between the US and China over the period of the trade war. The initial results show that tariff increases on Chinese products by the US and vice versa had a negative effect on trade up over four months and becoming statistically significant, at the 5% level, two months after the increase — one month when considering bilateral trade with the US. The high percentage decrease of international trade can be explained by the large estimation window, including the start of the COVID-19 pandemic, since the data cover the first four months of 2020 (Figure 5.5). It is also important to note that there are significant increases before the event period. However, when we restrict the period to remove the COVID-19 period (01/2017–12/2019), the impact of the event is still negative, but the absolute value of the coefficient decreases (Figure 5.6). Further results show that tariff increases have had a negative and significant

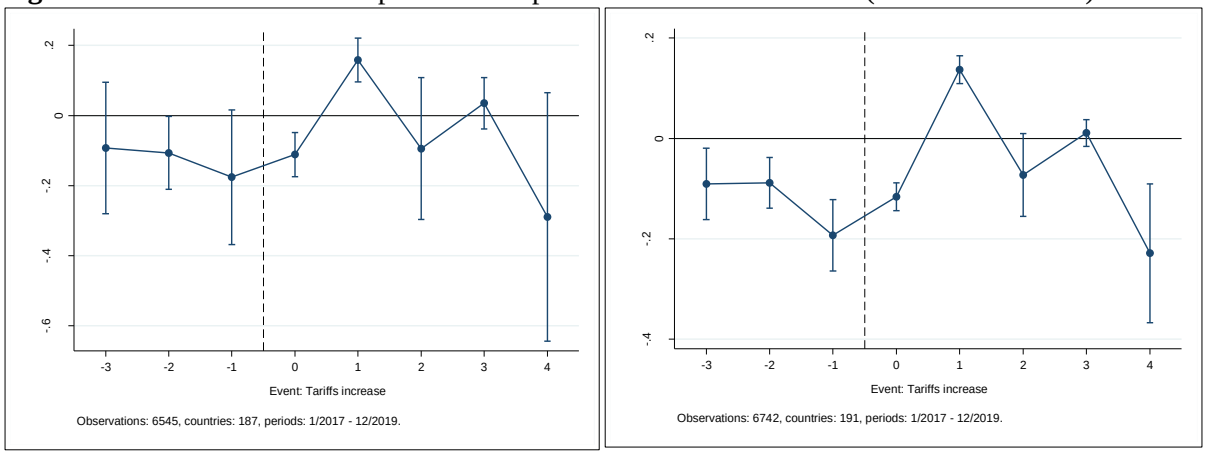
effect, at the 5% level on trade four months after the tariff increase episodes. The impact of the event on trade with the US is negative but statistically non-significant (Figure 5.6).

Figure 5.5: Results – The event period corresponds to US tariffs increase (large window).



Note: No binning and no normalization at -1. The graphs show point estimates and 95%-confidence intervals based on standard errors clustered by country. The estimation window is not restricted and goes from 2013 to 2020. Control variables including commodity prices and exchange rate were considered. Time fixed effect were included.

Figure 5.6: Results –The event period corresponds to US tariffs increase (restricted window).



Note: No binning and no normalization at -1. The graphs show point estimates and 95%-confidence intervals based on standard errors clustered by country. The estimation window goes from 2017 to 2019. Control variables, including commodity prices and exchange rate were considered. Time fixed effects were included.

The previous findings shown evidence of adverse spillover effects of uncertainty related to President Trump's election, demonstrating that there are risks associated with GVC participation. The negative impact of the uncertainty generated in the two important GVC production hubs (the US and China) is due to the deep involvement of these countries in GVCs, through inputs and commodities imports from several countries, and through exports of input or final products to the rest of the world. This interconnectedness of countries clearly shows why uncertainty in the US can translate into a drop in

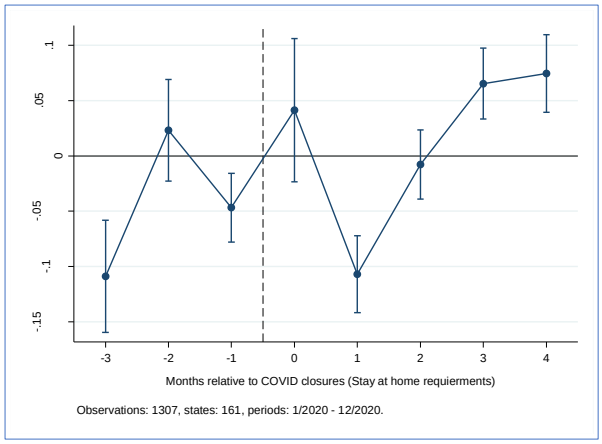
global trade. The recent COVID-19 pandemic has also created a simultaneous supply and demand shock over countries pushing them to take restrictive measures in addition to the health crisis, generating uncertainty. Thus, it is also essential to investigate how these restrictive measures have impacted trade.

5.5.3. The event is COVID-19-related closures.

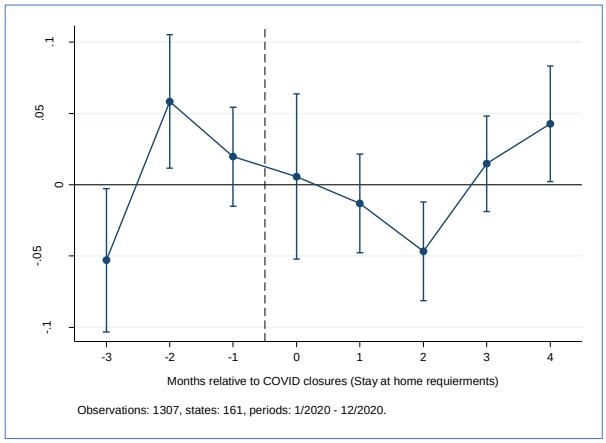
Now focusing on COVID-19, this section investigates the impact of COVID's restrictive measures on trade. The pandemic has affected almost all sectors of countries' economies. In this section, we consider restrictive measures implemented as an event variable. We define months of closures and internal movement restrictions as event periods.

Figure 5.7: Results – The event period corresponds to US tariffs increase.

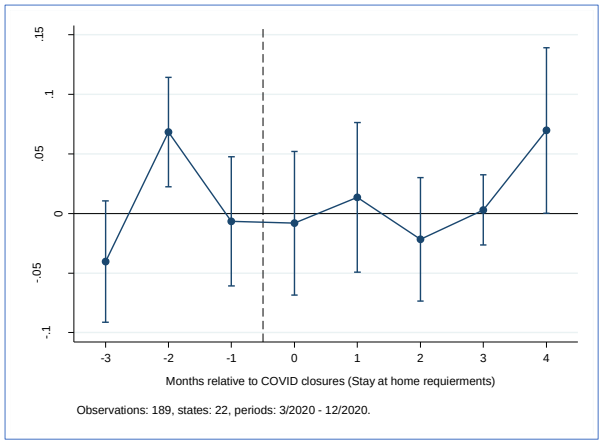
A- Effect of restrictions without control variables



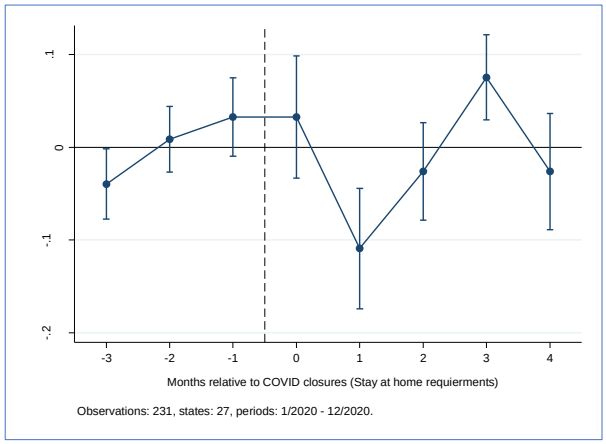
B- Effect of restrictions controlled for prices.



A- Effect of restrictions on Low GVCs countries



B- Effect of restrictions on high GVCs countries



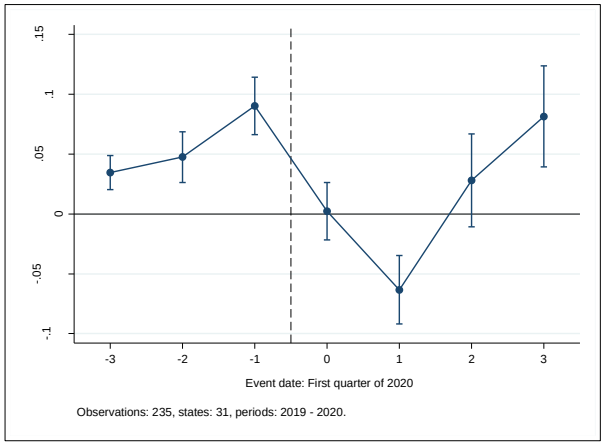
Note: No binning and no normalization at -1. The graphs show point estimates and 95%-confidence intervals based on standard errors clustered by country. The estimation window goes from 3/2020 to 12/2020. Control variables including commodity prices and exchange rate were included.

The results indicate that stay-at-home requirements have had a negative effect on trade up over four months and becoming statistically significant at the 5%-level one month after their implementation. The stay-at-home requirements generated a decrease in international trade by 11% one month after their implementation. For robustness purposes, we controlled our estimations for commodity prices that significantly suffered from the pandemic and exchange rate. The results show that the stay-at-home requirements decreased international trade by 5%, two months after their implementation. However, international trade quickly recovered three to four months afterward. When controlling for the state of GVCs participation, the results highlight a non-significant impact for countries with a low GVCs participation index. However, the effect is negative and significant, with a fall in trade by 10% for countries with high GVCs participation one month after the measures and a slight recovery the third month after. These results support the previous findings and show that countries that are well integrated into GVCs were most affected by the uncertainty generated by the COVID-19 restrictive measures, but those countries also recovered quickly (Figure 5.7).

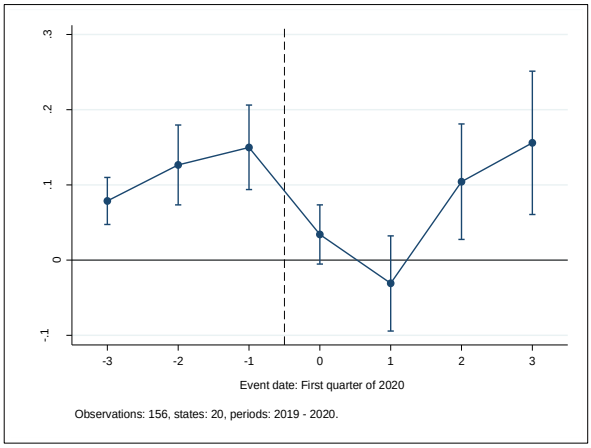
5.6. Result of the impact of COVID-19 on GDP

Figure 5.8: Event Study Results – The impact of COVID-19 of GDP

A – High level of global value chains integration



B – Low and medium level of global value chains integration



Note: No binning and no normalization at -1. The graphs show point estimates and 95%-confidence intervals based on standard errors clustered by country. The event date is Q12020, and we considered time *fixed effects.*

We also investigated the impact of the COVID-19 pandemic on GDP. Using quarterly data on nominal GDP from 2019 to 2020, we considered the first quarter of 2020 as the event date. The results highlight that the COVID-19 pandemic has negatively and significantly affected GDP (Figure 5.8).

The pandemic led to a 5% decrease in GDP (significant at a 5% level) one quarter after the event date, before recovering in the second and the third quarter. However, we divided our sample into two groups, as previously discussed in the trade case. The first group comprises countries that are well integrated into GVCs, while the second group is composed of countries with low and medium levels of integration.

The results show that countries with high GVCs participation index have been negatively affected by the pandemic, reporting a 6% significant decrease in GDP. Countries with low and medium levels of GVCs participation have also been affected negatively by the pandemic, but the result is not significant.

5.7. Conclusion

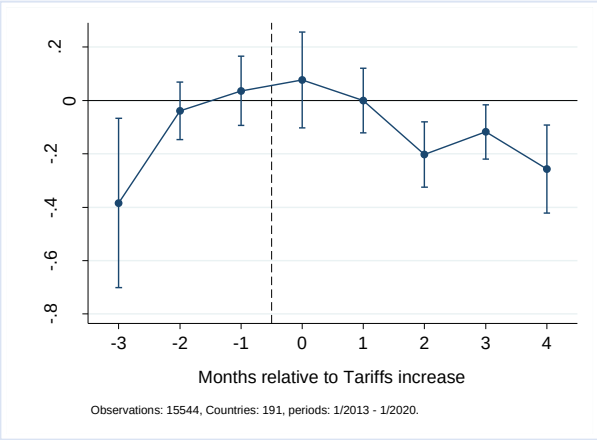
This chapter studies the transmission of economic shocks through GVCs. To do so, it borrows the well-known event study methodology, widely used in the finance literature, to investigate how GVCs allow for the transmission of economic shocks. Focusing first on President Trump's election as event date and then on COVID-19 related restrictions, we show that uncertainty generated in a GVC production hubs can have negative spillover effects on the rest of the world. Our findings also suggest that restrictive measures implemented by countries to combat COVID-19 have negatively impacted trade. This impact is independent from the drop in commodity prices and exchange rate fluctuations that affected economies at the early stage of the COVID-19 pandemic but is purely related to uncertainty. More importantly, countries that are well integrated into GVCs were most affected, but they are also the ones that recovered fast.

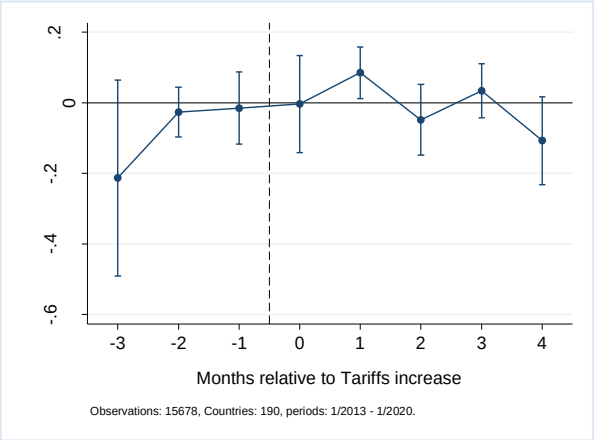
In terms of policy, our findings suggest that GVCs participation is risky since it increases and spreads economic shocks but, at the same time, it allows for quick recovery. This finding means that promoting GVCs is essential and necessary for economic growth, as depicted by several studies. Still, developing countries should be careful in doing so and be ready to face any shock transmitted through their direct and indirect trade partners. The COVID-19 pandemic has demonstrated risks associated with deep GVCs participation; several countries faced supply chain disruptions caused by inactivity and restrictions implemented by the world's biggest production hubs. Thus, promoting GVCs participation is excellent for economies, but developing countries should also be prepared at any time to face the downsides of GVCs participation. Further research should investigate how climatic shock can also affect countries that are well integrated into GVCs.

Appendix : Results of the Event Study

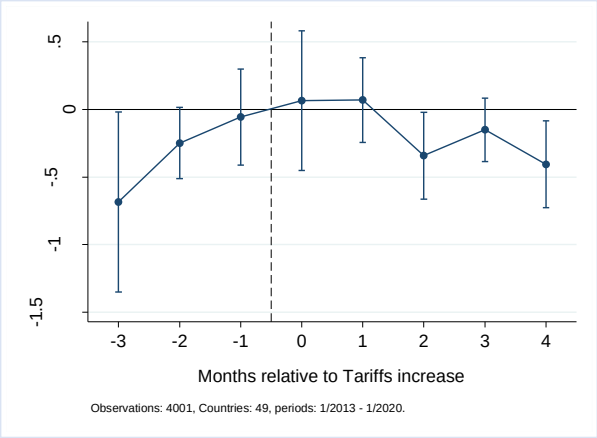
Figure A 5.1: Event Study Results when controlling for COVID-19 period – The event variable corresponds to US tariffs increase on China's products.

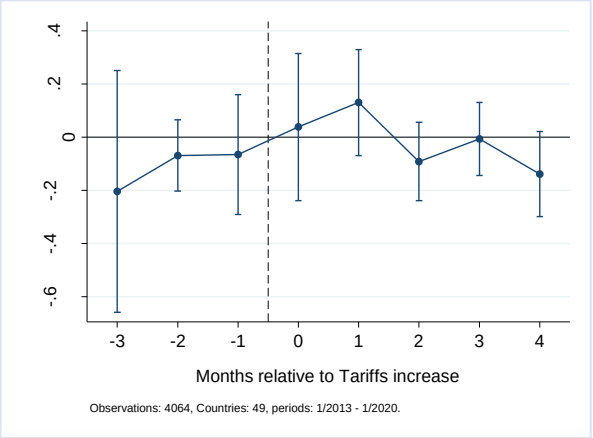
A- All the countries (No binning and no normalization at -1)





B- African countries (No binning and no normalization at -1)

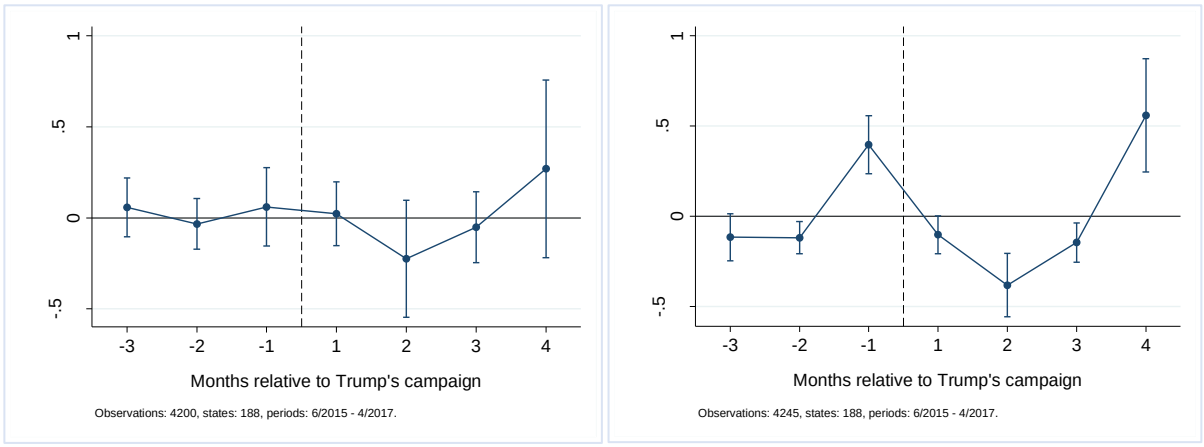




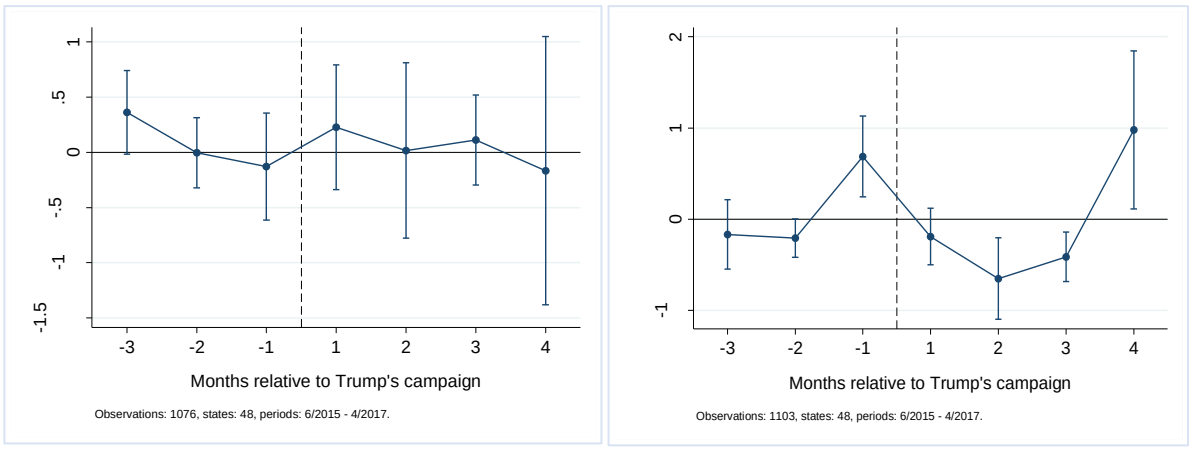
Note: The graphs show point estimates and 95%-confidence intervals based on standard errors clustered by country.

Figure A 5.2: Event Study Results when controlling for COVID-19 period – The event period goes from President Trump's campaign launch to its victory in the presidential elections.

A- All the countries (No binning and no normalization at -1)



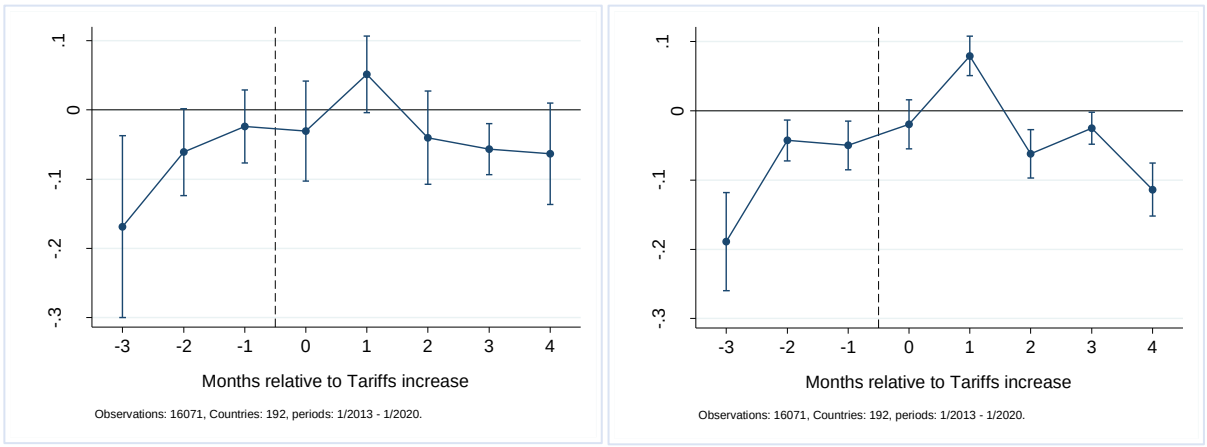
B- African countries (No binning and no normalization at -1)



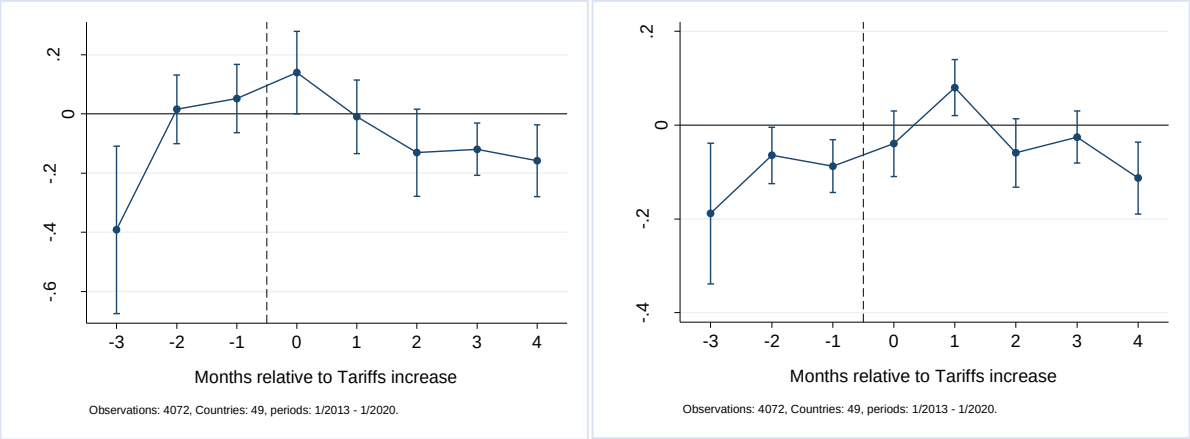
Note: The graphs show point estimates and 95%-confidence intervals based on standard errors clustered by country.

Figure A 5.3: Event Study Results when controlling for COVID-19 period – The event variable corresponds to US tariffs increase on China's products (dependent is variable global trade)

A- All the countries (No binning and no normalization at -1)



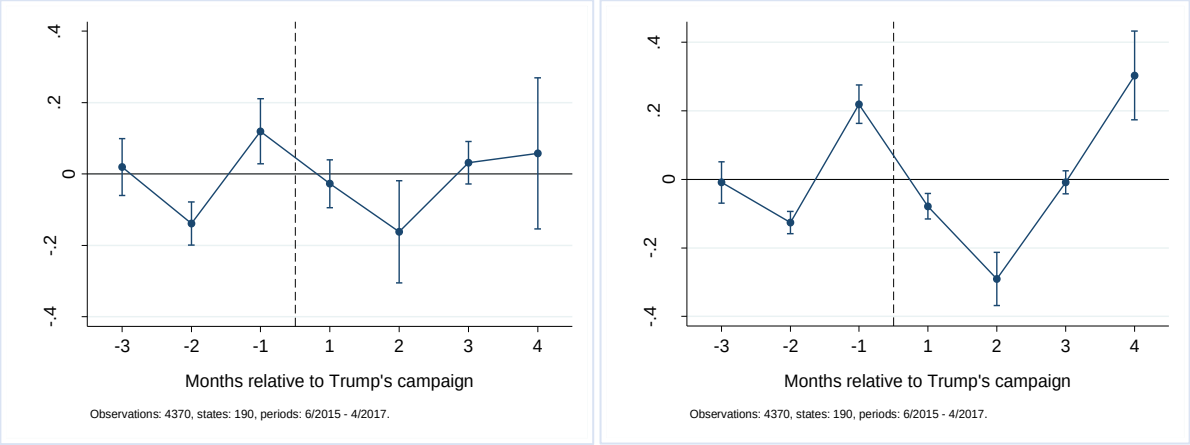
B- African countries (No binning and no normalization at -1)



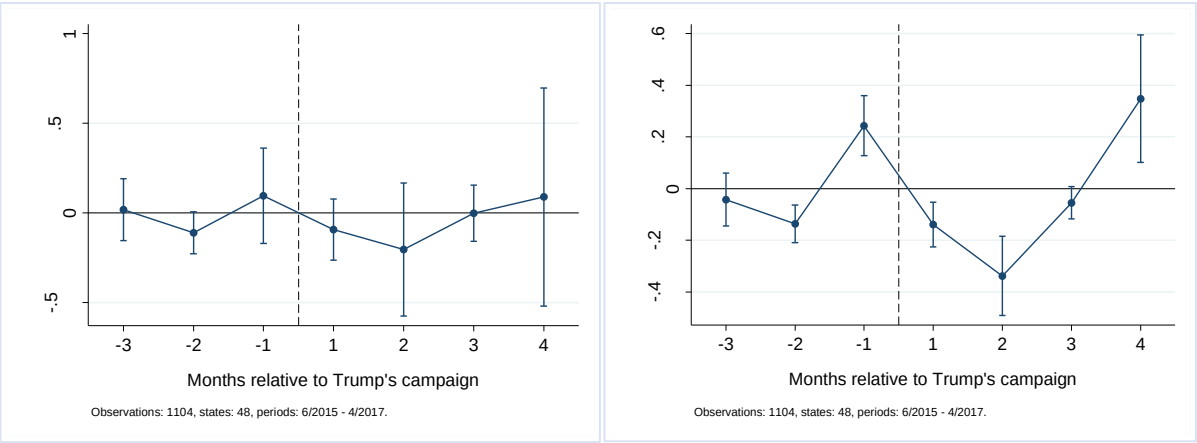
Note: The graphs show point estimates and 95%-confidence intervals based on standard errors clustered by country.

Figure A 5.4: Event Study Results when controlling for COVID-19 period – The event period goes from President Trump's campaign launch to its victory in the presidential elections (dependent is variable global trade)

A- All the countries (No binning and no normalization at -1)



B- countries (No binning and no normalization at -1)



Note: The graphs show point estimates and 95%-confidence intervals based on standard errors clustered by country.

Chapter 6. Trade and investment through GVCs and technology transfer - The case of China and Africa

6.1. Introduction

International cooperation between countries has long been characterized by profit maximization as well as political and geopolitical interests. The last decades have been distinguished by the increasing presence of China on the international economic stage and its increasing presence in Africa. This is marked by the presence of Chinese-owned firms in Africa, the increasing volume of trade between the two parties (China has become the first trade partner of overall African countries (W. Chen et al., 2018)) and Chinese loans to these countries. The presence of China in Africa has long been debated by policy makers in Africa and abroad. Some analysts think that China's increasing interest in Africa is only guided by its need for natural resources to meet energy and manufacturing needs (Cai, 1999; W. Chen et al., 2018). Former US presidential candidate Hillary Clinton warned against "*new colonialism*" in Africa. However, despite this negative conception of the Chinese presence in Africa, other analysts consider the interaction between China and Africa to be a way for African countries to upgrade and to foster their growth (Dollar, 2016); this is in line with what China's President Xi Jinping declared during the 2018 Beijing summit of the Forum on China–Africa Cooperation: "China does not invest in vanity projects in Africa and is helping the continent build its infrastructure." Therefore, two theories exist regarding the presence of China in Africa. Proponents of the Chinese presence usually argue in favor of its spillover effects on African countries growth (i.e., the resulting learning effects from Chinese experience). Indeed, trade and foreign direct investments (FDIs) through global value chains (GVCs) have become effective channels through which developing economies can upgrade their industrialization process and avoid following the same path that developed countries used to achieve their development. With changes in the production process and international fragmentation, countries have become more connected with each other. Such connection (i.e., openness through GVCs) may be a good opportunity for developing countries to learn from advanced countries and upgrade their technology. This is why some policy makers believe that regardless of the objective behind China's presence in Africa, the relevant question is whether this interaction have been beneficial for African countries.

Since its accession to the World Trade Organization in 2001, China has been one of the best examples in Asia as well as globally in terms of technology upgrading, economic development, and GVCs integration. The country's success in trade is partly due to its success in taking advantage of FDIs. However, since the 2008 financial crisis, which lowered the demand for Chinese goods, China has been planning to change its economic model. In addition, the minimum wage is increasing in China, and the resulting higher labor costs are encouraging Chinese firms to relocate overseas, providing opportunities

for less developed countries in Africa and Asia (W. Chen et al., 2016). The presence of multinational enterprises (MNEs) in China was partly because of the low labor costs. Thus, increasing labor costs raises the issue of the location of the MNEs and Chinese state-owned enterprises (because of competitiveness concerns). Fan et al. (2018) showed that the increase in the minimum wage can explain approximately 32% of the growth in outward investment from China during 2001–2012. Therefore, China is offshoring some firms to countries in Asia and Africa and MNEs might leave the country. Thanks to lower transportation and coordination costs, MNEs and other firms are now able to maximize their profits even with offshored firms. Developing countries that will host these flows of firms and MNEs will benefit. China has already benefited from such a move and its shift from an industrial product-assembling country to a producer of high-tech intermediate goods demonstrates its ability to take advantage from international cooperation (Rueda Maurer, 2017). But what about African countries?

The aim of this chapter is to investigate whether the presence of China in Africa during the past 20 years has led to technology transfer. Following fixed effect and panel smooth threshold regression (PSTR) approaches on 49 African countries from 1995 to 2015, this chapter determines the empirical effects of Chinese exports to Africa as well as Chinese FDIs on the level of African countries' export sophistication. It proposes a new approach of technological Sophistication based on domestic value-added exports. The results hold evidence of the absence of direct technology transfer with the existence of a threshold of absorptive capacity (human capital and quality of institutions) above which direct technology transfer starts to be effective. This study is a contribution to a large body of extant literature on the spillover effects of FDIs and imports, on GVCs integration, but also question years of utilization of export sophistication index as a proxy of domestic sophistication index. The current chapter proposes two critical contributions to the empirical literature. First, it provides descriptive evidence that export sophistication indexes used in the past in the literature are outdated in the context of GVCs. It proposes a new approach of domestic value-added exports sophistication that captures the level of domestic technology embodied in exports. This chapter includes a GVCs aspect to the calculation process following the previous approaches. Future studies that involve export sophistication should consider the new indicator - or at least the calculation process. Second, it adds empirical evidence on the importance of having sufficient human capital to benefit from GVCs, going beyond the geopolitical determinants of international cooperation. The chapter provides evidence that although the need for natural resources may drive the relationship between China and African countries, African countries can only benefit from this interaction if they are well endowed in human capital. The remainder of the chapter is organized as follows: Section 6.2 presents a literature review on the presence of China, FDIs, Imports, and the international cooperation–technology transfer nexus; Section 6.3 presents a historical approach to Sino–African relations; Section 6.4 describes the methodology used for our study; Section 6.5

presents the results of our simple model estimations; section 6.6 presents the PSTR approach and Section 6.7 concludes the chapter.

6.2. Literature review

6.2.1. Chinese presence in Africa: Investment Trade and technology transfer

The literature review will cover all the aspects of the international cooperation–technology transfer nexus. We will first question the literature on the channel through which FDIs and trade can lead to technology transfer and then focus on the key findings of the literature about China's presence in Africa. The effect of interactions between countries (in the context of GVCs) on technology transfer is an old debate that has taken many forms: it has been presented through the spillover effects of FDIs and imports as well as directly through the advantages of integrating GVCs. Technology transfer can occur through licensing and FDIs as well as more indirectly through imports of intermediate goods and/or machinery, transport equipment, and demand effects. Licensing is a way for developing countries to benefit from high technology. However, licensing is said to be risky for the developed country (or lead firm) that provides the license if the receiving country does not have a strong rule of law or strong contract enforcement systems (Stone et al., 2015). FDIs are the second way in which interactions in GVCs can lead to direct technology transfer. The literature on technology transfer through FDIs is highly rich and varied. Indeed, this is embodied in the literature on FDIs' spillover effects, from which two types can be distinguished: horizontal and vertical spillover effects. Horizontal spillover effects refers to firms acting in the same sectors; studies have found evidence of negative effects caused by foreign competition that capture market shares to the detriment of domestic firms (Aitken & Harrison, 1999; Stone et al., 2015). Vertical spillover effects are the most probable and represented by the case of a lead firm deciding to improve the efficiency of the value chain to which it belongs, which it achieves through giving technology to its suppliers and taking advantage of a comparative advantage owned by the supplier in a specific task. In addition, once the lead firm's demand pattern changes and becomes more technology-intensive, the suppliers must follow that evolution and upgrade in technology to meet the demand (Havranek & Irsova, 2011; Stone et al., 2015). The literature on trade spillover effects shows that capital and the movement of intermediate goods as well as the knowledge they embody can lead to technology transfer. First, imports of capital goods are likely to lead to technology transfer because capital goods mainly comprise machinery transport equipment, which contains high-tech components. Therefore, for developing countries, importing capital goods from developed countries can lead to a technological upgrade (Eaton & Kortum, 2001; Stone et al., 2015). This positive effect can be explained through the diffusion of knowledge from the use of machinery imported by a firm. In addition, workers can export that knowledge to competitors and spread it through the country. Moreover, firms can use their engineering skills to deconstruct and understand how technology works and attempt to use it in

their own production process or make a reproduction of the given capital good. Second, having access to the world market of intermediate goods helps countries obtain access to high-tech inputs that they would not have been able to produce. Thus, countries obtain access to sophisticated inputs, which increase their own productivity and development of new products (Amiti & Konings, 2007; Goldberg et al., 2010). Another indirect way of technology transfer is demand effects, which pass through demand. When developing countries produce to meet local demand, they tend to be less concerned with quality and standards. However, in the case of GVCs, some countries are integrated in global markets and have to supply developed countries' domestic demand. In that case, they will attempt to follow international standards, which will lead to technology upgrading (Atkin et al., 2014; Bastos & Silva, 2010; Manova & Zhang, 2012).

The literature on the Chinese presence in Africa is well furnished but composed of divergent findings. A growing body of literature considers the presence of China in Africa as a grace because the approach of China differs from Western countries, which have a bad reputation in Africa because of their role in the continent's colonial past. Some recent studies have found evidence of positive effects of the presence of China in Africa (Donou-Adonsou & Lim, 2018; Klaver & Trebilcock, 2011, p. 201; Otchere et al., 2016). However, some less optimistic studies have highlighted the absence of positive spillover effects of China's presence in Africa (Ademola et al., 2009; Klaver & Trebilcock, 2011; Osabutey & Jackson, 2019). Osabutey & Jackson (2019) investigated the effect of Chinese MNEs' presence in Africa, mainly in Ghana. Their findings suggested the absence of specific technology and knowledge transfer policies and strategies in Sino–African relations. Klaver & Trebilcock (2011) analyzed Chinese investment in Africa and identified seven ways Chinese investment contribute to African growth (commodity prices, capacity to extract, infrastructure, manufacturing, employment, market access, and consumers' access to cheap products). Their findings also highlighted the existence of negative effects, because Chinese FDIs may deindustrialize Africa by outcompeting African firms given that African manufacturing is weak and suffers from many ills. Without econometric analyses, Ademola et al. (2009) conclude on the existence of both negative and positive effects but the negative effects may outweigh the positive ones for many African countries. Alfaro et al. (2004), investigate the existence of a channel through which Chinese FDIs may have positive spillover effects focusing on physical or human capital. They find no evidence of physical or human capital as the main channels through which countries benefit from FDIs. However, earlier in in the 90s, Borensztein et al. (1998), highlighted that FDIs positive effects are highly dependent on the level of educated workforce. In a most recent literature, Alfaro et al. (2004), used both theoretical and empirical approaches to examine the different links between FDIs, financial markets, and growth. The model shows that increased foreign investment increases output in the investment sector (foreign production) and in the domestic sector (domestic production). Their empirical results indicate that investment contributes to economic growth owing to the development of the local financial market. Using human development index and real GDP per capita as measures of poverty. Following

approximately the same method, Gohou & Soumaré (2012) examined the effect of FDIs on poverty reduction in Africa. Their results indicated a significant positive relationship between the two variables. In a different approach (i.e using poverty headcount to measure poverty), Fowowe & Shuaibu (2014) and Fauzel et al. (2015) confirmed the positive relationship between FDIs and poverty reduction. Additional studies have investigated the effects of FDIs on growth. Otchere et al. (2016) in a study of the direction of the causality between FDIs and financial market development find that FDIs has a positive and significant effect on economic growth in Africa. This result is corroborated by Soumaré (2015) when investigating foreign investment and economic development in Northern Africa. Donou-Adonsou & Lim (2018), used fixed-effects and instrumental variable to investigate the effects of Chinese presence. Their results indicate that Chinese investment improves income in Africa. However, they found a more pronounced impact for U.S. and German investment. Most research on direct and indirect technology transfer has been in the form of firm-level–based studies, and the level of technological sophistication is often captured by productivity. Few country-level studies have been conducted on this topic, and those that have tried have focused on the spillover effects of FDIs on productivity, growth and poverty. The aim of this chapter is to study country-level technology transfer using an innovative approach of technological sophistication index.

