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Effect of Aid for Trade on Recipient-Countries' Participation in Global Value Chains

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Abstract

The present analysis has investigated, at the country-level, the effect of Aid for Trade (AfT) flows on recipient countries' participation in Global Value Chains (GVCs), measured through countries' participation in forward and backward GVCs as well as their position in GVCs. The analysis has covered 80 countries over the period from 2002 to 2018, and used the within fixed effects, the random effect Mundlak approach and the "Quantile via Moments" approach. It has established several findings. On average, AfT interventions promote backward GVC participation, but do not affect forward GVC participation. Total AfT flows (including AfT flows for economic infrastructure, AfT for productive capacities and AfT for trade policy and regulation) enhance backward GVC participation across all quantiles, and the magnitude of this positive is larger for countries in lower quantiles (including the lowest one) than for those in upper quantiles. These resource inflows do not affect forward GVC participation by countries situated in upper quantiles, but do increase forward GVC participation by countries located in lower quantiles. They do not affect the GVC position of countries in lower quantiles, but encourage more engagement in downstream activities than in upstream activities for countries located in the 75th and 90th quantiles. The effects of the three components of AfT flows on countries' forward GVC participation and GVC position are mixed, and vary across quantiles. Finally, the analysis has shown that the effect of AfT interventions on countries' participation in GVCs does depend on the overall trade costs faced by countries, including their tariff and nontariff costs.

Keywords: Aid for Trade flows; Participation in Global Value Chains.

JEL Classification: F15; F35.

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1. Introduction

Do Aid for Trade (AfT) flows enhance the participation of developing countries in global value chains (GVCs)? This question has received a little attention in the literature, and is at the heart of the present analysis. The main argument in the analysis is that AfT flows would foster developing countries' participation in GVCs through their effect on trade costs.

Antràs (2019: p3) has defined a global value chain (GVC) as consisting of a series of stages involved in producing a product or service that is sold to consumers, with each stage adding value, and with at least two stages being produced in different countries. A firm participates in a GVC if it produces at least one stage in a GVC. A similar definition has been provided by the World Bank (2020: p17) whereby a global value chain (GVC) is "*the series of stages in the production of a product or service for sale to consumers. Each stage adds value, and at least two stages are in different countries.*"

The international fragmentation and internationalisation of production processes across countries along with durable firm-to-firm relationships that facilitate access to capital and inputs along chains is at the core of participation in GVCs (Antràs, 2016; 2020). Firms' participation in GVCs is measured in terms of vertical specialization through backward participation and/or forward participation (e.g., Hummels et al. 2001). Backward participation in GVCs reflects a country's engagement in GVCs as a "seller", and captures the foreign value-added content of total gross exports. In contrast, forward participation in GVCs reflects a country's engagement in GVCs as a "buyer", and captures the domestic value added (used as intermediate inputs) in other countries' value-added exports (e.g., Hummels et al., 2001; Koopman et al., 2014; Kowalski et al., 2015; UNCTAD, 2013). In other words, backward participation in GVCs assesses how dependent on foreign inputs a country's export sector is, while forward participation in GVCs shows how domestic exports rely on other countries' exports (e.g., Smichowski et al., 2021).

A voluminous studies have considered the economic and social effects of participation in GVCs by developing countries. For example, participation in GVCs allows developing countries' firms to specialise in core tasks, to have access to cheaper and higher quality intermediate inputs, new ideas, technology transfer, and external knowledge, to expand exports (e.g., Criscuolo and Timmis, 2017; Pahl and Timmer, 2020). In this regard, it provides domestic firms in developing with greater opportunities for fast technological learning and skill acquisition (e.g., Pietrobelli and Rabelloti, 2011). It fosters productivity (e.g., Constantinescu et al., 2019; Criscuolo and Timmis, 2017; World Bank, 2020), promotes export product upgrading (e.g., Banga, 2023; Ebeke, 2023; Ndubuisi and Owusu, 2021; Pahl and Timmer, 2020; Stolzenburg et al., 2019), helps enhance economic growth (e.g., Ebeke, 2023; Ignatenko et al., 2019; World Bank, 2020), reduce poverty (e.g., Ebeke, 2023; Van den Broeck et al., 2017; Vos and Catteno, 2021) and dampen within-country income inequality (e.g., Carpa and Martínez-Zarzoso, 2022; Duarte et al., 2022; Jithin et al., 2023). The literature has also emphasized that backward participation in GVCs is more relevant for economic development of developing countries that tend to export primary commodities as well as labour-intensive products. This is because forward GVC participation by these countries entails exporting raw commodities and intermediate inputs to foreign countries that will process them (e.g., AfDB et al. 2014; Veeramani and Dhir, 2022), while greater backward GVC participation by these countries is associated with higher absolute levels of gross exports, domestic value added and employment (e.g., Veeramani and Dhir, 2022). In addition, backward GVC participation exerts greater (and more robust) positive effect on domestic productivity than does forward GVC participation (Constantinescu et al. 2019).

On the other hand, the Members of the World Trade Organization (WTO) launched at the 2005 Hong Kong Conference of Trade Ministers the AfT initiative, with a view to fostering the participation of developing countries in the global trading system. The set up of this initiative arose from the observation by WTO Members that developing countries, and especially the least developed countries (LDCs)² among them were facing major trade-related obstacles³ that hampered their participation in international trade. Paragraph 57 of the Hong Kong Ministerial Declaration provides clearly the objective of this initiative (WTO, 2005). It states that "*Aid for Trade should aim to help developing countries, particularly LDCs, to build the supply-side capacity and trade-related infrastructure that they need to assist them to implement and benefit from WTO Agreements and more broadly to expand their trade.*"

AfT flows are nothing else than the portion of total official development assistance (ODA) flows aiming at enhancing the participation of developing countries in international trade. The WTO organizes every two years, the Global Review of Aid for Trade. The purpose of this Review is "*to strengthen the monitoring and evaluation of Aid for Trade to provide a strong incentive to both donors and recipients for advancing the Aid for Trade agenda*"⁴. Thus far, eight Global Review⁵ of Aid for Trade have been organized, the first one being held in 2007, and the most recent one was organized in 2022, focusing on the theme "Empowering Connected Sustainable Trade".

Since the launch of the AfT initiative, many studies⁶ have examined the economic effects (including trade effects) and social effects of AfT flows. However, to the best of our knowledge, no study has investigated the effect of AfT flows on recipient countries' participation in global value chains. Only one study (Zhang and Martínez-Zarzoso, 2022) has examined empirically the relationship between development aid (i.e., total official development assistance) - not specifically AfT flows - and recipient countries' participation in GVCs. Zhang and Martínez-Zarzoso (2022) have used a bilateral donor-recipient setting that comprises 12 new donors and 130 recipient countries over the period from 2000 to 2014, to examine whether new donors use foreign aid to facilitate their integration into the world economy, that is, whether foreign aid is linked to commercial interests and internationalization strategies for new donors. In so doing, they have explored the effect of foreign aid on donors' exports, but also on the length of GVC. The analysis has revealed that the foreign aid effects are heterogenous across donors, weak in the short term, but large in the long term. Specifically, foreign aid promotes new donors' exports, but to a lower extent than it did for traditional donors. In addition, for some new donors (Czech Republic, Hungary, Poland, South Korea, Thailand and Turkey), foreign aid supports both exports and the length of GVC. However, for Israel and Russia, foreign aid affects only gross exports, while for

² The category of LDCs was developed and updated regularly by the Committee on Development Policy of the United Nations using three criteria, including the income, the human assets, and the Economic and Environmental Vulnerability. This group includes countries qualified as the poorest and most vulnerable (in the world) to exogenous economic, financial and environmental shocks. Detailed information on this group of countries could be found online at: <https://www.un.org/ohrlls/content/least-developed-countries>

³ These obstacles include trade-related infrastructure and capacity constraints that undermine their participation in international trade (e.g., Hallaert, 2010; Hallaert and Munro, 2009).

⁴ See information online at: https://www.wto.org/english/tratop_e/devel_e/a4t_e/aid4trade_e.htm

Three objectives have been assigned to the Global Aid-for-Trade Review: to take stock of what is happening on Aid for Trade; to identify what should happen next; and to improve WTO monitoring and evaluation (see information online at: https://www.wto.org/english/tratop_e/devel_e/a4t_e/global_review07_e.htm).

⁵ The next (ninth Global Review of Aid for Trade) is scheduled to take place on 26-28 June 2024.

⁶ A recent literature survey could be found in Benziane et al. (2022). Other literature reviews on the matter are provided for example by Cadot et al. (2014) and OECD/WTO (2013). Some of the recent studies include, for example, Gnanngnon (2023a,b,c) and Ly-My et al. (2020).

China, Kuwait, Saudi Arabia and the United Arab Emirates, foreign aid exerts no significant effect on exports and the length of GVC.

This analysis by Zhang and Martínez-Zarzoso (2022) has provided a first insight into the relationship between development aid and GVCs, focusing on the total development aid (not specifically on its AfT component) provided by new donors (not all donors, including both traditional and new ones), as well as on exports by donors, not by recipient countries.

Other studies are analytical in nature and not backed by empirical support. For example, Keane (2013) has explored how AfT flows have been instrumental in helping developing countries tap into high-value GVCs and global production networks, and how the potential benefits of the above approach be enhanced, and disadvantages be mitigated. Mayer and Milberg (2013) have considered the relationship between AfT flows and participation in GVCs from the perspective of the distribution of the rents (that arise from the trade costs reduction effect of AfT flows) among firms in the value chains. The analysis by these two authors has revealed that the benefits of AfT flows may disproportionately accrue to firms that have considerable power (including lead firms) in the chain and not to the intended beneficiaries (enterprises, households and communities), unless these resource inflows are geared towards the enhancement of the capacities of workers and small producers to capture such gains (e.g., through the improvement of their productivity).

Our analysis does not question the distribution of rents arising from trade costs reduction owe to higher AfT flows, but rather aims to investigate, at the country-level, the effect of AfT flows on participation in GVCs through the channel of trade costs. In so doing, it intends to contribute to the debate on the relationship between foreign aid and GVCs, by using the country-level analytical framework to examine how AfT flows have affected recipient-countries' participation in GVCs. The analysis has relied on a panel dataset of 80 AfT recipient countries over the period from 2002 to 2019. It has used the within fixed effects estimator, the random Mundlak estimator, and primarily the Method of Moments Quantile Regression (MMQR) with fixed effects (also known as the "Quantile via Moments" approach) developed by Machado and Santos Silva (2019), to establish several findings. AfT interventions affect countries' participation in GVCs (including through backward and forward GVC participation as well as their GVC position), and this effect operates via trade costs. However, the magnitude and statistical significance of this effect varies across quantiles of the distribution of GVC indicators. More importantly, total AfT and its major components (AfT for economic infrastructure, AfT for productive capacities and AfT for trade policy and regulation) promote backward GVC participation across all quantiles, with the effect being larger in countries situated in lower quantiles than in those in upper quantiles. AfT flows encourage the development of downstream activities relatively to upstream activities in countries located in higher quantiles (75th and 90th quantiles).