6.2.2. Technology: Sophistication Index

Several studies attempted to investigate sophistication. Most of them follows the same structure and the same methodology of calculation implemented by Rodrik (2006) and Hausmann et al. (2007). This index of exports sophistication has been widely used across the literature (Hausmann et al., 2007; Lall et al., 2006; Lectard & Rougier, 2018; Rodrik, 2006; Schott et al., 2008; Van Assche & Van Biesebroeck, 2018; Xu & Lu, 2009). Xu & Lu (2009) examined variations in level of export sophistication across China's manufacturing industries. The paper relies on the well-known export sophistication index introduced by Hausmann et al. (2007). More recently Van Assche & Van Biesebroeck (2018) analyzed if there is evidence of functional upgrading in China. They measured industry upgrading from the composition of China's exports across products of different sophistication within a broader sector, building on a method pioneered by Rodrik (2006) and Hausmann et al. (2007). However, several papers assessed innovation and technology upgrading using other type of measures (Koopman et al., 2010; Rueda Maurer, 2017; Wei et al., 2017). Wei et al. (2017) in their paper, assessed the likelihood of China to make the necessary transition to generate productivity increase, and domestic innovation. One of the key questions the paper answers is what is the growth of innovation by Chinese firms? To answer this question, the paper makes use of data on patents from China State Intellectual Property Office, the United States Patent and Trademark Office, and World Intellectual Property Office. It uses patent applications and patents granted by firms both at home and in the United States as proxy for innovative activities. Koopman et al. (2010) tried to assess if China’s exports compete head to head

with those of high- income countries. It defined an index for a lack of sophistication by the dissimilarity between the product structure of a region's exports and that of the G3 economies, or the export dissimilarity index (EDI). The sophistication of a city's export structure is measured on a year- by- year basis by its similarity with that of the G3 high- income countries. Nevertheless, Rueda Maurer (2017) introduced a new index of export sophistication similar to Hausmann et al. (2007). The paper analyzed how economic integration and the international division of labor have evolved among the "ASEAN + 3" countries in the last 20 years. It proposed an indicator of the level of technological sophistication based on revealed comparative advantages. Using comparative advantages, the methodology is presented as follow: The number of products with the Balassa (1965) index of Revealed Comparative Advantages that are greater than 1 in each category are added up, weighted by the share of each product group in the country's total exports. This weighted sum multiplied by their corresponding category level are added up in the final Technology Sophistication index. The index varies from 0 to 7.7 being the highest level of technological sophistication. The current chapter integrates this relevant literature by introducing a new type of sophistication index based on domestic value-added exports.

6.3. Stylized facts: History of Sino–African relations

6.3.1. China–Africa: A historical perspective of the Chinese presence in Africa

China and Africa have made contact throughout history, and up to 1949 these interactions were more the result of international trade with common trade partners and merchant civilizations (Arabs, Persians, and Turks). Such contact with African countries would later move from passive indirect contact to more involved relationships. The post-1949 relations between China and African countries have been easier because of their common past under Western imperialism.

Historically, Chinese interactions with African countries are not recent and started with indirect trade relations. In fact, while not as well documented as Africa's links with Europe, trade relations between China and Africa date back to the first Han emperors of the second century BC (Jinyuan, 1984; Renard, 2011). Indeed, according to (Alden & Alves, 2008), Chinese interaction with African countries started during the reign of Emperor Wuti (140–87 BC) through an expedition sent west in search of allies. This expedition is said to have reached Alexandria (Egypt), which may have resulted in contact with African civilizations. The major economic achievement of the Han Dynasty (206 BCE–220 CE) was probably the opening of the Silk Road, the routes of which stretched from China through India, Asia Minor, up throughout Mesopotamia, to Egypt, Greece, Rome, and Britain. Africa was a part of this Silk Road trade between different civilizations, and Africa and China may have made contact even indirectly through the Silk Road. This indirect contact via trade was made possible by intermediates that were common trade partners to both parties. Chinese products were imported by African countries through Arabs, Turks and Persian merchants that used to trade with Chinese. These civilizations where in contact with

both parties and were trading with them. At the same time, they were selling African products to Chinese. Contacts between China and Africa also occurred during the Tang dynasty (618–907) and were characterized by trade with Arab merchants. In addition, under the Song dynasty (960–1279), indirect contact (via common trade partners as previously described) was made and instances became more frequent. This historical fact was evidenced by archaeological discoveries in eastern Africa and Chinese written records prove it (Alden & Alves, 2008). Chinese knowledge of Africa increased during the Yuan dynasty (1279–1368) due to Chinese contact with the Arabs, Persians, and Turks. The climax of relations between China and Africa was reached during the Ming Dynasty (1368–1644) when China was at the height of shipping technology, leading to a series of expeditions that reached East Africa under the command of Admiral Zheng He (Alden & Alves, 2008). History states that Admiral Zheng He's fleet visited the eastern coast of Africa (Somalia and Kenya) two or three times and made contact with local kings, who reciprocated by sending official delegations to China. This growing friendship was however relatively short because of internal issues, conducing the Ming Dynasty to forbid any overseas contact, simultaneously paving the way to the Europeans' incursions in Africa. This was also the starting point of Western countries presence in Asia. Different to their previous contact and beyond their indirect trade relations, contacts between China and Africa occurred in the early 20th century when European powers used Chinese labor to work in their African colonies. During this period, both China and Africa were colonialism's victims, a situation that would later reinforce the relations between the two. After these periods of contact, it was only with the establishment of the People's Republic of China in 1949 that the Chinese again raised their interest in other developing countries, mainly after the Bandung Conference[42]. However, the presence of China in other developing countries has not been limited to the economic and commercial domains. China has supported the independence process of various less developed countries (Burma, Malaysia, and Vietnam) and it has provided economic assistance to some of them (Mongolia and North Korea). In the post-colonial period, China positioned itself for the least developed countries as an alternative to the former colonialists' power. The need for the Chinese to extend their influence in developing countries made them adopt a strategic plan consisting of sharing a common anti-imperialist doctrine with the least developed countries and proposing alternative solutions that were—or appeared—better.

Later, after the establishment of the People's Republic of China in 1949 and the waves of African countries' political independence movements, China found natural allies in these newly independent countries and a potential solution to its legitimacy problems (reinforced by their common colonial links). This was important because China was not a member state of the United Nations (UN) or recognized by the United States (US), which maintained diplomatic relations with the Republic of China on the

[42] Bandung Conference: In April 1955, representatives from twenty-nine governments of Asian and African nations gathered in Bandung, Indonesia to discuss peace and the role of the Third World in the Cold War, economic development, and decolonization.

island of Taiwan, supporting it as the legitimate government of China. At the beginning, China's involvement in Africa was driven by its close relations with the Soviet Union. Its direct involvement was soon confirmed with the Afro-Asian Peoples' Solidarity Organization, created in 1957. The foreign policy of China toward Africa was focused on three main axes: the export of the "Chinese model," the struggle against the superpowers, and China's third world policy (Yu, 1977, 1988).

During the first Cold War, several African countries recognized the People's Republic of China as the legitimate government of China, namely Morocco and Algeria in 1958 and Sudan and Guinea in 1959. The following two decades turned out to be much more fertile in terms of international recognition with 14 African countries establishing diplomatic ties with China during the 1960s and 22 during the 1970s (Alden & Alves, 2008). This was the result of the independence movements of African states in the southern Sahara. The official ties of African countries with China consisted of four main categories: Friendship treaties based on the "Five Principles of Peaceful Coexistence"; cultural pacts; trade and payment agreements intended to promote commercial relations; and economic aid and technical assistance agreements.

However, these great growing relationships between China and Africa were weakened because of the Cultural Revolution in 1966, which almost saw an end to overt Chinese political actions on the continent. Furthermore, African countries made strategic rapprochements with the US in response to the increasing "Soviet menace" in the 1960s and 70s, as evidenced by Sino–Soviet border clashes in 1969 and the Brezhnev doctrine[43], which was accompanied by the Soviet invasion of Czechoslovakia in 1968, making the Soviet Union China's primary enemy. The evolution of Sino–African diplomatic relations during the Cold War was marked by many diplomatic achievements, which are represented by the following specific cases: (i) In 1956, Egypt was the first African country to establish official diplomatic relations with China. China currently maintains diplomatic relations with 54 African states, with Sao Tome and Principe (2016) and South Sudan (2011) being the most recent. (ii) In 1971, China secured a permanent seat on the UN Security Council with support of 26 African states (34% of the General Assembly votes). In 1970–75, the most celebrated Chinese development assistance project in Africa was the Tazara Railway, requested by the previous Zambian president Kenneth Kuanda and his Tanzanian counterpart, Julius Nyerere.

In the 2005s-2010s, China has continually trumpeted its 50-year-old involvement in Africa as positive, progressive, and grounded in the eternal and principled truths of noninterference (Strauss, 2009). However, rigorous analysis of available data must be undertaken to estimate the effect of China's presence in Africa before concluding to any positive effect.

[43] The Brezhnev doctrine allows Moscow to interfere in any socialist country

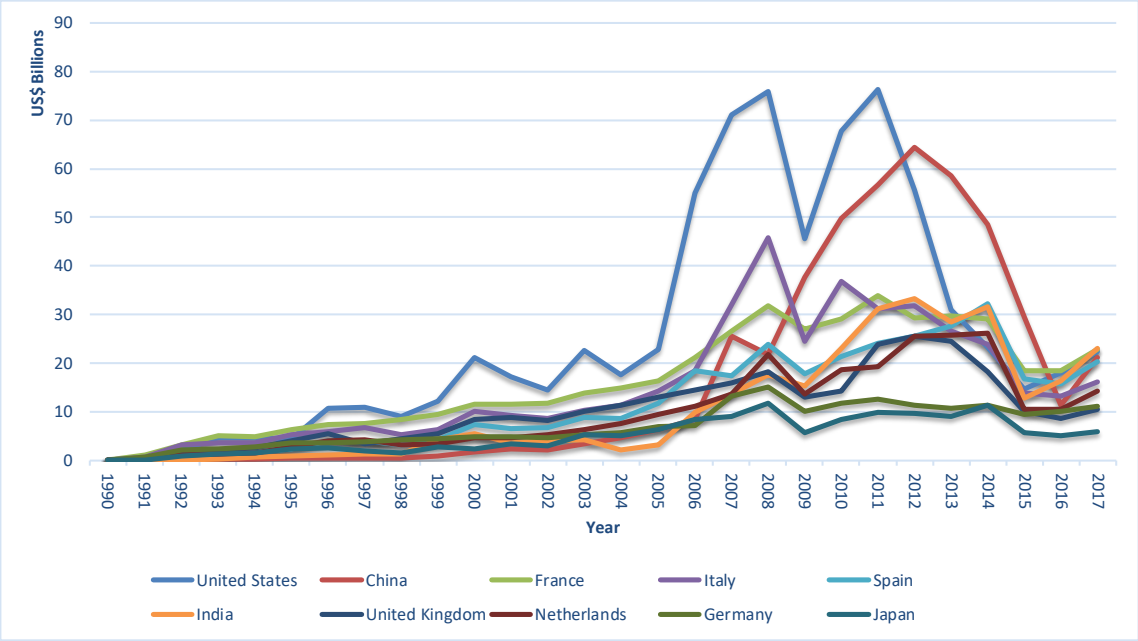
6.3.2. Stylized facts: Trade and investment between China and Africa

6.3.2.1. African countries' trade: Change in trade partners

In the past, international trade was driven by developed countries (North-North flows). However, in the last two decades, North-South and South-South trade flows have risen considerably. By 2014, the value of South-South trade had reached almost US$ 5.5 trillion, a magnitude close to that of trade between developed countries (North-North) (Autor et al., 2013). In 2018, goods worth US$ 6.9 trillion (36%) were exchanged between developed economies (North-North trade), whereas merchandise trade among developing and transition economies (South-South trade) amounted to US$ 5.4 trillion (28%). Exports from developed to developing economies and vice-versa (North-South, and South-North trade) totaled US$ 6.9 trillion (36%).[44]

The configuration of African countries' trade partners has evolved over time. Before 1995, African countries' exports were mostly routed to France, which was the first export partner of overall African countries (African countries' total exports). After 1995, the US was the largest importer of African products, followed by France, positions they would retain until 2012. The data highlight an increasing presence of China as an important trade partner (importer) of African countries over the years. In 2009, China became the second-largest importer of African products, and in 2012, African countries' exports to China reached US$ 64 billion, conferring to China the position of the largest importer of African products, replacing the US until 2016 (Figure 6.1).

Figure 6.1: Trends in African countries' gross export destinations (top 10 partners) from 1990 to 2017.

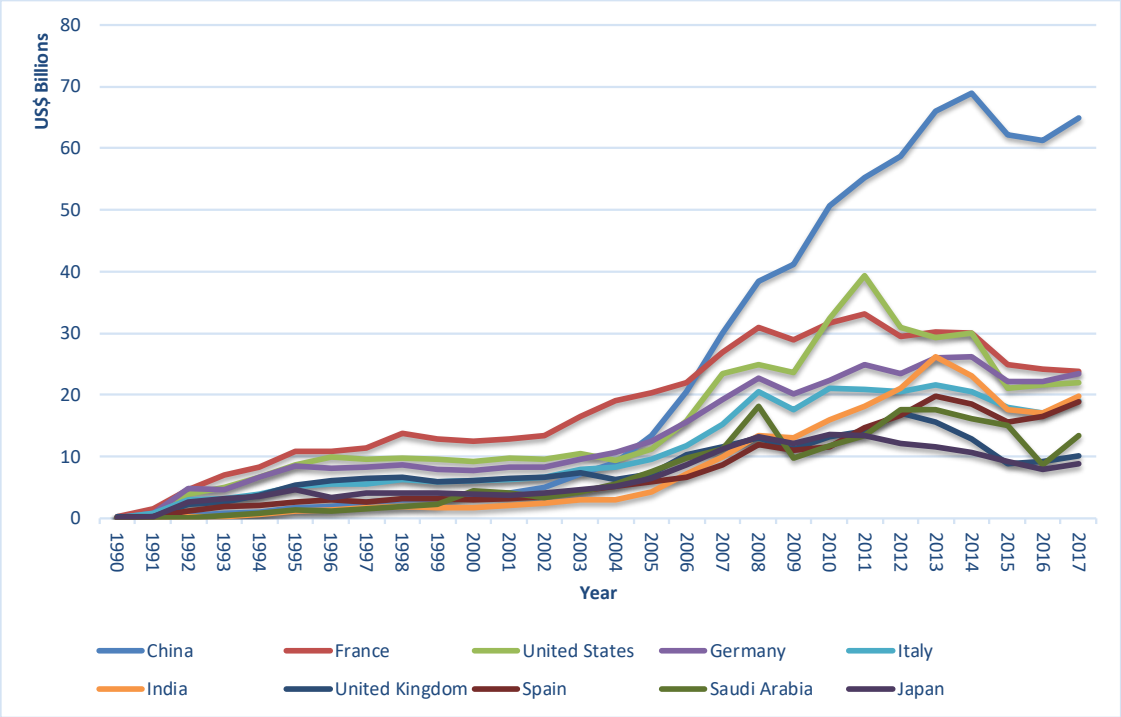


Source: Author's calculation based on UN-COMTRADE data.

[44] UNCTAD: Key Statistics and Trends in Trade Policy 2018, New York and Geneva 2019, United Nations Conference on Trade and Development, available at https://unctad.org/en/PublicationsLibrary/ditctab2019d1_en.pdf.

From 1990 to 2006, France was the largest exporter to overall African countries (African countries' gross imports), followed by the US and Germany. In 2006, France, the US and Germany lost their places to China, which became the primary exporter to African countries until 2017 (Figure 6.2). Between 2006 and 2017, African countries' imports from China increased at an annual average growth rate of 10%, going from approximately US$ 20 billion in 2006 to US$ 65 billion in 2017, reaching it highest value in 2014 (US$ 69 billion). This trend of African countries' gross imports shows that China started being a major actor in African countries' economies in 2006, and it is now a major trade partner if not the first. This is why it is necessary to investigate the increasing and deep presence of China in Africa.

Figure 6.2: Trends in African countries' imports (top 10 partners) from 1990 to 2017.

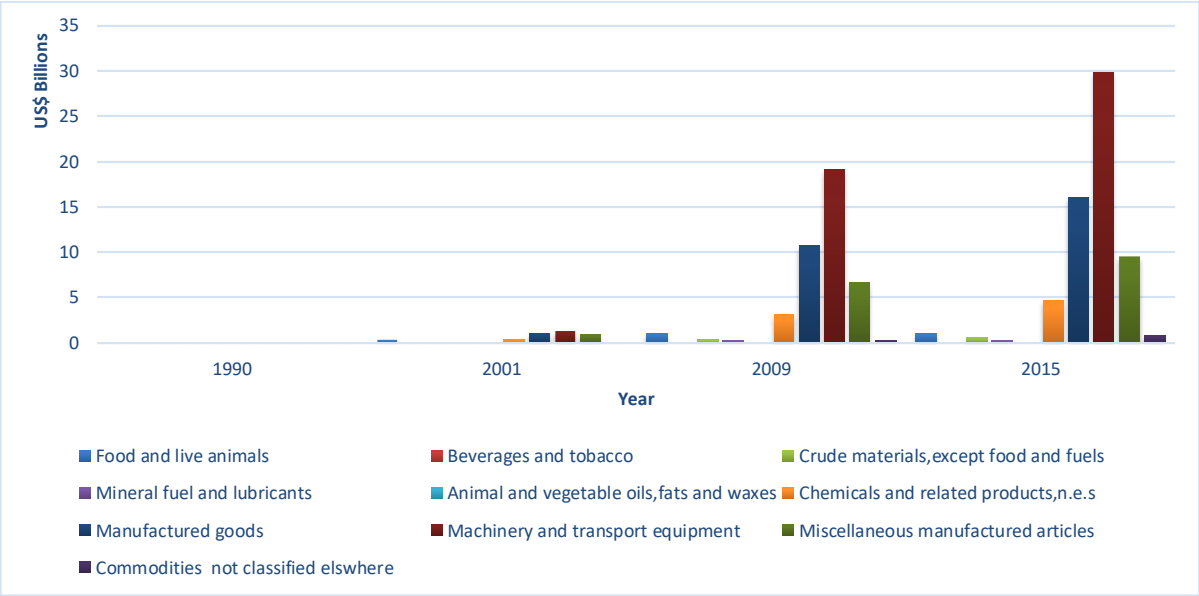


Source: Author's calculation based on UN-COMTRADE data.

The composition of African countries' imports from China by product[45] type is necessary to include when investigating the reasons for as well as the effects of the Chinese presence in Africa. Since the 1990s, African countries' imports from China have mainly comprised manufactured goods, machinery and transport equipment, and miscellaneous manufactured articles. In 2001, 2009, and 2015, the top product types imported by African countries from China were machinery and transport equipment followed by manufactured goods and miscellaneous manufactured articles. The common property of these products is the technology they embody (Figure 6.3).

[45] The Nomenclature used is: SITC Revision 3

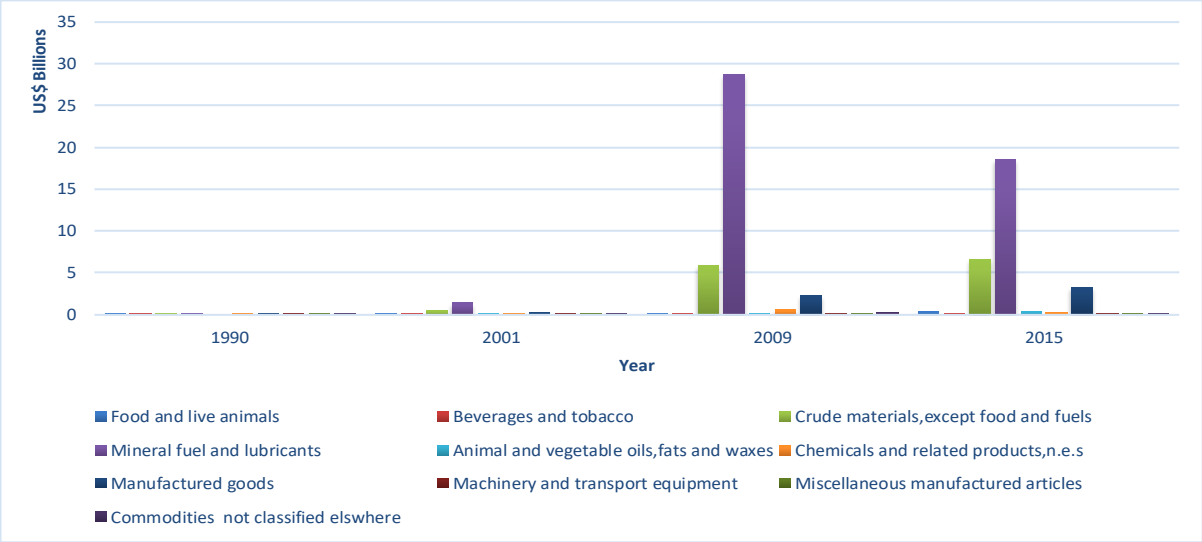
Figure 6.3: African countries' imports from China by Product Types



Source: Author's calculation based on UN-COMTRADE data

However, the structure of African countries' exports to China is different, which mainly comprise mineral fuel and lubricants followed by crude materials, except food and fuel, and manufactured goods (2009–2015). In contrast to imports from China, these exports are more resource-based (Figure 6.4). This highlights the objective and the potential gain of China in its trade relations with African countries, namely obtaining market opportunities for their products and natural resources to meet their energy concerns. Therefore, it will be difficult for African countries to take advantage of their exports to China in terms of technology upgrading.

Figure 6.4: African countries' exports to China by Product Types

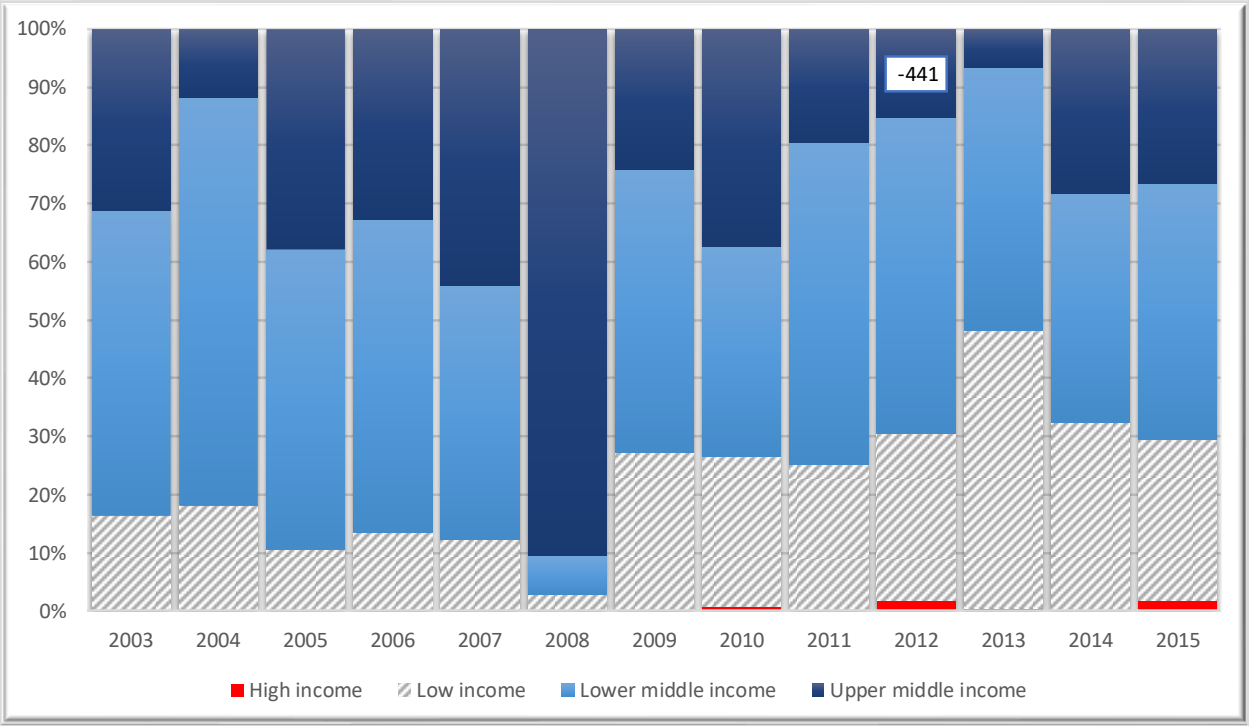


Source: Author's calculation based on UN-COMTRADE data

6.3.2.2. Foreign direct investments

Relevant data on Chinese FDIs to African countries are recent and date back to 2003. Analyzing these data by income group provides an idea about which income group receives the most FDIs from China. Indeed, from 2003 to 2015, Chinese FDIs were directed more to lower-middle-income countries, except in 2008 where approximately 90% of Chinese FDIs in Africa were located in upper-middle-income countries. Low-income countries have also received FDIs from China, starting from 16% in 2003 and increasing to 27% in 2015 with minor fluctuations in the trend. Although we claim that FDIs are located more in lower-middle-income countries, the reparation by income groups tends to be equal with small differences (except in high-income countries) and according to the considered period. In fact, the mean percentages (2003–2015) of Chinese FDIs by income group are as follows: lower-middle-income countries (40%), followed by upper-middle-income countries (35%), low-income countries (24%), and high-income countries (1%). (Figure 6.5)

Figure 6.5: Chinese foreign direct investments to Africa by income group (2003–2015).



Source: Author's calculation based on Chinese official reports.
Note: In 2012, net FDIs inflow to upper-middle-income countries was negative (US$ 441 million) meaning that FDIs outflows from Africa upper-middle-income countries into China was higher than FDIs inflows from China.

6.4. Empirical methodology

6.4.1. Theory

This chapter investigates technology transfer in South-South trade and investment relations and relies on comparative advantages — adapted to GVCs — to compute technological sophistication index. Following Ignatenko et al. (2019), the empirical methodology relies on a production function and its decomposition. For a country i, gross output Yi can be expressed in a Cobb-Douglas production function with equation (6.1, where DVAi is domestic value-added and FVAi is foreign value-added:

$$Y_{\mathrm{i}} = DVA_i^{1-\alpha} FVA_i^{\alpha} \tag{6.1}$$

At the same time, country i's domestic value-added is produced using capital, labor, and productivity — technology. This can be expressed with equation (6.2) where Ki and Ni denote a country's endowment in capital and labor, Ai is the level of technological sophistication, Si represents the workers' average years of schooling and $\Phi(Si)$ is a piecewise linear function that transforms years of schooling into human capital.

$$DVA_{\mathrm{i}} = A^{\delta} K_i^{\beta} [e^{\varphi(S_i)} N_i]^{1-\beta-\delta} \tag{6.2}$$

The combination of equations (6.1) and (6.2) can be rewritten as:

$$Y_{\mathrm{i}} = A_i^{\delta(1-\alpha)} K_i^{\beta(1-\alpha)} e^{(1-\alpha)(1-\beta-\delta)\varphi(S_i)} N_i^{(1-\beta-\delta)(1-\alpha)} FVA_i^{\alpha} \tag{6.3}$$

Linearizing equation (6.3) by taking logs, presents the following decomposition of country i's level of technology:

$$\begin{aligned} \log(A_{\mathrm{i}}) \; = & \frac{1}{\delta(1-\alpha)} \log(Y_i) - \frac{\beta}{\delta} \log(k_i) + \frac{(\beta+\delta-1)}{\delta} \varphi(S_i) + \frac{(\beta+\delta-1)}{\delta} \log(N_i) \\ & + \frac{\alpha}{\delta(\alpha-1)} \log(FVA_i) \end{aligned} \tag{6.4}$$

To estimate empirically the impact of interactions between China and African countries through GVCs on the level of African countries technological sophistication, we relied on equation (6.4) to which we added additional control variables. Our main question is: Are African countries getting transformed technologically thanks to their interaction with China in Global Value Chains?

6.4.2. Empirical methodology

For our basic estimation, we used a panel fixed-effects model with Country and Time fixed-effects. That first-step estimation will allow us to identify direct and indirect technology transfer between China and African countries. Our basic econometric model for this estimation is the following:

$$\begin{aligned} logTSI_{i,t} &= \beta_0 + \eta_t + \beta_1 logK_{i,t} + \beta_2 logL_{i,t} + \beta_3 logHK_{i,t} + \beta_4 FDI_{i,t} + \beta_5 logIMPI_{i,t} \\ &+\beta_6 logEXPI_{i,t} + \beta_7 FDI_{i,t} \times logHK_{i,t} + \beta_8 logIMPI_{i,t} \times logHK_{i,t} + \mu_i \\ &+\epsilon_{i,t} \end{aligned} \tag{6.5}$$

Where TSI represents technological sophistication; $K_{i,t}$ is the level of capital; $L_{i,t}$ represents the level of labor; $HK_{i,t}$ is human capital; $FDI_{i,t}$ represents FDI flows from China; $IMPI_{i,t}$ is the amount of intermediates good imported by African countries from China and $EXPI_{i,t}$ the amount of intermediates good exports to China. The coefficient β_4 in front of the variable $FDI_{i,t}$, if it is positive, quantifies "direct technology transfer" whereas the coefficients β_5 in front of $IMPI_{i,t}$, represents "indirect technology transfer".

6.4.3. Variables and data sources

The dataset includes annual data from 1995 to 2015 for 49 African countries. Our variable of interest is the technological sophistication index, which is computed following (Rueda Maurer, 2017). The explicative variables are mainly trade in intermediate goods, computed using input–output tables, and Chinese FDIs registered in Chinese official reports as overseas FDIs (OFDI) and obtained from the China Statistical Yearbook. The control variables are labor (employed population), which is obtained from the World Bank World Development Indicators (WDI); private capital stock, which comes from the IMF Investment and Capital Stock Dataset; and human capital, measured using the ratio of gross enrollment in tertiary education, which comes from the WDI.

6.4.4. Imports of intermediates goods from China

We compute imports of intermediate goods from China using input–output data from EORA-MRIO databases (Lenzen et al., 2013). The process follows the same methodology used by (Koopman et al., 2014) to decompose gross exports into different components. Exports of intermediate goods can directly be identified in input–output tables; however, such tables also include domestic intermediate goods produced and used at home.

Table 6.1: First part of the input–output table: Intermediate goods

		Country 1		Country 2		Country 3	
		Sector 1	Sector 2	Sector 1	Sector 2	Sector 1	Sector 2
Country 1	Sector 1	a_{11}	a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
	Sector 2	a_{21}	a_{22}	a_{23}	a_{24}	⋯	a_{26}
Country 2	Sector 1	a_{31}	⋮	⋱			⋮
	Sector 2	a_{41}	⋮		⋱		a_{46}
Country 3	Sector 1	a_{51}	a_{52}			⋱	
	Sector 2	a_{61}	a_{62}	⋯	a_{64}	⋯	a_{66}

Note: Simplified input output table with only intermediate goods. Full table is available in Chapter 1 Annex 1.3. **Reminder:** a_{13} represents exports of intermediate goods from Country 1 (sector 1) and used (imported) by Country 2 in its sector 1.

Exports or imports of intermediate goods are obtained by extracting all intermediate goods from input–output tables and setting to zero (0) domestic intermediate goods produced and used at home. Following the general example of Table 6.1, we can attempt to compute imports of intermediate goods of Country 2 from Country 1. The general formula of imports of intermediate goods of Country 2 from Country 1 is presented as follows:

$$M_{2,1} = \sum_{j=1}^{2} \left(a_{j,3} + a_{j,4}\right) = (a_{13} + a_{14}) + (a_{23} + a_{24}) \quad \text{with } n = 2 \text{ (two sectors)} \tag{6.6}$$

The general formula is as follows (using the Table 6.1 as a simplified case):

$$M_{k,i} = \sum_{\substack{j=2i-1 \\ k \neq i}}^{2i+n-2} (a_{j,2k-1} + a_{j,2k+n-2}) \tag{6.7}$$

Where $M_{k,i}$ is the imports of Country k from Country i, and n is the number of sectors.

6.4.5. Technological Sophistication Index

The Hausmann et al. (2007) export sophistication index[46] is computed using Balassa's Revealed Comparative Advantages (RCA) Index and weighed by the country's Gross Domestic Product (GDP).

[46] Available on: World Integrated Trade Solution (WITS)

Rueda Maurer (2017) followed the same methodology using Revealed Comparative Advantages (RCA) to compute an index of technological sophistication without weighting by countries' GDP. This chapter introduced an innovative approach, used only in this chapter and for the first time in the literature. This approach is not too far from both Rueda Maurer (2017) and Hausmann et al. (2007) approach but is necessary and relevant in this context of GVCs. Indeed, the Technological Sophistication Index (TSI) is computed using the principle of Balassa's RCAs. However, with the rise of GVCs, comparative advantage theory no longer works the same way. Thus, TSI calculation methods should evolve with the phenomenon of GVCs. Countries are now specializing in tasks. They are now exporting intermediate goods that third countries will use to produce other goods or assembled goods produced using intermediate goods from third countries. Therefore, using gross exports to compute RCA and then the TSI index is misleading and can overestimate countries' level of technological sophistication. This chapter relies on domestic value-added exports instead of gross exports to overcome the potential overestimation of current technological sophistication indexes. It allows us to compute TSI based on value added effectively created by the country.

Koopman et al. (2014) provided a framework to decompose gross exports into different elements. Gross Exports comprises Domestic value-added in direct final goods exports (VAEFD), domestic value-added in intermediate exports absorbed by direct importers (VAEI1), domestic value-added in intermediate re-exported to third countries (VAEI2); these three elements are Value-added exports (VATRD). We also have domestic value-added in intermediate that returns via final imports (VARHF), domestic value-added in intermediate goods that returns via intermediate imports (VARHI), foreign value-added in final goods and intermediate goods exports (FVA), and Pure double counted (two terms). We are interested in Value-added exports (VATRD), representing the domestic value-added embodied in gross exports. The new Balassa RCA index based on value added exports is presented as follow:

$$RCAIndex(VA)_{ip} = \frac{VATRD_{ip} / VATRD_{i}}{VATRD_{wp} / VATRD_{w}} \tag{6.8}$$

And

$RCAIndex(VA)_{ip}$: is RCA in term of domestic value added;
$VATRD_{ip}$:represents value added exports of product p from country i;
$VATRD_{i}$:is total value added exports from country i;
$VATRD_{wp}$: is world value added exports of product p;
$VATRD_{w}$: is the world total value added exports.

Following ISIC Rev3 classification, we determined the technological sophistication associated with each sector (Table A 6.1 and Table A 6.2). A country is specialized in a specific product if the $RCAindex(VA)$ associated to this product is greater than one ($RCAIndex(VA) \geq 1$). After identifying products in which countries have a comparative advantage, we can start computing the TSI. The products with $RCAIndex(VA) \geq 1$ are aggregated into five (5) different level of technological sophistication. We followed OCDE, (2003) for the classification and we referred to Lenzen et al. (2013) for correspondence between EORA-MRIO sector classification and ISIC Rev3 (Table A 6.2).

Table 6.2: Classifications of Technological level base on OCDE, (2003)

Level of technological Sophistication (TS)	Technologycal Sophistication Code (TS)
Primary sector and services	0
Low technology	1
Medium-low technology	2
Medium-high technology	3
High technology	4

Source: ANBERD and STAN databases, May 2003 (OCDE, 2003)

For each country, products group with $RCAIndex(VA) \geq 1$ belonging each category of technological sophistication level are added up, weighted by the percentage of the exported value-added of each product in the country's total value-added exports. In other words, for each country, the share of each product group value added in the country's total value-added exports are added up for each category of technological sophistication level. This weighted sum is then multiplied by the corresponding technological sophistication code and the sum gives finally the TSI.

$$TSI_i = \sum_{TS=0}^{4} \left[TS \times \sum_{p}^{N} \left(\frac{VATRD_{i,TS,p}}{VATRD_i} \right) \right] \tag{6.9}$$

TS:Technological Sophistication Code.

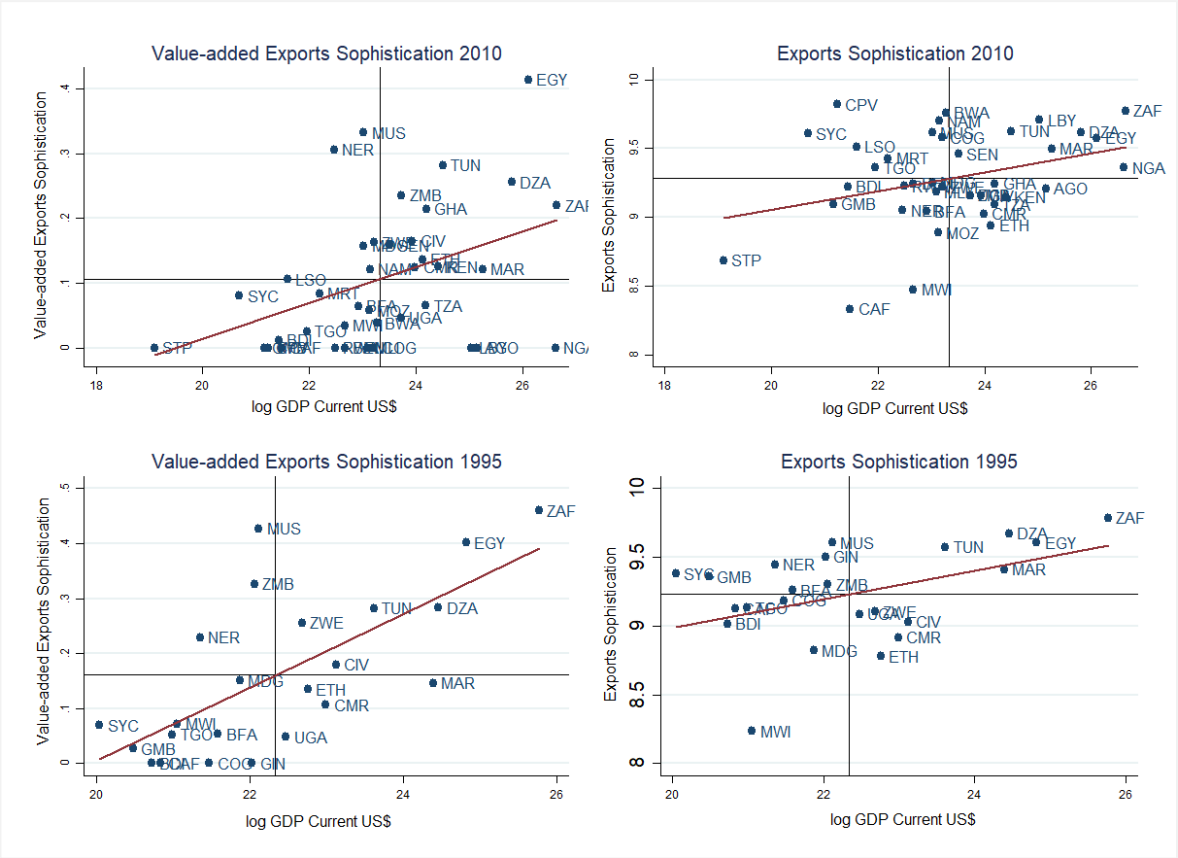
N: The number of product groups with $RCAIndex(VA) \geq 1$.