The rest of the analysis is structured around four sections. Section 2 provides a brief theoretical discussion on how AfT flows can affect countries' participation in GVCs. Section 3 presents the empirical strategy, and Section 4 interprets empirical outcomes. Section 5 provides a summary of findings and discusses their policy implications.

2. Theoretical motivation

The main argument underpinning this study is that AfT interventions influence recipient countries' participation in GVCs through their effect on trade costs. This section first presents a brief literature review on the effect of trade costs on participation in GVCs (sub-section 2.1), and

then discusses how AfT flows can affect GVC participation through the channel of trade costs (sub-section 2.2).

2.1. Effect of trade costs on GVCs

Trade costs encompass all the costs incurred in getting a good from the point of production to the final user other than the marginal cost of producing the good itself. These include transportation costs (both freight costs and time costs), policy barriers (tariffs and nontariff barriers), information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs, and local distribution costs (wholesale and retail) (Anderson and van Wincoop, 2004).

Escaith (2017) has noted that in the context of the fragmentation of the production of a final good across many countries, trade costs lead to additional production costs by increasing the purchase price of inputs, parts, and components, and hence the sale price, which is transmitted to the next production step. Thus, as they pass through the steps associated with modern supply chains, trade costs (e.g., applied tariffs, transportation and insurance costs, and other border taxes and fees) are amplified. This generates the so-called "cascading effect" that arises from the accumulation of trade costs as intermediate goods are imported and then re-exported farther downstream, going through different processing nodes before reaching the final consumer (Escaith, 2017: p97). Hence, through a cascading effect across many production stages, these costs accumulate in the supply chain and ultimately lead to an increase in the price paid by the final consumer. This is in line with the argument that trade costs undermine the development of complex GVCs, especially when the accumulation and magnification effects of cascading trade costs exceed a certain threshold (e.g., Antràs and De Gortari, 2020; Yi, 2003; 2010). According to Escaith (2017), trade frictions would result in an average increase of the production cost in a single stage of the value by 18 per cent. Jakubik and Stolzenburg (2020) have shown that trade costs do not affect only the volume of trade flows within GVCs, but also the spatial organization of GVCs. Some stages of GVCs are more sensitive to changes in trade costs than others. In particular, production stages featured by high share of foreign value added in total gross value added (those with little domestic value added, i.e., backward participation in GVCs) are more sensitive to changes in trade costs than production stages featured by a high contribution of domestic value added to total gross value added. This is because as many trade costs apply to the value of an exported final good or intermediate good, the share of trade costs to value added is larger for production stages where less value is added. Jakubik and Stolzenburg (2020) have qualified these as "more footloose production stages" because they are more exposed to trade costs changes (see also Diakantoni⁷ et al. 2017). On another note, Diakantoni et al. (2017) have reviewed the implications of trade costs for competitiveness at industry, national and global levels, and concluded that in view of the high trade costs faced by countries that are not well integrated into international trade, the direct benefits of trade costs reduction will be proportionally higher for them.

⁷ At each consecutive productive stage in the value chain, specialised processing firms need to recoup the associated trade cost applying to the full value of the good from the smaller fraction of value-added created. As a result, individual businesses incur a large relative weight of transaction expenses on their profitability, which exposes them to trade costs increases (Diakantoni et al. 2017).

Studies have also emphasized that trade facilitation affects differently trade in intermediates and final goods, and consequently influences incentives to engage in international production sharing through GVCs (e.g., Aichele and Heiland, 2018; Kumar and Shepherd, 2019; Saslavsky and Shepherd, 2014; Shepherd, 2022; Sübidey, 2016; Wilson et al. 2005). For example, Aichele and Heiland (2018) have developed a model that allows analysing how a change in trade policy (captured through a change in iceberg trade costs) affects production sharing across sectors and countries. The authors have applied their theoretical model to the case of China's accession to the WTO, and found that the changes in trade costs associated with China's membership of the WTO have enhanced the fragmentation of global production, and contributed to explaining about 6% to 12% of the decrease in the observed world domestic value added content of exports ratio between 2000 and 2007. This analysis has also revealed that China's accession to the WTO contributed significantly to the strengthening of production networks with its neighbors. In the same vein, Shepherd (2022) has developed a general equilibrium 'new quantitative trade model' to analyse the impacts of trade policy changes (i.e., a change in iceberg trade costs) on GVC trade. He has shown that improvements in trade facilitation between 2015 and 2019 affected differently intermediate and final goods, and contributed significantly to explaining changes in GVC trade over the same period.

Overall, this brief literature review points to the significant adverse effects of trade costs on countries' participation in GVCs. The subsequent question is, therefore, if trade costs inhibit countries' participation in GVCs, how could then AfT flows influence countries' participation in GVCs through their effect on trade costs? The next section explores theoretically this question.

2.2. Effect of Aid for Trade flows on GVC participation through trade costs

In assessing the effects of AfT flows on recipient countries' economies, the literature has considered three main categories⁸ of ODA flows that form total AfT flows (see OECD/WTO, 2007, 2011). In other words, AfT interventions take three main forms (that reflect the three components of total AfT flows). These are AfT interventions for the build-up/strengthening of economic infrastructure, AfT interventions for the build-up/strengthening of productive capacities, and AfT interventions related to trade policy and regulation. While AfT flows for economic infrastructure relate to the build-up of hard infrastructure (e.g., transport, ports, roads and railroads) and soft infrastructure (e.g., the development of information and communication technology base), AfT flows relating to the enhancement of productive capacities aim at fostering the capacity of firms in recipient countries to produce and export goods and services demanded in the international trade markets. AfT for productive capacity covers a variety of productive sectors, including banking and financial services, business and other services, agriculture, fishing, industry, mineral resources and mining, and tourism. This category of AfT flows can specifically involve the supply of physical plant and equipment as well as support for cooperatives (e.g., Mayer and Milberg, 2013). Finally, AfT interventions in support for trade policy and regulation help recipient countries' policymakers improve their capacity to participate in trade negotiations, develop adequate (WTO-consistent) trade-related institutions (e.g., customs, standards administration, and export promotion) and devise WTO-consistent trade policy that aligns with their development objectives. Specifically, part of the AfT flows for trade policy and regulation

⁸ These categories of ODA flows that constitute AfT flows are described in Appendix 1.

allow recipient countries to streamline trade procedures, and facilitate trade at borders, including through the reduction of the time, cost, and number of documents necessary for export and import. In addition, part of this AfT intervention aims to compensate less productive firms for the adverse effects of trade liberalization reforms.

Now, the question that needs to be addressed here is how AfT flows affect recipient countries' participation in GVCs through their effects on trade costs.

In the context of the fourth Global Review of Aid for Trade held in July 2013, the WTO and OECD undertook a joint monitoring exercise in order to identify the main barriers to developing country firms' participation in value chains and to explore how AfT flows can help firms overcome these obstacles. Responses to the surveys conducted in this context were provided by 52 donors and 80 developing countries, including 36 LDCs in the public sector, and by 697 firms⁹, including 524 developing country suppliers and 173 lead firms in the private sector. Three main barriers stood out as major hindrances to developing country firms participation in value chains. These include "*inadequate infrastructure (including transport and ICT infrastructure and unreliable supplies of electricity); limited access to trade finance, especially for small exporters; and compliance (usually through certification) with a wide range of standards (technical, health and safety requirements) if firms were to access mature markets and participate in value chains.*" (OECD/WTO, 2013: p113-114). OECD/WTO (2013: p114) has argued that the presence of these barriers might matter more for participation in GVCs than for trade in final goods. The analysis by OECD/WTO (2013) has also revealed that countries with low rates of GVC participation have a number of characteristics such as lower quality of transportation and communication infrastructure, weaker institutional quality, in particular legal systems; longer procedures required for starting a business; longer waiting times at the border; and high levels of protection of intellectual property rights.

The analysis of the results of the 2022 joint OECD-WTO Aid for Trade monitoring and evaluation exercise has also shown that top AfT priorities identified by developing countries (including in the in the context of industrialization or national industrial strategies promotion) and donors were the promotion of international competitiveness, the build-up of productive capacities and connection to value chains (WTO, 2022).

A wealth of studies have now shown empirically that AfT interventions have contributed to reducing trade costs in recipient countries (e.g., Busse et al. 2012; Cali and te Velde, 2011; de Melo and Wagner, 2016; Donaubaauer et al., 2016; Gngangnon, 2023d; Hoekman and Nicita, 2010; OECD/WTO, 2015; Tadesse et al. 2017; Tadesse et al. 2019, and Tadesse et al. 2021; Vijil and Wagner, 2012). Therefore, one may be inclined to argue that AfT interventions could promote countries' participation in GVCs, in particular their participation in backward GVCs. The reality is that AfT interventions can take place at different points of a supply chain, that is, AfT can enter a value chain at any point (e.g., Mayer and Milberg, 2013).

Better infrastructure promotes engagement in international trade, including at the extensive margins (e.g., Bonfatti and Poelhekke, 2017; Coşar and Demir, 2016; Donaubaauer et al., 2018; Feenstra and Ma, 2014; Verma, 2024; Wu et al. 2023) and to a greater extent than internal trade (e.g., Han and Li, 2022). In general, AfT interventions for strengthening economic infrastructure do not target any specific sectors but rather help reduce trade costs for all firms in the recipient

⁹ These firms were engaged in five value chains, including agrifood, ICT, textiles and apparel, tourism, and transport and logistics (see OECD/WTO, 2013).

country (e.g., Cirera and Winters, 2015). For example, AfT interventions that help reduce transport costs at the border could tighten the link between a first-tier supplier and a lead firm in a value chain. Thus, AfT interventions to build hard infrastructure or improve existing hard infrastructure (e.g., port facilities) could enhance firms' competitiveness through trade costs reduction. These interventions could also improve the efficiency of the entire value chain (e.g., Mayer and Milberg, 2013), and ultimately promote backward participation in GVCs. Similarly, AfT flows that support the build-up of roads and railroads with a view to connecting remote regions and a port within a country would reduce the costs of moving goods from isolated regions to the international market. Such AfT interventions would reduce the costs faced by first-tier suppliers or exporting firms that buy from suppliers in the now less-isolated regions (e.g., Mayer and Milberg, 2013). In this regard, they could promote forward participation in GVCs through encouragement of countries to export intermediate inputs (including raw materials) to foreign firms that use them to process exportable goods. Likewise, the development of ICT infrastructure (e.g., greater connectivity) can promote backward participation in GVCs (e.g., Fernandes et al., 2022) by improving the competitiveness of firms that rely on foreign intermediate inputs to produce and export higher value-added goods and services.

Against this backdrop, and in view of the sector-neutral nature of AfT interventions for economic infrastructure, AfT flows for economic infrastructure may result in greater backward GVC participation and/or greater forward GVC participation by recipient countries. Nevertheless, their sector-neutral character, AfT interventions for strengthening economic infrastructure may favour sectors of comparative advantage in the absence of large sector distortions (e.g., Cirera and Winters, 2015). This may lead countries that are highly dependent on the export of primary commodities to take advantage of the trade costs reduction brought about by higher AfT flows for economic infrastructure, by increasing their export of primary commodities. In such a case, higher AfT flows for economic infrastructure would encourage forward participation in GVCs. Conversely, the trade costs reduction effect of AfT interventions for economic infrastructure may lead productive firms in the recipient countries to improve their backward participation in GVCs by reducing the costs of sourcing inputs - from the domestic markets as well as from the international markets - that are needed in the process of upgrading export products.

AfT interventions for strengthening productive capacities target specific sectors, and could therefore promote developing country firms' participation in GVCs, particularly their participation in backward GVCs. Indeed, such AfT flows can enter the value chain at or near the bottom of the chain (e.g., Mayer and Milberg, 2013), and in this regard, provide incentives for beneficiary firms to increase their imports of foreign inputs with a view to producing higher quality exportable goods. This is because importing new inputs (including intermediate inputs) is critical for the expansion of the export portfolio, in particular at the extensive margins (i.e., by adding new products) (e.g., Bas and Strauss-Kahn, 2015; Castellani and Fassio, 2019; Feng et al., 2016) and, AfT flows facilitate the import of goods by recipient countries (Hühne et al., 2014), and promote the diversification of imported goods (Gnangnon, 2021a; Ly-My, 2021). On another note, many studies have demonstrated that higher trade costs hinder export upgrading (e.g., Bas and Strauss-Kahn, 2015; Beverelli et al., 2015; Chen and Juvenal, 2022; Regolo, 2013). This signifies that AfT

interventions could promote export product upgrading¹⁰ and hence encourage participation in GVCs, notably through enhanced backward GVC participation. Against this backdrop, we can argue that AfT flows for productive capacities can promote countries' participation in backward GVCs, eventually at the detriment of their participation in forward GVCs.

Finally, the previous section (section 2.1) has well elaborated on how trade facilitation measures promote countries' participation in GVCs. This implies that thanks to their positive trade facilitation effect, AfT interventions for trade policy and regulation could promote countries' participation in GVCs, especially their backward GVC participation. Likewise, AfT flows for trade policy and regulation could help policymakers develop WTO-consistent trade-related institutions and trade policies (e.g., lower tariffs and non-tariff policy barriers) that encourage the import of intermediate inputs needed in the process of upgrading export products. Furthermore, the compensation mechanism allowed for by this type of AfT interventions in favour of less productive firms could help them improve their productivity and their competitiveness in the value chain by becoming active participants in backward GVCs.

More generally, Antràs and De Gortari (2020) have provided that trade costs, in sequential (or snake-like) GVCs, compound as the gross value of trade flows increases further downstream along a value chain. As a result, they have greater incidence on downstream stages than on upstream stages. This implies that trade costs are likely to exert a higher negative effect on backward participation in GVCs than on forward participation in GVCs (e.g., Fernandes et al., 2022). In this context, one may surmise that by helping reduce trade costs, AfT interventions could exert a larger positive effect on backward participation in GVCs than on forward participation in GVCs, if any effect at all on the latter. In other words, AfT flows could allow firms in recipient countries to engage more in downstream¹¹ activities than in upstream¹² activities in the production network. In this case, firms would be inclined to specialize in the last stages of production where they imports many intermediate inputs from foreign countries, eventually with a view to upgrading their export product baskets. This suggests that higher AfT flows would affect positively the ratio of the indicator of backward GVC participation to the indicator of forward GVC participation (i.e., negatively the ratio of the indicator of forward GVC participation to the indicator of backward GVC participation – considered as the indicator of countries' position in the GVCs).

Building on this discussion, we postulate the following hypotheses.

Hypothesis 1: AfT interventions would promote recipient countries' participation in GVCs, particularly in backward GVC participation, eventually at the expense of their forward participation in GVCs.

Hypothesis 2: In view of their eventual positive effect on backward GVC participation relatively to forward GVC participation, AfT interventions would exert a negative effect on countries' position in the GVCs measured by the ratio of forward GVC participation to the

¹⁰ See for example, Arpacı-Ayhan (2023); Gnanon (2019, 2021b, 2023e); Gnanon and Roberts (2017); Kim (2019) and Nathoo et al. (2021).

¹¹ Downstream activities in the production network are those that add value to intermediate goods for further export, and therefore entail ultimately the export of higher value-added products.

¹² In the value chains, upstream activities take place at the start of the production process, and involve activities of production of raw materials or intangibles, that is, activities relating to minimally processed or unprocessed materials, research and development, innovation, design, consulting, market intelligence,...etc.

backward participation in GVCs. That is, AfT interventions would likely lead firms in recipient countries to engage more in downstream activities than in upstream activities.

Hypothesis 3: The positive effect of AfT interventions on recipient countries' participation in GVCs (including both backward and forward GVC participation as well as their GVC position) is likely to depend on the magnitude of trade costs faced by countries that engage in GVCs.

The empirical analysis will test these two hypotheses.

3. Empirical strategy

This section starts by presenting the model specification (section 3.1). It, then, briefly describes data on key variables of interest in the analysis (section 3.2). Finally, it discusses the econometric approaches used in the analysis (section 3.3).

3.1. Model specification

As noted above, the effect of AfT interventions on GVC participation likely depends on the point in the value chain at which such AfT interventions take place. Unfortunately, the OECD/DAC-CRS¹³ data does not provide data on the amount of development aid (including AfT) flows in different locations in the value chains (so as to differentiate the effect of AfT flows on GVC participation by location in the value chain). Therefore, we carry out the analysis by using data on the aggregate AfT flows (including on each of the three major components of AfT flows) alongside data on aggregate indicators of participation in GVCs, especially backward participation in GVCs, forward participation in GVCs and GVC position.

We investigate the empirical effect of AfT flows on recipient countries' participation in GVCs by building on recent works on the determinants of GVC participation (through backward and forward participation) at the country-level (e.g., Bontadini, 2021; Fernandes et al., 2022; Kowalski et al., 2015; World Bank, 2020). Thus, in addition to the AfT variable (i.e., our variable of main interest), we consider a number of control variables that are: the development level, proxied by the real per capita income, and denoted "GDPC"; human capital, denoted "HUM"; the real effective exchange rate, denoted "REER"; the market size, proxied by the population size, denoted "POP"; the institutional and governance quality, denoted "INST"; foreign direct investment (FDI) inflows, denoted "FDI" and the level of financial development, denoted "FINDEV". We also add as regressor, the variable ("NAFTTOT") that captures development aid flows allocated for other sectors than the trade sector in developing countries.

The development level is an important factor that explains a country's level of participation in GVCs. According to Kowalski et al. (2015), the relationship between the development level and GVC participation is complex, as it may for example, reflect differences in labour productivity, labour costs, or domestic capacity and purchasing power. In general, the majority of developed and developing countries are engaged in both backward and forward GVCs, although those with strong backward linkages tend to have relatively weaker forward linkages (e.g., Kowalski et al. 2015; World Bank, 2020). Countries with low development levels (i.e., those at the early stage of

¹³ The acronym OECD/DAC-CRS refers to the Organization for Economic Cooperation and Development/Donor Assistance Committee)-Credit Reporting System (CRS).

economic development) tend to specialize in primary products, used as inputs by foreign countries in their production processes. In this case, one can argue that the lower the development level, the higher the level of forward participation in GVCs. Similarly, countries that are dependent on primary commodities can also enhance their backward linkages by engaging in factor-type activities such as assembly. In such a case, a low level of development would be associated with a higher engagement in backward participation in GVCs. Kowalski et al. (2015) have observed empirically that the development level is negatively and significantly associated with backward participation in GVCs, and positively and significantly associated with forward participation in GVCs.

A large market size provides an opportunity for countries to source a large pool of inputs from the domestic market, including at lower prices due to economies of scale (e.g., Kowalski et al. 2015). Hence, the larger the market size (the population size), the lower the foreign inputs share in production for exportation (i.e., the lower the level of backward GVC participation), and possibly the higher the share of domestic inputs used by foreign countries in their exports (i.e., the higher the level of forward GVC participation).

We also expect that higher NonAfT flows could promote backward GVC participation (eventually at the expense of forward GVC participation), especially in countries that use part of these resource inflows to import intermediate inputs in order to upgrade their export product baskets.

The institutional and governance quality is also an important factor underpinning participation in GVCs (e.g., Antràs, 2016; 2019, 2020; Dollar and Kidder, 2017; Ignatenko et al., 2019; Kowalski et al. 2015; Montfaucon et al., 2023). For example, Dollar and Kidder (2017) have emphasized the crucial role of institutional quality for effective participation in GVCs. For example, ensuring equitable protection of rights, increasing the enforceability of contracts, enhancing transparency and adopting anticorruption measures make easier the participation of firms in GVCs. According to Antràs (2016; 2019; 2020), the prevalence of weak institutions that prevent contract enforcement is a significant deterrent for GVC participation, insofar as GVC trade involves significant firm-to-firm interactions characterized by contracting and specialized products and investment.

Education and training is equally critical for reaping the benefits of participation in GVCs (e.g., Bontadini, 2021; Fernandes et al., 2022; Ignatenko et al., 2019; Kowalski et al. 2015). For example, Kowalski et al. (2015) have emphasized that tertiary graduates in the workforce enhance the creation of value added through GVCs. Also, Ignatenko et al. (2019) have obtained a positive effect of human capital on GVC participation.