$VATRD_{i,TS,p}$:Value added exports of product p with $RCAIndex(VA)_{ip} \geq 1$.

Following this method, we obtain a TSI free from foreign value added that measures the adequate level of technology created by a given country. Visual representation (Figure 6.6) of the relation between TSI and GDP allows us to see the existence of a positive correlation between the two variables. It legitimates the value-added approach and shows how African countries are positioned or ranked in terms of technology. The most interesting is the complete change in the ranking of some top countries with

higher level of technological sophistication. However, it is also essential to mention countries that kept their relative position compared to the gross exports' sophistication ranking.

Figure 6.6: The relationship between TSI and GDP



Source: Author's calculation

6.5. Results of the panel fixed effect estimations and robustness

Table 6.3 reports the results of estimates. TSI is negatively correlated to labor, whereas it is positively correlated to capital. The results show that Chinese FDI inflows do not significantly impact African countries' level of technological sophistication (Table *6.3* column 1). However, the interaction between human capital and FDI inflows is positive and significant. The higher the level of human capital, the more the negative effect of FDIs from China on technological sophistication decreases and becomes positive. The results show that an increase in FDI net inflows from China by US$ 1 million would reduce TSI by 0.186 percent if human capital were null (Table *6.3* column 6). The interactive term between the log of human capital and FDIs is positive and significant, suggesting the existence of a threshold of human capital[47] above which it exists direct technology transfer from China to African countries through FDIs. Human capital data ranges between 0.094% and 61.14%. In a situation of

[47] The threshold corresponds to a value of gross enrollment ratio in tertiary school for both sexes equal to 29.96%. It is the level of human capital for which the impact of FDIs on TSI is greater or equal to 0 (i.e., $(\beta_4 + \beta_7 \times logHK_{i,t}) \geq 0$)

minimum level of human capital, an increase in Chinese FDI net inflows US$ 1 million decreases TSI by 0.32%.[48] However, for the highest level of human capital in the sample, an increase of Chinese FDIs by US$ 1 million increases TSI by 0.0398%.[49] Such results suggest that technology transfer depends on the capacities of the host country.

The reason is that African countries with a low level of Human capital cannot take advantage of technology brought by foreign firms. In addition, most FDIs directed to Africa are resource based FDIs. These types of FDIs do not increase the competitiveness of local firms and reduce technological sophistication because their activities destroy the industrial tissue of the host countries and reduce their ability to upgrade the technology chain. However, this can translate into a positive impact if African countries get a sufficient level of human capital. The positive impact of Chinese FDIs on technological sophistication can pass through many channels. First, it can be through supply chains. In this case, technology upgrading can occur when local firms become suppliers of foreign firms. Since the foreign firms produce products that embody high technology, local suppliers have to meet the expectations of the foreign firm standard, leading to technology upgrades of local firms. Moreover, multinational firms or foreign firms can directly help their local suppliers to ensure that they use quality inputs; this will be characterized by product design, assisting with technology acquisition, and production techniques (Paus & Gallagher, 2008). Upgrading technology can also happen when foreign firms subcontract their activities to some local firms. These are channels through which local firms can upgrade in terms of technology, but they highly depend on the strategy of the foreign firm in terms of FDIs (Farole & Winkler, 2014). Chinese FDIs can also lead to upgrading through diffusion effects. Indeed, the entry of a foreign firm into the local market will increase competition between local suppliers and lower the prices for the foreign firm. Since the prices become low, local suppliers will compete to improve the quality of their products (provided that the country is well endowed with human capital). Therefore, that competition will lead to a technology upgrade in the country.

Focusing now on imports of intermediate goods from China, results show that imports of intermediate goods from China significantly increase the level of technological sophistication of African countries - indirect technology transfer between China and African countries. A 1% increase in imports of intermediate goods from China increases the TSI level by 0.24% (Table *6.3* column 2, 5 and 6). Indeed, entering new and efficient markets gives access to high-quality intermediate goods. Therefore, the import of sophisticated intermediate goods increases the production of new and enhanced products. The result follows Goldberg et al. (2010) that found that liberalization in India gives them access to more sophisticated intermediate goods at lower prices, increasing their productivity. Moreover, the

[48] The marginal effect of FDIs on TSI is $(\beta_4 + \beta_7 \times logHK_{i,t}) \times 100$. The corresponding marginal effect of FDI in the case of a minimum level of human capital (0.094%) is $0.32 = (-0.00186 + 0.000549 \times \log(0.094)) \times 100$

[49] The marginal effect of FDIs on TSI is $(\beta_4 + \beta_7 \times logHK_{i,t}) \times 100$. The corresponding marginal effect of FDI in the case of a maximum level of human capital (61.14%) is $0.32 = (-0.00186 + 0.000549 \times \log(61.14)) \times 100$

capacity of African countries to use technology incorporated in imports can improve the positive impact of intermediate goods imports from China. Also, imports of intermediate goods can increase competition between domestic producers of intermediate goods and foreign producers. Domestic companies will therefore need to upgrade technology for survival concerns.

Table 6.3: Results of estimates using fixed effect

	First step		Threshold effect		All	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
FDI CHN_t	-0.000168		-0.00174**		-0.00151*	-0.00186***
	(0.000153)		(0.000653)		(0.000781)	(0.000621)
Log Imports CHN_t		0.241***		0.247***	0.234*	0.243*
		(0.0796)		(0.0772)	(0.126)	(0.127)
Log HK_t × FDI CHN_t			0.000581**		0.000455*	0.000549***
			(0.000215)		(0.000246)	(0.000198)
Log HK_t × Log Imports CHN_t				-0.00577	0.0403	0.0380
				(0.0159)	(0.0321)	(0.0319)
Log $Exports_t$						-0.0478*
						(0.0237)
Log $Labor_t$	-0.0442	-0.452	-0.196	-0.391	-0.460	-0.447
	(0.605)	(0.335)	(0.547)	(0.345)	(0.519)	(0.512)
Log $Capital_t$	0.116	0.107	0.138	0.100	0.229	0.229
	(0.191)	(0.146)	(0.189)	(0.157)	(0.219)	(0.216)
Log HK_t	0.00257	-0.000964	0.0200	0.0514	-0.366	-0.334
	(0.0682)	(0.0487)	(0.0675)	(0.142)	(0.331)	(0.328)
Constant	9.059***	8.655***	9.586***	8.383***	8.129***	8.383***
	(2.401)	(1.580)	(2.182)	(1.438)	(2.050)	(2.066)
Observations	298	444	298	444	283	283
R-squared	0.073	0.174	0.114	0.175	0.190	0.199
Number of id	41	42	41	42	39	39
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: FDI CHN_t represents FDI net inflows from China; Log Imports CHN_t is the logarithm of intermediates good imported from China; Log HK_t is the logarithm of human capital; Log $Exports_t$ is the logarithm of intermediates good exports; Log $Labor_t$ represents the logarithm of labor and Log $Capital_t$ is the logarithm of private capital. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

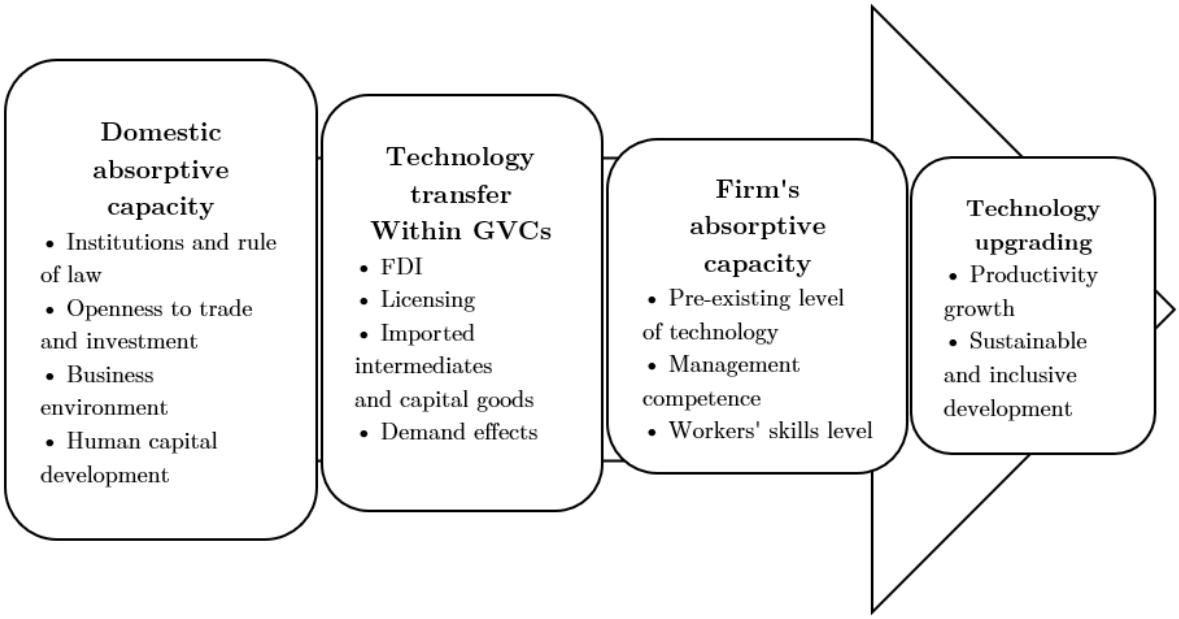
Further estimates relied on the lagged value of import of intermediates from China to account for the lagged effect of indirect technology transfer, considered other measures of FDIs, and corrected for potential model misspecification. The results follow the previous findings and suggest that one period lag of intermediates good from China has a positive and significant effect on TSI (**Table A 6.3**). Our estimates also consider FDIs from the Rest Of the World (ROW) to avoid omitted potential variable issues. The results are also in line with the initial finding and confirm that FDIs from China have a negative and significant effect on the level of TSI, and FDIs from the ROW do not significantly impact TSI. In contrast, the coefficient in front of imports is significant and positive. The results also confirm

the existence of a threshold of human capital above which FDIs from China positively impact TSI (**Table A 6.4**). Thus, the first step of the study finds robust results about the presence of a threshold effect in technology transfer and evidence from indirect technology transfer. The existence of the threshold effect needs more attention. The following section will provide more information using a nonlinear model.

6.6. A Panel Smooth Transition Regression (PSTR) approach

Previous models and estimations highlighted the existence of a threshold of human capital above which technology transfer exists. In this section, we focused on a Panel Smooth Transition Regression (PSTR) approach to consider non linearities observed in the first step regressions. Following the literature, we made the assumption that the capacity of African countries to take advantage of their interaction with China depends on their absorptive capacity (human capital and governance). Absorptive capacity can be defined as the ability of an organization or a region to take advantages from its interactions between other entities by identifying, assimilating, and exploiting knowledge from the environment (Cohen & Levin, 1989). The literature on technology transfer has continuously highlighted the role of countries' absorptive capacity in capturing technology embodied in FDIs and imported products (Fu, 2008; Stone et al., 2015).

Figure 6.7: From technology diffusion to national upgrading—The role of absorptive capacity.



Source: Illustrative figure obtained from (Stone et al., 2015).

Technology transfer between countries is supposed to help the recipient country upgrade, thereby increasing its productivity and leading to sustainable and inclusive development. However, the recipient

country should have a strong absorptive capacity to capture technology from its partner (Figure 6.7). Thus, the effect of the Chinese presence in Africa seems not to be linear but conditioned by African countries' capacities. Therefore, we should choose an appropriate model to take into account this nonlinear effect, which is why we use a PSTR model.

6.6.1. Presentation of the PSTR model

As a reminder, threshold regression models draw a jumping character, a structural break in the interaction (relation) between two variables. These models consider that individual observations can be split into classes based on the value of an observed variable (B. E. Hansen, 1999). They are developed for nondynamic panels with individual fixed effects. Threshold regression models are therefore a type of regime-switching model that are characterized by a changing slope parameter according to the regime. Indeed, the first panel threshold regression (PTR) model developed by (B. E. Hansen, 1999) assumes a brutal transition between regimes, which is not really realistic. Rather than being brutal, the transition between regimes should be smooth if we want the model to be closest to reality. The PSTR method proposed by (Gonzalez et al., 2004), in contrast to the PTR model, assumes a gradual transition between regimes. Thus, the transition function, instead of being an indicator, will be a continuous function. The PSTR model is presented in the following form:

$$Y_{it} = \alpha_i + \beta_0 X_{it} + \beta_1 X_{it} g(q_{i,t}; \gamma; c) + \theta_3 W_{i,t} + \epsilon_{it} \tag{6.10}$$

where α_i represents the individual fixed effects; ϵ_{it} is the error term, which is independent and identically distributed; Y_{it} is the explained variable represented here by the logarithm of the technological sophistication index; X_{it} represents the explicative variables; q is the transition variable, which is represented here by two types of variables, namely human capital and government effectiveness (e.g., government effectiveness, political stability, rule of law, and control of corruption), representative of the absorptive capacity; and $W_{i,t}$ is a vector of control variables composed of labor and capital. We follow (Gonzalez et al., 2004; Granger & Terasvirta, 1993) by supposing that the transition function $g(q_{i,t}; \gamma; c)$ is a logistic function with a single threshold.

$$g(q_{it}; \gamma; c) = \left(1 + \exp\left(-\gamma \prod_{j=1}^{m} (q_{it} - c_j)\right)\right)^{-1}, with\ \gamma > 0, c_1 \leq \cdots \leq c_m \tag{6.11}$$

where $c = (c_1 \leq \cdots \leq c_m)$, which represents a vector (dimension m) of location parameters (threshold parameters), and γ is the slope of the transition function.

According to the values taken by the slope parameter and location parameters, several cases exist: ***(i)*** **1st case:** With $m = 1$ and $\gamma \longrightarrow \infty$, Equations (6.10) and (6.11) represent the two-regime PTR (Hansen 1999). ***(ii)*** **2nd case:** With $m > 1$ and $\gamma \longrightarrow \infty$, the number of identical regimes is two, and the function switches between zero and one at $c_1, \dots, c_m$. ***(iii)*** **3rd case:** With $\gamma \longrightarrow 0$, the transition function (Equation (6.11) is constant, and the model is the standard linear fixed-effect model.

The marginal effect is given by the following equation:

$$\frac{dY_{it}}{dX_{it}} = \beta_{it} = \beta_0 + \beta_1 g(q_{it}; \gamma; c) \;\; With\, \beta_0 \leq \beta_{it} \leq \beta_0 + \beta_1 \tag{6.12}$$

In this case, we have two extreme values: β_0, which is the effect of FDIs or imports of intermediates from China on the level of technological sophistication if $g(q_{it}; \gamma; c) = 0$, and $\beta_0 + \beta_1$, which represents the effect if $g(q_{it}; \gamma; c) = 1$. However, if the transition function takes any value between 0 and 1 (if $g \in]0,1[$), the effect is given by $\beta_{it} = \beta_0 + \beta_1 g(q_{it}; \gamma; c)$. This PSTR model can be generalized to $r + 1$ extreme regimes. Therefore, the model becomes:

$$Y_{it} = \alpha_i + \beta_0 X_{it} + \sum_{j=1}^{r} \beta_j X_{it} g_j\left(q_{it}; \gamma_j; c\right) + \; \theta_3 W_{i,t} + \epsilon_{it} \tag{6.13}$$

The estimation of the parameters of the PSTR model consists of using the fixed effect estimator and nonlinear least squares on the previously transformed model (Colletaz & Hurlin, 2006; Gonzalez et al., 2004). Before estimating the PSTR model, following Gonzalez et al. (2004), we use a testing procedure to first test the linearity against the PSTR model and then to determine the number "r" of transition functions. The tests consist of testing the linearity of the model first without introducing the transition function. Hypothesizes are presented as follows:

- H0: r = 0 Linear model without introducing the transition function (linearity).
- H1: r = 1 Model with threshold effects with a minimum of a transition function.

If $H0$ is rejected, then this means that no linearity exists, and we have at least one transition function in the model. Then, three statistics are computed: the Wald tests (LM), Fisher tests (LMF), and pseudo-LRT statistics.

$$LM = \left(\frac{TN(SSR_0 - SSR_1)}{SSR_0}\right) \tag{6.14}$$

$$LM_F = \left[\frac{(SSR_0 - SSR_1)Km}{SSR_0(TN - N - Km)}\right] \quad (6.15)$$

$$LRT = (log(SSR_0) - log(SSR_1) \quad (6.16)$$

where K is the number of explanatory variables; SSR_0 is the panel sum of squared residuals under $H0$ (linearity); SSR_1 is the panel sum of squared residuals under $H1$; N is the number of countries; and T is time. The LM and pseudo-LRT statistics have an $\chi^2(mK)$ distribution under a null hypothesis, whereas the F-statistic (LM_F) has an approximate $F(mK; TN - N - mK)$ distribution under a null hypothesis.

Once the test confirms the absence of linearity, the next step is to change the hypothesis by increasing the number of values that "r" can take to find the number of transition functions that should be admitted in the model. In other words, this involves testing the number of possible significant transition functions in an iterative manner, ranging from two (when r = 1) to "r+1" possible transition functions.

- H0: r = j Model with threshold effects with a minimum of j transition functions (j ≥ 2).
- H0: r = j + 1 Model with threshold effects with a minimum of j + 1 transition functions (j ≥ 2).

As in the previous cases, we use the LM, LM_F, and pseudo-LRT statistics computed according to the same definitions. The procedure ends when the null hypothesis H0 is accepted, and the conclusion is that there are "j" transition functions. However, if the null hypothesis of linearity is rejected and the null hypothesis of "H0: r = 2" is also rejected, we have a situation of nonlinearity with one transition function.

6.6.2. Results of the PSTR

Threshold variables used in this study comprise a set of variables that capture the absorptive capacity of African countries. These variables are as follows: human capital measured by the gross enrollment ratio in tertiary education, government effectiveness, political stability, rule of law, and control of corruption. Pre-estimation results presented in **Table *6.4***, shows that there is at least one transition function. Therefore, the model is nonlinear, and we can search for threshold effects**Table *6.4***.[50]

[50] Before proceeding with estimations, we should ensure that the model is nonlinear and can be estimated using PSTR

Table 6.4: Linearity tests

H0: Linear Model and H1: PSTR model with at least one threshold variable (r = 1)					
Threshold Variables	Human Capital	Government Effectiveness	Political Stability	Rule of Law	Control of Corruption
Wald Tests (LM):	47,437***	19,077 ***	13,616**	16,035***	12,066**
Fisher Tests (LMF):	10,601***	3,722 ***	2,145 **	3,082**	2,275**
LRT Tests (LRT):	52,674***	19,951 ***	14,054 **	16,646***	12,408**

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

The second step consists of identifying the number of regimes. The linearity test is repeated with increasing values of "r" ($H0: r = j$ and $H1: r = j + 1$ with $j \geq 2$) until the null hypothesis is accepted. Tables in appendix (Table A 6.5, Table A 6.6, and Table A 6.7) present the results of LM, LM_F, and pseudo-LRT statistics tests. All the tests conclude in nonlinearity with a single threshold (i.e., "r=1") except when the threshold variable is *"Rule of Law,"* where the number of thresholds equals 2. Once the nonlinearity of the model is confirmed and the number of regimes is defined, the estimations provide the results detailed in the following subsections.

6.6.3. Human capital as the threshold variable

When considering the level of human capital as the threshold variable, in regime one (below the threshold), FDIs negatively impact TSI. However, in regime two (above the threshold), FDIs positively affect TSI (Table A 6.8 and Figure A 6.5). FDIs received by African countries from China negatively impact TSI when the level of human capital is below the threshold. Two factors can explain this adverse effect. The first is the nature of FDIs received by African countries from China, mainly extractive industries and mostly natural resource based. Indeed, FDIs' composition varies from one country to another, and they are more diversified in some countries than in others (G. Chen et al., 2015). The main determinants of FDIs are as follows: the importance of the host country's market size (Jaumotte, 2004; Morisset, 1999), natural resources (Asiedu, 2006), and a low cost of labor (Mody & Srinivasan, 1998; Wheeler & Mody, 1992). Findings on FDIs' spillover effects highlighted that FDIs' determinants affect their impact (G. Chen et al., 2015). This means that when the need for skilled labor is the reason of the presence of FDIs, it may have more substantial effects than FDIs attracted by unskilled cheap labor. This can explain the negative effects of Chinese FDIs in Africa because most are located in extractive sectors[51] and come with a crucial role of their own workers at the expense of the local labor force. Second, this negative effect is explained by the low level of human capital because benefiting from

[51] When looking at a country level, some countries have more diversified FDIs

foreign firms' technology requires a high level of human capital to learn, understand, and copy this technology. In addition, countries with low human capital attract FDIs that are unskilled labor-intensive, which does not encourage increases in human capital and the level of technological sophistication. When unskilled labor-intensive companies enter a country, the need for unskilled workers will increase their average wage and decrease the average wage of highly skilled workers. The direct consequence will be a decrease in people willing to learn or become qualified since the preference for unskilled labor in the country is high. This behavior will have adverse effects on the level of human capital and, therefore, on the level of technological sophistication of the country. The results highlight that when African countries reach a certain level of gross enrollment ratio in tertiary education[52], FDIs from China start to have positive spillover effects on the level of technological sophistication of the host country.

The results are different when focusing on imports. Indeed, imports of intermediate goods from China positively affect technological sophistication (Table A 6.8). Countries import intermediate goods in their production process as inputs to produce final products or other intermediate goods exported or used domestically. Over the years, China increased its production of high-tech intermediate goods; therefore, imports of intermediate goods by African countries from China help them improve the level of technological sophistication of their exports through learning effects.

6.6.4. Quality of institutions as the threshold variable

We used four measures of the quality of institutions, namely "government effectiveness," "political stability," "rule of law," and "control of corruption." The interaction between China and African countries through GVCs led to a technological transfer after a certain threshold of government effectiveness (Table A 6.9 and Figure A 6.3). In the literature on technology transfer, institutional quality is said to be a key determinant of technological transfer. Indeed, in regime 1, FDIs and imports of intermediates from China have negative and significant effects on the TSI of African countries; however, after a certain threshold of government effectiveness, the coefficients in front of FDIs from China and intermediates good imports become positive. The results highlight the existence of a threshold of government effectiveness required for direct and indirect technological transfer from China to Africa.[53] Indeed, the higher the level of government effectiveness, the higher the spillover effects of Chinese FDIs and their exports of intermediates to Africa. Therefore, governments should create a better environment to take advantage of foreign technology. Political stability can also be a proxy of African countries' institutional strength, and it is a part of absorptive capacity. The stability of a state is a

[52] This threshold of gross enrolment ratio in tertiary school is 3,72%, which seems to be very low compared to the panel fixed effect model finding. However, this threshold has been obtained using a sample of countries with low gross enrolment ratio. Therefore, the value of 3,72 is not so important. The importance is the presence of the threshold and the change sign between the two regimes.

[53] With the threshold of government effectiveness = -0,71 and GE $\in [-2.45\ ,\ 2.44]$ for all the countries

prerequisite for its technological upgrade. The results of the PTSR indicate the existence of a threshold[54] of political stability, below which (regime 1) Chinese FDIs have a negative impact on African countries' TSI. However, in regime 2, the coefficient in front of Chinese FDIs is positive but nonsignificant, whereas the coefficient in front of imports of intermediates is positive and significant (Table A 6.10 and Figure A 6.2). Using the "rule of law" as a threshold variable provides the same results. Chinese FDIs in both regimes 1 and 2are nonsignificant[55], whereas the import of intermediate goods is significant and positive in regime 2 (Table A 6.11 and Figure A 6.1). Control of corruption is also a key variable that measures the quality of institutions; therefore, it can also be considered a proxy of absorptive capacity. Using control of corruption as a threshold variable, regime 1 shows a negative and significant effect of both FDIs and imports of intermediates on the level of technological sophistication. In regime two, the effect becomes positive and significant[56] (Table A 6.12 and Figure A 6.4). These results reconcile both parties of literature and demonstrate that both negative and positive effects depend on the level of the host country's absorptive capacity.

6.7. Conclusion and recommendations

This chapter investigated the question of the Chinese presence in Africa over the past 20 years, focusing on its effect on the level of technological sophistication of African countries' exports (technology transfer from China to African countries). The relations between China and African countries have increased in recent years. Using panel data of 49 countries from 1995 to 2015, the empirical findings suggest that African countries' absorptive capacity conditions direct technology transfer. In other words, Chinese FDIs do not positively impact the level of technological sophistication of African countries, except those that are well endowed with human capital and strong institutions. Depth analysis using the PSTR model revealed the existence of a threshold of absorptive capacity of African countries (human capital level and institutional concerns) above which direct technology transfer (FDIs) through GVCs is effective. Moreover, the results reveal the existence of indirect technology transfer (through imports of intermediate goods from China).

This chapter is innovative and contributes a lot to the existing literature. The innovation lies in creating a new value-added exports sophistication index approach that allows measuring domestic technology created and exported. This new approach of sophistication index based on forefathers' methods with an integration of the principle of GVCs, removes double counting and makes sure that export sophistication does not include foreign technology. Future studies that aim to use export sophistication indexes to

[54] Threshold of political stability = -0,24 and PS $\in [-3.31\ ,\ 1.96]$ for all the countries
[55] Threshold of rule of law = -0,80 and RL $\in [-2.06\ ,\ 2.10]$ for all the countries
[56] Threshold of control of corruption = -0,91 with CC $\in [-1{,}868714{,}2{,}469991]$ for all the countries

measure technology at a country level should refer to domestic value-added export instead of gross exports. Otherwise, the results would be misleading.

In terms of policy, while it is clear from studies that African countries should first redefine their cooperation with China to attract more diversified FDIs, policymakers should also spend time understanding how African countries can benefit from partnerships. The results of the current chapter suggest that African countries should work to improve their absorptive capacity because it matters — from the beginning to the end — in international relations. Better institutions will ensure upstream that FDIs are growth and development-friendly and favor efficient contract enforcement. Moreover, the level of human capital is crucial for technology upgrading through GVCs. Therefore, policymakers should invest more in tertiary education by offering a wide range of education and training programs if they want to take advantage of future FDIs inflows. Regardless of the relations between China and African countries, the following question remains: Can the competition in capturing market shares between China and Western countries help African countries improve their export sophistication?

Appendix: Fixed effects and PSTR Results (tables and figures)

Table A 6.1: Correspondence between EORA codes data and ISICRev3 codes

Sector Name	Code	ISICRev3
Agriculture	1	1, 2
Fishing	2	5
Mining and Quarrying	3	10, 11, 12, 13, 14
Food & Beverages	4	15, 16
Textiles and Wearing Apparel	5	17, 18, 19
Wood and Paper	6	20, 21, 22
Petroleum, Chemical and Non-Metallic Mineral Products	7	23, 24, 25, 26
Metal Products	8	27, 28
Electrical and Machinery	9	29, 30, 31, 32, 33
Transport Equipment	10	34, 35
Other Manufacturing	11	36
Recycling	12	37
Electricity, Gas and Water	13	40, 41
Construction	14	45
Maintenance and Repair	15	50
Wholesale Trade	16	51
Retail Trade	17	52
Hotels and Restaurants	18	55
Transport	19	60, 61, 62, 63
Post and Telecommunications	20	64
Financial Intermediation and Business Activities	21	65, 66, 67, 70, 71, 72, 73, 74
Public Administration	22	75
Education, Health and Other Services	23	80, 85, 90, 91, 92, 93
Private Households	24	95
Others	25	99
Re-export & Re-import	26	NA

Source : Lenzen et al. (2013) correspondence EORA data and ISIC Rev 3

Table A 6.2: Correspondence between MRIO EORA classification, ISICRev3 and the level of technological sophistication

Code	ISICRev3	Technological Sophistication Code	Manufacturing Technology Level
1	1, 2	0	Primary sector and services
2	5	0	Primary sector and services
3	10, 11, 12, 13, 14	0	Primary sector and services
4	15, 16	1	Low technology
5	17, 18, 19	1	Low technology
6	20, 21, 22	1	Low technology
7	23, 24, 25, 26	2	Medium-low technology
8	27, 28	2	Medium-low technology
9	29, 30, 31, 32, 33	4	High technology
10	34, 35	3	Medium-high technology
11	36	1	Low technology
12	37	1	Low technology
13	40, 41	0	Primary sector and services
14	45	0	Primary sector and services
15	50	0	Primary sector and services
16	51	0	Primary sector and services
17	52	0	Primary sector and services
18	55	0	Primary sector and services
19	60, 61, 62, 63	0	Primary sector and services
20	64	0	Primary sector and services
21	65, 66, 67, 70, 71, 72, 73, 74	0	Primary sector and services
22	75	0	Primary sector and services
23	80, 85, 90, 91, 92, 93	0	Primary sector and services
24	95	0	Primary sector and services
25	99	0	Primary sector and services
26	NA	0	Primary sector and services

Source: Author's organization based OECD, (2011) and OECD, (2003)

Table A 6.3: Results of estimates using one period lag of intermediates good imports from China

VARIABLES	(1)	(2)	(4)
$FDI\ CHN_t$	-0.00174***		-0.00185***
	(0.000486)		(0.000529)
$Log\ HK_t \times FDI\ CHN_t$	0.000582***		0.000541***
	(0.000172)		(0.000178)
$Log\ Imports\ CHN_{t-1}$		0.230***	0.272***
		(0.0613)	(0.0910)
$Log\ HK_t \times$ Log Imports CHN_{t-1}		-0.00513	0.0412***
		(0.00772)	(0.0132)
$Log\ Labor_t$	-0.00497	-0.00763	-0.00850
	(0.00768)	(0.00475)	(0.00763)
$Log\ Capital_t$	0.141	0.106	0.235**
	(0.0996)	(0.0659)	(0.103)
$Log\ HK_t$	0.0184	0.0456	-0.341**
	(0.0583)	(0.0773)	(0.131)
Constant	9.083***	7.340***	6.781***
	(0.562)	(0.613)	(1.095)
Observations	298	444	283
R-squared	0.115	0.172	0.212
Number of id	41	42	39
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Table A 6.4: Results of estimates with FDIs and imports from the Rest of the World

VARIABLES	(1)	(2)	(4)
$FDI\ CHN_t$	-0.00172**		-0.00180***
	(0.000650)		(0.000636)
$FDI\ RW_t$	-6.21e-06		-5.46e-06
	(1.25e-05)		(1.18e-05)
$Log\ HK_t \times FDI\ CHN_t$	0.000573**		0.000586***
	(0.000215)		(0.000194)
Δ (Log Imports CHN_t)		0.226	0.361**
		(0.208)	(0.144)
Δ (Log Imports RW_t)		0.0176	6.616
		(6.693)	(5.598)
$Log\ Capital_t$	0.143	0.0930	0.176
	(0.188)	(0.153)	(0.211)
$Log\ HK_t$	0.0236	0.00842	0.0335
	(0.0649)	(0.0509)	(0.0662)
Constant	9.559***	10.64***	9.816***
	(2.160)	(1.555)	(2.130)
Observations	298	444	283
R-squared	0.115	0.148	0.153
Number of id	41	42	39
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Table A 6.5: Wald tests (LM)

Hypothesis on the Number of Thresholds using Wald Tests (LM)	Threshold Variables				
	Human Capital	Government Effectiveness	Political Stability	Rule of Law	Control of Corruption
H0: r=0 vs H1: r=1	47,437 ***	19,077 ***	13,616**	6,035***	12,066**
H0: r=1 vs H1: r=2	2,807	4,219	6,228	11,897**	1,758
H0: r=2 vs H1: r=3	NA	NA	NA	NA	NA

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

Table A 6.6: Fisher tests (LMF)

Hypothesis on the Number of Thresholds using F-Tests (LMF)	Threshold Variables				
	Human Capital	Government Effectiveness	Political Stability	Rule of Law	Control of Corruption
H0: r=0 vs H1: r=1	10,601***	3,722 ***	2,145 **	3,082**	2,275**
H0: r=1 vs H1: r=2	0,49	0,728	0,889	2,128*	0,3
H0: r=2 vs H1: r=3	NA	NA	NA	NA	NA

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

Table A 6.7: Pseudo LRT

Hypothesis on the Number of Thresholds using LRT Tests (LRT)	Threshold Variables				
	Human Capital	Government Effectiveness	Political Stability	Rule of Law	Control of Corruption
H0: r=0 vs H1: r=1	52,674***	19,951 ***	14,054 **	16,646***	12,408**
H0: r=1 vs H1: r=2	2,823	4,260	6,318	12,229**	1,765
H0: r=2 vs H1: r=3	NA	NA	NA	NA	NA

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

Table A 6.8: PSTR results — Threshold variable is human capital

Threshold variable: log of Human Capital		
	Coefficient Estimate	
	Regime 1	Regime 2
FDIs	-0,0023***	0,0022***
	-0,0005	-0,0005
log Imports of Intermediates	0,1168***	-0,1540***
	-0,0337	-0,026
Labor	-0,0128**	0,0147***
	-0,006	-0,0025
Capital	0,0519	0,2024***
	-0,0891	-0,0381
Log Exports of Intermediates	0,0197*	-0,0268**
	-0,0125	-0,0128
Transition Functions		
	Estimated Transition Parameter	
Slope parameters (γ)	6,8940	
Threshold (c)	1,3133	

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

Table A 6.9:PSTR results — Threshold variable is government effectiveness index

Threshold variable: Government Effectiveness Index		
	Coefficient Estimate	
	Regime 1	Regime 2
FDIs	-0,0027***	0,0025**
	-0,0011	-0,0011
log Imports of Intermediates	-0,0573*	0,1455***
	-0,0374	-0,0287
labor	0,0100**	-0,0154***
	-0,0057	-0,0025
Capital	0,2621***	-0,1331***
	-0,1026	-0,0711
Log Exports of Intermediates	0,0006	-0,0031
	-0,0063	-0,0075
Transition Functions		
	Estimated Transition Parameter	
Slope parameters (γ)	10,7052	
Threshold (c)	-0,7129	

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

Table A 6.10: PSTR results — Threshold variable is political stability and absence of violence

Threshold variable: Political Stability and Absence of Violence		
	Coefficient Estimate	
	Regime 1	Regime 2
FDIs	-0,0004	0,0002
	-0,0003	-0,0004
log Imports of Intermediates	0,0273	0,1950***
	-0,0349	-0,0416
labor	0,0094*	-0,0131***
	-0,006	-0,0031
Capital	0,4207***	-0,3447***
	-0,1012	-0,0637
Log Exports of Intermediates	0,0016	-0,002
	-0,0064	-0,0085
Transition Functions		
	Estimated Transition Parameter	
Slope parameters (γ)	29,1382	
Threshold (c)	-0,2445	

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

Table A 6.11: PSTR results — Threshold variable is rule of law

Threshold variable: Rule of Law		
	Coefficient Estimate	
	Regime 1	Regime 2
FDIs	-0,000	-0,0004
	-0,0006	-0,0007
log Imports of Intermediates	-0,0342	0,0948***
	-0,034	-0,0236
labor	0,0079*	-0,0066***
	-0,006	-0,0018
Capital	0,2554***	-0,1451***
	-0,0861	-0,0446
Log Exports of Intermediates	-0,0053	0,0086
	-0,0072	-0,0088
Transition Functions		
	Estimated Transition Parameter	
Slope parameters (γ)	1,1693e+03	
Threshold (c)	-0,7956	

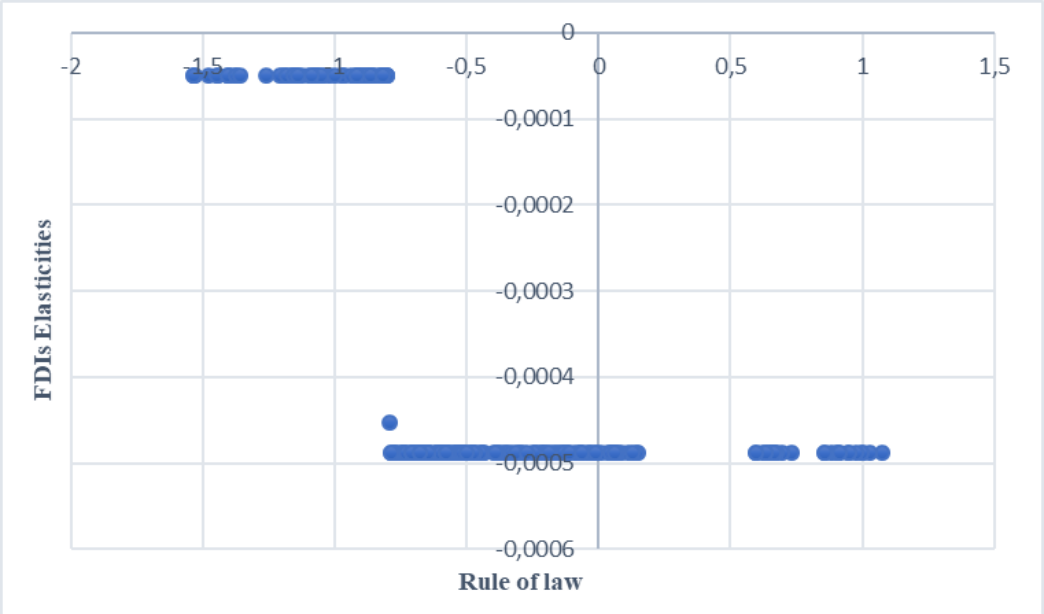
*** p<0.01, ** p<0.05, * p<0.1

Table A 6.12:PSTR results — Threshold variable is control of corruption

Threshold variable: Control of Corruption		
	Coefficient Estimate	
	Regime 1	Regime 2
FDIs	-0,0028**	0,0026**
	-0,0014	-0,0014
log Imports of Intermediates	-0,1190**	0,2192***
	-0,0687	-0,0765
labor	0,0235***	-0,0266***
	-0,0098	-0,0088
Capital	0,1559	-0,103
	-0,125	-0,1449
Log Exports of Intermediates	-0,0011	-0,0043
	-0,0076	-0,0105
Transition Functions		
	Estimated Transition Parameter	
Slope parameters (γ)	5,0221	
Threshold (c)	-0,9071	