The level of financial development is a source of comparative advantage and determines how easier firms can have access to finance to, *inter alia*, reduce sunk entry costs to export and sunk entry costs to import inputs. As a result, it plays an important role in GVC participation, and even more than in traditional trade (e.g., Fernandes et al., 2022; Kowalski et al. 2015).

While a depreciation of the real exchange rate tends to foster traditional exports, its effect on GVC participation is more muted (Fernandes et al., 2022). In line with this, Adler et al. (2019) have found that while greater integration into GVCs reduces the exchange rate elasticity of gross trade volumes over the short and medium terms, it is also associated with larger gross trade flows, which tends to amplify the trade balance effect of exchange rates. Overall, the effect of the real exchange rate on GVC participation, including backward and forward GVC participation is to be determined empirically.

Finally, FDI inflows can help countries integrate into GVCs, but the effect of these capital inflows depends on the type of FDI that flows to a given country (e.g., market-seeking FDI, resource-seeking FDI; export-platform FDI). The existing empirical evidence tends to show that openness to FDI affects positively participation in GVCs (e.g., Buelens and Tirpak, 2017; Cheng et al. 2015; Fernandes et al., 2022; Kowalski et al. 2015).

The extent to which each of these control variables affects countries' backward and forward GVC participation would determine their effect on countries' GVC position.

We consider the following baseline model specification (1):

$$GVC_{it} = \beta_0 + \beta_1 \text{Log}(AFT)_{it} + \beta_2 \text{Log}(NAFTTOT)_{it} + \beta_3 \text{Log}(GDPC)_{it} + \beta_4 \text{HUM}_{it} + \beta_5 \text{Log}(REER)_{it} + \beta_6 FDI_{it} + \beta_7 \text{FINDEV}_{it} + \beta_8 \text{INST}_{it} + \beta_9 \text{Log}(POP)_{it} + \gamma_t + \mu_i + \varepsilon_{it} \quad (1)$$

i and t are subscripts that represent respectively a country and a year in the unbalanced panel dataset of 80 developing countries over the annual period from 2002 to 2018.

β_0 to β_9 are parameters that will be estimated. γ_t are year dummies that represent global shocks influencing simultaneously all countries' levels of GVC participation. μ_i are countries' time invariant specific effects, and ε_{it} is a well-behaving error term.

The dependent variable "GVC" is the indicator of GVC participation. It can be the backward participation in GVCs (denoted "BGVC"), the forward participation in GVCs (denoted "FGVC") or countries' position in the GVCs (denoted "GVC").

Our first indicator of the participation in GVCs (the backward participation in GVCs) reflects a country's engagement in GVCs as "seller", and captures the foreign value-added that is embodied in gross exports. In other words, it represents the share of the value added of foreign (imported) goods (used as intermediate inputs to produce output for exports) in gross exports. The formula used to calculate the indicator "BGVC" is: $BGVC = \frac{DVX}{GE}$, where "DVX" is the foreign value-added that is embodied in gross exports and "GE" is the indicator of gross exports. An increase in the values of this index reflects greater backward participation in GVCs.

The indicator of forward participation in GVCs ("FGVC") is the second indicator of countries' participation in GVCs. It reflects a country's participation in GVCs as "buyer", and captures the domestic value added (used as intermediate input) in other countries' value-added exports. It is calculated as the share (in gross exports) of the exports of intermediate goods used by foreign countries for the production of exportable goods. The formula used to calculate the indicator "FGVC" is: $FGVC = \frac{FVA}{GE}$, where "FVA" is the domestic value added used in the export of third countries. "GE" is as defined above. An increase in the values of this index reflects greater backward participation in GVCs.

The variables "DVX", "FVA" and "GE" are collected from the UNCTAD-Eora Global Value Chain Database¹⁴.

Countries that have different degrees of GVC participation may have the same position in GVCs. Thus, we use countries' position within the GVCs as third indicator of their participation in GVCs. Following Koopman et al. (2014), a country's position in GVCs in a given year is

¹⁴ It is available online at: <https://worldmrio.com/unctadgvc/>

calculated as the share of forward GVC participation relative to the share of backward GVC participation: $GVCPOS = \ln\left(1 + \frac{DVX}{GE}\right) - \ln\left(1 + \frac{FVA}{GE}\right)$, where "DVX", "DVA" and "GE" are as defined above. The symbol "Ln" is the natural logarithm. The index "GVCPOS" reflects a country's supply of intermediate goods used in foreign countries' exports relatively to this country's use of imported intermediate goods in its own production. Higher values of the index "GVCPOS" for a given country provide the indication that its forward participation is higher than its backward participation. This signifies that the country is engaged in upstream activities in the production network, that is, it is located in the first stages of production where it exports a lot of intermediate products abroad. Conversely, lower values of the indicator "GVCPOS" for a given country show that the country's forward participation in GVCs is lower than its backward participation in GVCs. This signifies that the country is situated more downstream in the value chain, that is, it is specialized in the last stages of production where it imports a lot of intermediate products from foreign countries.

As "BGVC" and "FGVC" are proportion variables (i.e., variables whose values range between 0 and 1 - as they are not expressed in percentage), the estimation of model (1) using these dependent variables could yield predictions of these variables outside the unit interval, including nonsensical predictions for extreme values of the regressors (Baum, 2008). Baum (2008) has proposed to handle the bounded nature of the dependent variable by transforming the indicator using the 'logit' function, and then use the linear regression (including the appropriate estimator) to estimate the model with the transformed dependent variable. We apply the method proposed by Baum (2008) to transform the variables "BGVC" and "FGVC" as follows: $BGVC1 = \text{Logit}(BGVC)$ and $FGVC1 = \text{Logit}(FGVC)$.

The indicator "AfT" represents the real gross disbursements of AfT flows, expressed in constant prices 2020, US Dollar. In the analysis, and in line with our theoretical discussion, we consider total AfT (denoted "AfTTOT") and each of its three components highlighted above, to examine empirically the effect of AfT flows on recipient-countries' participation in GVCs. The three components of AfT flows (also described in Appendix 1) are AfT flows for economic infrastructure ("AfTINF"), AfT flows for productive capacities ("AfTIPR"), and AfT flows related to trade policy and regulation ("AfTPOL").

As also noted above, the variable "NAfTTOT" represents the development aid (ODA) flows allocated to other sectors than the trade sector in the economy of a recipient country. It is calculated as the difference between the gross disbursements of total ODA and the gross disbursements of total AfT, both being expressed in constant prices 2020, US Dollar. AfT variables and the gross disbursements of total ODA were extracted from OECD/DAC-CRS database.

Appendix 1 contains the description and source of all control variables used in the analysis. Appendix 2 reports descriptive statistics on all variables utilized in the analysis, and Appendix 3 presents the list of the 80 countries in the full sample.

3.2. Data analysis

Before turning to the discussion of the econometric approach used to test hypotheses 1 to 3, we find useful to provide an insight into the correlation between total AfT flows and GVC indicators. To that end, we provide in Figure 1 the development of GVC indicators and total AfT

flows, on average, over the full sample. We display in Figure 2 the scatter plot between GVC indicators and total AfT flows over the full sample.

[Insert Figure 1, here]

It appears from Figure 1 that AfT recipient countries displayed higher forward participation in GVCs than backward GVC participation. In other words, they tended to export significantly more goods used as inputs by foreign countries than they import intermediate inputs from foreign countries. Moreover, both countries' backward and forward GVC participation exhibited an upward trend from 2002 to 2008, decreased between 2008 and 2009 (probably because of the 2008 financial crisis) and then rebounded between 2009 and 2010. However, from 2008 to 2018, both forward and backward GVC indicators showed a downward trend, possibly reflecting the growing protectionist measures and the backlash against globalization. As for countries' average position in GVCs, we observe that it fluctuated over the entire period. It tended to increase slightly from 2002 to 2008, and then declined between 2008 and 2009. The GVC position then rose between 2009 and 2010, but decreased again between 2010 and 2011. It remained relatively stable over the sub-period 2011-2014, and subsequently improved until 2017. Between 2017 and 2018, the GVC position slightly decreased.

[Insert Figure 2, here]

We note from Figure 2 that total AfT flows are positively correlated with forward GVC participation as well as with the GVC position. However, these resource inflows are negatively correlated with backward GVC participation. But these correlation patterns between total AfT flows and indicators of participation in GVCs do not necessarily reflect the existence of a causal relationship (including the direction of this relationship) between these GVC indicators and total AfT flows.

3.3. Econometric approach

In this section, we present empirical results based on the estimation of specifications of model (1) with each of the three indicators of GVCs, that is, indicators of backward GVC participation, forward GVC participation and GVC position.

The Cluster-robust Hausman test of Kaiser (2015) that helps choose between a fixed-effects model and a random effects model indicates p-values relating to the Chi-square statistics¹⁵ higher than 0.10 at the 10% level, for the three specifications of model (1) where the dependent variable is respectively "BGVC1", "FGVC1" and "GVCPOS". These outcomes suggest that either the fixed effects estimator or the random effects estimator could be appropriate for estimating these specifications of model (1). In the present analysis, we may be tempted to use the fixed effects estimator because it allows for the correlation between countries' invariant unobservable specific effects (i.e., here fixed effects) and their time-variant observable characteristics, whereas the random effects model rests on the assumption of absence of such correlation. We use the within-fixed effects estimator (denoted "FEDK") along with the approach proposed Driscoll and Kraay (1998) to correct estimates' standard errors for the presence of the heteroscedasticity, serial correlation and contemporaneous cross-sectional dependence in the residuals. In the meantime, this estimator has the drawback of disregarding the between-country variations of variables, as it

¹⁵ The outcomes (Chi2 statistic and p-value in brackets) of the test are 7.78 (0.5560); 6.39 (0.7008) and 5.41 (0.7973) for three different specifications of model (1) where the dependent variable is respectively "BGVC1", "FGVC1" and "GVCPOS".

takes into account only the within-country variations of variables. Therefore, we complement the empirical analysis based on the FEDK estimator with the random-effects Mundlak estimator (denoted "RE Mundlak" approach) (see Mundlak, 1978; Wooldrige, 2010). The random-effects Mundlak estimator is a hybrid estimator that allows taking into account differences in within and between-countries. This involves introducing in the random effects specification, both the time-invariant variables and the demeaned coefficients from the fixed-effects model. The set of time-averaged regressors allows controlling for time-invariant unobserved heterogeneity (between-country effects) in the regressions. Thus, the use of the random effects Mundlak estimator would allow uncovering within-effects estimates through estimated parameters β_0 to β_9 , given that the between-effects estimates in the regressions are captured through the introduction of the averages of regressors across years and per country in the regressions.