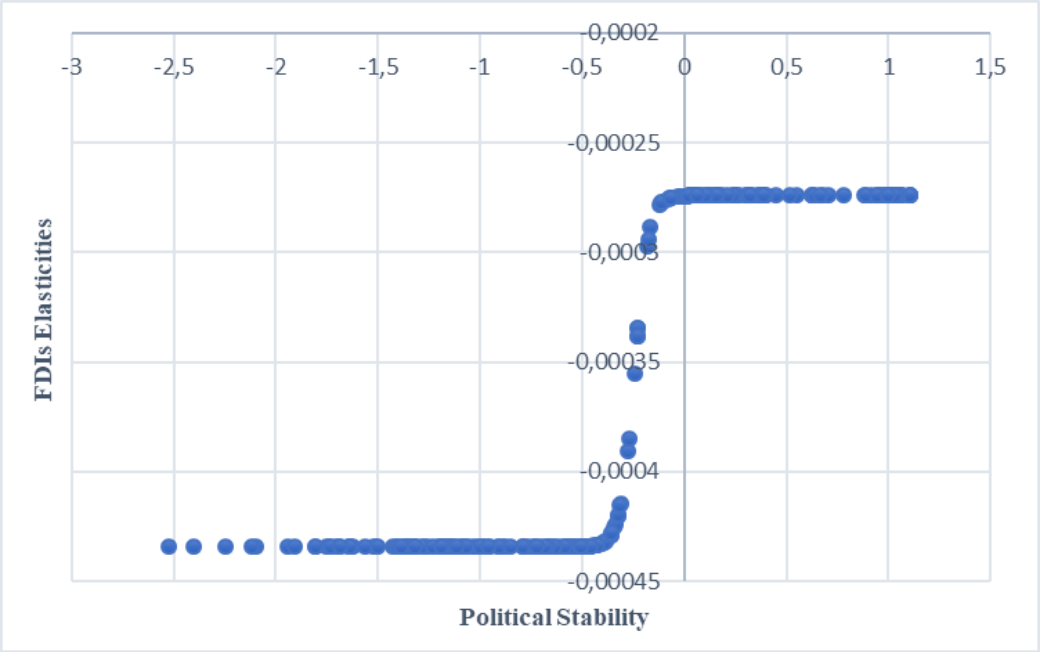
*** p<0.01, ** p<0.05, * p<0.1

Figure A 6.1: Transition function when the threshold variable is rule of law



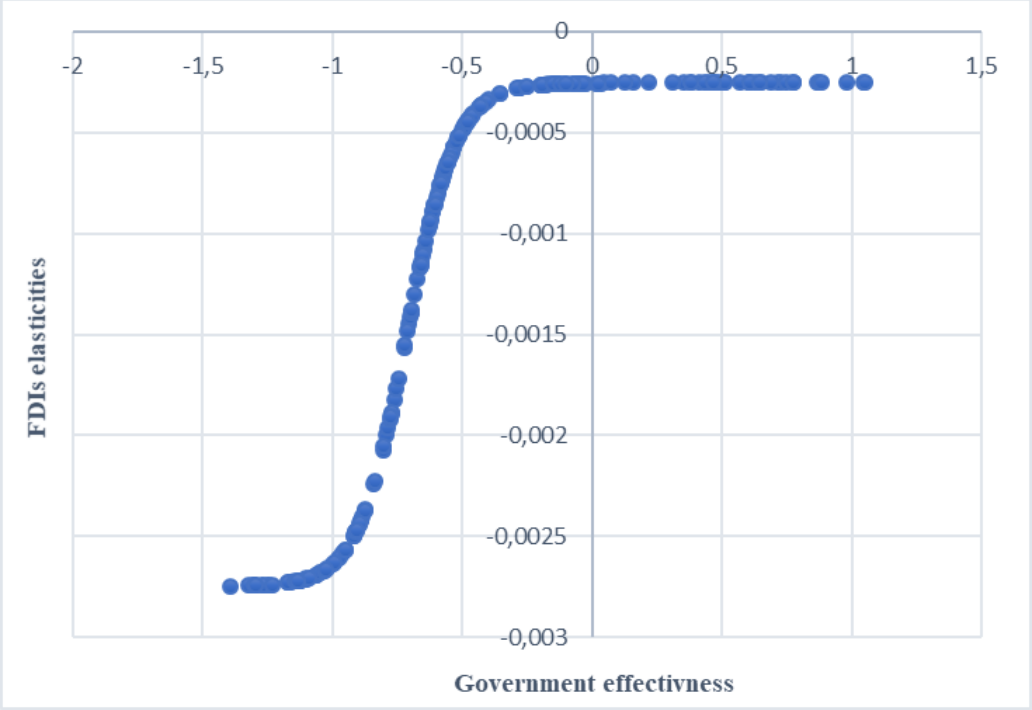
Source: Author's calculation based on estimations' results

Figure A 6.2: Transition function when the threshold variable is political stability



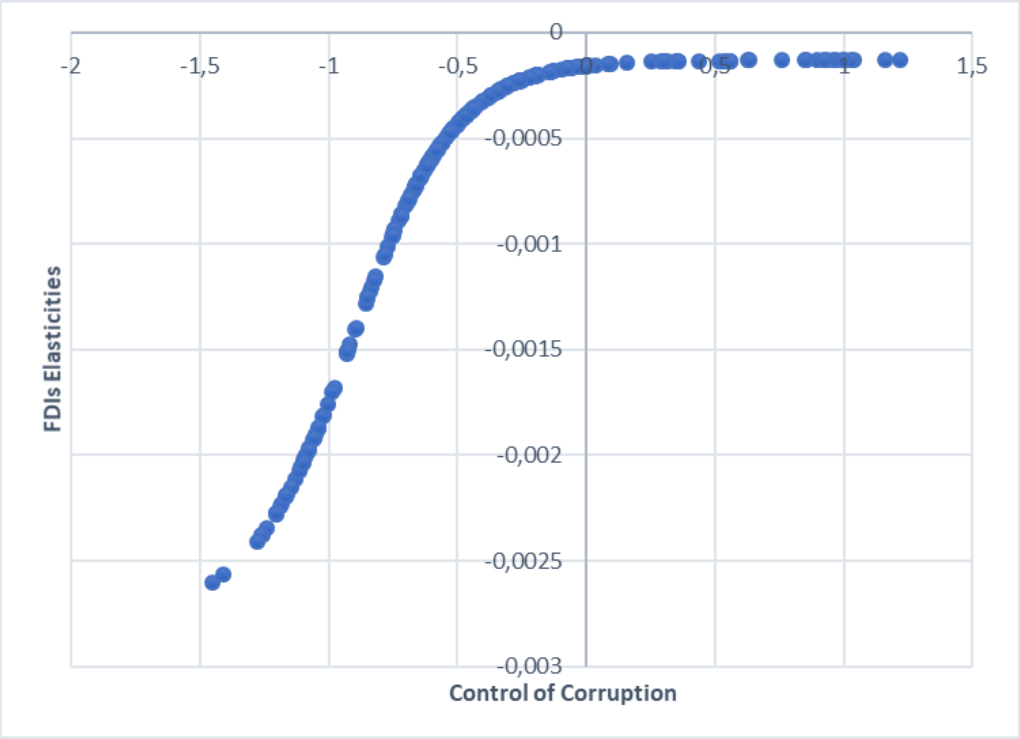
Source: Author's calculation based on estimations' results

Figure A 6.3: Transition function when the threshold variable is government effectiveness



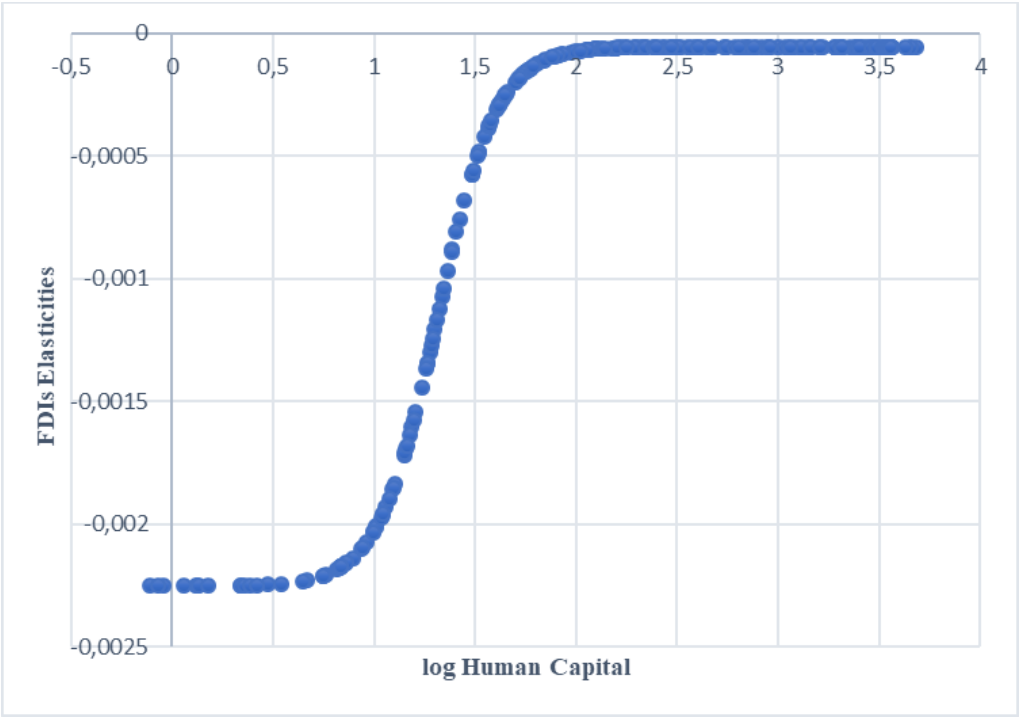
Source: Author's calculation based on estimations' results

Figure A 6.4: Transition function when the threshold variable is control of corruption



Source: Author's calculation based on estimations' results

Figure A 6.5: Transition function when the threshold variable is human capital



Source: Author's calculation based on estimations' results

Chapter 7. Global Value Chains, Economic Growth, and Income Inequality: Evidence from Africa

7.1. Introduction

There is wide recognition that international trade increasingly involves separating the production of a final good between firms and/or plants of a firm in several countries, with each of them focusing on their comparative advantage based on efficiency in tasks (WTO-IDE, 2011). GVCs have been shown to induce structural change and transform the nature of production (Lim & Kim, 2021), and represent an emerging opportunity in recent years in not only connecting countries but also raising their competitiveness in world trade (Allard et al., 2016; WTO, 2014). GVCs allow countries to benefit from the comparative advantages of other countries both at the sectoral and production stages within the sectors. GVCs have been shown to induce technological progress (Nana, 2021; S. Wang et al., 2021), increase firm and country level productivity (Amiti & Konings, 2007; Pahl & Timmer, 2020), generate rising markups (De Loecker et al., 2016), and lead to growth and structural transformation (Goldberg et al., 2010, p. 201; Lim, 2021; Sampson, 2016). These changes have led to increasing income streams (Van den Broeck et al., 2017) with implications for economic welfare and development (Dünhaupt & Herr, 2021; Pahl & Timmer, 2020). GVCs have also been associated with increasing employment shares and job creation effects (Banga, 2016; Farole, 2016; Lim & Kim, 2021) that resulted in significant labour market implications (E. Lee & Yi, 2018).

Although it is argued that GVCs have the potential to increase incomes, they could generate differential effects along the distribution of income, which could lead to income inequality if the effects are regressive. However, less is known or at best has not been documented about such deviations along the distribution of income. Despite this, evidence from production fragmentation points to the fact that there exists a relationship between GVCs participation and income inequality, and GVCs could even lead to more pronounced distribution of wage incomes within countries (Antràs, 2020; W. Wang et al., 2021). This relationship is akin to and evokes insights from some theorems in traditional and modern international trade that trade integration could lead to wage inequality (Goldberg & Pavcnik, 2007; Helpman et al., 2017). Following this, GVCs may increase income inequality in less developed countries, although the relationship could also be negative since it is expected that income gains from GVCs are likely to trickle down to everyone and reduce inequality (Carpa & Martínez-Zarzoso, 2022; Van den Broeck et al., 2017).

This chapter investigates the relationship between GVCs participation and position on economic growth and income inequality in two steps. First, it identifies and track the evolution of various country participation and position in GVCs as well as identify patterns of specialization. Second, it investigates

the relationship between GVCs participation (conditioned by the type of specialization) and position on economic and welfare outcomes (economic growth and income inequality). In doing so, it identifies segments of GVCs that match or contribute better to economic growth and income inequality. The chapter uses a novel constructed panel of 48 countries over a period of 27 years (1990-2016) and employs different empirical strategies such as a panel fixed effect estimator and an instrumental variable estimator with the specification of theory led and innovative instruments to reduce potential concerns about endogeneity. It also examines the response of GDP per capita to an increase in the level of GVCs participation using the local projections approach.

The findings suggest that GVCs participation and position are associated with increasing GDP among African countries. GVCs also exhibit a positive association with income inequality, implying that GVCs have the potential to increase income inequality. This is an important finding given the interests of many governments and development organizations to both create wealth and reduce inequality. Deep diving into the relationship between GVCs and GDP per capita, find evidence that this relationship may be driven by trade in knowledge-intensive goods and services. The chapter also provide suggestive evidence that forward GVCs participation is more effective than backward GVCs participation in driving economic growth and income inequality. The findings are robust to various variable transformations and alternative measures of income inequality. This study offers three novel contributions to the empirical literature on GVCs. First, the chapter tracks and provides evidence on the evolution of African countries' along GVCs as well as their specialization patterns. Empirical literature has mostly focused on developed countries and emerging markets. GVCs offer many African countries that have long been excluded from the industrialization game, unique opportunities to specialize in different stages of the production focus, allowing them to participate in the production of complex products (AfDB et al., 2014; Inomata & Taglioni, 2019; Sommer et al., 2017). Second, the chapter adds empirical evidence on the importance of GVCs by going beyond economic growth to establish the relationship with income inequality. Empirical evidence on this relationship between GVCs participation and position is scarce in the literature. One exception is Carpa & Martínez-Zarzoso (2022) who examined the relationship between GVCs and income inequality, establishing a positive association between offshoring and income inequality in the short run which vanishes in the long run. However, their analysis mainly considers developed and advanced countries in Europe with a smaller number of observations which limits external validity. The chapter therefore builds on this, adding evidence on this relationship in the context of Africa, given the heavy involvement of African countries in GVCs. Like Carpa & Martínez-Zarzoso (2022) highlighted, the effect of GVCs participation on income inequality may be different for least developed countries which make the bulk of our sample. Finally, while GVCs create opportunities for developing countries to industrialize, African countries remain at the bottom of the chain, mostly specializing in resource-based activities with little possibilities to upgrade the chains (Foster-McGregor et al., 2015; Owusu, 2021). The chapter uncovers what could be driving the

relationship between GVCs and economic growth. It shows that trade in knowledge intensive goods and services could be playing a role here. In this regard, the analysis provides an improved understanding pertaining to GVCs which may be relevant in stirring economic development in Africa. In the face of growing inequality and poverty in many developing nations, the study provides some entry and leveraging points for policy in a bid to reduce inequality and poverty, boost shared prosperity and fast-track economic development in Africa.

The rest of the chapter is organized as follow. Section 7.2 describes the data and the data sources. It also offers some description of the variables used in the regression models. Section 7.3 establishes some stylized facts, discussing some of the descriptive results on the evolution and position of GVCs among African countries. The empirical strategy for establishing the relationship between GVC, growth and income inequality is then presented in section 7.4. The results are discussed in section 7.5 with the robustness checks and the article concludes in section 7.6.

7.2. Empirical Application

7.2.1. Data

This study is based on a constructed panel data from 48 African countries from 1990-2016. This panel was constructed based on different datasets and databases. To construct the outcomes of interest, the chapter uses two different sources. For GDP per capita, it collates information from the World Bank World Development Indicators (WDI) databank. For income inequality, it relies on the World Income Inequality Database (WIID)[57] hosted by the United Nations University World Institute for Development Economics Research (UNU-WIDER) to get data on income inequality. This database has widely been used to characterize and describe inequality trends at both country and global levels. The measure of GVCs follows the method used in Chapter 1, section 1.2 with additional sectoral assessment. Information on other controls used in the regression framework was obtained from different sources like the WDI and the International Monetary Fund (IMF). Some of these variables include private and public investment, capital formation, human capital, measured through school enrollment ratio, population, natural resource rent and democracy and institutions.

7.2.2. Measurement of key outcomes

The chapter uses two different variables as outcomes for the study: GDP per capita, and income inequality. GDP per capita measures the market value of all goods and services produced within a county divided by its total population. It is reported in constant US $. GDP per capita is gross domestic product divided by mid-year population. For our second outcome, income inequality, the chapter uses the Gini[58]

[57] The WIID uses a multiple imputation model to compute missing observations, which is criticized by some authors such as Jenkins (2015).

[58] Several measures have so far been used to capture income inequality with the Gini coefficient being the most widely used in the literature.

coefficient. The Gini coefficient is based on the Lorenz curve, which is a representation of the distribution of income in a population. It plots quantiles/share of the population against cumulative income of individuals below or at that quantile (Deininger & Squire, 1996). The Gini coefficient is highly reported in many official sources and is usually based on primary data. Missing country-year observations are obtained through interpolation of adjacent survey years, or extrapolation of the initial or ending survey-year observations. In a few cases, the income distribution was imputed based on the population-weighted average prevailing in the same country, region, and income group. Gini indices usually range from 0 to 100 indicating increasing levels of inequality. While a value of 0 represents perfect equality, a value of 100 represents perfect inequality. Beyond the Gini index, the chapter also uses the income shares by quantile (S. Chen et al., 1994). The data for the Gini indices and income share quantiles for each year and each country was obtained from the World Income Inequality Database (WIID).[59]

7.2.3. Measurement of GVC integration

To compute GVC participation indices, the current study used world input output (IO) tables from EORA Multi-Region Input-Output Tables (MRIOs), following the export decomposition framework of Koopman et al. (2014). This framework allows to track the evolution of African countries integration into GVCs by country/sector. The methodology goes from raw Input Output (IO) tables (see Table A 1.1— Chapter 1) to sophisticated indexes obtained through decomposition of gross exports. One objective of the study is to delve deep in identifying the GVCs participation at the sectoral level. The chapter uses available input output table to compute GVCs participation indices (see more details in Chapter 1). Sectors are aggregated following different archetypes of GVCs (Table 7.1 and Table A 7.4).

Table 7.1: Different GVCs archetypes

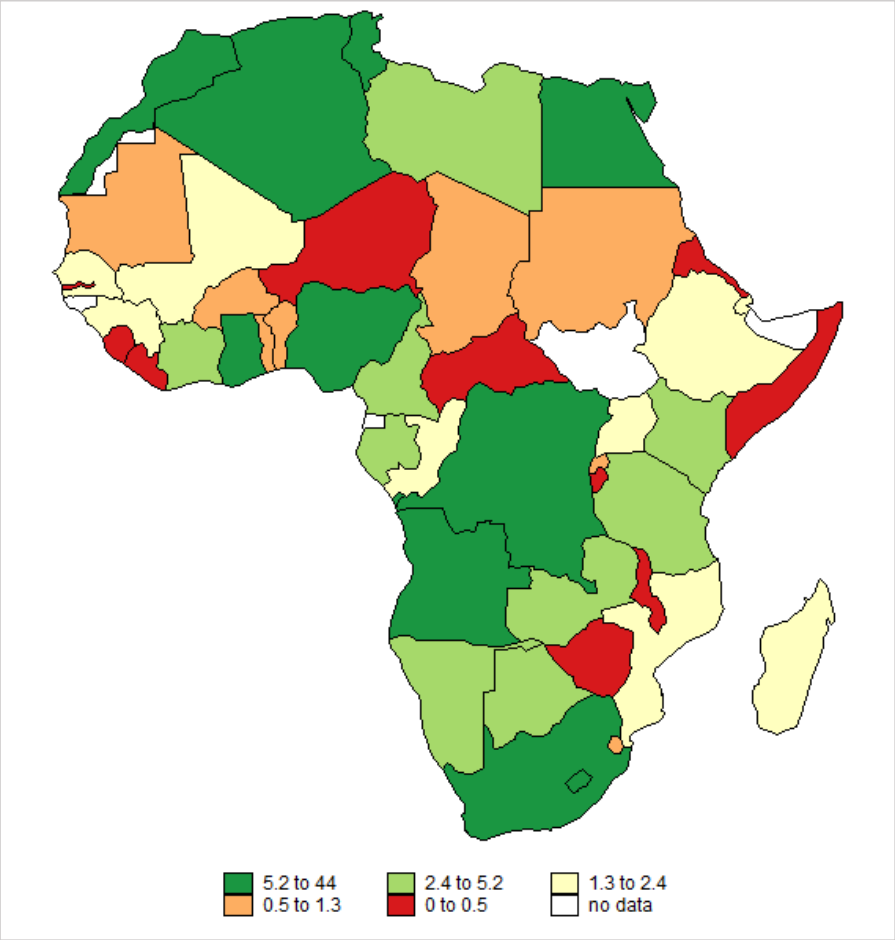
GVC archetypes
Commodities (Com)
Labor-intensive goods (LIG)
Labor-intensive services (LIS)
Regional processing (RP)
Knowledge-intensive goods (KIG)
Knowledge-intensive services (KIS)
Others

[59] The WIID uses a multiple imputation model to compute missing observations, which is criticized by some authors such as Jenkins (2015).

7.3. Stylized facts on evolution of GVCs in Africa – Trend and drivers

There exists anecdotal evidence that shows that most of Africa is heavily involved in GVCs, though with significant heterogeneity across countries (Foster-McGregor et al., 2015). As shown in Figure 7.1, countries in the North (Algeria, Morocco, Egypt) and South (South Africa, Lesotho, Angola) of Africa are the most engaged countries in GVCs. South Africa has the highest GVCs participation. Other highly engaged countries are Nigeria, Democratic Republic of Congo and Ghana. Countries participate differently in GVCs along different sectoral lines. As shown in Figure A 7.5, countries specialize in different sectors[60] and segments of production and broadly participate in GVCs based on their comparative advantage.

Figure 7.1: GVCs participation level in Africa in 2016 ($US Million)

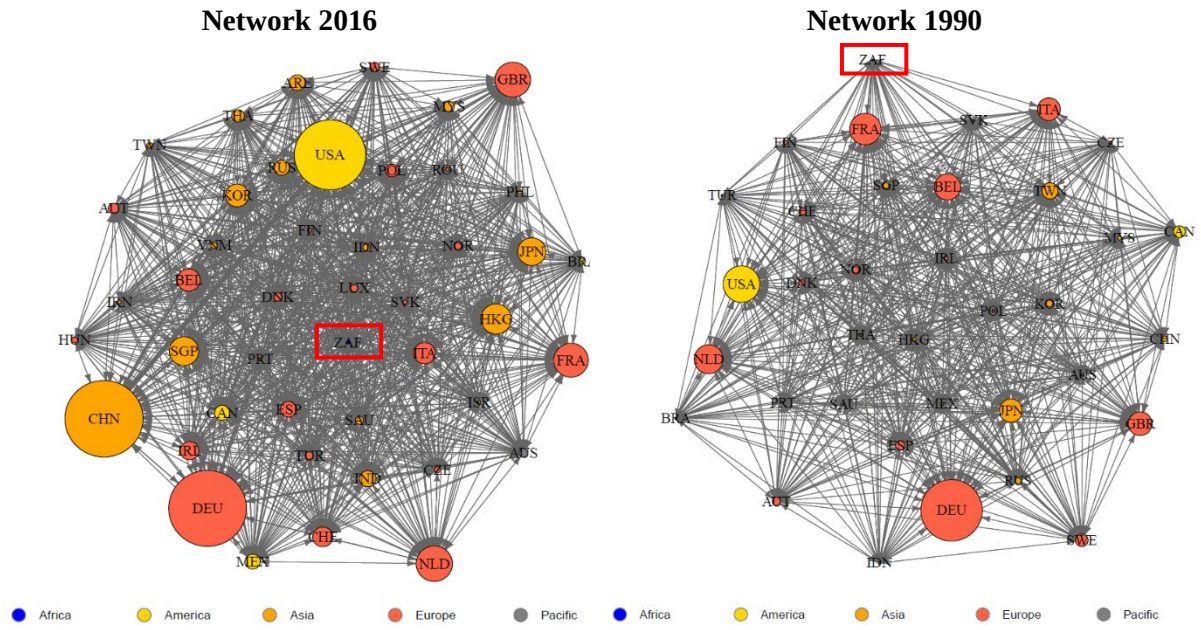


Source: Authors' calculations based on EORA MRIO input output databases

[60] Sectors can be classified in several broad GVCs components, focusing on their tradability (labor intensity and knowledge intensity). These components include commodities, regional processing, labor-intensive goods, knowledge-intensive goods, labor-intensive services and knowledge-intensive services (Qiang et al., 2021). Commodities exporters are most located in Sub-Saharan Africa and the Middle East, with few countries in Latin America and Asia. However, regional processing countries are mostly located in South America and Eastern Europe. Labor-intensive goods are produced around the world, involving countries such as Bangladesh, Pakistan, Turkey, Honduras and the Dominican Republic. Several countries from North America, Western Europe and East Asian and Pacific regions are involved in knowledge-intensive goods. African, Caribbean, and Pacific countries are involved in labor-intensive services. Knowledge intensive services, usually only next to knowledge-intensive goods are GVCs segments that are located in many advanced countries such as the United States, Singapore and the United Kingdom.

While countries like China have shown a phenomenal growth in GVCs participation between 1990 and 2016 as shown in the directed networks in Figure 7.2, African countries cannot be seen on the nodes due to their low level of participation. South Africa is an exception here as can be captured in the red boxes. However, its participation is relatively small compared to other hub countries (in terms of trade links/values) in the GVCs network.

Figure 7.2: Global value chains and value-added exported network – world



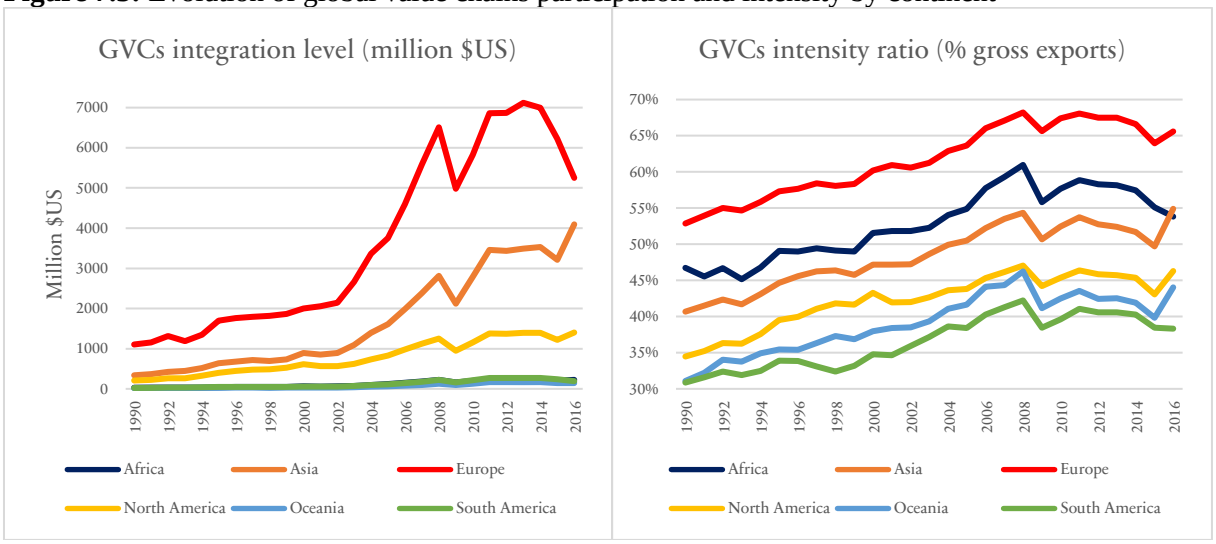
Source: Authors' calculations based on EORA MRIO input output tables 1990 - 2016.

Note: These two graphs are directed networks. The size of each node represents the level of global val ue chain integration in $US and the thickness of the links represents value added exported. For networ k 2016, node sizes represent GVCs / $US 30 million and edge width based on bilateral value-added ex ports (Value added exports / $US 100 million). For network 1990 node sizes represent GVCs in $US m illion while edge width based on bilateral value added exported (Value added exports / $US 100 millio n). Only bilateral links worth at least US$ 43 million are included in network 2016 ($US 7 million for n etwork 1990). Nodes are colored by continent.

When considering GVCs intensity between 1990 and 2016, as shown in Figure 7.3, Africa is somewhat well integrated and comes after Europe and followed by Asia, North America, Oceania, and South America, respectively. However, Asia dethroned Africa in 2016 to become the second largest integrated region (In 2016 Asia GVCs intensity was 55% versus 54 for Africa). The high integration of Africa earlier on in the 90s could be due to the high domestic value-added exports, which also demonstrates the place of Africa as a commodity supplier in the world. However, this metric on GVCs intensity can

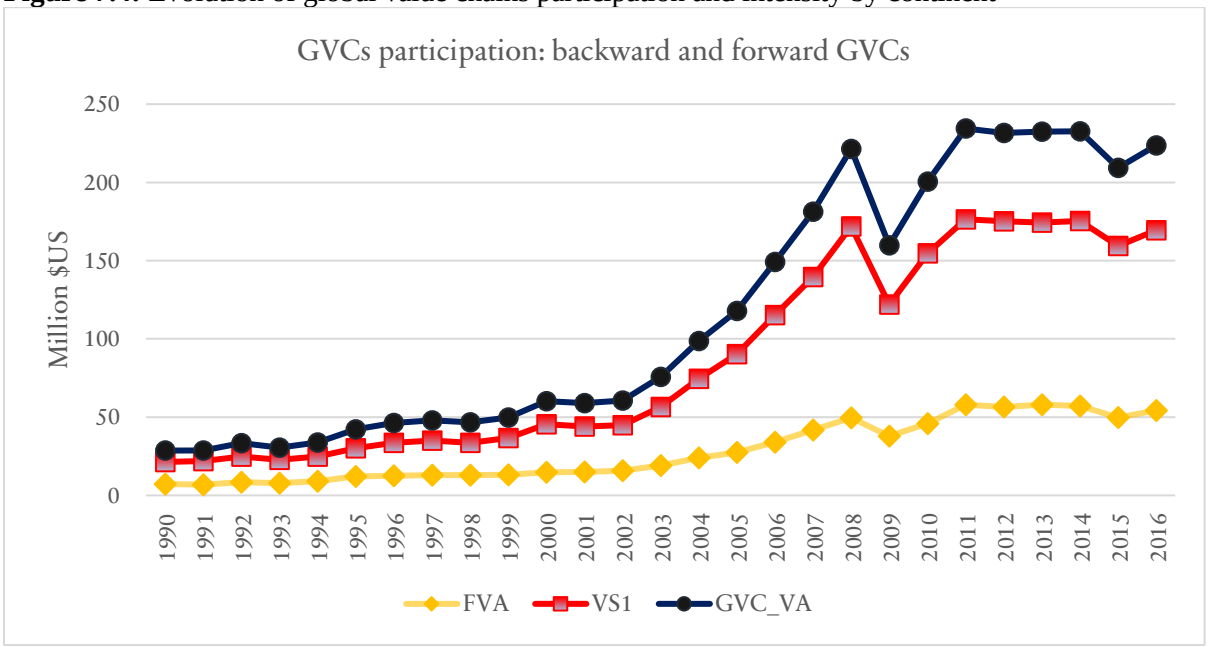
be misleading since it gives the impression that GVCs participation in Africa is very high. Thus, absolute GVCs participation in terms of value added is appropriate.

Figure 7.3: Evolution of global value chains participation and intensity by continent



Source: Authors' computation based on EORA MRIO input output databases

Figure 7.4: Evolution of global value chains participation and intensity by continent



Source: Authors' computation based on EORA MRIO input output databases

Note: FVA represents foreign value added embodied in exports; VS1 is domestic value added and GVC_VA represents GVCs participation as the sum of FVA and VS1.

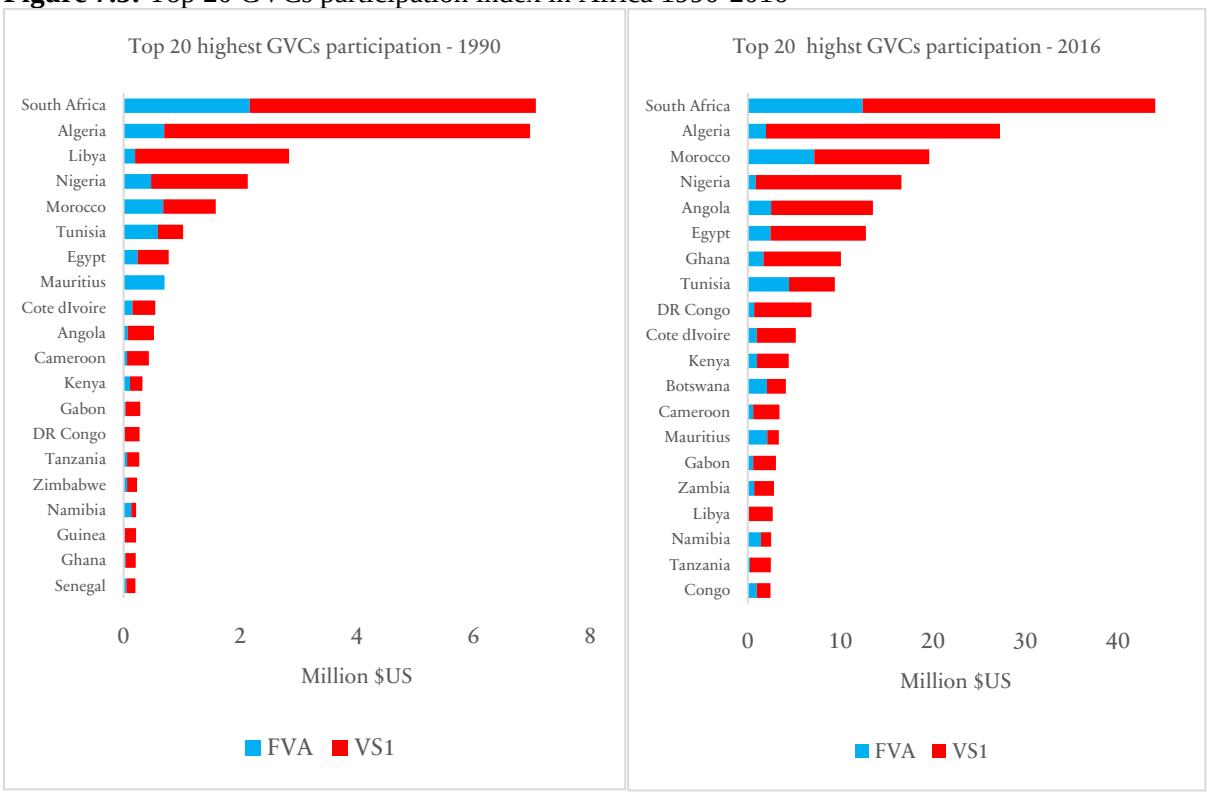
Delving deeper through a decomposition of GVCs participation, we show that forward GVCs participation is higher than backward GVCs participation (Figure 7.4). This forward participation is a sign of high commodity exports, which does not create more value-added. However, this may not be the case for industrialized countries and most integrated African countries. Forward GVCs participation is

made of domestic value added and an assessment of domestic value-added exported shows similarities between domestic value added exported by world GVCs production hubs and African countries (Figure A 7.1 and Figure A 7.4).

Like the regional rankings, the ranking of top African countries that are participating in GVCs depend on the measure considered. In 1990, Mauritius (87%), Lesotho (71%), Algeria (67%), DR Congo (59%) and Guinea (57%) had the highest GVCs intensity. This ranking changed slightly in 2016 with Libya (86%), Djibouti (83%), Guinea (81%), Algeria (80%) and Burundi (80%) being the top countries with the highest GVCs intensity (Figure A 7.2). Given that this metric does not distinguish the value-added created by various countries, countries highly involved in commodity exports with relatively lower gross exports will tend to be ranked first compared to countries that export more.

Returning to GVCs participation in value-addition, it is important to note that top African countries with the highest GVCs participation level did not change much since the 90s even though the rankings are different when using GVCs intensity (Figure 7.5). In 1990 the top 5 African countries with the highest GVCs participation level were South Africa, Algeria, Libya, Nigeria, and Morocco. In 2016, South Africa was still topping the charts with a total GVCs participation level of $US 44 million, followed by Algeria ($US 27 million). The rest of the countries that make the top 5 included Morocco ($US 20 million), Nigeria ($US 17 million) and Angola ($US 14 million).

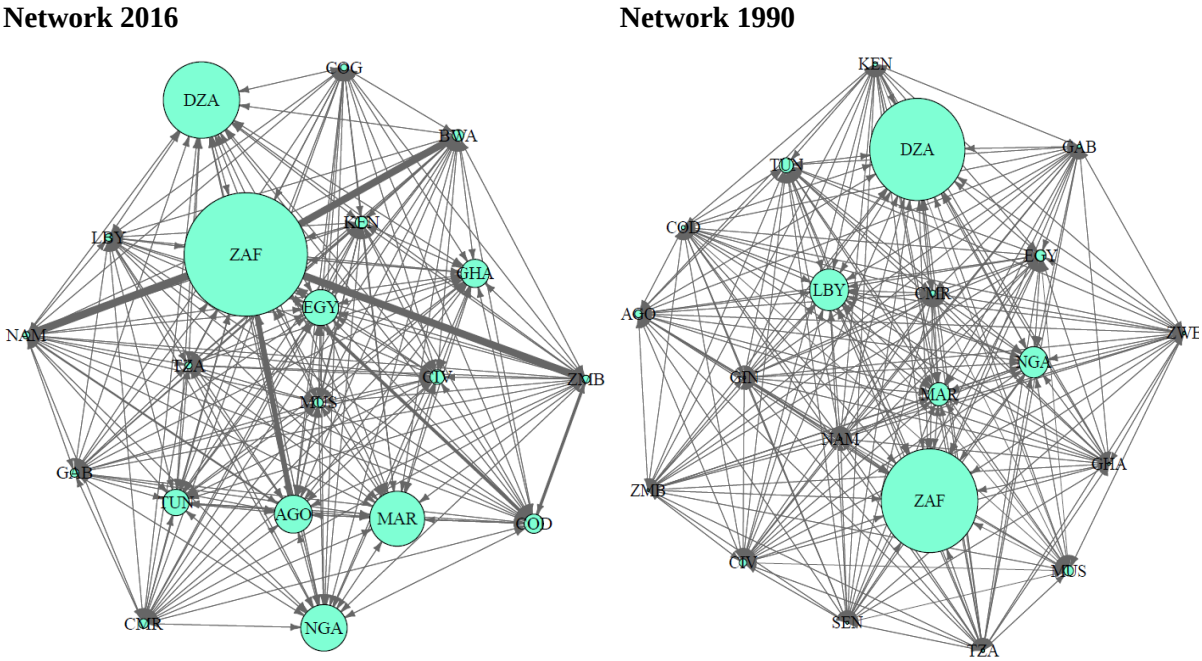
Figure 7.5: Top 20 GVCs participation index in Africa 1990-2016



Source: Authors' computation based on EORA MRIO input output databases

The dominant place of South Africa and Algeria in the African continent are evidenced by the network analysis presented in Figure 7.6. Focusing now on this intra-African network analysis we can clearly identify the biggest GVCs actors in the continent and their trade in value added links. The 2016 network shows that in terms of value-added exports, the two biggest GVCs production hubs are not actively exchanging (the thickness of the links represents value added exported). In terms of intra African trade, the biggest GVCs actor, South Africa is exchanging much more with countries in Southern Africa like Zimbabwe, Botswana, Angola, and Namibia, which just represents their geographic neighbours.

Figure 7.6: Global value chains and value-added exported network – Africa



Source: Authors' calculations based on EORA MRIO input output tables 1990 - 2016.

Notes: These two graphs are directed networks. The size of each node represents the level of global value chain integration in $US and the thickness of the links represents value added exported. For network 2016, node sizes represent GVCs / $US 100.000 and edge width based on bilateral value added exported (Value added exports / $US 500.000). For network 1990 node sizes represent GVCs / $US 500.000 while edge width based on bilateral value added exported (Value added exports / $US 500.000). Only bilateral links worth at least US$ 2 million are included in network 2016 analysis ($US 291160 for network 1990).

Decomposing this based on the various sectors, we show that the Top GVCs production hubs consist of knowledge-intensive goods and services (Figure A 7.5), while top African production hubs are driven by commodities and less sophisticated products except for a few countries. The top sectors driving GVC in South Africa are "mining and quarrying" (24% of total GVCs participation); "metal products" (16%);

"petroleum, chemical and mineral products" (11%); financial intermediation and business (10%) and electrical and machinery (7%). However, the rest of African countries with low GVCs participation do not have knowledge-intensive goods and services among their top 5 sectors driving GVCs as shown in Table A 7.1 and Table A 7.2 in the supplementary material.

7.4. Methodology and empirical model

To establish the relationship between GVCs participation and position on economic growth and income inequality, we use panel data covering 48 countries over the period 27 years (1990-2016). The empirical model is based on the linearization of an augmented production function like Mankiw et al. (1992) theoretical specification of the augmented Solow model. The empirical model is specified as:

$$\ln\left[{GDP}/{capita}\right]_{i,t} = \delta + \eta_i + \varphi_t + \alpha_1 \ln(GVCs\ participation)_{i,t} + \beta_1 \ln(Inv)_{i,t} + \beta_2 \ln(GovCons)_{i,t} + \beta_3 \ln(HK)_{i,t} + \theta Pop_{i,t} + \gamma \ln(NatRes)_{i,t} + \partial Polity4_{it} + \varepsilon_{i,t} \quad (7.1)$$

and

$$\ln[GINI]_{i,t} = \delta + \eta_i + \varphi_t + \alpha_1 \ln(GVCs\ participation)_{i,t} + \beta_1 \ln(Inv)_{i,t} + \beta_2 \ln(GovCons)_{i,t} + \beta_3 \ln(HK)_{i,t} + \theta Pop_{i,t} + \gamma \ln(NatRes)_{i,t} + \partial Polity4_{it} + \varepsilon_{i,t} \quad (7.2)$$

Where $\eta_i\ and\ \varphi_t$ represents time invariant unobserved heterogeneity and time-specific effects respectively. $\ln(Inv)_{i,t}$ represents the logarithm of investment (measured by private investment- gross fixed capital formation); $\ln(GovCons)_{i,t}$ represents government consumption; $\ln(HK)_{i,t}$ is the logarithm of human capital (measured by average year of schooling), $\ln(Pop)_{i,t}$ represents the logarithm of active population (aged between 15 and 64) ; $\ln(NatRes)_{i,t}$ is the logarithm of natural resources rents; $Polity4_{i,t}$ represents political stability and $\varepsilon_{i,t}$ represents the stochastic error term.

We include a battery of controls to improve the precision of the model. The set of control variables include private investments that have been argued to be a key determinant of growth (Balasubramanyam et al., 1996; Rasmidatta, 2011; Stiglitz & Yusuf, 2001). It is measured as gross fixed capital formation obtained from the IMF capital database. Government expenditures obtained from the World Bank WDI databases is also used as a proxy of public investment. It includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditures on national defense and security but excludes government military expenditures that are part of a government's capital formation. The data are in constant 2015 prices and expressed in U.S. dollars. Human capital, a fundamental determinant of economic growth is included as another control

variable. We proxy for human capital using the secondary school enrollment ratio[61]. The gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown.

Additionally, we include variables like population, and natural resources rent which also come from the World Bank WDI databases. Total natural resources rent is the sum of oil rent, natural gas rent, coal rent (hard and soft), mineral rent, and forest rent. Finally, we include controls for democracy and institutions which have been highlighted as crucial in the process of economic growth (e.g., Beck & Laeven, 2006; Dawson, 1998; Góes, 2016). We use the Polity2 indicator from the polity4 database[62] to get country level information on democracy and institutions. The Polity2 indicator is a revised and combined version of the Polity score indicator, which captures the authority spectrum of the political regime on a scale from -10 (hereditary monarchy) to 10 (consolidated democracy). The summary statistics of all these variables are presented in the supplementary material.

7.4.1. Estimation techniques and identification strategy

Given the linear nature of our outcomes, we estimate Equations (7.1) and (7.2) using the panel fixed effect estimator. The advantage of using the panel estimator over the random effect model lies in its flexibility to control for time invariant unobserved heterogeneity without assuming strict exogeneity between the controls and unobserved heterogeneity. For this reason, the fixed effect estimator has been used as the work horse in estimating panel linear models. Our choice of the fixed effects estimator is further supported by the Hausman test.

After controlling for time invariant unobserved heterogeneity, we may still have endogeneity concerns arising from reverse causality and measurement error. While participation in GVCs has the potential to increase GDP per capita, through better trading opportunities, GDP per capita could also enhance participation in GVCs. This implies that beyond time invariant unobservables, there may be some time variant factors affecting this relationship. To control for this and any other residual endogeneity, we rely on instrumental variable estimators with the specification of instrumental variables. Getting valid instruments is not trivial as they must be relevant and exogenous. This is even more the case in the trade led growth literature, where getting instruments exogenous to trade has been a challenge. We make use of a theory led and innovative instrument as we highlight below.

GVCs participation measures vertical specialization and therefore trade. Estimating econometrically the relationship between GVCs participation and GDP per capita like we mentioned may be biased due to

[61] The gross enrollment ratio in secondary school measures the flow of human capital. This measure can be misleading for some developing countries because they may have a low enrollment ratio for a given year, giving the impression of a lack of sufficient human capital, while they have an important stock.

[62] The Polity dataset covers all major, independent states in the global system over the period 1800-2018 (i.e., states with a total population of 500,000 or more in the most recent year; currently 167 countries).

endogeneity. Apart from unobserved heterogeneity, this may also arise from reverse causality. While GVCs participation can increase GDP per capita, economic growth can also affect the evolution of a country and trigger participation in global value chains, implying reverse causality. To reduce these endogeneity concerns, we use four instruments namely the mean of "top 5 GDP of export partners", the mean of "top 5 GDP of import partner's GDP", the mean "distance to the top 5 GVCs production hubs", and the country's "air transport freight capacity". We explain how our instruments satisfy both relevance and exogeneity conditions.

For the top 5 GDP of trade (exports and imports) partners, we argue that they are clearly relevant for GVC participation and exogeneous to domestic growth. The only way through which partners' income can impact domestic GDP is through trade[63], and GVCs trade constitutes an important share of global trade. For the distance to the top GVCs production hubs, we argue from the gravity model where bilateral distance has been shown to be a significant determinant of international trade. Countries tend to exchange more with their neighbors. On the contrary, countries that are separated from each other with a natural obstacle (landmasses or oceans) will tend to trade less or differently. Therefore, we considered the mean distance to the top 5 GVCs production hubs as an instrument, which allows us to have a distance measure in a simple specification (not a gravity model). The closer a country is to a global production hub, the more it trades. Finally, for our last instrument, the country's air transport freight capacity, we argue that shipment technology has evolved. In addition to road and sea transportation, air transport capacity has been on the increase over the years. Due to technological progress, air freight capacity has increased, allowing faster and safe trade of some products. This variable is a good determinant of trade but may only affect growth only through trade. Based on the above justifications, these instruments are both relevant since they significantly explain GVCs.

Moving to the exogeneity condition to ascertain the validity of the instruments, we begin by cautioning that there are no specific tests to confirm the exogeneity of instruments. However, we cannot think of any possible route through which the instruments may affect our outcomes except through GVCs. That said, it is important to mention that getting valid instruments in a non-experimental setting is not trivial but given that we also control for time invariant unobserved heterogeneity, our instruments may be valid, making our estimates not overly biased if at all.

7.4.2. Local projections approach

To estimate the relationship between GVCs, growth and inequality, we follow Jordà (2005) local projections techniques which can be regarded as a first robustness check. The local projections approach is an alternative to Vector Autoregressive (VAR) models, but admittedly has several advantages. Some

[63] We do not expect the trade of African partners to affect the GDP of the top five exporters, importers, and production hubs. However, this will be correlated with the trade intensity of the African countries.

of these advantages are; (1) they can be estimated with simple least squares, (2) they provide appropriate inferences that do not require asymptotic delta-method approximations nor of complex numerical techniques for their calculation, (3) they are robust to misspecification in the Data Generating Process (Jordà, 2005; Kpodar et al., 2019) and (4) they easily accommodate experimentation with highly nonlinear specifications that are often impractical or infeasible in a multivariate context. The model is presented as follows for each future period k,

$$\Delta_k Y_{i,t-1} = \propto_{i,k} + \delta_{t,k} + \theta_k \Delta\, GVCs_{i,t-1} + \sum_{j=1}^{l} \gamma_{j,k}\, \Delta Y_{i,t-j} + \sum_{j=0}^{l} \beta_{j,k} X_{i,t-j} + \varepsilon_{i,t,k} \qquad (13)$$

Where $\Delta_k Y_{i,t-1} = y_{i,t+k} - y_{i,t-1}$ and corresponds to change in GDP per capita or inequality difference from the base year $t-1$ up to year $t+k$ with k= 0,1, ...,8; $\propto_{i,k}$ and $\delta_{t,k}$ are the country and time fixed effects; $\gamma_{j,k}$ captures the persistence of the logarithm of the outcomes and $\beta_{j,k}$ capture the effect of a change in control variables. The Impulse Response Function is obtained by plotting the estimated coefficient θ_k for $k = 1, \dots, 8$.

7.5. Estimation results and discussion

7.5.1. Global value chains and growth

Table *7.2* shows the relationship between GVCs, and growth measured as GDP per capita. We estimate different specifications using both the fixed effects estimator and the instrumental variable (IV) estimator. In the first specification, we assume that endogeneity is not an issue in the analysis and run a simple fixed effect model. Throughout all the specifications, we find evidence that GVCs participation increases GDP per capita. The results are robust to the different specifications as we find similar effect sizes. Using both fixed effects and IV estimation, we show that a 10-percentage point increase in GVCs participation level increases income per capita by 0.44 and 4.5 percentage points for both the fixed effect estimator and the IV estimator. While we find similar insights for forward GVCs, we find little or no evidence from the data about any relationship between backward GVCs and GDP per capita. Excluding all controls, we find a positive and statistically significant relationship between backward GVCs and GDP per capita as we show in the supplementary material. However, this significance vanishes when we control for the endogeneity of GVCs. This result is probably due to the specialization of many African countries in commodity exports, which increases their forward GVCs participation level. Our findings on the positive relationship between GVCs and growth corroborate earlier findings on the productivity and growth impacts of GVCs (Amiti & Konings, 2007; Jangam & Rath, 2021; Pahl & Timmer, 2020) with significant potentials for stirring development (Dünhaupt & Herr, 2021).

Table 7.2: Estimates of the relationship between GVCs participation and GDP per capita

	OLS - Fixed – Effect				FE-IV			
VARIABLES	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)
Log GVCs	0.0445***				0.458**			
	(0.0169)				(0.218)			
Log VS1		0.0574***		0.0678***		0.408**		0.398*
		(0.0159)		(0.0168)		(0.188)		(0.205)
Log FVA			-0.0101	-0.0251*			0.201	0.141
			(0.0127)	(0.0133)			(0.155)	(0.201)
Log Inv	0.0466***	0.0476***	0.0506***	0.0496***	0.0191	0.0183	0.0310***	0.0161
	(0.00755)	(0.00742)	(0.00758)	(0.00748)	(0.0137)	(0.0141)	(0.0105)	(0.0157)
Log Gov Cons	0.120***	0.113***	0.120***	0.108***	0.0893***	0.0458	0.164***	0.0694
	(0.0132)	(0.0133)	(0.0134)	(0.0136)	(0.0298)	(0.0461)	(0.0294)	(0.0603)
Log School E	0.132***	0.138***	0.122***	0.140***	0.269***	0.261***	0.175***	0.286***
	(0.0212)	(0.0214)	(0.0211)	(0.0214)	(0.0726)	(0.0691)	(0.0436)	(0.0828)
Log Pop 15-65	-1.022***	-1.000***	-1.005***	-1.002***	-1.433***	-1.097***	-1.319***	-1.223***
	(0.0770)	(0.0776)	(0.0773)	(0.0775)	(0.221)	(0.153)	(0.226)	(0.244)
Log Nat Rent	-0.0126	-0.0120	-0.00809	-0.0106	-0.0492***	-0.0509***	-0.0367**	-0.0563***
	(0.00861)	(0.00858)	(0.00865)	(0.00859)	(0.0173)	(0.0184)	(0.0144)	(0.0214)
Polity	0.000536	0.000405	0.000894	0.000439	0.00126	0.000791	0.00373	0.000351
	(0.00165)	(0.00166)	(0.00166)	(0.00165)	(0.00295)	(0.00318)	(0.00229)	(0.00352)
Constant	18.95***	18.64***	19.37***	18.92***	20.82***	17.44***	21.22***	17.34***
	(1.219)	(1.227)	(1.228)	(1.233)	(2.150)	(2.570)	(1.968)	(2.802)
Observations	626	625	626	625	397	396	397	396
R-squared	0.765	0.764	0.762	0.766				
Number of id	41	41	41	41	34	34	34	34
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Log GVCs is the logarithm of GVCs participation in terms of value-added (VS1 + FVA); Log VS1 is the logarithm of forward GVCs integration in terms of value-added; Log FVA is the logarithm of backward GVCs integration in terms of value-added; Log Inv is the logarithm of private investment; Log Gov Cons represents the logarithm of government consumption; Log pop represents the logarithm of population aged between 15 and 64; Log School E is the logarithm of secondary school enrollment ratio; Log Nat Rent is the logarithm of natural resource rent in percentage of GDP; and Polity represents the level of political stability (the regime). The instruments used for the IV method are mean the country top 5 trade partners' GDP: the distance to the top trade partner and air freight capacity. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

7.5.2. Global value chains and income inequality

While initial results confirm the positive association between GVCs participation and GDP per capita, we also look at the effect of GVCs participation on income inequality measured using the Gini coefficient. The fixed effect regression shows that a 10-percentage point increase in GVCs participation increases the weighted Gini coefficient by 2.96 percentage points (Table 7.3). This result highlights that GVCs participation increases income inequality. This is an important and surprising finding given that GVCs increases both GDP per capita and income inequality. However, this is a plausible finding which may result from the unequal distribution of public wealth. In an earlier closely related analysis, Goldberg & Pavcnik (2007) examine and discuss some channels through which globalization may increase income inequality in developing countries. One important channel that they highlighted is that offshoring may increase the demand for skill workers in less developed countries which may push up wage inequality. There exists a growing literature that has established a positive association between GVCs and wage inequality (Banga, 2016; Farole, 2016; E. Lee & Yi, 2018; Lim & Kim, 2021; W. Wang et al., 2021).

This association with wage inequality may also be due in part to the notion that GVCs may be more skilled and capital intensive than traditional trade flows since they are geared at quality sensitive consumers. Our results that GVCs increase income inequality in African countries partially corroborates the findings of Carpa & Martínez-Zarzoso (2022) that show that GVCs increase inequality in the shortrun but could be offset in the longrun for a subset of developed and advanced countries. When not controlling for endogeneity, backward GVC is associated with reductions in inequality while forward GVCs is not statistically significant.

Table 7.3: Estimates of the relationship between GVCs participation and income inequality (Gini coefficient 0-100)

	OLS - Fixed – Effect				**FE-IV**			
VARIABLES	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)
Log GVCs	-0.00844				0.279**			
	(0.00778)				(0.134)			
Log VS1		0.00626		0.0126		0.262**		0.269**
		(0.00739)		(0.00778)		(0.120)		(0.119)
Log FVA			-0.0123**	-0.0155**			-0.0558	-0.100
			(0.00579)	(0.00618)			(0.0739)	(0.117)
Log Inv	0.0164***	0.0156***	0.0169***	0.0168***	0.0119	0.0109	0.0224***	0.0125
	(0.00348)	(0.00345)	(0.00347)	(0.00347)	(0.00843)	(0.00903)	(0.00502)	(0.00911)
Log Gov Cons	-0.0229***	-0.0241***	-0.0249***	-0.0274***	-0.0626***	-0.0920***	-0.0435***	-0.109***
	(0.00608)	(0.00620)	(0.00611)	(0.00631)	(0.0183)	(0.0295)	(0.0140)	(0.0350)
Log School E	0.00470	0.00814	0.00549	0.00910	0.106**	0.107**	0.00851	0.0898*
	(0.00980)	(0.00996)	(0.00965)	(0.00992)	(0.0447)	(0.0442)	(0.0208)	(0.0481)
Log Pop 15-65	-0.0208	-0.0229	-0.0209	-0.0238	-0.306**	-0.123	-0.0202	-0.0334
	(0.0355)	(0.0361)	(0.0353)	(0.0359)	(0.136)	(0.0977)	(0.108)	(0.142)
Log Nat Rent	-0.0138***	-0.0148***	-0.0133***	-0.0139***	-0.0311***	-0.0336***	-0.0141**	-0.0298**
	(0.00397)	(0.00399)	(0.00395)	(0.00399)	(0.0107)	(0.0118)	(0.00686)	(0.0125)
Polity	-0.00281***	-0.00291***	-0.00276***	-0.00289***	-0.00491***	-0.00544***	-0.00240**	-0.00513**
	(0.000763)	(0.000771)	(0.000761)	(0.000768)	(0.00182)	(0.00203)	(0.00109)	(0.00204)
Constant	4.917***	4.793***	4.989***	4.965***	6.229***	4.381***	5.836***	4.454***
	(0.562)	(0.571)	(0.562)	(0.572)	(1.323)	(1.644)	(0.938)	(1.628)
Observations	626	625	626	625	397	396	397	396
R-squared	0.258	0.257	0.262	0.266				
Number of id	41	41	41	41	34	34	34	34
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Log GVCs is the logarithm of GVCs participation in terms of value-added (VS1 + FVA); Log VS1 is the logarithm of forward GVCs integration in terms of value-added; Log FVA is the logarithm of backward GVCs integration in terms of value-added; Log Inv is the logarithm of private investment; Log Gov Cons represents the logarithm of government consumption; Log pop represents the logarithm of population aged between 15 and 64; Log School E is the logarithm of secondary school enrollment ratio; Log Nat Rent is the logarithm of natural resource rent in percentage of GDP; and Polity represents the level of political stability (the regime). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

We also consider GVCs position and estimate its relationship with growth and income inequality. As shown in Table 7.4, panels A and B, GVCs exhibits a positive association with growth and income inequality both in the OLS-FE model and the IV-FE model. In the IV model, the coefficients are a little lower than participation in GVCs. GVCs position is not statistically significant for GDP per capita but we have statistical support from the data for the case of income inequality. Here a 10-percentage point increase in GVCs participation increases income inequality by approximately 3.1 percentage points.

Table 7.4: Impact of GVCs participation and GVCs position on GDP per capita (Panel A) and Income inequality (Panel B)

	OLS - Fixed – Effect			**FE-IV**		
Panel A	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Log GVCs	0.0445***		0.0494***	0.458**		0.470*
	(0.0169)		(0.0167)	(0.218)		(0.244)
GVCs position		0.0393***			0.122	
		(0.0120)			(0.105)	
GVCs position * Log GVCs			0.00340***			0.00284
			(0.000939)			(0.00889)
Log Inv	0.0466***	0.0518***	0.0478***	0.0191	0.0321***	0.0179
	(0.00755)	(0.00745)	(0.00746)	(0.0137)	(0.00945)	(0.0141)
Log Gov Cons	0.120***	0.110***	0.107***	0.0893***	0.0896**	0.0739
	(0.0132)	(0.0136)	(0.0136)	(0.0298)	(0.0420)	(0.0508)
Log School E	0.132***	0.130***	0.144***	0.269***	0.143***	0.269***
	(0.0212)	(0.0211)	(0.0213)	(0.0726)	(0.0275)	(0.0736)
Log Pop 15-65	-1.022***	-0.993***	-1.027***	-1.433***	-0.947***	-1.298***
	(0.0770)	(0.0777)	(0.0776)	(0.221)	(0.141)	(0.210)
Log Nat Rent	-0.0126	-0.00717	-0.0107	-0.0492***	-0.0274**	-0.0465***
	(0.00861)	(0.00851)	(0.00853)	(0.0173)	(0.0109)	(0.0170)
Polity	0.000536	0.000859	0.000622	0.00126	0.00426**	0.00169
	(0.00165)	(0.00165)	(0.00164)	(0.00295)	(0.00205)	(0.00291)
Constant	18.95***	19.24***	19.19***	20.82***	19.36***	18.93***
	(1.219)	(1.231)	(1.239)	(2.150)	(1.841)	(2.365)
Observations	626	625	625	397	396	396
R-squared	0.765	0.763	0.768			
Number of id	41	41	41	34	34	34
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Panel B	OLS - Fixed – Effect			FE-IV		
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Log GVCs	0.0186		0.0246	0.737**		0.690*
	(0.0206)		(0.0203)	(0.313)		(0.353)
GVCs position		0.0768***			0.305**	
		(0.0144)			(0.146)	
GVCs position * Log GVCs			0.00564***			0.0118
			(0.00114)			(0.0129)
Log Inv	0.0309***	0.0364***	0.0331***	0.0310	0.0495***	0.0296
	(0.00923)	(0.00892)	(0.00904)	(0.0196)	(0.0131)	(0.0204)
Log Gov Cons	0.0642***	0.0424***	0.0425***	0.0267	-0.0128	-0.0300
	(0.0161)	(0.0163)	(0.0164)	(0.0427)	(0.0583)	(0.0735)
Log School E	0.131***	0.143***	0.152***	0.375***	0.188***	0.380***
	(0.0260)	(0.0253)	(0.0258)	(0.104)	(0.0381)	(0.106)
Log Pop 15-65	-0.758***	-0.740***	-0.781***	-1.739***	-0.894***	-1.480***
	(0.0941)	(0.0930)	(0.0940)	(0.317)	(0.195)	(0.304)
Log Nat Rent	-0.0426***	-0.0384***	-0.0401***	-0.0803***	-0.0481***	-0.0760***
	(0.0105)	(0.0102)	(0.0103)	(0.0249)	(0.0152)	(0.0246)
Polity	-0.00357*	-0.00356*	-0.00359*	-0.00365	0.000355	-0.00319
	(0.00202)	(0.00198)	(0.00199)	(0.00423)	(0.00284)	(0.00421)
Constant	14.45***	14.78***	15.08***	21.01***	18.41***	18.72***
	(1.491)	(1.474)	(1.501)	(3.081)	(2.554)	(3.420)
Observations	626	625	625	397	396	396
R-squared	0.631	0.644	0.642			
Number of id	41	41	41	34	34	34
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Log GVCs is the logarithm of GVCs participation in terms of value-added (VS1 + FVA); GVCs position is GVCs position measures as the log difference between forward (log VS1) and forward (log FVA) GVCs participation; Log Inv is the logarithm of private investment; Log Gov Cons represents the logarithm of government consumption; Log pop represents the logarithm of population aged between 15 and 64; Log School E is the logarithm of secondary school enrollment ratio; Log Nat Rent is the logarithm of natural resource rent in percentage of GDP; and Polity represents the level of political stability (the regime). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

5.3 Insights from Sectoral GVCs

Using sectoral GVCs data, we further investigate which sectors of GVCs drive growth in GDP per capita. We aggregate the 26 sectors from the input-output country/sectoral data into six different GVCs archetypes (Table 7.1 and Table A 7.4), following the World Bank adaptation of MGI (2019). Estimating the relationship between the disaggregated GVCs participation and GDP per capita, we find a positive association between all separately integrated GVCs participation archetypes and GDP per capita. Here we report higher association coefficients for knowledge intensive goods. A 10-percentage point increase in GVCs participation in knowledge intensive goods increases GDP per capita by 1.2 percentage point (Table 7.5, column 1 to 6). Including all sectors, the results are different and only the impact of knowledge intensive services GVCs participation is significant and positive (Table 7.5, column 7). This makes us to surmise that the positive relationship between of GVCs participation and GDP per capita is driven by knowledge intensive goods and services and this is especially true given that they make the top 5 sectors of top GVCs production hubs' sectors.

Table 7.5: Estimates of sectoral GVCs participation and GDP per capita

	OLS - Fixed – Effect						
VARIABLES	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Log GVCs Com	0.0772***						0.0164
	(0.0274)						(0.0329)
Log GVCs KIG		0.0744**					-0.0241
		(0.0305)					(0.0529)
Log GVCs KIS			0.117***				0.107**
			(0.0321)				(0.0433)
Log GVCs LIG				0.0695***			-0.000592
				(0.0245)			(0.0334)
Log GVCs LIS					0.105***		0.0248
					(0.0307)		(0.0534)
Log GVCs RP						0.0839**	0.000550
						(0.0334)	(0.0523)
Log Inv	0.0418**	0.0473***	0.0465***	0.0482***	0.0464***	0.0430**	0.0449***
	(0.0176)	(0.0170)	(0.0160)	(0.0171)	(0.0151)	(0.0173)	(0.0152)
Log Gov Cons	0.180***	0.193***	0.162***	0.190***	0.165***	0.182***	0.154***
	(0.0356)	(0.0332)	(0.0301)	(0.0336)	(0.0316)	(0.0334)	(0.0344)
Log School E	0.137**	0.150**	0.160**	0.127**	0.119**	0.149**	0.150**
	(0.0574)	(0.0619)	(0.0609)	(0.0582)	(0.0564)	(0.0592)	(0.0643)
Log Pop 15-65	-0.281**	-0.313**	-0.394***	-0.249**	-0.337***	-0.300**	-0.396***
	(0.121)	(0.144)	(0.124)	(0.112)	(0.113)	(0.127)	(0.134)
Log Nat Rent	-0.0180	-0.0166	-0.0250	-0.0195	-0.0275	-0.0168	-0.0275
	(0.0322)	(0.0308)	(0.0291)	(0.0326)	(0.0307)	(0.0303)	(0.0292)
Polity	0.00176	0.000189	2.66e-05	0.000129	0.00135	0.000925	0.000581
	(0.00315)	(0.00323)	(0.00308)	(0.00334)	(0.00308)	(0.00332)	(0.00312)
Constant	6.273***	6.589***	7.938***	5.846***	7.229***	6.488***	8.042***
	(1.737)	(1.866)	(1.707)	(1.575)	(1.578)	(1.752)	(1.763)
Observations	636	636	636	636	636	636	636
R-squared	0.682	0.684	0.708	0.680	0.698	0.687	0.710
Number of id	42	42	42	42	42	42	42
Country FE	YES	YES	YES	YES	YES	YES	YES

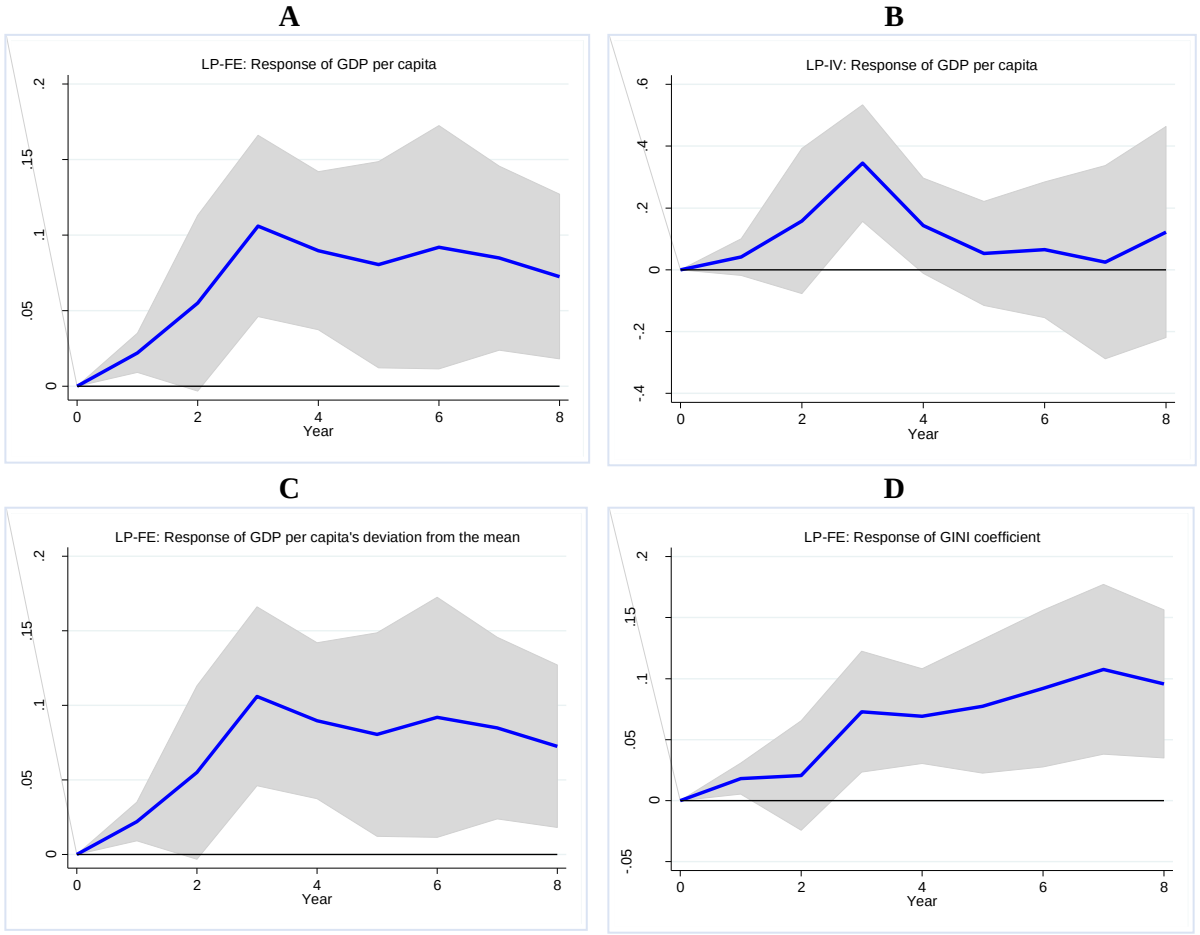
Note: Log Inv is the logarithm of private investment; Log Gov Cons represents the logarithm of government consumption; Log pop represents the logarithm of population aged between 15 and 64; Log School E is the logarithm of secondary school enrollment ratio; Log Nat Rent is the logarithm of natural resource rent in percentage of GDP; and Polity represents the level of political stability (the regime). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

5.4 Estimates of the local projections

To investigate the response of GDP per capita, and income inequality to a change in GVCs participation, we rely on local projections to estimate Impulse Response Function (IRF). Local projection estimates

consider both country and time fixed effects. The results of the local projections confirm previous findings and provide additional insights on GDP per capita. According to the findings, GVC participation increases GDP per capita. The positive association starts immediately after the increase (year 1) and is significant as shown in **Figure *7.7***. The association stays positive and increases until year 3. It then begins to decrease in year 3 but stays positive and significant until year 8 (**Figure *7.7*** A). When using the IV approach in our local projection method, the results show a positive association of GVCs participation on GDP per capita that is only significant at year 3 (**Figure *7.7*** B). Our fixed-effects estimation confirms the existence of a positive and significant relationship starting from year 1 until year 8 (**Figure *7.7*** C). We also examine the association of GVCs participation on inequality. The result highlights a positive association between GVCs participation and inequality, which confirms that GVCs participation increases inequality. This effect is clearly significant from year 3 until year 8 (**Figure *7.7*** D). The local projection approach not only provides more information on the evolution of the response but also confirms initial findings of coupled positive association with both GDP per capita and inequality.

Figure 7.7:GVCs participation, GDP per capita and inequality



Source: Results of the local projection estimations

Note: LP-FE represents the combination between local project and panel fixed -effects, which means that the equation has been estimated using the fixed effect approach. LP-IV refers to local projections with the equation estimated using the IV Method.

5.5 Robustness and sensitivity checks

We perform a couple of robustness checks to confirm our study results. In the first place, we use different variables to capture inequality. We test the robustness of our estimations to a change in the measure of income inequality. The World Income Inequality Database (WIID) contains an extensive list of variables measuring inequality. We use the mean GDP per capita deciles and the standardized Gini coefficients as alternative measures of income inequality. Running some fixed effects estimations, we show that GVCs participation increases mean income deciles as shown in **Table *7.6***. These results confirm our initial findings that GVCs participation is positively associated with income inequality.

Table 7.6: Estimates of GVCs participation and mean income deciles (d1 to d10) - IV method

VARIABLES	Decile 1 (1)	Decile 2 (2)	Decile 3 (3)	Decile 4 (4)	Decile 5 (5)	Decile 6 (6)	Decile 7 (7)	Decile 8 (8)	Decile 9 (9)	Decile 10 (10)
Log GVCs	-1.273	-0.700	-0.404	-0.211	-0.0724	0.0204	0.110	0.245	**0.447***	**0.751****
	(0.847)	(0.516)	(0.342)	(0.259)	(0.214)	(0.197)	(0.191)	(0.198)	(0.233)	(0.318)
Log Inv	0.00454	0.0105	0.0111	0.0112	0.0100	0.0107	0.0115	0.0106	0.0116	0.0363*
	(0.0531)	(0.0324)	(0.0215)	(0.0163)	(0.0134)	(0.0124)	(0.0120)	(0.0124)	(0.0146)	(0.0200)
Log Gov Cons	0.321***	0.260***	0.226***	0.202***	0.178***	0.158***	0.143***	0.121***	0.0874***	0.0227
	(0.115)	(0.0704)	(0.0467)	(0.0354)	(0.0291)	(0.0269)	(0.0261)	(0.0270)	(0.0317)	(0.0434)
Log School E	-0.0255	0.0498	0.0820	0.114	0.132*	0.143**	0.164***	0.198***	0.256***	0.389***
	(0.282)	(0.172)	(0.114)	(0.0863)	(0.0711)	(0.0656)	(0.0636)	(0.0658)	(0.0775)	(0.106)
Log Pop 15-65	-0.236	-0.964*	-0.921***	-0.950***	-0.936***	-0.915***	-0.960***	-1.076***	-1.327***	-1.833***
	(0.858)	(0.523)	(0.347)	(0.263)	(0.217)	(0.200)	(0.194)	(0.200)	(0.236)	(0.322)
Log Nat Rent	0.131*	0.0829**	0.0462*	0.0196	0.00351	-0.0111	-0.0213	-0.0290*	-0.0423**	-0.0817***
	(0.0673)	(0.0410)	(0.0272)	(0.0206)	(0.0170)	(0.0157)	(0.0152)	(0.0157)	(0.0185)	(0.0253)
Polity	0.0363***	0.0243***	0.0166***	0.0123***	0.00906***	0.00688***	0.00533**	0.00354	0.000968	-0.00329
	(0.0115)	(0.00699)	(0.00463)	(0.00351)	(0.00289)	(0.00267)	(0.00259)	(0.00268)	(0.00315)	(0.00430)
Constant	18.38**	24.21***	20.92***	19.67***	18.45***	17.60***	17.70***	18.44***	20.69***	26.72***
	(8.336)	(5.084)	(3.370)	(2.553)	(2.106)	(1.942)	(1.884)	(1.947)	(2.292)	(3.132)
Observations	397	397	397	397	397	397	397	397	397	397
Number of id	34	34	34	34	34	34	34	34	34	34
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Log GVCs is the logarithm of GVCs participation in terms of value-added (VS1 + FVA); Log Inv is the logarithm of private investment; Log Gov Cons represents the logarithm of government consumption; Log pop represents the logarithm of population aged between 15 and 64; Log School E is the logarithm of secondary school enrollment ratio; Log Nat Rent is the logarithm of natural resource rent in percentage of GDP; and Polity represents the level of political stability (the regime). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The result of the estimation using the standardized Gini coefficients follow the results obtained from the Gini coefficient. GVCs participation has a positive association with inequality (results are presented in the supplementary material). Akin to the previous findings, this positive association may be driven by forward GVCs participation. Coupled with the positive association with GDP per capita, we conclude that GVCs participation increases GDP per capita but the repercussion of growth on income is not strong, possibly leading to an increase in inequality.

Beyond these inequality measures, we also use the income shares which we divide into 7 separate outcomes as shown in **Table *7.7***. We again use the instrumental variable estimator to estimate the relationship between GVCs and income shares. Participation in GVCs is associated with reductions in the income shares of the bottom 5%, 20% and 40%. In contrast, we find increase in income shares for the top 20%, 10% and 5%. While GVCs may increase the incomes of the non-poor and those in the highest category of income, it may also reduce the income of the poor, a typical like scenario for the aphorism that « the rich get richer, and the poor get poorer. This finding offers more insights to the estimated relationship between GVCs and income inequality. Specifically, it supports the insight that GVCs may increase income inequality.

Table 7.7: Estimates of GVCs participation and income shares (IV method)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Bottom 5%	Bottom 20%	Bottom 40%	Middle 50%	Top 20%	Top 10%	Top 5%
Log GVCs	-2.062*	-1.397**	-0.964**	-0.223**	0.155**	0.292**	0.308*
	(1.074)	(0.712)	(0.467)	(0.108)	(0.0781)	(0.141)	(0.157)
Log Inv	-0.0140	-0.00988	-0.00806	-0.00846	0.00327	0.0172*	0.0215**
	(0.0674)	(0.0447)	(0.0293)	(0.00678)	(0.00490)	(0.00884)	(0.00986)
Log Gov Cons	0.267*	0.199**	0.150**	0.0342**	-0.0322***	-0.0666***	-0.0763***
	(0.146)	(0.0971)	(0.0636)	(0.0147)	(0.0106)	(0.0192)	(0.0214)
Log School E	-0.341	-0.257	-0.203	-0.0734**	0.0436*	0.119**	0.144***
	(0.357)	(0.237)	(0.155)	(0.0360)	(0.0260)	(0.0469)	(0.0523)
Log Pop 15-65	1.482	0.790	0.642	0.318***	-0.190**	-0.400***	-0.424***
	(1.088)	(0.721)	(0.473)	(0.110)	(0.0791)	(0.143)	(0.159)
Log Nat Rent	0.224***	0.151***	0.104***	0.0224***	-0.0123**	-0.0325***	-0.0372***
	(0.0854)	(0.0566)	(0.0371)	(0.00860)	(0.00620)	(0.0112)	(0.0125)
Polity	0.0400***	0.0272***	0.0172***	0.00258*	-0.00264**	-0.00455**	-0.00486**
	(0.0145)	(0.00963)	(0.00632)	(0.00146)	(0.00106)	(0.00191)	(0.00213)
Constant	-2.968	2.787	1.767	1.176	5.289***	7.335***	7.305***
	(10.58)	(7.011)	(4.597)	(1.065)	(0.769)	(1.388)	(1.548)
Observations	397	397	397	397	397	397	397
Number of id	34	34	34	34	34	34	34
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Log GVCs is the logarithm of GVCs participation in terms of value-added (VS1 + FVA); Log Inv is the logarithm of private investment; Log Gov Cons represents the logarithm of government consumption; Log pop represents the logarithm of population aged between 15 and 64; Log School E is the logarithm of secondary school enrollment ratio; Log Nat Rent is the logarithm of natural resource rent in percentage of GDP; and Polity represents the level of political stability (the regime). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

7.6. Concluding Remarks

This chapter fills a gap in the literature regarding the relationship between GVCs participation and position and growth and income inequality for African countries. Using a constructed panel of 48 countries over 27 years from 1990 to 2016, this chapter begins by presenting stylized facts on GVCs in Africa, with details at the sectoral level to identify the drivers of higher value-added captured through GVCs trade. After establishing this and generating GVC participation indices, we use different empirical

strategies like the panel fixed effects estimator, instrumental variable estimators, and local projection methods to link GVCs to growth and income inequality.