To sum-up, we use the FEDK estimator and the random effects Mundlak estimator to estimate the three specifications of model (1).

However, model (1) is likely plagued with endogeneity concerns that can arise from the bi-directional causality between all variables but the population size, and the dependent variables, i.e., the GVC indicators. For example, AfT variables (notably total AfT flows) are likely endogenous. This is because while we expect AfT interventions to affect recipient countries' participation in GVCs, it is also possible that the level of these countries' participation in GVCs potentially determine the amounts of AfT flows that these countries receive from donors, insofar as donors might be willing to supply higher AfT flows to countries with low levels of GVC participation. The same reasoning can apply to all other control variables, with the exception of the population size. To mitigate these endogeneity concerns, we follow Cali and te Velde (2011) and use one-year lagged values of total AfT flows in the three specifications of model (1) estimated using the FEDK and RE Mundlak approaches, with a view to accounting for the possible lag effect of total AfT flows on countries' participation in GVCs. In so doing, we are able to mitigate the endogeneity of the variable representing total AfT flows in the analysis. As the choice of the lag with which total AfT flows could affect recipient countries' participation in GVCs may be arbitrary, we also follow Cali and te Velde (2011) and use two-year lagged values of total AfT flows. We also subsequently use the indicator capturing NonAfT flows with one-year and two-year lags when performing the analysis, in order to account for the eventual lag effects of this variable on GVC participation indicators. Finally, to reduce the endogeneity problem of all other regressors (except for the population size) in model (1), we use the one-year lag of these variables.

In a nutshell, we use both the FEDK estimator and the random effects Mundlak estimator to test hypotheses 1 and 2, that is, to estimate the three specifications of model (1) (i.e., with each indicator of GVC participation). In these model specifications, the variable "AfT" is measured by total AfT flows and is considered (along with the variable "NAfTTOT") at the one-year lag (see results in Table 1) and at two-year lag (see results in Table 2). It is worth noting that in all these specifications, all other regressors (i.e., with the exception of the population size) are introduced at year $t-1$, and the population size indicator is introduced at year t in the regressions.

The use of lags of aid variables helps mitigate their endogeneity concerns while accounting for the possible lag effects of AfT flows (and NonAfT flows) on recipient countries' participation in GVCs. The same applies to other regressors that were lagged (with a one-year) in the previous estimations. However, this procedure might not fully eliminate the endogeneity problems that plague model (1), especially the endogeneity of the AfT variable(s). In addition, the estimates

obtained when using the FEDK and RE-Mundlak estimators represent 'average' effects of explanatory variables, including AfT flows on GVC participation indicators over the full sample. This may, in fact, hide differentiated effects of AfT flows on GVC participation across different quantiles of the distribution of each of the indicators of participation in GVCs.

To better handle these endogeneity problems while taking into account the possibility of differentiated effects of AfT flows on GVC indicators across different quantiles, we utilize the Method of Moments Quantile Regression (MMQR) with fixed effects approach (also referred to as "Quantile via Moments") developed by Machado and Santos Silva (2019). Contrary to other standard quantile regression approaches (e.g., Canay, 2011; Koenker, 2004), the MMQR estimator helps address problems such as the heteroscedasticity and outliers problems. In addition, this estimator is different from the standard quantile regression estimators to the extent that in MMQR-based regressions, countries' time-invariant fixed effects vary across different quantiles of the conditional distribution of the dependent variable (here, the GVC indicators), while in other standard quantile regression approaches, countries' time-invariant fixed effects are treated as location (intercept) shifters. More importantly, by relying on the method of moments, the MMQR approach allows tackling the endogeneity problems (in particular the reverse causality issue of regressors) in the model specifications.

In the present analysis, we employ the MMQR estimator not only to address the possible endogeneity problem that plague model (1), but also to explore how the effect of regressors, in particular AfT flows on countries' GVC participation varies across the distribution of GVC indicators. The empirical analysis is carried out over five quantiles, including the 10th quantile (Q10th), 25th quantile (Q25th), 50th quantile (Q50th), 75th quantile (Q75th) and 90th quantile (Q90th). Note that the MMQR estimator is utilized to estimate specifications of model (1) where all explanatory variables are considered at year t , and using each of the three GVC indicators as dependent variable. The outcomes arising from these estimations (where the variable "AfT" is measured by total AfT flows) allow testing hypotheses 1 and 2, and are reported in Tables 3 to 5 respectively for the specification of model (1) where the backward GVC indicator, the forward GVC indicator and the indicator of GVC position are respectively the dependent variable.

Outcomes reported in Table 6 are obtained by estimating the specifications of model (1) (with each component of total AfT flows, introduced once in the model) using as dependent variable each of the three indicators of countries' participation in GVCs. These estimates also allow testing hypotheses 1 and 2.

We test hypothesis 3 by utilizing the MMQR approach to estimate variants of model (1) (where the regressor "AfT" is measured by total AfT flows and the dependent variable is measured by each of the indicators of countries' participation in GVCs) that contain an indicator of trade costs (or its two components described below) alongside the interaction between the trade costs indicator and the variable capturing total AfT flows. The outcomes stemming from these estimations are presented in Table 7. The variable capturing the total trade costs is computed for a country in a given year, as the average of the bilateral overall trade costs on goods across all trading partners of this country (calculated by Arvis et al. 2012, 2016). This computation follows the approach proposed by Novy (2013), and uses the definition of trade costs provided by Anderson and van Wincoop (2004). The overall trade costs indicator has two components that are the indicator of the average tariff costs, and the indicator of the average nontariff costs. The tariff component of the average overall trade costs has been calculated for a country in a given year, as

the average of the bilateral comprehensive tariff costs across all trading partners of this country. The second component (i.e., nontariff component) of the comprehensive trade costs is computed for a country in a given year, as the average bilateral comprehensive nontariff costs (i.e., the comprehensive trade costs, excluding the tariff costs) across all trading partners of this country. Details on the computation of the indicators of the overall trade costs and its two main components are provided in Appendix 1. Note that the trade costs indicators are potentially endogenous, so are also the interaction between these indicators and the variable capturing total AfT flows. This justifies the use of the MMQR approach to estimate the model specifications that contain these indicators.

Note that we present in Tables 6 and 7 outcomes only concerning our main variables of interest, including AfT flows variables and trade costs indicators, in order to save space. Results on all regressors could be obtained upon request.

4. Empirical outcomes

We find from Table 1 that total AfT flows in year $t-1$ exert a positive and significant effect (at the 1% level) on backward GVC participation in year t , with the magnitude of the effect being similar in columns [1] and [2] (i.e., results based respectively on the FEDK and RE-Mundlak estimators). In the meantime, outcomes in columns [3] and [4] of Table 1 indicate that the one-year lag of total AfT flows exerts no significant effect on forward GVC participation. Estimates presented in column [5] of Table 1 show the absence of total AfT flows on the GVC position at the 10% level. Concurrently, results in column [6] of the Table (based on the RE-Mundlak approach) show that at the 5% level, total AfT flows affect negatively countries' position in GVCs, that is, these resource inflows allow firms to engage more in downstream activities than in upstream activities in the production network. Hence, if the RE-Mundlak estimator was our preferred estimator (in view of its hybrid nature), we would conclude that AfT flows tend to favour (with a one-year lag effect) backward GVC participation at the expense of forward GVC participation. These outcomes are largely confirmed in Table 2, including with similar estimates. In relation to hypotheses 1 and 2, we conclude that on average over the full sample, total AfT flows foster countries' participation in backward GVCs, but exert no significant effect on forward GVC participation. Meanwhile, these resource inflows allow firms to engage more in downstream activities than in upstream activities in the GVCs.

[Insert Table 1, here]

[Insert Table 2, here]

Results concerning control variables in Tables 1 and 2 are quite similar. They suggest that NonAfT flows promote backward GVC participation (see columns [1] and [2]), reduce forward participation in GVCs (see columns [3] and [4]), and are ultimately associated with a greater countries' engagement in backward GVCs participation relatively to forward GVC participation (see columns [5] and [6]). Likewise, as countries' real per capita income improves, they tend to increase their backward GVC participation at the expense of their forward GVC participation, and hence, foster their engagement in downstream activities than in upstream activities in the production network. These findings run in contrast with the ones by Kowalski et al. (2015), although the country coverage by the latter is not the same as ours. While the depreciation of the real exchange rate and higher FDI inflows exert no significant effect on forward GVC participation, they tend to promote backward GVC participation, and induce greater engagement

in downstream activities than in upstream activities. The accumulation of human capital and the improvement of the institutional and governance quality appear to reduce countries' participation in backward GVCs, and encourage their engagement in upstream activities relatively to downstream activities. These outcomes do not fully align with theoretical predictions (e.g., Bontadini, 2021; Fernandes et al., 2022; Ignatenko et al., 2019; Kowalski et al. 2015), and may suggest that as countries accumulate human capital, and as they improve the quality of institutions and governance, they tend to shift to upstream activities at the expense of downstream activities (i.e., perhaps they tend to reinforce their reliance on sectors of comparative advantage). Nevertheless, these specific outcomes may hide differentiated effects of human capital and institutional and governance quality on GVC participation across countries in the full sample. Financial development and the population size exert no significant effect on GVC participation.

[Insert Table 3, here]

Outcomes in Table 3 indicate that the location parameter relating to the variable "AfTTOT" (see column [1]) is positive and significant at the 1% level, while the scale parameter associated with the same variable (see column [2]) is negative but not significant at the conventional significance levels. These two outcomes show that the effect of total AfT flows on backward GVC participation is always positive but its magnitude (i.e., scale) decreases as we move from lower quantiles to upper quantiles in the distribution of the indicator of backward GVC participation. The scale of this effect is 0.041 for the lowest quantile (i.e., 10th quantile) and 0.029 for the highest quantile (90th quantile). These findings suggest that AfT interventions (total AfT flows) exert a larger positive effect on countries located in the lower quantiles, especially in the lowest one (i.e., those with the lowest levels of backward GVC participation) than in countries located in relatively higher quantiles.