We find four key results. First, the participation of African countries in GVCs is increasing but significant heterogeneity remains. While we do not explore what may be constraining participation in GVCs, it may be important for future research efforts to identify these factors as they may inform policy action. Second, we establish a positive association between GVCs and income inequality, a result which is robust to the use of different estimators. GVCs increase income inequality despite increasing GDP per capita. The results for income inequality are robust to different measures of inequality. Third, and related to the first, we establish a positive relationship between forward GVCs and economic growth and inequality but find little or no evidence for backward GVCs. Finally, we show that the positive relationship between GVCs and GDP per capita is explained by trading in knowledge intensive goods and services.

In terms of policy implications, our findings clearly highlight the importance of promoting GVCs as they have the potential to stimulate economic growth which may enable some leapfrogging of African nations. In this case, investments in knowledge intensive goods and services should take central stage given their established relationship with growth but more importantly that they may raise the necessity to implement redistribution policy to improve national wealth redistribution such that inequality can be reduced. The main question now is to understand how developing countries can promote GVCs participation and what kind of policy should be implemented to improve wealth distribution? We do not provide answers to this question in this study. However, these are great areas of research where future efforts could be directed to. In terms of the key findings that GVCs have the potential to increase economic growth but increase inequality, it will be important for policy to streamline various mechanisms in using GVCs to achieve growth while simultaneously reducing income inequality.

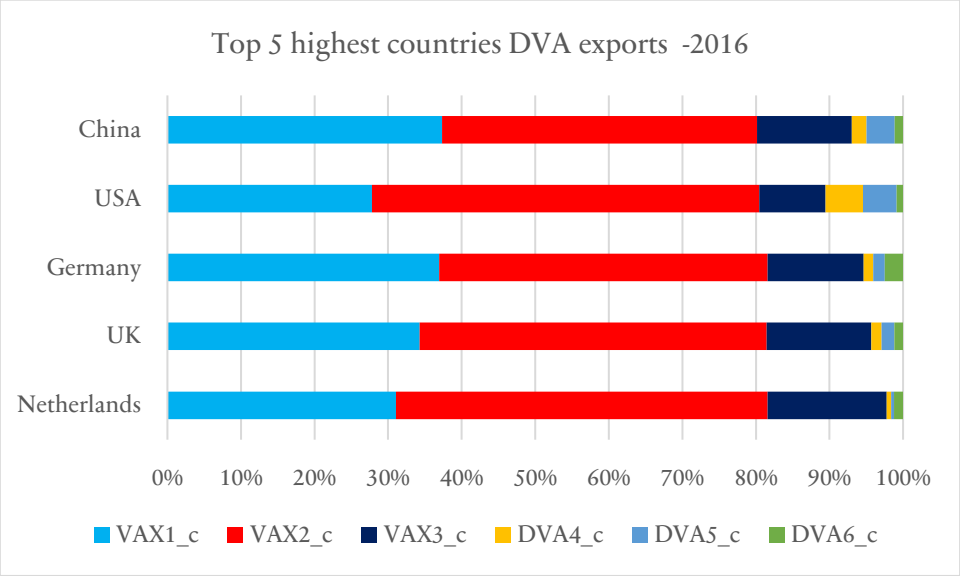
As suggested, increases in income inequality may arise from GVCs participation, thereby suggesting wage adjustments and/or employment changes. These are critical entry and leveraging points for policy. Skill upgrading may be necessary to match value addition with new tasks. It may also be necessary for policy to delve into skill based technological change as they may reduce income inequality. This will involve various educational training and labour market programs that can improve the skill level of workers. Also, various labour market policies and adjustment programs should be rolled out to reduce unemployment that may be associated with GVCs. Specifically, the use of policy instruments like job specific educational and training programs, re-employment services may be steps in the right direction of reducing income inequality arising from increased GVC participation. Beyond upgrading the skill set of the labour force through education and training, minimizing human input through automation and technology adoption may increase gains from GVC participation with the potential to reduce inequality.

To end, we guide the understanding of our analysis from an association point of view. We have controlled for many confounding factors including the three ruffians of endogeneity: unobserved

heterogeneity, reverse causality, and measurement error. However, our employed strategies may not be perfect especially given that we do not have experimental data. We thus refrain from implying any causality about the analysis. That notwithstanding, the insights from the analysis should be very much in order and suggestive of the impacts of GVCs on growth, and income inequality.

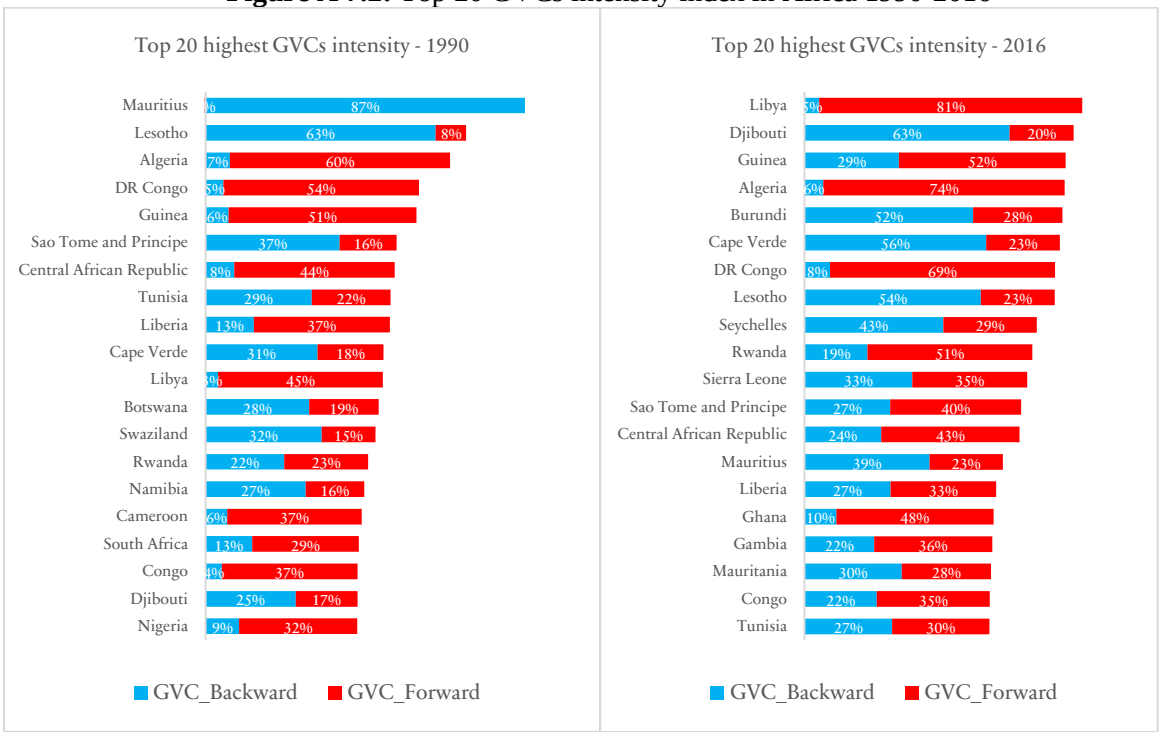
Appendix – Additional information (charts and tables)

Figure A 7.1: Top 5 Domestic Value-Added Exports in the World 1990-2016



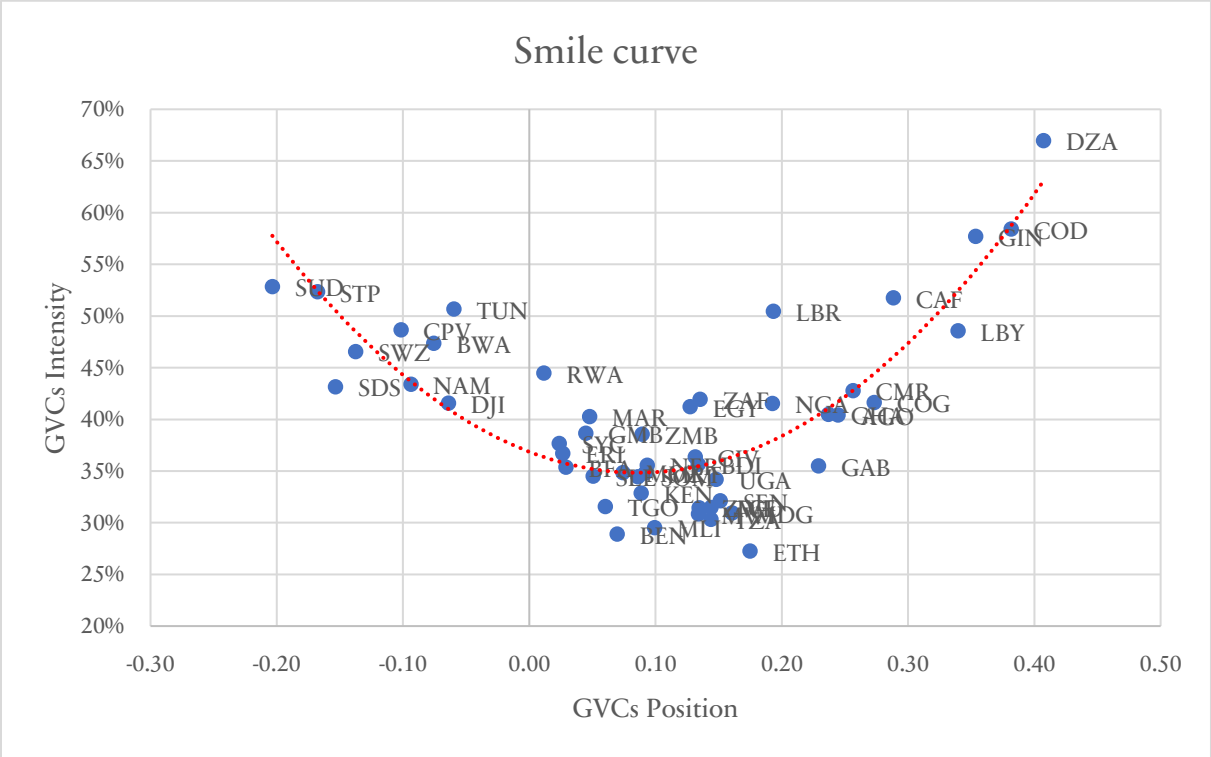
Source: Authors' calculation base on EORA MRIO input output databases
Note: VAX1_c, VAX2_c and VAX3_c are value-added exports. They are domestic value added (DV) in direct final goods exports, DV in intermediates exports absorbed by direct importers, and DV in intermediates reexported to third countries. DVA4_c and DVA5_c includes the source country's value-added in both its final and intermediate goods imports, which are first exported but eventually returned and consumed at home and DVA6_c is a double counted intermediate exports produced at home

Figure A 7.2: Top 20 GVCs intensity index in Africa 1990-2016



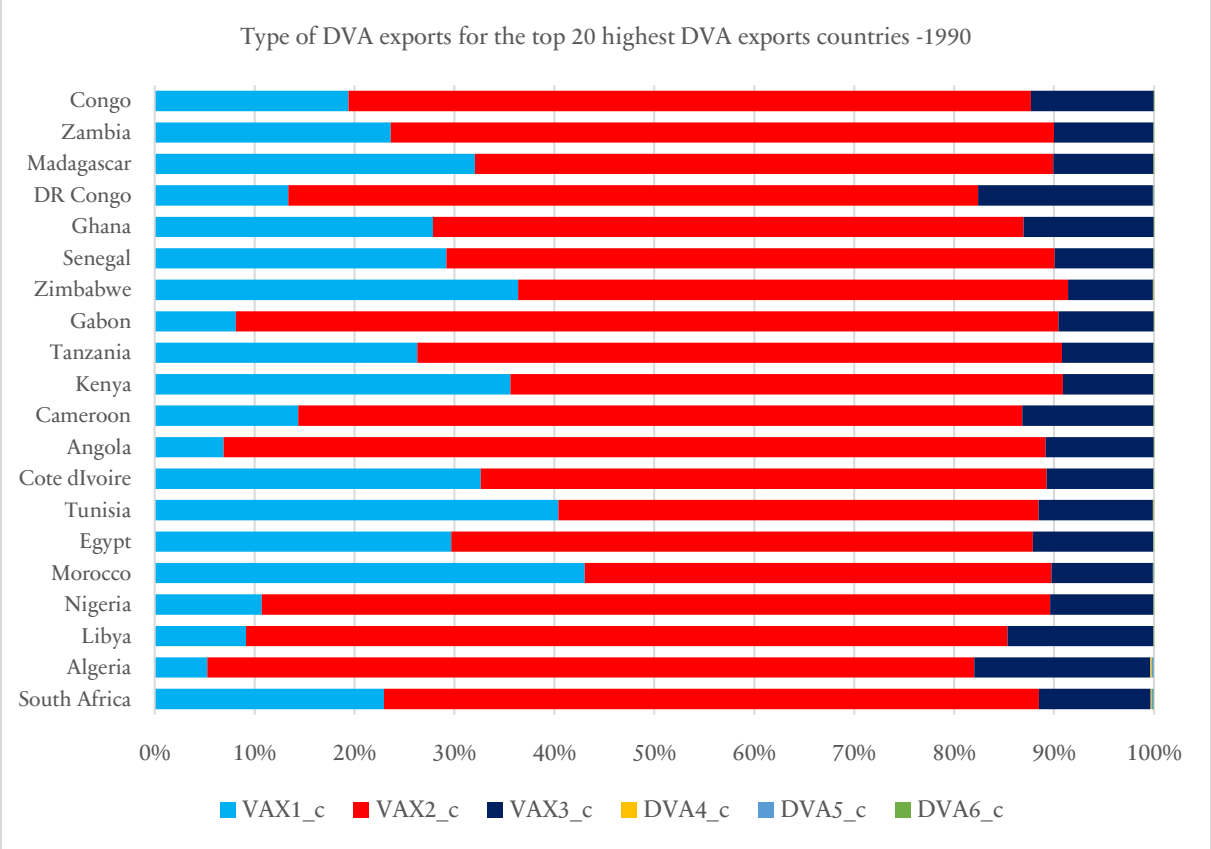
Source: Authors' calculation base on EORA MRIO input output databases

Figure A 7.3: Scatter plot representing GVCs position and GVCs intensity – 2016



Source: Authors' calculation based on EORA MRIO database

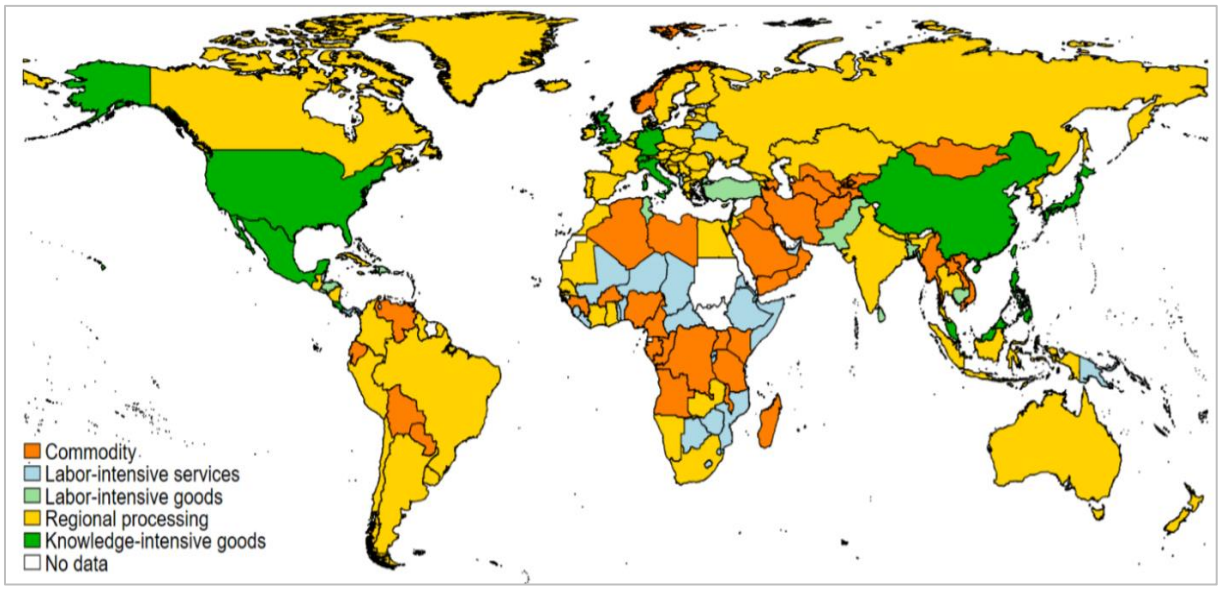
Figure A 7.4: Top 20 Domestic Value-Added Exports in Africa 1990-2016



Source: Authors' calculation based on EORA MRIO input-output databases

Note: VAX1_c, VAX2_c and VAX3_c are value-added exports. They are domestic value added (DV) in direct final goods exports, DV in intermediates exports absorbed by direct importers, and DV in intermediates reexported to third countries. DVA4_c and DVA5_c includes the source country's value-added in both its final and intermediate goods imports, which are first exported but eventually returned and consumed at home and DVA6_c is a double counted intermediate exports produced at home

Figure A 7.5: Global value chains integration by production segment



Source: The World Bank Group – Qiang et al., (2021).

Table A 7.1: Ranking of top 5 GVCs sectors for highest integrated countries in 2016

	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5
China	Electrical and Machinery US$ 269437974.2	Petroleum, Chemical and Mineral Products US$ 135286312.2	Metal Products US$ 94149142.87	Textiles and Wearing Apparel US$ 86683267.54	Financial Intermediation and Business US$ 81554630.16
Germany	Re-export & Re-import US$ 249376261.9	Electrical and Machinery US$ 162470481.2	Petroleum, Chemical and Mineral Products US$ 132719307.4	Transport Equipment US$ 97190353.19	Financial Intermediation and Business US$ 93233619.51
UK	Electrical and Machinery US$ 88058203.07	Financial Intermediation and Business US$ 78115915.02	Petroleum, Chemical and Mineral Products US$ 59390452.09	Re-export & Re-import US$ 48584879.41	Metal Products US$ 29525754.08
Netherlands	Re-export & Re-import US$ 208634877.4	Petroleum, Chemical and Mineral Products US$ 58511872.96	Financial Intermediation and Business US$ 43167120.57	Electrical and Machinery US$ 36587347.25	Food & Beverages US$ 22510476.34
USA	Financial Intermediation and Business US$ 237136512.2	Petroleum, Chemical and Mineral Products US$ 150228024.1	Electrical and Machinery US$ 149235500.9	Wholesale Trade US$ 106092333.9	Transport Equipment US$ 49580807.6

Source: Authors' calculation based on EORA MRIO database
Note: Sectors represents top 5 sectors driving GVCs. Value between parenthesis represents the level of GVCs participation for the sector. Countries are the top 5 countries with the highest GVCs participation level. Countries are listed in alphabetical order.

Table A 7.2: Ranking of top 5 GVCs sectors for highest integrated African countries in 2016

	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5
Angola	Mining and Quarrying US$ 7483000.561	Electricity, Gas and Water US$ 1344339.192	Financial Intermediation and Business US$ 1006596.101	Transport US$ 707805.833	Construction US$ 608339.4914
Algeria	Mining and Quarrying US$ 20931336.68	Electricity, Gas and Water US$ 1714682.604	Petroleum, Chemical and Mineral Products US$ 1071680.286	Transport US$ 953367.6801	Financial Intermediation and Business US$ 656358.3328
Morocco	Electrical and Machinery US$ 4999861.275	Agriculture US$ 2932306.174	Petroleum, Chemical and Mineral Products US$ 1609343.183	Financial Intermediation and Business US$ 1481702.478	Textiles and Wearing Apparel US$ 1449752.792
Nigeria	Mining and Quarrying US$ 9067315.08	Agriculture US$ 3555698.806	Transport US$ 887981.7759	Financial Intermediation and Business US$ 885613.6977	Petroleum, Chemical and Mineral Products US$ 500850.3353
South Africa	Mining and Quarrying US$ 10553053.71	Metal Products US$ 6927070.219	Petroleum, Chemical and Mineral Products US$ 4704344.516	Financial Intermediation and Business US$ 4438264.387	Electrical and Machinery US$ 2890384.862

Source: Authors' calculation based on EORA MRIO database
Note: Sectors represents top 5 sectors driving GVCs. Value between parenthesis represents the level of GVCs participation for the sector. Countries are the top 5 African countries with the highest GVCs participation level. Countries are listed in alphabetical order.

Table A 7.3: Ranking of top 5 GVCs sectors for highest integrated African countries in 1990

	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5
Algeria	Mining and Quarrying US$ 3181728.294	Financial Intermediation and Business US$ 992604.1456	Transport US$ 693455.1454	Petroleum, Chemical and Mineral Products US$ 665622.9907	Electricity, Gas and Water US$ 348448.8397
Libya	Financial Intermediation and Business US$ 804377.3184	Mining and Quarrying US$ 624967.1125	Petroleum, Chemical and Mineral Products US$ 281865.3667	Transport US$ 228666.3092	Wholesale Trade US$ 172707.6457
Morocco	Textiles and Wearing Apparel US$ 208886.8599	Financial Intermediation and Business US$ 206718.1206	Food & Beverages US$ 197704.9136	Petroleum, Chemical and Mineral Products US$ 169022.1642	Electrical and Machinery US$ 146036.9311
Nigeria	Mining and Quarrying US$ 993633.4748	Financial Intermediation and Business US$ 281931.976	Petroleum, Chemical and Mineral Products US$ 179094.7067	Transport US$ 158838.4686	Wholesale Trade US$ 89596.73442
South Africa	Mining and Quarrying US$ 1514988.026	Metal Products US$ 1179425.846	Financial Intermediation and Business US$ 863473.9521	Petroleum, Chemical and Mineral Products US$ 731422.2378	Transport US$ 609846.0661

Source: Authors' calculation based on EORA MRIO database

Note: Sectors represents top 5 sectors driving GVCs. Value between parenthesis represents the level of GVCs participation for the sector. Countries are the top 5 African countries with the highest GVCs participation level. Countries are listed in alphabetical order.

Table A 7.4: correspondence between sectors and GVCs archetypes

Sectors	**GVC archetypes**
Agriculture	Commodities
Fishing	Commodities
Mining and Quarrying	Commodities
Food & Beverages	Regional processing
Textiles and Wearing Apparel	Labor-intensive goods
Wood and Paper	Regional processing
Petroleum, Chemical and Non-Metallic Mineral Products	Commodities
Metal Products	Regional processing
Electrical and Machinery	Knowledge-intensive goods
Transport Equipment	Knowledge-intensive goods
Other Manufacturing	Regional processing
Recycling	Others
Electricity, Gas and Water	Others
Construction	Labor-intensive services
Maintenance and Repair	Labor-intensive services
Wholesale Trade	Labor-intensive services
Retail Trade	Labor-intensive services
Hotels and Restaurants	Labor-intensive services
Transport	Labor-intensive services
Post and Telecommunications	Knowledge-intensive services
Financial Intermediation and Business Activities	Knowledge-intensive services
Public Administration	Others
Education, Health and Other Services	Labor-intensive services
Private Households	Others
Others	Others
Re-export & Re-import	Others

Source: Qiang, Liu, and Steenbergen (2021), United Nations Comtrade; United Nations Conference on Trade and Development–Eora Global Value Chain database; World Bank calculations.

Table A 7.5: Estimates of GVCs participation and inequality (Gini coefficient)

	OLS - Fixed – Effect				FE-IV			
VARIABLES	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)
Log GVCs	0.0186				0.737**			
	(0.0206)				(0.313)			
Log VS1		0.0624***		0.0912***		0.670**		0.667**
		(0.0194)		(0.0202)		(0.277)		(0.281)
Log FVA			-0.0486***	-0.0697***			0.145	0.0407
			(0.0153)	(0.0160)			(0.169)	(0.275)
Log Inv	0.0309***	0.0299***	0.0365***	0.0353***	0.0310	0.0292	0.0534***	0.0286
	(0.00923)	(0.00905)	(0.00914)	(0.00899)	(0.0196)	(0.0208)	(0.0115)	(0.0215)
Log Gov Cons	0.0642***	0.0561***	0.0580***	0.0411**	0.0267	-0.0462	0.121***	-0.0394
	(0.0161)	(0.0162)	(0.0161)	(0.0164)	(0.0427)	(0.0678)	(0.0321)	(0.0827)
Log School E	0.131***	0.144***	0.123***	0.148***	0.375***	0.368***	0.184***	0.375***
	(0.0260)	(0.0261)	(0.0254)	(0.0257)	(0.104)	(0.102)	(0.0475)	(0.114)
Log Pop 15-65	-0.758***	-0.741***	-0.741***	-0.744***	-1.739***	-1.220***	-1.340***	-1.256***
	(0.0941)	(0.0946)	(0.0932)	(0.0931)	(0.317)	(0.225)	(0.246)	(0.335)
Log Nat Rent	-0.0426***	-0.0440***	-0.0364***	-0.0401***	-0.0803***	-0.0846***	-0.0508***	-0.0861***
	(0.0105)	(0.0105)	(0.0104)	(0.0103)	(0.0249)	(0.0270)	(0.0157)	(0.0294)
Polity	-0.00357*	-0.00386*	-0.00308	-0.00377*	-0.00365	-0.00465	0.00132	-0.00478
	(0.00202)	(0.00202)	(0.00201)	(0.00199)	(0.00423)	(0.00468)	(0.00250)	(0.00483)
Constant	14.45***	13.85***	15.10***	14.62***	21.01***	15.79***	21.02***	15.76***
	(1.491)	(1.495)	(1.481)	(1.482)	(3.081)	(3.783)	(2.147)	(3.843)
Observations	626	625	626	625	397	396	397	396
R-squared	0.631	0.632	0.637	0.644				
Number of id	41	41	41	41	34	34	34	34
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Log GVCs is the logarithm of GVCs participation in terms of value-added (VS1 + FVA); Log VS1 is the logarithm of forward GVCs integration in terms of value-added; Log FVA is the logarithm of backward GVCs integration in terms of value-added; Log Inv is the logarithm of private investment; Log Gov Cons represents the logarithm of government consumption; Log pop represents the logarithm of population aged between 15 and 64; Log School E is the logarithm of secondary school enrollment ratio; Log Nat Rent is the logarithm of natural resource rent in percentage of GDP; and Polity represents the level of political stability (the regime). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A 7.6: Impact of GVCs participation and GVCs position on Income inequality (Gini)

	OLS - Fixed – Effect			FE-IV		
VARIABLES	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Log GVCs	0.0186		0.0246	0.737**		0.690*
	(0.0206)		(0.0203)	(0.313)		(0.353)
GVCs position		0.0768***			0.305**	
		(0.0144)			(0.146)	
GVCs position * Log GVCs			0.00564***			0.0118
			(0.00114)			(0.0129)
Log Inv	0.0309***	0.0364***	0.0331***	0.0310	0.0495***	0.0296
	(0.00923)	(0.00892)	(0.00904)	(0.0196)	(0.0131)	(0.0204)
Log Gov Cons	0.0642***	0.0424***	0.0425***	0.0267	-0.0128	-0.0300
	(0.0161)	(0.0163)	(0.0164)	(0.0427)	(0.0583)	(0.0735)
Log School E	0.131***	0.143***	0.152***	0.375***	0.188***	0.380***
	(0.0260)	(0.0253)	(0.0258)	(0.104)	(0.0381)	(0.106)
Log Pop 15-65	-0.758***	-0.740***	-0.781***	-1.739***	-0.894***	-1.480***
	(0.0941)	(0.0930)	(0.0940)	(0.317)	(0.195)	(0.304)
Log Nat Rent	-0.0426***	-0.0384***	-0.0401***	-0.0803***	-0.0481***	-0.0760***
	(0.0105)	(0.0102)	(0.0103)	(0.0249)	(0.0152)	(0.0246)
Polity	-0.00357*	-0.00356*	-0.00359*	-0.00365	0.000355	-0.00319
	(0.00202)	(0.00198)	(0.00199)	(0.00423)	(0.00284)	(0.00421)
Constant	14.45***	14.78***	15.08***	21.01***	18.41***	18.72***
	(1.491)	(1.474)	(1.501)	(3.081)	(2.554)	(3.420)
Observations	626	625	625	397	396	396
R-squared	0.631	0.644	0.642			
Number of id	41	41	41	34	34	34
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: Log GVCs is the logarithm of GVCs participation in terms of value-added (VS1 + FVA); GVCs position is GVCs position measures as the log difference between forward (log VS1) and forward (log FVA) GVCs participation; Log Inv is the logarithm of private investment; Log Gov Cons represents the logarithm of government consumption; Log pop represents the logarithm of population aged between 15 and 64; Log School E is the logarithm of secondary school enrollment ratio; Log Nat Rent is the logarithm of natural resource rent in percentage of GDP; and Polity represents the level of political stability (the regime). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A 7.7: Impact of GVCs participation on inequality (Gini Standard Deviation)

	OLS - Fixed – Effect				FE-IV			
VARIABLES	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)
Log GVCs	0.0293				0.804**			
	(0.0228)				(0.346)			
Log VS1		0.0720***		0.132***		0.723**		0.716**
		(0.0214)		(0.0191)		(0.304)		(0.313)
Log FVA			-0.0423**	-0.0283*			0.194	0.0843
			(0.0169)	(0.0164)			(0.198)	(0.306)
Log Inv	0.0414***	0.0409***	0.0472***	0.0430***	0.0425*	0.0409*	0.0663***	0.0396*
	(0.0102)	(0.00999)	(0.0101)	(0.0101)	(0.0217)	(0.0229)	(0.0135)	(0.0239)
Log Gov Cons	0.0508***	0.0417**	0.0458**	0.0711***	0.00364	-0.0741	0.111***	-0.0601
	(0.0178)	(0.0179)	(0.0179)	(0.0172)	(0.0472)	(0.0747)	(0.0376)	(0.0921)
Log School E	0.157***	0.170***	0.148***	0.204***	0.434***	0.424***	0.233***	0.438***
	(0.0287)	(0.0288)	(0.0282)	(0.0278)	(0.115)	(0.112)	(0.0557)	(0.126)
Log Pop 15-65	-0.754***	-0.731***	-0.735***	-0.346***	-1.863***	-1.298***	-1.471***	-1.373***
	(0.104)	(0.104)	(0.103)	(0.0711)	(0.351)	(0.247)	(0.289)	(0.372)
Log Nat Rent	-0.0488***	-0.0498***	-0.0424***	-0.0452***	-0.0915***	-0.0957***	-0.0612***	-0.0989***
	(0.0116)	(0.0115)	(0.0116)	(0.0110)	(0.0275)	(0.0298)	(0.0184)	(0.0327)
Polity	-0.00368	-0.00396*	-0.00316	-0.00503**	-0.00435	-0.00536	0.000876	-0.00563
	(0.00224)	(0.00223)	(0.00223)	(0.00212)	(0.00469)	(0.00515)	(0.00293)	(0.00537)
Constant	13.22***	12.57***	13.87***	5.631***	21.12***	15.51***	21.26***	15.44***
	(1.647)	(1.651)	(1.642)	(0.981)	(3.410)	(4.164)	(2.517)	(4.277)
Observations	626	625	626	625	397	396	397	396
R-squared	0.548	0.549	0.552	0.513				
Number of id	41	41	41	41	34	34	34	34
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Log GVCs is the logarithm of GVCs participation in terms of value-added (VS1 + FVA); Log VS1 is the logarithm of forward GVCs integration in terms of value-added; Log FVA is the logarithm of backward GVCs integration in terms of value-added; Log Inv is the logarithm of private investment; Log Gov Cons represents the logarithm of government consumption; Log pop represents the logarithm of population aged between 15 and 64; Log School E is the logarithm of secondary school enrollment ratio; Log Nat Rent is the logarithm of natural resource rent in percentage of GDP; and Polity represents the level of political stability (the regime). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A 7.8: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Key outcomes					
GDP per capita ($US)	1,204	2,137	2,598	164	13,606
Growth Inequality	1,204	-0.6	1	-2.5	1.9
Absolute Gini	1,293	236	244	24	1,216
Gini sd	1,293	66	69	7	328
GVCs participation in value added ($US million)					
GVCs participation	1,293	2.4	7	0.0016	70
VS1	1,293	1.8	6	0.0009	47
FVA	1,293	0.6	2	0.0007	23
GVCs ratio in % of gross exports					
GVCs ratio	1,293	0.5	0.11	0.25	0.89
Forward GVCs ratio	1,293	0.33	0.12	0.06	0.81
Backward GVCs ratio	1,293	0.16	0.11	0.02	0.65
Control variables					
Inv ($US million)	1,258	7,154	14,832	0	99,442
Gov Cons ($US million)	936	5,145	11.640	52	85,840
School E	802	41	26	5	116
Pop1564 (million)	1,288	9.5	13.8	0.04	98.8
Rents (% GDP)	1,243	12	12	0	69
Polity2	1,235	0.62	5.5	-10	10

Table A 7.9: Impact of GVCs on GDP per capita (without control variables)

	OLS - Fixed – Effect				FE-IV			
VARIABLES	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)
Log GVCs	0.164***				1.439**			
	(0.0162)				(0.702)			
Log VS1		0.174***		0.174***		0.633***		0.645**
		(0.0146)		(0.0155)		(0.201)		(0.316)
Log FVA			0.0500***	0.00413			0.421	0.648
			(0.0129)	(0.0130)			(0.397)	(0.652)
Constant	5.023***	5.007***	6.439***	4.955***	-10.50	-0.347	2.493	-7.557
	(0.193)	(0.167)	(0.138)	(0.184)	(8.588)	(2.369)	(4.345)	(8.364)
Observations	1,242	1,241	1,241	1,240	792	791	791	790
R-squared	0.518	0.532	0.482	0.533				
Number of id	48	48	48	48	44	44	44	44
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Log GVCs is the logarithm of GVCs participation in terms of value-added (VS1 + FVA); Log VS1 is the logarithm of forward GVCs integration in terms of value-added; Log FVA is the logarithm of backward GVCs integration in terms of value-added. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A 7.10: Impact of GVCs on Growth Inequality (without control variables)

	OLS - Fixed – Effect				FE-IV			
VARIABLES	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)
Log GVCs	0.164***				1.439**			
	(0.0162)				(0.702)			
Log VS1		0.174***		0.174***		0.633***		0.645**
		(0.0146)		(0.0155)		(0.201)		(0.316)
Log FVA			0.0500***	0.00413			0.421	0.648
			(0.0129)	(0.0130)			(0.397)	(0.652)
Constant	-2.483***	-2.499***	-1.067***	-2.550***	-18.00**	-7.853***	-5.013	-15.06*
	(0.193)	(0.167)	(0.138)	(0.184)	(8.588)	(2.369)	(4.345)	(8.364)
Observations	1,242	1,241	1,241	1,240	792	791	791	790
R-squared	0.095	0.122	0.028	0.125				
Number of id	48	48	48	48	44	44	44	44
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Log GVCs is the logarithm of GVCs participation in terms of value-added (VS1 + FVA); Log VS1 is the logarithm of forward GVCs integration in terms of value-added; Log FVA is the logarithm of backward GVCs integration in terms of value-added. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A 7.11: Impact of GVCs on Gini Coefficient (without control variables)

	OLS - Fixed – Effect				FE-IV			
VARIABLES	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)
Log GVCs	0.0913***				1.573*			
	(0.0155)				(0.838)			
Log VS1		0.119***		0.135***		0.642***		0.662*
		(0.0142)		(0.0155)		(0.212)		(0.346)
Log FVA			0.0173	-0.0300**			0.391	0.687
			(0.0127)	(0.0137)			(0.490)	(0.858)
Constant	3.879***	3.617***	4.772***	3.753***	-14.20	-2.496	0.785	-10.23
	(0.185)	(0.162)	(0.136)	(0.174)	(10.26)	(2.507)	(5.374)	(10.83)
Observations	1,296	1,295	1,294	1,293	801	800	799	798
R-squared	0.398	0.416	0.389	0.426				
Number of id	48	48	48	48	45	45	45	45
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Log GVCs is the logarithm of GVCs participation in terms of value-added (VS1 + FVA); Log VS1 is the logarithm of forward GVCs integration in terms of value-added; Log FVA is the logarithm of backward GVCs integration in terms of value-added. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Chapter 8. Concluding remarks

In the current thesis, I investigate the determinants of GVCs participation as well as what happens when countries are well integrated into these GVCs. This thesis addresses a number of gaps in the existing literature on trade and GVCs. It is structured around six main chapters (excluding the general introduction and the conclusion) divided into two main parts. The first part, chapters 2 and 3, discusses the determinants of GVC integration, focusing on public policy and international assistance. It shows how education public expenditures and AfT can affect GVCs participation. The second part (chapters 4, 5, 6 and 7), focuses on the consequences of GVC integration. It assesses both positive and negative implications of developing countries' integration into GVCs. Chapters 4 and 5 warn that a simple shock related to uncertainty can spread through GVCs and have a negative impact on trade. Chapter 6 uses a specific case to investigate how interaction between countries through GVCs can lead to technology transfer. Finally, the last chapter assess whether GVCs participation by African countries has impacted growth and inequality.

Chapter 2 of this thesis discusses the importance of education expenditures for helping countries upgrade within GVCs and capture more value-added. Using two types of estimation methods, we showed that an increase in education expenditures positively impacts GVC integration. First, I used linear regressions—namely, panel fixed effects and IV estimations methods—and the results indicate a positive relationship between education expenditure and GVC integration. I further deepened the analysis by evaluating the response of GVC integration to an increase in public expenditure on education through a recent local projections method that makes it possible to construct IRFs. The result suggests a positive reaction of the GVC integration index to increasing education expenditures. This effect was found to be only significant from the third year (or the 6th year when considering time fixed effects). The impact of education public spending on GVC integration is therefore positive but not instantaneous. The lagged effect is expected given that education expenditure is composed of expenditures dedicated to primary, secondary, and tertiary education and before impact GVCs participation, education expenditures should be able to raise the level human capital. More importantly, the chapter sheds light on whether competition between nations in increasing education expenditures leads to more GVCs participation. Our findings suggest that investing in education expenditures improves the level of GVCs participation but that embarking on a competition to increase public spending on education has no significant effect on the level of GVCs participation. This competition effect is measured by identifying high increases in education expenditures, above regional mean. I demonstrate that increasing education expenditure more than the regional mean does not necessarily increase GVCs participation. This means that the quality of this expenditure and how it is used also matter. The positive impact of education expenditures channels through the impact of education on human capital. GVCs involve several segments, and a country's position along these chains depends on a set of internal variables and policies.

GVCs participation goes hand in hand with countries' endowment in skilled or unskilled labor. Thus, human capital has its importance in the process of integrations, and it determines countries' locations. Therefore, competition between countries does not lead to an increase in GVCs participation because of the quality and efficiency in the allocation of education public expenditures. Despite the importance of human capital, an increase in education expenditures does not necessarily translate into increased human capital. In addition, the extent to which increased education expenditures have positive externalities on human capital depends on the effectiveness of institutions. This condition, if not respected, breaks the transmission channel.

Chapter 3 goes in the same direction as chapter 2. In the same spirit of studying the determinants of GVC integration, we investigated whether AfT promotes developing countries' trade, helps them integrate themselves into international markets, and positively impacts their level of integration into GVCs. The results show that AfT has a positive and heterogenous impact on the GVCs participation of recipient countries by impacting domestic infrastructure and by improving the capacity of the private sector. AfT has a positive impact on value-added exported and on GVCs participation. My findings suggest that a 1% increase in AfT leads to a 0.047% increase in value-added exported. AfT has a positive and significant impact on both backward and forward GVC integration. Both panel fixed effects and IV results support the positive and significant impact of AfT on the level of GVCs participation. AfT comprises different categories: building productive capacity, economic infrastructure, trade policy regulation, and trade-related adjustment. All these categories directly affect important sectors of developing economies. Our findings indicate that AfT allocated to economic infrastructure positively impacts countries' domestic value-added exported, while the impact of AfT allocated to both building productive capacity and trade policy is not significant. According to the results, a 1% increase in AfT dedicated to trade infrastructures led to a 0.022% significant increase in domestic value-added. However, this effect varies depending on the region. AfT dedicated to building productive capacity positively impacts domestic value-added exported in American countries. AfT dedicated to improving economic infrastructure has a positive and significant impact in Africa and America. AfT dedicated to trade policy regulation only shows positive and significant results in Asia. These results may reflect the need of each region in terms of aid and may give an overview of sectors where AfT can be impactful. AfT composition also matters. Our results suggest that loans perform better than grants. A 1% AfT loan leads to a 0.18% significant increase in the beneficiary country's domestic value-added exported, while the effect of grants (although positive) is not significant. AfT is provided by DAC members, other bilateral providers, and multilateral institutions. The fixed-effect model shows that AfT has a positive and significant effect on the level of domestic value-added exported. However, this positive effect is only significant for DAC members and multilateral institutions. The impact of AfT on domestic value-added exported channels through increase in factors productivity and infrastructures, easing the production process and improving export capabilities. AfT directly impacts some areas of recipient

countries that are related to trade. In addition to the positive impact generated by AfT as currently structured, AfT can broaden its field of activity and be extended into the field of trade finance.

The lessons learned from this first part indicate that investing in education can promote GVCs participation and have a long-term effect on domestic value-added exports. However, the government still needs to ensure that this investment is efficient and not affected by any form of corruption. In addition, the first part of this thesis suggests that AfT offered by developing countries (depending on the source of this AfT and the sector of allocation) can have positive impacts on GVCs participation. This finding supports years of results on the determinants of GVCs participation.

Part I discusses the determinants of GVCs with the assumption that GVCs participation may benefit developing countries. The findings suggest that both education public expenditures and AfT positively impact GVCs participation. This thesis would have been incomplete without a focus on the implications of GVCs participation. The second part of the thesis focuses on the consequences (positive and negative) of integrating GVCs. The first two chapters of the second part investigate the effect of uncertainty, while the third chapter of the second part discusses how technology transfer occurs through GVCs.

Chapter 4 evaluates the impact of a negative shock (e.g., uncertainty in our case) on macroeconomic variables. Using a gravity model, the chapter investigated the impact of uncertainty on trade. The results indicate that an increase of uncertainty in both importer and exporter countries decreases bilateral trade. This result is also valid for trade uncertainty. Several reasons can explain this negative impact. In fact, in addition to the direct impact of uncertainty on productivity and income, the negative impact of uncertainty can be explained by an increase in risk aversion, which pushes countries to adopt restrictive measures that lower bilateral trade. An increase in risk aversion encourages both exporters and importers to diversify their trade partners. In addition to these transmission channels, uncertainty can affect trade by reducing trade finance availability and supply. African countries show different results, especially importing countries. The results highlight the dependence of African countries on imports. When the exporter is from an African country, both global uncertainty and trade uncertainty in the exporter and importer's country negatively impact bilateral trade. When the importer is an African country, both global and trade uncertainty in the exporter's country still negatively impact bilateral trade. However, the impact of uncertainty in the importer's country is either insignificant or positive, meaning that an increase in African countries' uncertainty increases their imports. This result highlights the dependence of African countries on imports for their basic needs, obliging them to continue importing in a period of uncertainty. Finally, for intra-African trade (when both the exporter and importer are African countries), the results corroborate the previous cases. Uncertainty in the exporter's country hurts bilateral trade, while uncertainty in the importer's country does not have any significant, clear impact on trade. We also investigated the impact of uncertainty on bilateral trade by type of products (sectors), according to the Standard International Trade Classification system (SITC). The results show that global uncertainty in both exporter and importer's countries hurts the bilateral trade of primary products. The results also

highlight that uncertainty in exporters and importers countries negatively impacts bilateral exports of manufacturing products. We also investigated the impact of uncertainty on bilateral oil trade. The findings suggest a negative impact of global uncertainty from all sides of borders on the bilateral trade of mineral fuel. Chapter 4 also studies the impact of uncertainty on bilateral trade when exporters or importers are among the top GVC production hubs. When the importer is among the top 10 traders, both uncertainty in the importer and exporter's country negatively impact bilateral trade. When the exporter is among the top 10 global traders, both global and trade uncertainty in the importer and the exporter's country have a negative and significant impact on bilateral trade. The chapter further investigated the spillover effects of uncertainty. It studied how uncertainty in important GVC production hubs can impact the trade of the rest of the world. The results suggest that global uncertainty in the top countries integrated into GVCs—namely, the US, China, and Germany—negatively impacts trade. In addition, trade uncertainty in the US and China has spillover effects on other countries' trade. Chapter 4 concludes that economic shocks resulting from uncertainty can spread through GVCs and that uncertainty in the world's biggest hubs spreads in the economy of the rest of the world through GVCs. We further investigated the consequences of GVCs using specific cases and relying on an event study methodology widely used in the finance literature. This case, presented in chapter 5, investigated how GVCs allow for the transmission of economic shocks. It focuses first on President Trump's election as an event date and then on COVID-19-related restrictions. The results indicate that uncertainty generated in a GVC production hub (the US in our case) can have negative spillover effects on the rest of the world. Independently from the drop in commodity prices and exchange rate fluctuations that have affected economies at the early stage of the COVID-19 pandemic, restrictive measures implemented by countries to combat COVID-19 have negatively impacted trade. More importantly, countries that are well integrated into GVCs have been most affected, but they are also the ones that recovered quickly. This recovery is a positive signal that GVCs are resilient and can lead to positive outcomes.

0 of the current thesis investigates the consequences of GVC integration, focusing on the benefits. Chapter 6 covers technology transfer through GVCs, focusing on the case of China and African countries. Results of both panel fixed effects and PSTR suggest that there is no direct technology transfer through FDIs in the relations between China and African countries—except for African countries that are well endowed with human capital. The results show the existence of a threshold of absorptive capacity of African countries (human capital level and institutional concerns), above which direct technology transfer (FDIs) through GVCs is effective. The results also suggest that this effect is true for low-income countries. Moreover, results also show the existence of indirect technology transfer (imports of intermediate goods). This transfer is robust to many specifications and the estimation method. The analysis of this chapter focuses on exports sophistication index as a measure of technology. The measure of technology sophistication as presented does not match with trade in value chains. This chapter has created a new measure of technological sophistication that matches better with trade through global

value chains. This new approach focuses on domestic value-added export sophistication instead of exports sophistication. It makes it possible to measure only technology created from the domestic value added (i.e., domestic value added effectively created by the country), thus withdrawing foreign technology embodied in gross exports. The results highlight the existence of indirect technology transfer through imports of intermediate goods and value-added imported, whereas direct technology transfer is not robust and always depends on the level of human capital.

Finally, the last chapter of the current dissertation — Chapter 7 — fills a gap in the literature regarding the relationship between GVCs participation and position and growth and income inequality for African countries. The chapter identifies four key results with strong policy implications. First, the sectoral GVCs participation indexes indicate that the participation of African countries in GVCs is increasing but significant heterogeneity remains and most of the countries are commodities based GVCs participation. Second, the chapter shows that GVCs participation increases income inequality despite increasing GDP per capita. Third, forward GVCs is positively associated with economic growth and inequality but backward GVCs do not provide accurate results. Finally, the chapter shows that the positive relationship between GVCs and GDP per capita is explained by trading in knowledge intensive goods and services. These four findings have strong policy implication.

The findings clearly highlight the importance of promoting GVCs as they have the potential to stimulate economic growth which may enable some leapfrogging of African nations. In this case, investments in knowledge intensive goods and services should take central stage given their established relationship with growth but more importantly that they may raise the necessity to implement redistribution policy to improve national wealth redistribution such that inequality can be reduced. The chapter closes a wide and complete analysis that starts with understanding how developing countries can promote GVCs participation and end with the consequences of such integration. After showing that GVCs participation can be a source of spread in uncertainty, the current dissertation show that it can also help upgrade technology of African countries and increase income per capitata. However, efforts need to be done to improve the repartition of these gains from GVCs participation.

In terms of policy implications, all the chapters of the current dissertation bring something new to the literature. If well managed, it can help developing countries' policymakers handle their countries' strategies regarding GVCs. The key takeaway from this dissertation is that GVCs participation can foster nation growth and provide diverse gains such as technology transfer and increased productivity. In terms of policy implications, the findings clearly highlight the importance of promoting GVCs as they have the potential to stimulate economic growth, which may enable some leapfrogging of African and other developing nations. Improving knowledge intensive goods and services trade is necessary and important to leverage gains from GVCs trade. To promote developing countries' integration, governments need to invest more and efficiently in human capital in addition to the required infrastructures, but their development partners also need to well manage their support and provide aid to sectors in need.

However, despite the potential gains from GVCs participation, countries that participate actively in GVCs trade see an increase in inequality and are subject to the quick transmission of economic shocks. These negative consequences of GVCs participation raise the necessity to implement a redistribution policy to reduce inequality. It also paradoxically raises the question of the necessity of developing countries to protect from shocks without retrenching from these chains. The only way to do so is to diversify trade partners and to have a clear mapping of essential product routes and chains.

References

Abreha, K., Lartey, E., Mengistae, T., Owusu, S., & Zeufack, A. (2020). *Africa in Manufacturing Global Value Chains*.

Ademola, O. T., Bankole, A. S., & Adewuyi, A. O. (2009). China–Africa Trade Relations: Insights from AERC Scoping Studies. *The European Journal of Development Research*, *21*(4), 485–505.

AfDB, OCDE, & UNDP. (2014). *African Economic Outlook 2014*. https://www.oecd-ilibrary.org/content/publication/aeo-2014-en

Aggarwal, R. (2013). LDCs and Global Value Chains: Using Aid for Trade to Seize New Opportunities. *International Trade Centre (ITC), Geneva: ITC*, *xii*, 24 pages.

Ahir, H., Bloom, N., & Furceri, D. (2018). *The World Uncertainty Index* (SSRN Scholarly Paper ID 3275033). Social Science Research Network. https://doi.org/10.2139/ssrn.3275033

Ahir, H., Bloom, N., & Furceri, D. (2022). *The World Uncertainty Index* (Working Paper No. 29763; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w29763

Aitken, B. J., & Harrison, A. E. (1999). Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela. *American Economic Review*, *89*(3), 605–618. https://doi.org/10.1257/aer.89.3.605

Aizenman, J., Chinn, M. D., & Ito, H. (2016). Monetary policy spillovers and the trilemma in the new normal: Periphery country sensitivity to core country conditions. *Journal of International Money and Finance*, 33.

Akıncı, Ö. (2013). Global financial conditions, country spreads and macroeconomic fluctuations in emerging countries. *Journal of International Economics*, *91*(2), 358–371. https://doi.org/10.1016/j.jinteco.2013.07.005

Alden, C., & Alves, C. (2008). History & Identity in the Construction of China's Africa Policy. *Review of African Political Economy*, *35*(115), 43–58. https://doi.org/10.1080/03056240802011436

Alfaro, L., Chanda, A., Kalemli-Ozcan, S., & Sayek, S. (2004). FDI and economic growth: The role of

local financial markets. *Journal of International Economics*, *64*(1), 89–112. https://doi.org/10.1016/S0022-1996(03)00081-3

Ali, S., & Dadush, U. (2011). The rise of trade in intermediates: Policy implications. *International Economic Bulletin*, *10*.

Allard, C., Kriljenko, J. I. C., Chen, W., Gonzalez-Garcia, J. R., Kitsios, E., & Treviño, J. (2016). Trade Integration and Global Value Chains in Sub-Saharan Africa: In Pursuit of the Missing Link. *Departmental Papers*, *2016*(004). https://doi.org/10.5089/9781498349901.087.A001

Amiti, M., & Konings, J. (2007). Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia. *American Economic Review*, *97*(5), 1611–1638. https://doi.org/10.1257/aer.97.5.1611

Anderson, J. E., & van Wincoop, E. (2003). Gravity with Gravitas: A Solution to the Border Puzzle. *American Economic Review*, *93*(1), 170–192. https://doi.org/10.1257/000282803321455214

Anderson, R. M., Heesterbeek, H., Klinkenberg, D., & Hollingsworth, T. D. (2020). How will country-based mitigation measures influence the course of the COVID-19 epidemic? *The Lancet*, *395*(10228), 931–934. https://doi.org/10.1016/S0140-6736(20)30567-5

Antràs, P. (2020). Conceptual Aspects of Global Value Chains. *The World Bank Economic Review*, *34*(3), 551–574. https://doi.org/10.1093/wber/lhaa006

Antràs, P., & de Gortari, A. (2017). *On the Geography of Global Value Chains* (Working Paper No. 23456; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w23456

Arkolakis, C., Costinot, A., & Rodríguez-Clare, A. (2012). New Trade Models, Same Old Gains? *American Economic Review*, *102*(1), 94–130. https://doi.org/10.1257/aer.102.1.94

Armitage, S. (1995). Event Study Methods and Evidence on Their Performance. *Journal of Economic Surveys*, *9*(1), 25–52. https://doi.org/10.1111/j.1467-6419.1995.tb00109.x

Arndt, C., Jones, S., & Tarp, F. (2015). Assessing Foreign Aid's Long-Run Contribution to Growth and Development. *World Development*, *69*, 6–18.

https://doi.org/10.1016/j.worlddev.2013.12.016

Asiedu, E. (2006). Foreign Direct Investment in Africa: The Role of Natural Resources, Market Size, Government Policy, Institutions and Political Instability. *The World Economy*, *29*(1), 63–77. https://doi.org/10.1111/j.1467-9701.2006.00758.x

Atkeson, A. (2020). *What Will Be the Economic Impact of COVID-19 in the US? Rough Estimates of Disease Scenarios* (Working Paper No. 26867; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w26867

Atkin, D., Khandelwal, A. K., & Osman, A. (2014). *Exporting and Firm Performance: Evidence from a Randomized Trial* (Working Paper No. 20690). National Bureau of Economic Research. https://doi.org/10.3386/w20690

Autor, D. H., Dorn, D., & Hanson, G. H. (2013). The China Syndrome: Local Labor Market Effects of Import Competition in the United States. *American Economic Review*, *103*(6), 2121–2168. https://doi.org/10.1257/aer.103.6.2121

Baccini, L., Fiorini, M., Hoekman, B., Altomonte, C., & Colantone, I. (2021). *Global Value Chains and Deep Integration* [Working Paper]. World Bank. https://doi.org/10.1596/1813-9450-9598

Baker, S., & Fradkin, A. (2017). The Impact of Unemployment Insurance on Job Search: Evidence from Google Search Data. *The Review of Economics and Statistics*, *99*(5). https://econpapers.repec.org/article/tprrestat/v_3a99_3ay_3a2017_3ai_3a5_3ap_3a756-768.htm

Balassa, B. (1965). Tariff Protection in Industrial Countries: An Evaluation. *Journal of Political Economy*, *73*(6), 573–594. https://doi.org/10.1086/259085

Balasubramanyam, V. N., Salisu, M., & Sapsford, D. (1996). Foreign Direct Investment and Growth in EP and is Countries. *The Economic Journal*, *106*(434), 92–105. https://doi.org/10.2307/2234933

Baldwin, R. (2009). *Integration of the North American Economy and New-Paradigm Globalisation* (SSRN Scholarly Paper ID 1507519). Social Science Research Network.

https://papers.ssrn.com/abstract=1507519

Baldwin, R. (2012). *Global supply chains: Why they emerged, why they matter, and where they are going* (CEPR Discussion Paper No. 9103). C.E.P.R. Discussion Papers. https://econpapers.repec.org/paper/cprceprdp/9103.htm

Banga, K. (2016). Impact of Global Value Chains on Employment in India. *Journal of Economic Integration*, *31*(3), 631–673.

Baqaee, D., Farhi, E., Mina, M., & Stock, J. H. (2020). Policies for a second wave. *Brookings Papers on Economic Activity*, *2020*(2), 385–443.

Bas, M., & Strauss-Kahn, V. (2015). Input-trade liberalization, export prices and quality upgrading. *Journal of International Economics*, *95*(2), 250–262. https://doi.org/10.1016/j.jinteco.2014.12.005

Basnett, Y., Kennan, J., Massa, I., & Velde, D. W. te. (2014, June 27). *Increasing the effectiveness of Aid for Trade: The circumstances under which it works best*. ODI: Think Change. https://odi.org/en/publications/increasing-the-effectiveness-of-aid-for-trade-the-circumstances-under-which-it-works-best/

Bastos, P., & Silva, J. (2010). The quality of a firm's exports: Where you export to matters. *Journal of International Economics*, *82*(2), 99–111. https://doi.org/10.1016/j.jinteco.2010.07.001

BBC News. (2017, April 25). President Trump: Seven ways the world has changed. *BBC News*. https://www.bbc.com/news/election-us-2016-37918242

Bearce, D. H., Finkel, S. E., Pérez-Liñán, A. S., Rodríguez-Zepeda, J., & Surzhko-Harned, L. (2013). Has the New Aid for Trade Agenda been Export Effective? Evidence on the Impact of US AfT Allocations 1999-2008. *International Studies Quarterly*, *57*(1), 163–170.

Beck, T., & Laeven, L. (2006). Institution building and growth in transition economies. *Journal of Economic Growth*, *11*(2), 157–186. https://doi.org/10.1007/s10887-006-9000-0

Becker, S., Ekholm, K., & Muendler, M.-A. (2013). Offshoring and the onshore composition of tasks and skills. *Journal of International Economics*, *90*(1), 91–106.

Beghin, J. C., Disdier, A.-C., & Marette, S. (2015). Trade restrictiveness indices in the presence of externalities: An application to non-tariff measures. *Canadian Journal of Economics/Revue Canadienne d'économique*, *48*(4), 1513–1536. https://doi.org/10.1111/caje.12157

Bergstrand, J. H. (1985). The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence. *The Review of Economics and Statistics*, *67*(3), 474–481. https://doi.org/10.2307/1925976

Bernard, A. B., Moxnes, A., & Ulltveit-Moe, K. H. (2018). Two-Sided Heterogeneity and Trade. *The Review of Economics and Statistics*, *100*(3), 424–439. https://doi.org/10.1162/rest_a_00721

Bhattarai, S., Chatterjee, A., & Park, W. Y. (2020). Global spillover effects of US uncertainty. *Journal of Monetary Economics*, *114*, 71–89. https://doi.org/10.1016/j.jmoneco.2019.05.008

Binder, J. (1998). The Event Study Methodology Since 1969. *Review of Quantitative Finance and Accounting*, *11*(2), 111–137. https://doi.org/10.1023/A:1008295500105

Blind, K., Mangelsdorf, A., & Wilson, J. S. (2013). 12 Mutual Recognition of Accreditation: Does it Matter to Trade? Evidence from the Food, Beverage, and Tobacco Industry. In J. C. Beghin (Ed.), *Nontariff Measures with Market Imperfections: Trade and Welfare Implications* (Vol. 12, pp. 291–310). Emerald Group Publishing Limited. https://doi.org/10.1108/S1574-8715(2013)0000012017

Bloom, N. (2009). The Impact of Uncertainty Shocks. *Econometrica*, *77*(3), 623–685. https://doi.org/10.3982/ECTA6248

Bloom, N., Floetotto, M., Jaimovich, N., Saporta-Eksten, I., & Terry, S. J. (2012). *Really Uncertain Business Cycles* (Working Paper No. 18245; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w18245

Bloom, N., & Reenen, J. V. (2011). Chapter 19—Human Resource Management and Productivity. In D. Card & O. Ashenfelter (Eds.), *Handbook of Labor Economics* (Vol. 4, pp. 1697–1767). Elsevier. https://doi.org/10.1016/S0169-7218(11)02417-8

Boehm, C. E., Flaaen, A., & Pandalai-Nayar, N. (2019). Input Linkages and the Transmission of Shocks:

Firm-Level Evidence from the 2011 Tōhoku Earthquake. *The Review of Economics and Statistics*, *101*(1), 60–75.

Borensztein, E., De Gregorio, J., & Lee, J.-W. (1998). How does foreign direct investment affect economic growth?1We are grateful for comments from Robert Barro, Elhanan Helpman, Boyan Jovanovic, Mohsin Khan, Se-Jik Kim, Donald Mathieson, Sergio Rebelo, Jeffrey Sachs, Peter Wickham, and two anonymous referees. Comments by participants in seminars at 1995 World Congress of the Econometric Society, Korean Macroeconomics Workshop, Kobe University, and Osaka University were very helpful. This paper was partially prepared while José de Gregorio and Jong-Wha Lee were at the Research Department, International Monetary Fund. Any opinions expressed are only those of the authors and not those of the institutions with which the authors are affiliated.1. *Journal of International Economics*, *45*(1), 115–135. https://doi.org/10.1016/S0022-1996(97)00033-0

Bown, C. P., & Kolb, M. (2018, April 16). *Trump's Trade War Timeline: An Up-to-Date Guide*. PIIE. https://www.piie.com/blogs/trade-investment-policy-watch/trump-trade-war-china-date-guide

Bratt, M. (2014). Estimating the bilateral impact of non-tariff measures (NTMs)(No. 14011). *Institut d'Economie et Econométrie, Université de Genève*.

Braun, M. (2005). *Financial Contractability and Asset Hardness* (SSRN Scholarly Paper ID 2522890). Social Science Research Network. https://doi.org/10.2139/ssrn.2522890

Brazys, S. R. (2013). Evidencing donor heterogeneity in Aid for Trade. *Review of International Political Economy*, *20*(4), 947–978. https://doi.org/10.1080/09692290.2012.734254

Brenton, P., & von Uexkull, E. (2009). Product specific technical assistance for exports – has it been effective? *The Journal of International Trade & Economic Development*, *18*(2), 235–254. https://doi.org/10.1080/09638190902916444

Brown, S. J., & Warner, J. B. (1985). Using daily stock returns: The case of event studies. *Journal of Financial Economics*, *14*(1), 3–31. https://doi.org/10.1016/0304-405X(85)90042-X

Bruhn, D. (2014). *Global Value Chains and Deep Preferential Trade Agreements: Promoting Trade at the Cost of Domestic Policy Autonomy?* (SSRN Scholarly Paper ID 2464136). Social Science Research Network. https://doi.org/10.2139/ssrn.2464136

Brülhart, M., & Trionfetti, F. (2004). Public expenditure, international specialisation and agglomeration. *European Economic Review*, *48*(4), 851–881. https://doi.org/10.1016/j.euroecorev.2003.09.002

Buelens, C., & Tirpák, M. (2017). Reading the Footprints: How Foreign Investors Shape Countries' Participation in Global Value Chains. *Comparative Economic Studies*, *59*(4), 561–584. https://doi.org/10.1057/s41294-017-0036-2

Burnside, C., & Dollar, D. (2000). Aid, Policies, and Growth. *American Economic Review*, *90*(4), 847–868. https://doi.org/10.1257/aer.90.4.847

Cadot, O., Fernandes, A., Gourdon, J., Mattoo, A., & de Melo, J. (2014). *Evaluating Aid for Trade: A Survey of Recent Studies*. World Bank. https://doi.org/10.1596/1813-9450-6742

Cai, K. G. (1999). Outward Foreign Direct Investment: A Novel Dimension of China's Integration into the Regional and Global Economy*. *The China Quarterly*, *160*, 856–880. https://doi.org/10.1017/S0305741000001363

Cali, M., Francois, J., Hollweg, C. H., Manchin, M., Oberdabernig, D. A., Rojas Romagosa, H. A., Rubinova, S., & Tomberger, P. (2016). The labor content of exports database. In *Policy Research Working Paper Series* (No. 7615; Policy Research Working Paper Series). The World Bank. https://ideas.repec.org/p/wbk/wbrwps/7615.html

Calì, M., & te Velde, D. W. (2011). Does Aid for Trade Really Improve Trade Performance? *World Development*, *39*(5), 725–740. https://doi.org/10.1016/j.worlddev.2010.09.018

CALIENDO, L., & PARRO, F. (2015). Estimates of the Trade and Welfare Effects of NAFTA. *The Review of Economic Studies*, *82*(1 (290)), 1–44.

Canova, F. (2005). The transmission of US shocks to Latin America. *Journal of Applied Econometrics*, *20*(2), 229–251. https://doi.org/10.1002/jae.837

Caraballo, J. G., & Jiang, X. (2016). Value-Added Erosion in Global Value Chains: An Empirical Assessment. *Journal of Economic Issues*, *50*(1), 288–296. https://doi.org/10.1080/00213624.2016.1148991

Cariolle, J., & Goujon, M. (2015). Measuring Macroeconomic Instability: A Critical Survey Illustrated with Exports Series. *Journal of Economic Surveys*, *29*(1), 1–26. https://doi.org/10.1111/joes.12036

Carpa, N., & Martínez-Zarzoso, I. (2022). The impact of global value chain participation on income inequality. *International Economics*, *169*, 269–290. https://doi.org/10.1016/j.inteco.2022.02.002

Carrère, C., & Schiff, M. (2005). On the Geography of Trade: Distance Is Alive and Well. *Revue Économique*, *56*(6), 1249–1274.

Carrière-Swallow, Y., & Céspedes, L. F. (2013). The impact of uncertainty shocks in emerging economies. *Journal of International Economics*, *90*(2), 316–325. https://doi.org/10.1016/j.jinteco.2013.03.003

Cattaneo, O., Gereffi, G., Miroudot, S., & Taglioni, D. (2013). *Joining, Upgrading and Being Competitive in Global Value Chains: A Strategic Framework*. World Bank. https://doi.org/10.1596/1813-9450-6406

Cavallo, E., & Frankel, J. (2008). Does openness to trade make countries more vulnerable to sudden stops, or less? Using gravity to establish causality. *Journal of International Money and Finance*, *27*(8), 1430–1452.

Chaney, T. (2018). The Gravity Equation in International Trade: An Explanation. *Journal of Political Economy*, *126*(1), 150–177.

Chang, R., Kaltani, L., & Loayza, N. (2009). Openness can be good for growth: The role of policy complementarities. *Journal of Development Economics*, *90*(1), 33–49.

Chen, G., Geiger, M., & Fu, M. (2015). *Manufacturing FDI in Sub-Saharan Africa*.

Chen, S., Datt, G., & Ravallion, M. (1994). Is poverty increasing in the developing world? *Review of*

Income and Wealth, *40*(4), 359–376.

Chen, W., Dollar, D., & Tang, H. (2016). Why is China investing in Africa? Evidence from the firm level. *The World Bank Economic Review*, *32*(3), 610–632.

Chen, W., Dollar, D., & Tang, H. (2018). Why Is China Investing in Africa? Evidence from the Firm Level. *The World Bank Economic Review*, *32*(3), 610–632. https://doi.org/10.1093/wber/lhw049

Cheng, F. (2007). *Tariff Escalation in World Agricultural Trade*. https://ecommons.cornell.edu/handle/1813/55744

Cheng, K., Seneviratne, D., Rehman, S., & Zhang, S. (2015). *Reaping the Benefits from Global Value Chains* (IMF Working Paper No. 2015/204). International Monetary Fund. https://econpapers.repec.org/paper/imfimfwpa/2015_2f204.htm

Chor, D. (2010). Unpacking sources of comparative advantage: A quantitative approach. *Journal of International Economics*, *82*(2), 152–167. https://doi.org/10.1016/j.jinteco.2010.07.004

Cirera, X., & Winters, L. A. (2015). *Aid for Trade and Structural Transformation in Sub-Saharan Africa*. Commonwealth iLibrary. https://doi.org/10.14217/5js6b1lp69ms-en

Clark, D. P. (2007). Distance, production, and trade. *The Journal of International Trade & Economic Development*, *16*(3), 359–371. https://doi.org/10.1080/09638190701526709

Cohen, W. M., & Levin, R. C. (1989). Chapter 18 Empirical studies of innovation and market structure. In *Handbook of Industrial Organization* (Vol. 2, pp. 1059–1107). Elsevier. https://doi.org/10.1016/S1573-448X(89)02006-6

Colletaz, G., & Hurlin, C. (2006). *Threshold Effects of the Public Capital Productivity: An International Panel Smooth Transition Approach*. https://halshs.archives-ouvertes.fr/halshs-00008056

Constantinescu, C., Mattoo, A., & Ruta, M. (2017). *Does Vertical Specialization Increase Productivity?* [Working Paper]. World Bank. https://doi.org/10.1596/1813-9450-7978

Constantinescu, C., Mattoo, A., & Ruta, M. (2019). Does vertical specialisation increase productivity? *The World Economy*, *42*(8), 2385–2402. https://doi.org/10.1111/twec.12801

Costa, C., & Delgado, C. (2019). *The Cashew Value Chain in Mozambique* [Working Paper]. World Bank. https://doi.org/10.1596/31863

Costinot, A. (2009). An Elementary Theory of Comparative Advantage. *Econometrica*, *77*(4), 1165–1192. https://doi.org/10.3982/ECTA7636

Costinot, A., Vogel, J., & Wang, S. (2013). An Elementary Theory of Global Supply Chains. *The Review of Economic Studies*, *80*(1), 109–144. https://doi.org/10.1093/restud/rds023

Danilov, D., & Magnus, J. R. (2004). On the harm that ignoring pretesting can cause. *Journal of Econometrics*, *122*(1), 27–46. https://doi.org/10.1016/j.jeconom.2003.10.018

Daudin, G., Rifflart, C., & Schweisguth, D. (2011). Who produces for whom in the world economy? *Canadian Journal of Economics/Revue Canadienne d'économique*, *44*(4), 1403–1437. https://doi.org/10.1111/j.1540-5982.2011.01679.x

Dawson, J. W. (1998). Institutions, Investment, and Growth: New Cross-Country and Panel Data Evidence. *Economic Inquiry*, *36*(4), 603–619. https://doi.org/10.1111/j.1465-7295.1998.tb01739.x

de Almeida, F. M., da Cruz Vieira, W., & da Silva, O. M. (2012). SPS and TBT agreements and international agricultural trade: Retaliation or cooperation? *Agricultural Economics*, *43*(2), 125–132. https://doi.org/10.1111/j.1574-0862.2011.00570.x

De Loecker, J., Goldberg, P. K., Khandelwal, A. K., & Pavcnik, N. (2016). Prices, Markups, and Trade Reform. *Econometrica*, *84*(2), 445–510. https://doi.org/10.3982/ECTA11042

Dearden, L., Reed, H., & Van Reenen, J. (2006). The Impact of Training on Productivity and Wages: Evidence from British Panel Data*. *Oxford Bulletin of Economics and Statistics*, *68*(4), 397–421. https://doi.org/10.1111/j.1468-0084.2006.00170.x

Deininger, K., & Squire, L. (1996). A New Data Set Measuring Income Inequality. *The World Bank Economic Review*, *10*(3), 565–591.

Disdier, A.-C., Fontagné, L., & Mimouni, M. (2008). The Impact of Regulations on Agricultural Trade: Evidence from the SPS and TBT Agreements. *American Journal of Agricultural Economics*,

90(2), 336–350. https://doi.org/10.1111/j.1467-8276.2007.01127.x

Dollar, D. (2016). China's engagement with Africa. *From Natural Resources to Human Resources*.

Donou-Adonsou, F., & Lim, S. (2018). On the importance of Chinese investment in Africa. *Review of Development Finance*, *8*(1), 63–73. https://doi.org/10.1016/j.rdf.2018.05.003

Doucouliagos, H., & Paldam, M. (2007). *The Aid Effectiveness Literature: The Sad Results of 40 Years of Research* [Working Paper]. Faculty of Economics. https://doi.org/10.17863/CAM.5143

Dünhaupt, P., & Herr, H. (2021). Global value chains – a ladder for development? *International Review of Applied Economics*, *35*(3–4), 456–474. https://doi.org/10.1080/02692171.2020.1815665

Durowah, O. (2017). The Role of Aid for Trade and Foreign Direct Investment in Poverty Reduction: A Panel Data Analysis of 91 Developing Countries. *Electronic Theses and Dissertations*. https://openprairie.sdstate.edu/etd/1187

Eaton, J., & Kortum, S. (2001). Trade in capital goods. *European Economic Review*, *45*(7), 1195–1235. https://doi.org/10.1016/S0014-2921(00)00103-3

Edeme, R. K., Nkalu, C. N., & Ifelunini, I. A. (2017). Distributional impact of public expenditure on human development in Nigeria. *International Journal of Social Economics*, *44*(12), 1683–1693. https://doi.org/10.1108/IJSE-05-2016-0152

Eichenbaum, M. S., Rebelo, S., & Trabandt, M. (2021). The Macroeconomics of Epidemics. *The Review of Financial Studies*, *34*(11), 5149–5187. https://doi.org/10.1093/rfs/hhab040

Fan, H., Lin, F., & Tang, L. (2018). Minimum wage and outward FDI from China. *Journal of Development Economics*, *135*. https://doi.org/10.1016/j.jdeveco.2018.06.013

Farhani, R., Mhamdi, G., Aguir, A., & Smida, M. (2015). Effect of Financial Liberalization on the Probability of Occurrence of Banking Crises. *Expert Journal of Economics*, http://economics.expertjournals.com/wp.

Farole, T. (2016). Do global value chains create jobs? *IZA World of Labor*. https://doi.org/10.15185/izawol.291

Farole, T., & Winkler, D. (2014). *Making Foreign Direct Investment Work for Sub-Saharan Africa: Local Spillovers and Competitiveness in Global Value Chains*. World Bank. https://doi.org/10.1596/978-1-4648-0126-6

Fauci, A. S., Lane, H. C., & Redfield, R. R. (2020). Covid-19—Navigating the Uncharted. *New England Journal of Medicine*, *382*(13), 1268–1269. https://doi.org/10.1056/NEJMe2002387

Fauzel*, S., Seetanah, B., & Sannassee, R. (2015). Foreign direct investment and welfare nexus in sub Saharan Africa. *The Journal of Developing Areas*, *49*(4), 271–283. https://doi.org/10.1353/jda.2015.0133

Feenstra, R. C., & Hanson, G. H. (1997). Foreign direct investment and relative wages: Evidence from Mexico's maquiladoras. *Journal of International Economics*, *42*(3), 371–393. https://doi.org/10.1016/S0022-1996(96)01475-4

Feenstra, R., & Hanson, G. (1995). *Foreign Investment, Outsourcing and Relative Wages* (NBER Working Paper No. 5121). National Bureau of Economic Research, Inc. https://econpapers.repec.org/paper/nbrnberwo/5121.htm

Felbermayr, G., Teti, F., & Yalcin, E. (2019). Rules of origin and the profitability of trade deflection. *Journal of International Economics*, *121*, 103248. https://doi.org/10.1016/j.jinteco.2019.07.003

Fernandes, A., Kee, H. L., & Winkler, D. (2020). *Determinants of Global Value Chain Participation: Cross-Country Evidence* [Working Paper]. World Bank. https://doi.org/10.1596/1813-9450-9197

Fernandes, A. M., Kee, H. L., & Winkler, D. (2019). Factors affecting global value chain participation across countries. *Policy Research Working Paper. World Bank, Washington DC*.

Ferro, E., Portugal-Perez, A., & Wilson, J. S. (2014). Aid to the Services Sector: Does it Affect Manufacturing Exports? *The World Economy*, *37*(4), 530–541. https://doi.org/10.1111/twec.12151

Filip, B. F. (2016). Total Factor Productivity Determinants in Developed European Countries. *Journal*

of Public Administration, Finance and Law, *10*, 123–131.

Fink, F., & Schüler, Y. S. (2015). The transmission of US systemic financial stress: Evidence for emerging market economies. *Journal of International Money and Finance*, *55*, 6–26. https://doi.org/10.1016/j.jimonfin.2015.02.019

Foster-McGregor, N., Kaulich, F., & Stehrer, R. (2015). *Global Value Chains in Africa* (MERIT Working Paper No. 2015–024). United Nations University - Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT). https://econpapers.repec.org/paper/unmunumer/2015024.htm

Fowowe, B., & Shuaibu, M. I. (2014). Is foreign direct investment good for the poor? New evidence from African countries. *Economic Change and Restructuring*, *47*(4), 321–339. https://doi.org/10.1007/s10644-014-9152-4

Fu, X. (2008). Foreign Direct Investment, Absorptive Capacity and Regional Innovation Capabilities: Evidence from China. *Oxford Development Studies*, *36*(1), 89–110. https://doi.org/10.1080/13600810701848193

Furceri, D., & Zdzienicka, A. (2012). Banking Crises and Short and Medium Term Output Losses in Emerging and Developing Countries: The Role of Structural and Policy Variables. *World Development*, *40*(12), 2369–2378. https://doi.org/10.1016/j.worlddev.2012.03.021

Ghimire, S., Mukherjee, D., & Alvi, E. (2016). Aid-for-trade and export performance of developing countries. *Applied Econometrics and International Development*, *16*(1).

Ghodsi, M. (2015). *Determinants of Specific Trade Concerns Raised on Technical Barriers to Trade* (Working Paper No. 115). wiiw Working Paper. https://www.econstor.eu/handle/10419/203980

Giovanni, J. di, Levchenko, A. A., & Mejean, I. (2018). The Micro Origins of International Business-Cycle Comovement. *American Economic Review*, *108*(1), 82–108.