Concurrently, we observe from Table 4 that the location parameter relating to the variable "AfTTOT" (see column [1]) is positive and significant at the 5% level, while the scale parameter associated with the same variable (see column [2]) is negative and significant at the 1% level. It appears that total AfT flows exert a positive and significant effect (at least at the 5% level) in the lower quantiles of the distribution of the indicator of forward GVC participation, while these resource inflows exert no significant effect on forward GVC participation by countries in the upper quantiles of the distribution of the indicator of the same indicator. Put differently, total AfT flows promote the forward participation in GVCs by countries located in the 10th to 50th quantiles (the positive effect is larger in lower quantiles than in upper quantiles), but exert no significant effect on forward GVC participation by countries located in the upper quantiles of the distribution of the indicator of forward GVC participation.

[Insert Table 4, here]

Summing-up results in Tables 3 and 4 concerning the effect of total AfT flows on backward and forward GVC participation, we find that total AfT flows promote both backward and forward GVC participation by countries located in the 10th to 50th quantiles, with the positive effect of these resources inflows being higher for countries situated in the lower quantiles than those situated in the relatively higher quantiles. In addition, for countries in the 10th to 50th quantiles, the positive effects of total AfT flows on backward GVC participation are higher than the ones on forward GVC participation. On the other hand, total AfT flows exert a positive and significant effect on backward GVC participation for countries situated in upper quantiles, including the 75th and 90th quantiles of the distribution of the indicator of the backward GVC participation. These positive

effects of AfT flows are, however, lower in magnitude than those of countries located in the 10th to 50th quantiles. Meanwhile, there are no significant effect of total AfT flows on forward GVC participation by countries located in the upper quantiles (especially the 75th and 90th quantiles) of the distribution of the indicator of forward GVC participation.

Concerning control variables, we observe that NonAfT flows exert a positive and significant effect on backward GVC participation (see Table 3) with the magnitude of this positive effect being larger in lower quantiles (especially the lowest quantile) than in upper quantiles. Concurrently, the effect of NonAfT flows on forward GVC participation is always negative and significant at the 1% level, with its magnitude being larger for countries located in lower quantiles than for those situated in upper quantiles of the distribution of the indicator of forward GVC participation. An improvement in the real per capita income exerts a positive and significant effect on backward GVC participation across all countries in the conditional distribution, and the magnitude of this positive effect is higher for countries in the lower quantiles than for those in the upper quantiles. Conversely, at the conventional significance levels, there is no significant effect of the real per capita income on forward GVC participation across quantiles in the conditional distribution. The depreciation of the real exchange rate tends to foster backward GVC participation across all quantiles (with its positive effect being larger, the lower the quantile) (see Table 3), but reduces forward GVC participation (except for countries in the highest quantile, i.e., 90th quantile), with the magnitude of the negative effect being larger, the lower the quantile (see Table 4). Incidentally, in line with our findings in Tables 1 and 2, we obtain that countries that accumulate human capital tend to reduce their participation in backward GVCs (see Table 3), but the improvement in human capital does not affect countries' forward GVC participation (see Table 4). These findings may indicate that as they improve their education levels, countries tend to use their skilled people less in downstream activities, including in favour of upstream activities, as shown by results in Table 5 that we will interpret later in the analysis. At the 5% level, FDI inflows exert almost no significant effect on backward GVC participation across quantiles (except for countries located in the 75th and 90th quantiles where the effect is positive and significant at the 1% level) (see Table 3). At the same time, FDI inflows exert a significant (yet positive) effect on forward GVC participation only by countries in lower quantiles, that is, 10th to 50th quantiles of the distribution of the indicator of forward GVC participation. As obtained in Tables 1 and 2, financial development does not affect, at the conventional significance levels, countries' backward and forward GVC participation. At the 5% level, a better quality of institutions and governance reduces forward GVC participation by countries located in almost all quantiles (see Table 4), but it influences significantly (although negatively) only countries situated in the 75th and 90th quantiles. These outcomes may indicate that improving the quality of institutions and governance alone might not be sufficient to enhance countries' participation in GVCs. Finally, the increase in the population size exerts no significant effect on backward GVC participation, but tends to reduce forward GVC participation.

[Insert Table 5, here]

Estimates presented in Table 5 suggest that total AfT flows foster backward participation in GVCs only by countries located in the highest quantiles, including the 75th and 90th quantiles. For countries located in other quantiles, there is no significant effect of AfT flows on backward GVC participation. Specifically, total AfT flows reduce to a greater extent backward GVC participation by countries in the 90th quantile than by countries in the 75th quantile. Put differently, AfT flows do not affect significantly backward GVC participation by countries in the lower quantiles of the

distribution, but tend to encourage greater engagement by countries situated in the 75th and 90th quantiles (of the conditional distribution of the indicator of GVC position) in downstream activities (those that involve adding value to products) than in upstream activities (those that involve the exploitation of natural resources). Consistent, to some extent, with outcomes in Table 3, higher NonAfT flows promote greater engagement in downstream activities relatively to upstream activities across all quantiles of the distribution, with the magnitude of this effect being larger, the lower the quantile. The real per capita income influences significantly the GVC position of countries located in the upper quantiles: the higher the real per capita income, the greater the engagement of countries situated in the upper quantiles¹⁶ in downstream activities relatively to upstream activities of the production network. These outcomes lend support to hypothesis 3, especially for countries in 75th and 90th quantiles of the conditional distribution of the GVC position. Also consistent with the findings in Tables 3 and 4, we obtain that the improvement in human capital as well as an appreciation of the real exchange rate tend to be associated with greater engagement in upstream activities than in downstream activities in the GVCs by countries in all quantiles (the effect is higher, the lower the quantile). Improving the institutional and governance quality does not significantly affect countries' GVC position across all quantiles. Likewise, FDI inflows and financial development affect significantly only countries in the lower quantiles, especially those in the 10th and 25th quantiles, with this effect being negative (i.e., in favour of downstream activities) and larger for countries in the lowest quantile than for countries in the 25th quantile. At the 5% level, populous countries (located in the 10th to 50th quantiles) tend to engage more in downstream activities than in upstream activities, while the population size exerts no significant effect the GVC position of countries in the upper quantiles.

[Insert Table 6, here]

We now consider outcomes in Table 6. It is worth noting, at the outset, that across all lines of this Table, the outcomes concerning the effect of NonAfT flows on GVC indicators are consistent with those in Tables 3 to 5. Estimates in line (1) of Table 6 reveal that AfT interventions for economic infrastructure exert a positive and significant effect on backward GVC participation across all quantiles. The magnitude of this positive effect is larger, the lower the quantile. This signifies that countries with the lower levels of backward GVC participation (including those with the lowest backward GVC participation, i.e., those in the 10th quantile) enjoy a higher positive effect of AfT flows for economic infrastructure on backward GVC participation than countries with relatively higher degrees of participation in GVCs (countries situated in upper quantiles). In the meantime, there is no significant effect of AfT flows for economic infrastructure on forward GVC participation across all quantiles of the distribution of the indicator of backward participation in GVCs (see line (8) of Table 6). Interestingly, we obtain from line (15) of Table 6 that AfT interventions in support for economic infrastructure promote engagement in downstream activities relatively to upstream activities only for countries in higher quantiles (i.e., the 50th to 90th quantiles), with the effects of this category of AfT flows being larger in lower quantiles than in relatively higher quantiles.

AfT interventions to enhance productive capacities exert a positive and significant effect (at the 1% level) on backward GVC participation across all countries of the distribution (see line (21) of Table 6). The lower the degree of participation in backward GVCs (i.e., the lower the quantile),

¹⁶ Especially countries in the 75th and 90th quantiles.

the higher is the positive effect of AfT flows for productive capacities on backward GVC participation. In particular, countries with the lowest level of participation in backward GVCs (i.e., those in the 10th quantile in the distribution of the indicator of backward GVC participation) enjoy the highest positive effect of AfT flows for productive capacities on backward GVC participation, while countries with the highest level of backward GVC participation (i.e., those in the 90th quantile) experience the lowest positive effect of AfT flows for productive capacities on backward GVC participation. On the other side, results in line (28) of Table 6 show that AfT for productive capacities affects significantly (and yet positively) only countries in the lower quantiles (i.e., the 10th to 50th quantiles) of the distribution of the indicator of forward GVC participation, as for other quantiles its effect is statistically nil at least at the 10% level. More importantly, this category of AfT interventions exerts a higher positive effect on forward GVC participation in countries located in the lowest quantile than in countries situated in the 25th and 50th quantiles. At the 5% level, similar findings (although with different magnitudes of the effect) are obtained for the effect of AfT interventions in favour of trade policy and regulation on backward GVC participation (see line (41) and on forward GVC participation (see line (47)).

At the 5% level, the effect of AfT flows for productive capacities on countries' GVC position is statistically nil in all quantiles but the highest quantile (i.e., the 90th quantile) (see line (34) of Table 6). For countries in this specific quantile, AfT interventions for productive capacities induce greater engagement in downstream activities than in upstream activities of the production network. Similar findings (although with different estimates) are obtained concerning the effect of AfT flows for trade policy and regulation on countries' GVC position (see line (54) of Table 6).

[Insert Table 7, here]

Turning to results in Table 7, we note from line (1) that the effect of total AfT flows on backward GVC participation by countries in the 10th quantile does not depend on trade costs at the 10% level. However, for countries situated in other quantiles, AfT flows exert a positive effect on backward GVC participation by countries that experience lower trade costs, and the magnitude of this positive effect is larger as we move from the lower quantile (here, 25th quantile) to the highest quantile (90th quantile). Concurrently, we observe from line (10) that the effect of total AfT flows on forward GVC participation depends on the level of the overall trade costs only for countries located in the 75th and 90th quantiles, as for countries in other quantiles of the distribution of the indicator of forward GVC participation, this effect does not significantly depend on the level of the overall trade costs. Regarding countries located in the 75th and 90th quantiles, the magnitude of the positive effect of total AfT flows is greater, the lower the overall trade costs. Outcomes in line (20) show that at the 5% level, total AfT flows promote forward GVC participation relatively to backward GVC participation by countries located in lower quantiles, especially those in the 10th and 25th quantiles of the distribution of the indicator of GVC position. For countries located in other quantiles, the effect of total AfT flows on the position in the GVCs does not depend on the level of the overall trade costs. Concerning countries in the 10th and 25th quantiles of the distribution of the indicator of GVC position, total AfT flows foster engagement in downstream activities relatively to upstream activities in the production network as trade costs fall, and this positive effect of total AfT flows is larger for countries located in the lowest quantile (10th quantile) than for those in the 25th quantile.

Summing-up results in lines (1), (10) and (20) of Table 7, we find that total AfT flows promote participation in forward GVCs by countries situated in the 25th to 90th quantiles as the

overall trade costs fall, and the magnitude of this positive effect of AfT interventions on backward GVC participation is greater for countries in lower quantiles than for countries in upper quantiles. In parallel, the effect of total AfT flows on forward GVC participation does not depend on the overall trade costs for countries in lower quantiles. However, for countries in upper quantiles, especially those in the 70th and 90th quantiles, this effect is positive as the overall trade costs fall, and is greater for countries in the 70th quantiles than for those in the 90th quantile of the distribution of the indicator of forward GVC participation. Finally, as the overall trade costs decline, AfT interventions induce more engagement in downstream activities than in upstream activities by countries situated in lower quantiles, especially those in the 10th and 25th quantiles of the distribution of the indicator of GVC position, with this engagement being more pronounced for countries in the 10th quantile than in the 25th quantile. The main message conveyed by these findings is that AfT interventions do affect countries' participation in backward and forward GVCs as well as their GVC position through the channel of trade costs, but the magnitude and statistical significance of this effect varies across quantiles of the distribution of GVC indicators. These findings support hypothesis 3.

Results in lines (30) to (65) of Table 7 help analyse how the effects of total AfT flows on GVC indicators depend on the levels of tariff costs and nontariff costs across various quantiles of the distribution of GVC indicators. We find from line (30) of the Table that tariff costs and nontariff costs do not matter at all for the effect of AfT interventions on backward GVC participation by countries situated in the 10th and 25th quantiles. This is consistent with the finding in the upper part of Table 7, especially in line (1) and column (3) of that Table. In contrast, for countries in other quantiles (i.e., the 50th to 90th quantiles), total AfT flows promote GVC participation as tariff costs fall, and the magnitude of this positive effect is higher, the upper the quantile. Results in line (32) show that for countries in lower quantiles (10th and 25th quantiles of the distribution of the indicator of backward GVC participation), the effect of total AfT flows on backward GVC participation does not depend on nontariff costs. This outcome is also consistent with the findings in line (1) and column (3) of Table 7. However, for countries in higher quantiles, the effect of total AfT flows on backward GVC participation does depend on nontariff costs, and the lower the nontariff costs, the greater is the positive effect of AfT interventions on backward GVC participation. Moreover, countries in lower quantiles experience a larger positive effect of AfT interventions on backward participation in GVCs as nontariff costs fall than countries in the relatively upper quantiles do. Concurrently, we note from line (44) of Table 7 that nontariff costs do not matter for the effect of AfT interventions on forward GVC participation across all quantiles of the distribution of the indicator of forward GVC participation. At the same time, estimates reported in line (42) of the same Table indicate that for countries located in the 10th to 75th quantiles, AfT interventions promote forward GVC participation in countries that face higher tariff costs with the magnitude of this positive effect being larger, the lower the quantile. Incidentally, across all quantiles of the distribution of the indicator of forward GVC participation, nontariff costs do not matter for the effect of total AfT flows on forward GVC participation.

Outcomes in line (55) of Table 7 indicate that across all quantiles and at least at the 5% level, total AfT flows induce countries to engage more in downstream activities relatively to upstream activities, as their tariff costs decrease. The lower the quantile, the higher is the positive effect of AfT interventions on countries' greater engagement in downstream activities relatively to upstream activities. Likewise, we note from line (57) of Table 7 that at the 5% level, for countries in the

lower quantiles (i.e., 10th and 25th quantiles), total AfT flows generate greater engagement in downstream activities relatively to upstream activities, especially as these countries face lower nontariff costs. Total AfT flows exert a greater downstream engagement effect for countries in the 10th quantile than for those in the 25th quantile.

Overall, the findings in lines (30) to (65) of Table 7 suggest that although their effect (including in terms of magnitude and statistical significance) vary across quantiles, AfT interventions tend to promote backward GVC participation in countries that experience lower tariffs and nontariff costs, but encourage forward GVC participation in countries that face higher tariff costs. Across all quantiles, the effect of AfT flows on forward GVC participation does not depend on nontariff costs. As tariff costs fall, total AfT flows encourage greater engagement in downstream activities relatively to upstream activities in countries located in all quantiles, with countries located in lower quantiles experiencing this larger positive effect of total AfT flows. Finally, nontariff costs do not matter for the effect of AfT interventions on recipient-countries' GVC position across all countries in the distribution of the indicator of GVC position. .

5. Summary of results and policy implications

The present study has provided, at the country-level, an empirical analysis of the effect of AfT flows on recipient countries' participation in global value chains. The analysis has posited that AfT flows could affect recipient countries' participation in GVCs by reducing the trade costs faced by these countries. It has used three indicators of countries' participation in GVCs (including backward GVC participation, forward GVC participation and position in the GVCs) and total AfT flows as well as its three main components that are AfT flows for economic infrastructure, AfT flows for productive capacities, and AfT for trade policy and regulation. Moreover, the analysis has relied on a panel dataset of 80 AfT recipient countries over the period from 2002 to 2018, and used several estimators, including the within fixed effects, the random effect Mundlak approach and the Quantile via Moments approach. It has established several outcomes. First, total AfT flows, including the three components of the latter promote countries' participation in backward GVC, with the magnitude of this positive effect being larger for lower quantiles (including the lowest one) than for upper quantiles. On average, total AfT flows do not affect forward GVC participation over the full sample, but the effect of these resource inflows on forward GVC participation is significant (although positive) only for countries in lower quantiles, that is, those with lower levels of forward GVC participation. Interestingly, total AfT flows do not affect the GVC position of countries located in the lower quantiles, but do encourage more engagement in downstream activities than in upstream activities in countries located in upper quantiles, including the 75th and 90th quantiles.

AfT for economic infrastructure exert no significant on forward GVC participation across quantiles, but it enhances the development of downstream activities relatively to upstream activities in the higher quantiles (from the 50th to 90th quantiles).

AfT flows for productive capacities foster forward GVC participation by countries situated in lower quantiles, including those in 10th to 50th quantiles, with the magnitude of this positive being larger as we move from the 10th quantile to the 50th quantile.

Likewise, at the 5% level, AfT flows for trade policy and regulation encourage forward GVC participation in countries that have lower levels of forward GVC participation (i.e., those located in the 10th to 50th quantiles), with the magnitude of this positive effect being larger as we move

from the lowest quantile to the 50th quantile. Similar to AfT for productive capacities, AfT flows for trade policy and regulation affect significantly (at the 5% level) - although positively - the GVC position for countries situated only in the highest quantile, that is, those with the highest GVC positions.

Finally, the analysis has revealed that AfT interventions do affect countries' participation in GVCs through the channel of trade costs, including both tariffs costs and nontariff costs. These capital inflows promote backward GVC participation by countries in upper quantiles that experience lower trade costs (including tariffs and nontariff costs). They foster forward GVC participation in countries situated in all quantiles but the highest quantiles, especially when these countries face higher tariff costs. Across all quantiles, total AfT flows encourage more engagement in downstream activities than in upstream activities, especially by countries that face higher tariff costs. The scale of this positive effect is higher in countries located in the lower quantiles of the distribution of the indicator of GVC position than in those situated in upper quantiles of this distribution. Total AfT flows exert a significant (although positive) effect on the GVC position for countries in the 10th and 25th quantiles that face higher nontariff costs, with the positive effect being larger for countries in the 10th quantile than in those with the 25th quantile.

In the global production network, participation in downstream activities is more relevant (in terms of benefits) for developing countries than participation in upstream activities, especially if these countries were to upgrade their export goods and services. Developing countries' participation in forward GVCs entails essentially the export of raw commodities and intermediate inputs to foreign countries that will process them (e.g., AfDB et al. 2014; Veeramani and Dhir, 2022), while the enhancement of their backward GVC participation results in higher absolute levels of gross exports, domestic value added and employment (e.g., Veeramani and Dhir, 2022), and induces greater domestic productivity than does forward GVC participation (e.g., Constantinescu et al., 2019). The analysis has particularly revealed that AfT interventions, including through the build-up of economic infrastructure, the strengthening of productive capacities and support for trade policy and regulation, promote backward participation, especially by countries (e.g., LDCs) that have low levels of backward GVC participation. Thus, higher AfT flows would strongly help improve the participation in backward GVCs by recipient-countries, especially LDCs.

The present study sheds light on the importance of AfT flows for countries' GVC participation, including their backward GVC participation. In this regard, it complements the voluminous literature on the effectiveness of AfT flows, in particular with respect to recipient countries' participation in international trade. It has established the relevance of AfT interventions for recipient countries' participation in downstream activities, and in this regard, stress the need for sustained AfT flows to developing countries if the objective of enhancing their participation in GVCs and more generally in the global trading system were to be achieved.

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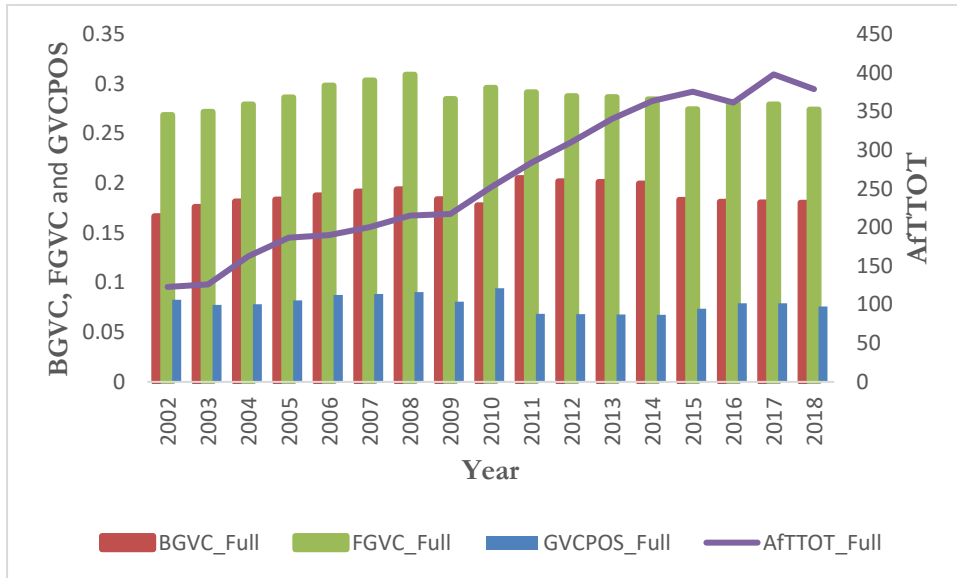
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FIGURES