Glick, R., & Rose, A. K. (1999). Contagion and trade: Why are currency crises regional? *Journal of International Money and Finance*, *18*(4), 603–617. https://doi.org/10.1016/S0261-

5606(99)00023-6

Gnangnon, S. K. (2019a). Aid for Trade and Employment in Developing Countries: An Empirical Evidence. *LABOUR*, *33*(1), 77–100. https://doi.org/10.1111/labr.12139

Gnangnon, S. K. (2019b). Aid for Trade and Recipient Countries' Export Structure: Does Trade Policy Liberalisation Matter? *Arthaniti: Journal of Economic Theory and Practice*, *18*(1), 56–85. https://doi.org/10.1177/0976747918806361

Góes, C. (2016). Institutions and growth: A GMM/IV Panel VAR approach. *Economics Letters*, *138*, 85–91. https://doi.org/10.1016/j.econlet.2015.11.024

Gohou, G., & Soumaré, I. (2012). Does Foreign Direct Investment Reduce Poverty in Africa and are There Regional Differences? *World Development*, *40*(1), 75–95. https://doi.org/10.1016/j.worlddev.2011.05.014

Goldberg, P. K., Khandelwal, A. K., Pavcnik, N., & Topalova, P. (2010). Imported Intermediate Inputs and Domestic Product Growth: Evidence from India. *The Quarterly Journal of Economics*, *125*(4), 1727–1767. https://doi.org/10.1162/qjec.2010.125.4.1727

Goldberg, P. K., & Pavcnik, N. (2007). Distributional Effects of Globalization in Developing Countries. *Journal of Economic Literature*, *45*(1), 39–82. https://doi.org/10.1257/jel.45.1.39

Gomanee, K., Girma, S., & Morrissey, O. (2005). Aid and growth in Sub-Saharan Africa: Accounting for transmission mechanisms. *Journal of International Development*, *17*(8), 1055–1075. https://doi.org/10.1002/jid.1259

Gonzalez, A., Terasvirta, T., & van Dijk, D. (2004). *Panel Smooth Transition Regression model and an application to investment under credit constraints*. 29.

Granger, C. W. J., & Terasvirta, T. (1993). *Modelling Non-Linear Economic Relationships*. Oxford University Press. https://ideas.repec.org/b/oxp/obooks/9780198773207.html

Graziano, A., Handley, K., & Limão, N. (2018). *Brexit Uncertainty and Trade Disintegration* (Working Paper No. 25334; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w25334

Grier, K. B., & Smallwood, A. D. (2007). Uncertainty and Export Performance: Evidence from 18 Countries. *Journal of Money, Credit and Banking*, *39*(4), 965–979. https://doi.org/10.1111/j.1538-4616.2007.00053.x

Griliches, Z. (1969). Capital-Skill Complementarity. *The Review of Economics and Statistics*, *51*(4), 465–468. https://doi.org/10.2307/1926439

Grossman, G. M., & Rossi-Hansberg, E. (2008). Trading Tasks: A Simple Theory of Offshoring. *American Economic Review*, *98*(5), 1978–1997. https://doi.org/10.1257/aer.98.5.1978

Ha, J., Kose, A., & Ohnsorge, F. L. (2019). *Global Inflation Synchronization*. The World Bank. https://doi.org/10.1596/1813-9450-8768

Hansen, B. E. (1999). Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of Econometrics*, *93*(2), 345–368. https://doi.org/10.1016/S0304-4076(99)00025-1

Hansen, H., & Tarp, F. (2001). Aid and growth regressions. *Journal of Development Economics*, *64*(2), 547–570. https://doi.org/10.1016/S0304-3878(00)00150-4

Hansson, B. (2009). *Job-Related Training and Benefits for Individuals: A Review of Evidence and Explanations* (SSRN Scholarly Paper ID 1347622). Social Science Research Network. https://doi.org/10.2139/ssrn.1347622

Hansson, P., & Henrekson, M. (1994). A new framework for testing the effect of government spending on growth and productivity. *Public Choice*, *81*(3), 381–401. https://doi.org/10.1007/BF01053239

Hasson, J. A. (1964). Review of Shaping the World Economy: Suggestions for an International Economic Policy [Review of *Review of Shaping the World Economy: Suggestions for an International Economic Policy*, by J. Tinbergen]. *Economica*, *31*(123), 327–330. https://doi.org/10.2307/2550637

Hausmann, R., Hwang, J., & Rodrik, D. (2007). What You Export Matters. *Journal of Economic Growth*, *12*(1), 1–25.

Havranek, T., & Irsova, Z. (2011). Estimating vertical spillovers from FDI: Why results vary and what

the true effect is. *Journal of International Economics*, *85*(2), 234–244. https://doi.org/10.1016/j.jinteco.2011.07.004

Helble, M., Mann, C. L., & Wilson, J. S. (2012). Aid-for-trade facilitation. *Review of World Economics / Weltwirtschaftliches Archiv*, *148*(2), 357–376.

Helpman, E., Itskhoki, O., Muendler, M.-A., & Redding, S. J. (2017). Trade and inequality: From theory to estimation. *The Review of Economic Studies*, *84*(1), 357–405.

Helpman, E., & Krugman, P. (1985). *Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition, and the International Economy*. MIT Press.

Herzer, D. (2013). Cross-Country Heterogeneity and the Trade-Income Relationship. *World Development*, *44*, 194–211. https://doi.org/10.1016/j.worlddev.2012.09.014

Hijzen, A., Martins, P. S., Schank, T., & Upward, R. (2013). Foreign-owned firms around the world: A comparative analysis of wages and employment at the micro-level. *European Economic Review*, *60*, 170–188. https://doi.org/10.1016/j.euroecorev.2013.02.001

Hühne, P., Meyer, B., & Nunnenkamp, P. (2014a). *Aid for trade: Assessing the effects on recipient exports of manufactures and primary commodities to donors and non-donors* (Kiel Working Paper No. 1953). Kiel Institute for the World Economy (IfW Kiel). https://econpapers.repec.org/paper/zbwifwkwp/1953.htm

Hühne, P., Meyer, B., & Nunnenkamp, P. (2014b). Who Benefits from Aid for Trade? Comparing the Effects on Recipient versus Donor Exports. *The Journal of Development Studies*, *50*(9), 1275–1288. https://doi.org/10.1080/00220388.2014.903246

Hummels, D., Ishii, J., & Yi, K.-M. (2001). The nature and growth of vertical specialization in world trade. *Journal of International Economics*, *54*(1), 75–96. https://doi.org/10.1016/S0022-1996(00)00093-3

Hynes, W., & Holden, P. (2016). What future for the Global Aid for Trade Initiative? Towards an assessment of its achievements and limitations. *Development Policy Review*, *34*(4), 593–619. https://doi.org/10.1111/dpr.12165

Ignatenko, A., Raei, F., Mircheva, B., & Papi, L. (2019). Global Value Chains: What are the Benefits and Why Do Countries Participate? *IMF Working Papers*, *2019*(018). https://doi.org/10.5089/9781484392928.001.A001

Inomata, S., & Taglioni, D. (2019). Technological progress, diffusion, and opportunities for developing countries: Lessons from China. *Global Value Chain Development Report 2019*, 83.

Irwin, D. A. (2015). Free Trade under Fire: Fourth Edition. In *Free Trade under Fire*. Princeton University Press. https://doi.org/10.1515/9781400866182

Irwin, D. A. (2020). Free Trade under Fire: Fifth Edition. In *Free Trade under Fire*. Princeton University Press. https://doi.org/10.1515/9780691203362

Isard, W., & Peck, M. J. (1954). Location Theory and International and Interregional Trade Theory. *The Quarterly Journal of Economics*, *68*(1), 97–114.

Jangam, B. P., & Rath, B. N. (2021). Do global value chains enhance or slog economic growth? *Applied Economics*, *53*(36), 4148–4165. https://doi.org/10.1080/00036846.2021.1897076

Jaumotte, M. F. (2004). *Foreign Direct Investment and Regional Trade Agreements: The Market Size Effect Revisited*. International Monetary Fund.

Javorcik, B. S. (2015). Does FDI Bring Good Jobs to Host Countries? *The World Bank Research Observer*, *30*(1), 74–94. https://doi.org/10.1093/wbro/lku010

Jenkins, S. P. (2015). World income inequality databases: An assessment of WIID and SWIID. *The Journal of Economic Inequality*, *13*(4), 629–671. https://doi.org/10.1007/s10888-015-9305-3

Jinyuan, G. (1984). China and Africa: The Development of Relations over Many Centuries. *African Affairs*, *83*(331), 241–250. JSTOR.

Johnson, R. C. (2014). Trade in Intermediate Inputs and Business Cycle Comovement. *American Economic Journal: Macroeconomics*, *6*(4), 39–83. https://doi.org/10.1257/mac.6.4.39

Johnson, R. C., & Noguera, G. (2012). Accounting for intermediates: Production sharing and trade in value added. *Journal of International Economics*, *86*(2), 224–236. https://doi.org/10.1016/j.jinteco.2011.10.003

Johnson, R. C., & Noguera, G. (2017). A Portrait of Trade in Value-Added over Four Decades. *The Review of Economics and Statistics*, *99*(5), 896–911. https://doi.org/10.1162/REST_a_00665

Jordà, Ò. (2005). Estimation and Inference of Impulse Responses by Local Projections. *American Economic Review*, *95*(1), 161–182. https://doi.org/10.1257/0002828053828518

Jordà, Ò., Schularick, M. HP., & Taylor, A. M. (2011). *When Credit Bites Back: Leverage, Business Cycles, and Crises* (Working Paper No. 17621; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w17621

Jordà, Ò., Schularick, M., & Taylor, A. M. (2020). The effects of quasi-random monetary experiments. *Journal of Monetary Economics*, *112*, 22–40. https://doi.org/10.1016/j.jmoneco.2019.01.021

Jouini, J. (2015). Linkage between international trade and economic growth in GCC countries: Empirical evidence from PMG estimation approach. *The Journal of International Trade & Economic Development*, *24*(3), 341–372. https://doi.org/10.1080/09638199.2014.904394

Jung, H.-S., & Thorbecke, E. (2003). The impact of public education expenditure on human capital, growth, and poverty in Tanzania and Zambia: A general equilibrium approach. *Journal of Policy Modeling*, *25*(8), 701–725. https://doi.org/10.1016/S0161-8938(03)00060-7

Karabarbounis, L., & Neiman, B. (2013). *The Global Decline of the Labor Share* (Working Paper No. 19136; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w19136

Keane, J. (2014, June 27). *Aid for Trade and engaging with global value chains: Developing trade and reducing food insecurity?* ODI: Think Change. https://odi.org/en/publications/aid-for-trade-and-engaging-with-global-value-chains-developing-trade-and-reducing-food-insecurity/

Kee, H. L. (2015). Local intermediate inputs and the shared supplier spillovers of foreign direct investment. *Journal of Development Economics*, *112*, 56–71. https://doi.org/10.1016/j.jdeveco.2014.09.007

Kee, H. L., & Tang, H. (2016). Domestic Value Added in Exports: Theory and Firm Evidence from China. *American Economic Review*, *106*(6), 1402–1436.

https://doi.org/10.1257/aer.20131687

Kim, D. H., & Lin, S. C. (2009). Trade and growth at different stages of economic development. *Journal of Development Studies*, *45*(8), 1211–1224. https://doi.org/10.1080/00220380902862937

Kim, D.-H. (2011). Trade, growth and income. *The Journal of International Trade & Economic Development*, *20*(5), 677–709. https://doi.org/10.1080/09638199.2011.538966

Klaver, M., & Trebilcock, M. (2011). Chinese Investment in Africa. *The Law and Development Review*, *4*(1), 168–217. https://doi.org/10.2202/1943-3867.1126

Koirala, A., Joo, Y. J., Khatami, A., Chiu, C., & Britton, P. N. (2020). Vaccines for COVID-19: The current state of play. *Paediatric Respiratory Reviews*, *35*, 43–49. https://doi.org/10.1016/j.prrv.2020.06.010

Koopman, R., Powers, W., Wang, Z., & Wei, S.-J. (2010). *Give Credit Where Credit Is Due: Tracing Value Added in Global Production Chains* (Working Paper No. 16426; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w16426

Koopman, R., Wang, Z., & Wei, S.-J. (2014). Tracing Value-Added and Double Counting in Gross Exports. *American Economic Review*, *104*(2), 459–494. https://doi.org/10.1257/aer.104.2.459

Kothari, S. P., & Warner, J. B. (2007). Chapter 1—Econometrics of Event Studies**We thank Espen Eckbo, Jon Lewellen, Adam Kolasinski, and Jay Ritter for insightful comments, and Irfan Safdar and Alan Wancier for research assistance. In B. E. Eckbo (Ed.), *Handbook of Empirical Corporate Finance* (pp. 3–36). Elsevier. https://doi.org/10.1016/B978-0-444-53265-7.50015-9

Kowalski, P. (2011). *Comparative Advantage and Trade Performance: Policy Implications*. Paris : OECD Publishing.

Kowalski, P., Gonzalez, J. L., Ragoussis, A., & Ugarte, C. (2015). *Participation of Developing Countries in Global Value Chains: Implications for Trade and Trade-Related Policies*. OCDE. https://doi.org/10.1787/5js33lfw0xxn-en

Kpodar, K. R., Goff, M. L., Singh, R. J., & Mansoor, A. M. (2019). Financial Deepening, Terms of Trade

Shocks, and Growth Volatility in Low-Income Countries. *IMF Working Papers*, *2019*(068). https://doi.org/10.5089/9781498303569.001.A001

Krusell, P., Ohanian, L. E., Ríos-Rull, J.-V., & Violante, G. L. (2000). Capital-skill Complementarity and Inequality: A Macroeconomic Analysis. *Econometrica*, *68*(5), 1029–1053. https://doi.org/10.1111/1468-0262.00150

Kusi, N. (2002). *Trade Liberalization And South Africa's Export Performance*. https://www.academia.edu/47657008/Trade_Liberalization_And_South_Africas_Export_Performance

Laget, E., Osnago, A., Rocha, N., & Ruta, M. (2018). *Deep Trade Agreements and Global Value Chains* [Working Paper]. World Bank. https://doi.org/10.1596/1813-9450-8491

Lall, S., Weiss, J., & Zhang, J. (2006). The "sophistication" of exports: A new trade measure. *World Development*, *34*(2), 222–237. https://doi.org/10.1016/j.worlddev.2005.09.002

Lectard, P., & Rougier, E. (2018). Can Developing Countries Gain from Defying Comparative Advantage? Distance to Comparative Advantage, Export Diversification and Sophistication, and the Dynamics of Specialization. *World Development*, *102*, 90–110. https://doi.org/10.1016/j.worlddev.2017.09.012

Lee, E., & Yi, K.-M. (2018). Global value chains and inequality with endogenous labor supply. *Journal of International Economics*, *115*, 223–241. https://doi.org/10.1016/j.jinteco.2018.09.006

Lee, H.-H., & Ries, J. (2016). Aid for Trade and Greenfield Investment. *World Development*, *84*, 206–218. https://doi.org/10.1016/j.worlddev.2016.03.010

Lee, S. L. (2018). *An Empirical Analysis of the Effects of Aid for Trade on Foreign Direct Investment: International Evidence* [Thesis, Seoul National University International Cooperation Major]. https://s-space.snu.ac.kr/handle/10371/141690

Lenzen, M., Moran, D., Kanemoto, K., & Geschke, A. (2013). Building Eora: A Global Multi-Region Input–Output Database at High Country and Sector Resolution. *Economic Systems Research*, *25*(1), 20–49. https://doi.org/10.1080/09535314.2013.769938

Levchenko, A. A. (2007). Institutional Quality and International Trade. *The Review of Economic Studies*, *74*(3), 791–819. https://doi.org/10.1111/j.1467-937X.2007.00435.x

Lewbel, A. (2012). Using Heteroscedasticity to Identify and Estimate Mismeasured and Endogenous Regressor Models. *Journal of Business & Economic Statistics*, *30*(1), 67–80. https://doi.org/10.1080/07350015.2012.643126

Li, R., Pei, S., Chen, B., Song, Y., Zhang, T., Yang, W., & Shaman, J. (2020). Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (SARS-CoV-2). *Science*, *368*(6490), 489–493. https://doi.org/10.1126/science.abb3221

Liao, W., & Santacreu, A. M. (2015). The trade comovement puzzle and the margins of international trade. *Journal of International Economics*, *96*(2), 266–288. https://doi.org/10.1016/j.jinteco.2015.02.004

Lim, S. (2021). Global Agricultural Value Chains and Structural Transformation. In *Risks in Agricultural Supply Chains*. University of Chicago Press. https://www.nber.org/books-and-chapters/risks-agricultural-supply-chains/global-agricultural-value-chains-and-structural-transformation

Lim, S., & Kim, S. W. (2021). *Global Agricultural Value Chains and Employment Growth* (SSRN Scholarly Paper No. 3915758). Social Science Research Network. https://doi.org/10.2139/ssrn.3915758

Looi Kee, H., Nicita, A., & Olarreaga, M. (2009). Estimating Trade Restrictiveness Indices. *The Economic Journal*, *119*(534), 172–199. https://doi.org/10.1111/j.1468-0297.2008.02209.x

MacKinlay, A. C. (1997). Event Studies in Economics and Finance. *Journal of Economic Literature*, *35*(1), 13–39.

Maćkowiak, B. (2007). External shocks, U.S. monetary policy and macroeconomic fluctuations in emerging markets. *Journal of Monetary Economics*, *54*(8), 2512–2520. https://doi.org/10.1016/j.jmoneco.2007.06.021

Maertens, M., & Swinnen, J. F. M. (2012). Gender and Modern Supply Chains in Developing Countries. *The Journal of Development Studies*, *48*(10), 1412–1430.

https://doi.org/10.1080/00220388.2012.663902

Magnus, J. R., & Durbin, J. (1999). Estimation of Regression Coefficients of Interest when Other Regression Coefficients are of no Interest. *Econometrica*, *67*(3), 639–643.

Magnus, J. R., Powell, O., & Prüfer, P. (2010). A comparison of two model averaging techniques with an application to growth empirics. *Journal of Econometrics*, *154*(2), 139–153. https://doi.org/10.1016/j.jeconom.2009.07.004

Malcolm F. McPherson & Tzvetana Rakovski. (2001). Understanding the Growth Process in Sub-Saharan Africa: Some Empirical Estimates. *African Economic Policy Discussion Paper*, *No. 54*.

Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A Contribution to the Empirics of Economic Growth*. *The Quarterly Journal of Economics*, *107*(2), 407–437. https://doi.org/10.2307/2118477

Manova, K., & Zhang, Z. (2012). Export Prices Across Firms and Destinations. *The Quarterly Journal of Economics*, *127*(1), 379–436. https://doi.org/10.1093/qje/qjr051

Markusen, J. R., & Trofimenko, N. (2009). Teaching locals new tricks: Foreign experts as a channel of knowledge transfers. *Journal of Development Economics*, *88*(1), 120–131. https://doi.org/10.1016/j.jdeveco.2008.02.002

Martínez-Zarzoso, I., Nowak-Lehmann D., F., & Rehwald, K. (2017). Is aid for trade effective? A panel quantile regression approach. *Review of Development Economics*, *21*(4), e175–e203. https://doi.org/10.1111/rode.12322

Matsumoto, A. (2011). Global Liquidity: Availability of Funds for Safe and Risky Assets1. *IMF Working Papers*, *2011*(136). https://doi.org/10.5089/9781455264452.001.A001

McCulloch, J. R. (1846). *The works of David Ricardo, Esq., MP [electronic resource]: With a notice of the life and writings of the author*. J. Murray.

McWilliams, A., & Siegel, D. (1997). Event Studies In Management Research: Theoretical And Empirical Issues. *Academy of Management Journal*, *40*(3), 626–657. https://doi.org/10.5465/257056

Mehl, A., Schmitz, M., & Tille, C. (2019). *Distance(s) and the Volatility of International Trade(s)* [SSRN

Scholarly Paper]. https://doi.org/10.2139/ssrn.3360229

Milberg, W., & Winkler, D. (2013). *Outsourcing Economics: Global Value Chains in Capitalist Development*. Cambridge University Press.

Mody, A., & Srinivasan, K. (1998). Japanese and U.S. Firms as Foreign Investors: Do They March to the Same Tune? *The Canadian Journal of Economics / Revue Canadienne d'Economique*, *31*(4), 778–799. JSTOR. https://doi.org/10.2307/136491

Moolio, P., & Kong, S. (2016). Foreign Aid and Economic Growth: Panel Cointegration Analysis for Cambodia, Lao PDR, Myanmar, and Vietnam. *Athens Journal of Business & Economics*, *2*(4), 417–428.

Moore, M. O., & Zanardi, M. (2011). Trade Liberalization and Antidumping: Is There a Substitution Effect? *Review of Development Economics*, *15*(4), 601–619. https://doi.org/10.1111/j.1467-9361.2011.00630.x

Morisset, J. (1999). *Foreign Direct Investment in Africa: Policies Also Matter*. The World Bank. https://doi.org/10.1596/1813-9450-2481

Müller, G. J. (2008). Understanding the dynamic effects of government spending on foreign trade. *Journal of International Money and Finance*, *27*(3), 345–371. https://doi.org/10.1016/j.jimonfin.2008.01.005

Musila, J. W., & Yiheyis, Z. (2015). The impact of trade openness on growth: The case of Kenya. *Journal of Policy Modeling*, *37*(2), 342–354. https://doi.org/10.1016/j.jpolmod.2014.12.001

Nakazawa, E., Yamano, N., & Webb, C. (2007). Determinants of trade in value-added: Market size, geography and technological gaps. *Korea*, *10*, 11th.

Nana, I. (2021). Chinese Presence in Africa: A Panel Smooth Threshold Regression Approach. In *Institutional Change and China Capitalism: Vol. Volume 2* (pp. 217–255). WORLD SCIENTIFIC (EUROPE). https://doi.org/10.1142/9781800611238_0009

Nana, I., & Starnes, S. K. (2020). When Trade Falls–Effects of COVID-19 and Outlook. *International Finance Corporation (IFC). Https://Www. Ifc. Org/Wps/Wcm/Connect/78f10cad-7e00-440d-*

B6fd-Da210e5a6d1e/IFC-Covid&Trade-Final-3. Pdf.

Nana, I., & Starnes, S. K. (2021). Taking Action on Trade: From Concern to Support. *International Finance Corporation (IFC). Https://Www.Ifc.Org/Wps/Wcm/Connect/Industry_EXT_Content/IFC_External_Corporate_Site/Financial+Institutions/Resources/Taking+Action+on+Trade*. https://www.ifc.org/wps/wcm/connect/Industry_EXT_Content/IFC_External_Corporate_Site/Financial+Institutions/Resources/Taking+Action+on+Trade

Nana, I., & Susan, S. K. (2020). Why Trade Finance Matters—Especially Now. *International Finance Corporation (IFC). Https://Www.Ifc.Org/Wps/Wcm/Connect/Publications_EXT_Content/IFC_External_Publication_Site/Publications_Listing_Page/Trade-and-Covid-19-Note-2*. https://www.ifc.org/wps/wcm/connect/Publications_EXT_Content/IFC_External_Publication_Site/Publications_Listing_Page/trade-and-covid-19-note-2

Neilson, J. (2014). Value chains, neoliberalism and development practice: The Indonesian experience. *Review of International Political Economy*, *21*(1), 38–69. https://doi.org/10.1080/09692290.2013.809782

Newfarmer, R., & Sztajerowska, M. (2012). Trade and employment in a fast-changing world. *Policy Priorities for International Trade and Jobs*, 7–73.

Nolan, P., & Zhang, J. (2010). Global competition after the financial crisis. *New Left Review*, *64*, 97–108.

Nunn, N. (2007). Relationship-Specificity, Incomplete Contracts, and the Pattern of Trade*. *The Quarterly Journal of Economics*, *122*(2), 569–600. https://doi.org/10.1162/qjec.122.2.569

OCDE. (2003). *OECD Science, Technology and Industry Scoreboard 2003*. https://www.oecd-ilibrary.org/content/publication/sti_scoreboard-2003-en

OECD. (2011). Technology intensity definition, classification of manufacturing industries into categories based on R&D intensities (2011). *URL:< Http://Www. Oecd.*

Org/Sti/Ind/48350231. Pdf, *3*.

OECD. (2019). *Aid for Trade at a Glance 2019: Economic Diversification and Empowerment*. Organisation for Economic Co-operation and Development. https://www.oecd-ilibrary.org/development/aid-for-trade-at-a-glance-2019_18ea27d8-en

OECD, & WTO. (2017). *Aid for Trade at a Glance 2017 Promoting Trade, Inclusiveness and Connectivity for Sustainable Development: Promoting Trade, Inclusiveness and Connectivity for Sustainable Development*. OECD Publishing.

Orefice, G., & Rocha, N. (2014). Deep Integration and Production Networks: An Empirical Analysis. *The World Economy*, *37*(1), 106–136. https://doi.org/10.1111/twec.12076

Osabutey, E. L. C., & Jackson, T. (2019). The impact on development of technology and knowledge transfer in Chinese MNEs in sub-Saharan Africa: The Ghanaian case. *Technological Forecasting and Social Change*, *148*, 119725. https://doi.org/10.1016/j.techfore.2019.119725

Otchere, I., Soumaré, I., & Yourougou, P. (2016). FDI and Financial Market Development in Africa. *The World Economy*, *39*(5), 651–678. https://doi.org/10.1111/twec.12277

Owusu, S. (2021). Powering structural transformation and productivity gains in Africa: The role of global value chains and resource endowments. In *MERIT Working Papers* (No. 2021–022; MERIT Working Papers). United Nations University - Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT). https://ideas.repec.org/p/unm/unumer/2021022.html

Pahl, S., & Timmer, M. P. (2020). Do Global Value Chains Enhance Economic Upgrading? A Long View. *The Journal of Development Studies*, *56*(9), 1683–1705. https://doi.org/10.1080/00220388.2019.1702159

Patel, G., & Annapoorna, M. S. (2019). Public Education Expenditure and Its Impact on Human Resource Development in India: An Empirical Analysis. *South Asian Journal of Human Resources Management*, *6*(1), 97–109. https://doi.org/10.1177/2322093718813407

Paus, E. A., & Gallagher, K. P. (2008). Missing Links: Foreign Investment and Industrial Development

in Costa Rica and Mexico. *Studies in Comparative International Development*, *43*(1), 53–80. https://doi.org/10.1007/s12116-007-9016-2

Petersburg, S. (2013). Implications of global value chains for trade, investment, development and jobs. *UNCTAD, WTO, OECD. Https://Unctad.Org/System/Files/Official-Document/Unctad_oecd_wto_2013d1_en.Pdf*.

Pfetsch, F. R. (2011). Abstract. *Negociations*, *16*(2), 39–56.

Pierola, M. D., Fernandes, A. M., & Farole, T. (2018). The role of imports for exporter performance in Peru. *The World Economy*, *41*(2), 550–572. https://doi.org/10.1111/twec.12524

Ponte, S., & Gibbon, P. (2005). Quality standards, conventions and the governance of global value chains. *Economy and Society*, *34*(1), 1–31. https://doi.org/10.1080/0308514042000329315

Pöyhönen, P. (1963). A Tentative Model for the Volume of Trade between Countries. *Weltwirtschaftliches Archiv*, *90*, 93–100.

Prasad, E. S., Rajan, R. G., & Subramanian, A. (2007). *Foreign Capital and Economic Growth* (Working Paper No. 13619; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w13619

Qiang, C. Z., Liu, Y., & Steenbergen, V. (2021). *An Investment Perspective on Global Value Chains*. The World Bank. https://doi.org/10.1596/978-1-4648-1683-3

Rajan, R. G., & Subramanian, A. (2005). *What Undermines Aid's Impact on Growth?* (Working Paper No. 11657; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w11657

Rasmidatta, P. (2011). *The relationship between domestic saving and economic growth and convergence hypothesis: Case study of Thailand*.

Raulatu, B. L., Ugbem, O. V., Augustine, U., & Paul, F. M. (2019). Uncertainties in Global Economic Policy and Nigerias Export Earnings. *International Journal of Business, Economics and Management*, *6*(1), 23–38. https://doi.org/10.18488/journal.62.2019.61.23.38

Razzaque, M. A., & te Velde, D. W. (2013). Aid for Trade: Effectiveness, Current Issues and Future

Directions–An Overview. *Assessing Aid for Trade: Effectiveness, Current Issues and Future Directions*, 1–13.

Redden, J. (2017). The Role of Aid for Trade in Building the Capacity of Developing Country Firms to Meet Sustainability Standards. *International Centre for Trade and Sustainable Development (ICTSD) International Environment House 2 7 Chemin de Balexert, 1219 Geneva, Switzerland*.

Renard, M.-F. (2011). China's Trade and FDI in Africa. *China and Africa: An Emerging Partnership for Development*, *25*.

Rey, H. (2013, August 31). Dilemma not Trilemma: The global financial cycle and monetary policy independence. *VoxEU.Org*. https://voxeu.org/article/dilemma-not-trilemma-global-financial-cycle-and-monetary-policy-independence

Rey, H. (2015). *Dilemma not Trilemma: The Global Financial Cycle and Monetary Policy Independence* (Working Paper No. 21162; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w21162

Rocha, N., & Winkler, D. E. (2019). *Trade and Female Labor Participation: Stylized Facts Using a Global Dataset* (SSRN Scholarly Paper ID 3510401). Social Science Research Network. https://papers.ssrn.com/abstract=3510401

Rodrik, D. (2006). *What's So Special about China's Exports?* (Working Paper No. 11947; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w11947

Rodrik, D. (2018). *New Technologies, Global Value Chains, and Developing Economies* (Working Paper No. 25164; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w25164

Rose, A. K. (2005). One reason countries pay their debts: Renegotiation and international trade. *Journal of Development Economics*, *77*(1), 189–206. https://doi.org/10.1016/j.jdeveco.2004.03.006

Roy, M. (2017). *The Contribution of Services Trade Policies to Connectivity in the Context of Aid for Trade* (SSRN Scholarly Paper ID 3036946). Social Science Research Network.

https://doi.org/10.2139/ssrn.3036946

Rueda Maurer, M. (2017). Supply chain trade and technological transfer in the ASEAN+3 region. *China Economic Review*, *46*, 277–289. https://doi.org/10.1016/j.chieco.2017.02.001

Sampson, T. (2016). Dynamic Selection: An Idea Flows Theory of Entry, Trade, and Growth *. *The Quarterly Journal of Economics*, *131*(1), 315–380. https://doi.org/10.1093/qje/qjv032

Saslavsky, D., & Shepherd, B. (2012). *Facilitating International Production Networks: The Role of Trade Logistics* (SSRN Scholarly Paper ID 2160675). Social Science Research Network. https://papers.ssrn.com/abstract=2160675

Schmidheiny, K., & Siegloch, S. (2019). *On Event Studies and Distributed-Lags in Two-Way Fixed Effects Models: Identification, Equivalence, and Generalization* (SSRN Scholarly Paper ID 3324212). Social Science Research Network. https://papers.ssrn.com/abstract=3324212

Schott, P. K., Fuest, C., & O'Rourke, K. (2008). The Relative Sophistication of Chinese Exports [with Discussion]. *Economic Policy*, *23*(53), 5–49.

Sharma, K. (2000). *Export Growth in India: Has FDI Played a Role?* [Working Paper]. Yale - Economic Growth Center. https://econpapers.repec.org/paper/fthyalegr/816.htm

Sly, N. (2016). Global uncertainty and U.S. exports. *Economic Review (Kansas City)*, *101*(2), 5–25.

Sommer, L., Calabrese, L., Mendez-Parra, M., & Luke, D. (2017). Smart industrialisation through trade in the context of Africa's transformation. *ODI Policy Briefing Paper*.

Soumaré, I. (2015). Does FDI improve economic development in North African countries? *Applied Economics*, *47*(51), 5510–5533. https://doi.org/10.1080/00036846.2015.1051655

Stehrer, R., Foster, N., & de Vries, G. (2010). Value added and factors in trade: A comprehensive approach. *Dynamics*, *67*, 40.

Stiglitz, J. E., & Yusuf, S. (2001). *Rethinking the East Asian Miracle*. World Bank Publications.

Stone, S., Mikic, M., Agyeben, M., Anukoonwattaka, W., Duval, Y., Heal, A., Kim, S., Proksch, M., Ratna, R., Saggu, A., Huang, F., Scagliusi, M., Shepherd, B., Utoktham, C., Parisotto, L., & Tomova, M. (2015). *Asia-Pacific Trade and Investment Report 2015: Supporting Participation*

in Value Chains (SSRN Scholarly Paper ID 2684985). Social Science Research Network. https://papers.ssrn.com/abstract=2684985

Strauss, J. C. (2009). The Past in the Present: Historical and Rhetorical Lineages in China's Relations with Africa*. *The China Quarterly*, *199*, 777–795. https://doi.org/10.1017/S0305741009990208

Taglioni, D., & Zavacka, V. (2013). *Innocent Bystanders: How Foreign Uncertainty Shocks Harm Exporters* (SSRN Scholarly Paper ID 2240185). Social Science Research Network. https://doi.org/10.2139/ssrn.2240185

te Velde, D. W., & Morrissey, O. (2003). Do Workers in Africa Get a Wage Premium if Employed in Firms Owned by Foreigners? *Journal of African Economies*, *12*(1), 41–73. https://doi.org/10.1093/jae/12.1.41

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

Timmer, M., Los, B., Stehrer, R., & Vries, G. J. de. (2016). *An anatomy of the global trade slowdown based on the WIOD 2016 release*. Groningen : University of Groningen, Groningen Growth and Development Centre.

Tinbergen, J. (1962). *Shaping the world economy; suggestions for an international economic policy*.

Tudela-Marco, L., Garcia-Alvarez-Coque, J.-M., & Martinez-Gomez, V. (2014). Are Non-Tariff Measures a Substitute for Tariffs in Agricultural Trade?: Recent Evidence from Southern Mediterranean Countries. *Outlook on Agriculture*, *43*(4), 235–240. https://doi.org/10.5367/oa.2014.0187

Ulaşan, B. (2015). Trade openness and economic growth: Panel evidence. *Applied Economics Letters*, *22*(2), 163–167. https://doi.org/10.1080/13504851.2014.931914

UNCTAD. (2013). *World investment report 2013: Global value chains: Investment and trade for development*. UN.

United Nations, D. of E. and S. A. (2020). *Report of the Inter-agency Task Force on Financing for*

Development 2020: Financing for Sustainable Development Report. United Nations.

Uribe, M., & Yue, V. Z. (2006). Country spreads and emerging countries: Who drives whom? *Journal of International Economics*, *69*(1), 6–36. https://doi.org/10.1016/j.jinteco.2005.04.003

Van Assche, A., & Van Biesebroeck, J. (2018). Functional upgrading in China's export processing sector. *China Economic Review*, *47*, 245–262. https://doi.org/10.1016/j.chieco.2017.07.012

Van den Broeck, G., Swinnen, J., & Maertens, M. (2017). Global value chains, large-scale farming, and poverty: Long-term effects in Senegal. *Food Policy*, *66*, 97–107. https://doi.org/10.1016/j.foodpol.2016.12.003

Vandenbussche, H., Connell, W., & Simons, W. (2019). Global Value Chains, Trade Shocks and Jobs: An Application to Brexit. In *CESifo Working Paper Series* (No. 7473; CESifo Working Paper Series). CESifo. https://ideas.repec.org/p/ces/ceswps/_7473.html

Vandenbussche, H., & Zanardi, M. (2008). What explains the proliferation of antidumping laws? *Economic Policy*, *23*(53), 94–138. https://doi.org/10.1111/j.1468-0327.2007.00196.x

Vijil, M., & Wagner, L. (2012). Does Aid for Trade Enhance Export Performance? Investigating the Infrastructure Channel. *The World Economy*, *35*(7), 838–868. https://doi.org/10.1111/j.1467-9701.2012.01437.x

Wang, S., He, Y., & Song, M. (2021). Global value chains, technological progress, and environmental pollution: Inequality towards developing countries. *Journal of Environmental Management*, *277*, 110999. https://doi.org/10.1016/j.jenvman.2020.110999

Wang, W., Thangavelu, S., & Lin, F. (2021). Global value chains, firms, and wage inequality: Evidence from China. *China Economic Review*, *66*, 101585. https://doi.org/10.1016/j.chieco.2021.101585

Wang, Z., Wei, S.-J., Yu, X., & Zhu, K. (2017a). *Characterizing Global Value Chains: Production Length and Upstreamness* (Working Paper No. 23261; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w23261

Wang, Z., Wei, S.-J., Yu, X., & Zhu, K. (2017b). *Measures of Participation in Global Value Chains and*

Global Business Cycles (Working Paper No. 23222; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w23222

Wei, S.-J., Xie, Z., & Zhang, X. (2017). From “Made in China” to “Innovated in China”: Necessity, Prospect, and Challenges. *Journal of Economic Perspectives*, *31*(1), 49–70. https://doi.org/10.1257/jep.31.1.49

Wheeler, D., & Mody, A. (1992). International investment location decisions: The case of U.S. firms. *Journal of International Economics*, *33*(1), 57–76. https://doi.org/10.1016/0022-1996(92)90050-T

Winters, L. A., & Martuscelli, A. (2014). Trade Liberalization and Poverty: What Have We Learned in a Decade? *Annual Review of Resource Economics*, *6*(1), 493–512. https://doi.org/10.1146/annurev-resource-110713-105054

World Bank. (2020). *World Development Report 2020: Trading for Development in the Age of Global Value Chains*. World Bank. https://doi.org/10.1596/978-1-4648-1457-0

World Bank Group. (2018). *Global Economic Prospects, January 2018: Broad-Based Upturn, but for How Long?* World Bank. https://doi.org/10.1596/978-1-4648-1163-0

World Bank, & WTO. (2019). *Global Value Chain Development Report 2019: Technological Innovation, Supply Chain Trade, and Workers in a Globalized World*. Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/384161555079173489/Global-Value-Chain-Development-Report-2019-Technological-Innovation-Supply-Chain-Trade-and-Workers-in-a-Globalized-World

WTO. (2014). *World Trade Report 2014: Trade and Development: Recent Trends and the Role of the WTO*. WTO. https://doi.org/10.30875/9f925144-en

WTO, W. T. O. (2016). *Trade Finance and SMEs: Bridging the Gaps in Provision*. WTO iLibrary. https://doi.org/10.30875/3d984cea-en

WTO-IDE, J. (2011). Trade patterns and global value chains in East Asia: From trade in goods to trade in tasks. *World Trade Organisation, Geneva, Switzerland.–2011*.

Xing, Y., & Detert, N. C. (2010). *How the iPhone Widens the United States Trade Deficit with the People's Republic of China* (SSRN Scholarly Paper ID 1729085). Social Science Research Network. https://doi.org/10.2139/ssrn.1729085

Xu, B., & Lu, J. (2009). Foreign direct investment, processing trade, and the sophistication of China's exports. *China Economic Review*, *20*(3), 425–439. https://doi.org/10.1016/j.chieco.2009.01.004

Yashiro, N., Backer, K. D., Hutfilter, A. F., Kools, M., & Smidova, Z. (2017). *Moving up the global value chain in Latvia*. OCDE. https://doi.org/10.1787/3a486c5e-en

Yu, G. T. (1977). China's Role in Africa. *The ANNALS of the American Academy of Political and Social Science*, *432*(1), 96–109. https://doi.org/10.1177/000271627743200109

Yu, G. T. (1988). Africa in Chinese Foreign Policy. *Asian Survey*, *28*(8), 849–862. JSTOR. https://doi.org/10.2307/2644590