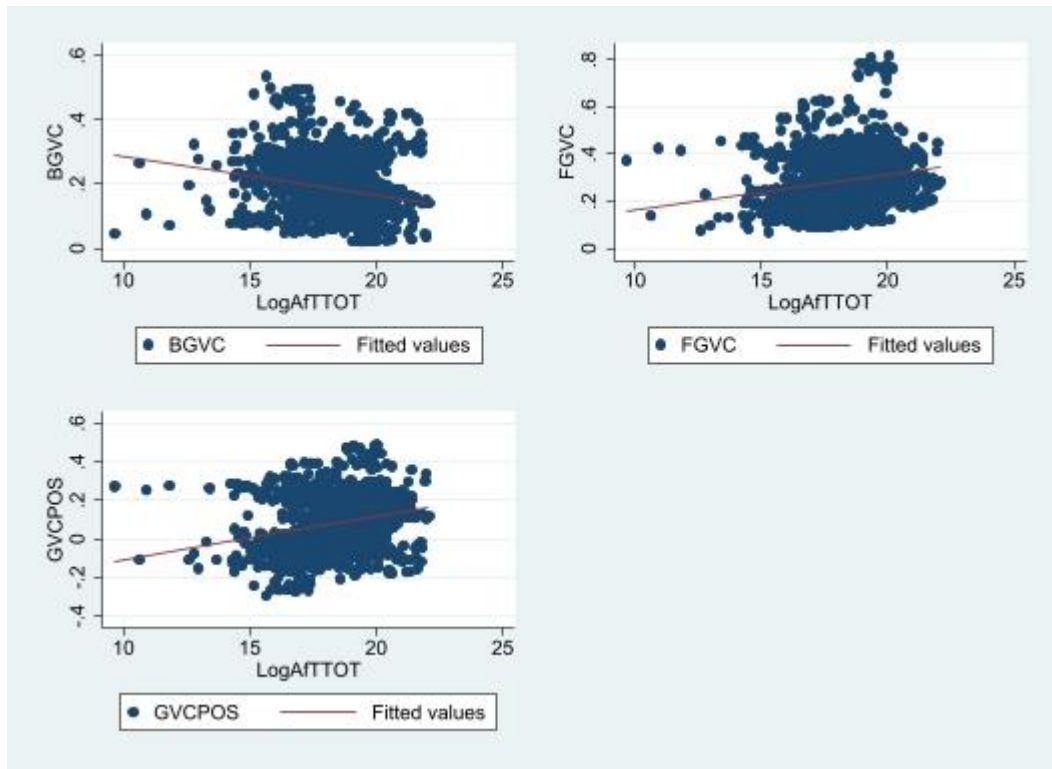
Figure 1: Development of the indicators of participation in GVCs and total AfT flows



Source: Author

Note: The variable "AfTTOT" is the gross disbursement of total Aid for Trade, and expressed in million US\$, constant 2020 prices. The variables "BGVC" and "FGVC" are not expressed in percentage.

Figure 2: Correlation pattern between the indicators of participation in GVCs and total AfT over the full sample



Source: Author

TABLES and APPENDICES

Table 1: Effect of AfT flows (with one-year lag) on the participation in GVCs
Estimators: FEDK and RE Mundlak

| Variables | FEDK | RE Mundlak | FEDK | RE Mundlak | FEDK | RE Mundlak |
|-------------------------------|-------------------------|------------------------|-------------------------|-------------------------|--------------------------|--------------------------|
| | BGVC1 | BGVC1 | FGVC1 | FGVC1 | GVCPOS | GVCPOS |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| [Log(AfTTOT)] _{t-1} | 0.0278*** (0.00972) | 0.0287*** (0.00678) | 0.00537 (0.00849) | 0.00254 (0.00570) | -0.00240 (0.00162) | -0.00320** (0.00140) |
| [Log(NAfTTOT)] _{t-1} | 0.0474*** (0.0132) | 0.0474*** (0.0112) | -0.0249*** (0.00938) | -0.0248*** (0.00938) | -0.00955*** (0.00283) | -0.00952*** (0.00231) |
| [Log(GDPC)] _{t-1} | 0.162*** (0.0548) | 0.168*** (0.0452) | -0.0627 (0.0388) | -0.0835** (0.0380) | -0.0264*** (0.00657) | -0.0323*** (0.00932) |
| HUM _{t-1} | -0.241*** (0.0416) | -0.229*** (0.0584) | 0.0879 (0.0788) | 0.0491 (0.0495) | 0.0487*** (0.0130) | 0.0377*** (0.0121) |
| [Log(REER)] _{t-1} | -0.273*** (0.0557) | -0.271*** (0.0374) | 0.0607 (0.0521) | 0.0526* (0.0313) | 0.0381*** (0.00437) | 0.0357*** (0.00769) |
| FDI _{t-1} | 0.317*** (0.0815) | 0.319*** (0.0859) | 0.0310 (0.0613) | 0.0260 (0.0718) | -0.0355*** (0.0127) | -0.0369** (0.0177) |
| FINDEV _{t-1} | 0.0459 (0.0819) | 0.0418 (0.0671) | -0.0131 (0.0934) | -7.72e-05 (0.0561) | -0.0181 (0.0128) | -0.0144 (0.0138) |
| INST _{t-1} | -0.0399*** (0.00763) | -0.0405*** (0.0144) | -0.0513** (0.0205) | -0.0494*** (0.0121) | -0.00240 (0.00282) | -0.00184 (0.00297) |
| Log(POP) | -0.0135 (0.106) | -0.0491 (0.0453) | -0.167* (0.0912) | -0.0534 (0.0446) | -0.0366** (0.0156) | -0.00434 (0.0102) |
| Constant | -2.323 (2.033) | 8.385** (3.575) | 2.132 (1.700) | -7.052* (4.103) | 0.841*** (0.253) | -1.965** (0.859) |
| Observations - Countries | 1,257 - 80 | 1,257 - 80 | 1,257 - 80 | 1,257 - 80 | 1,257 - 80 | 1,257 - 80 |
| Within R ² | 0.1134 | 0.1132 | 0.0404 | 0.0374 | 0.0673 | 0.0634 |
| Between R ² | | 0.5087 | | 0.2359 | | 0.4144 |
| Overall R ² | | 0.4781 | | 0.2252 | | 0.3946 |

Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust standard errors are in parenthesis.

Table 2: Effect of AfT flows (with two-year lag) on the participation in GVCs
Estimators: FEDK and RE Mundlak

| Variables | FEDK | RE Mundlak | FEDK | RE Mundlak | FEDK | RE Mundlak |
|-------------------------------|-------------------------|------------------------|-----------------------|-----------------------|-------------------------|--------------------------|
| | BGVC1 | BGVC1 | FGVC1 | FGVC1 | GVCPOS | GVCPOS |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| [Log(AfTTOT)] _{t-2} | 0.0232** (0.00965) | 0.0235*** (0.00658) | 0.000204 (0.00781) | -0.00329 (0.00547) | -0.00273* (0.00161) | -0.00363*** (0.00137) |
| [Log(NAfTTOT)] _{t-2} | 0.0375** (0.0144) | 0.0375*** (0.0109) | -0.0147 (0.0145) | -0.0141 (0.00898) | -0.00690* (0.00369) | -0.00677*** (0.00225) |
| [Log(GDPC)] _{t-1} | 0.135** (0.0613) | 0.138*** (0.0484) | -0.108*** (0.0270) | -0.137*** (0.0403) | -0.0299*** (0.00783) | -0.0373*** (0.0101) |
| HUM _{t-1} | -0.255*** (0.0426) | -0.251*** (0.0582) | 0.0652 (0.0752) | 0.0200 (0.0487) | 0.0489*** (0.0142) | 0.0372*** (0.0121) |
| [Log(REER)] _{t-1} | -0.244*** (0.0626) | -0.243*** (0.0380) | 0.113*** (0.0325) | 0.100*** (0.0315) | 0.0426*** (0.00488) | 0.0394*** (0.00788) |
| FDI _{t-1} | 0.280*** (0.0974) | 0.280*** (0.0830) | -0.00188 (0.0541) | -0.00258 (0.0686) | -0.0364** (0.0157) | -0.0366** (0.0172) |
| FINDEV _{t-1} | 0.0478 (0.0869) | 0.0462 (0.0689) | -0.0524 (0.0793) | -0.0358 (0.0570) | -0.0224** (0.0104) | -0.0181 (0.0143) |
| INST _{t-1} | -0.0375*** (0.00844) | -0.0378** (0.0151) | -0.0339* (0.0182) | -0.0304** (0.0125) | -0.000559 (0.00295) | 0.000354 (0.00313) |
| Log(POP) | -0.0489 (0.113) | -0.0624 (0.0461) | -0.235*** (0.0720) | -0.0907** (0.0454) | -0.0443*** (0.0159) | -0.00711 (0.0104) |
| Constant | -1.340 (2.120) | 8.173** (3.531) | 3.353** (1.386) | -7.703* (4.062) | 0.932*** (0.270) | -2.021** (0.851) |
| Observations - Countries | 1,179 - 80 | 1,179 - 80 | 1,179 - 80 | 1,179 - 80 | 1,179 - 80 | 1,179 - 80 |
| Within R ² | 0.1066 | 0.1066 | 0.0634 | 0.0588 | 0.0712 | 0.0662 |
| Between R ² | | 0.5116 | | 0.2133 | | 0.4098 |
| Overall R ² | | 0.4861 | | 0.2071 | | 0.3940 |

Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust standard errors are in parenthesis.

Table 3: Effect of AfT flows on backward participation in GVCs
Estimator. Method of Moments Quantile Regression (MMQR)

| Variables | Dependent variable: BGVC | | | | | | |
|--------------|--------------------------|------------------------|-----------------------|------------------------|------------------------|------------------------|------------------------|
| | Location ^a | Scale ^b | Q10 th | Q25 th | Q50 th | Q75 th | Q90 th |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Log(AfTTOT) | 0.0347*** (0.00754) | -0.00372 (0.00422) | 0.0409*** (0.0117) | 0.0382*** (0.00941) | 0.0345*** (0.00748) | 0.0314*** (0.00746) | 0.0290*** (0.00852) |
| Log(NAfTTOT) | 0.0499*** (0.0129) | -0.0148** (0.00652) | 0.0747*** (0.0194) | 0.0637*** (0.0161) | 0.0490*** (0.0128) | 0.0368*** (0.0123) | 0.0272** (0.0136) |
| Log(GDPC) | 0.231*** (0.0575) | -0.0366 (0.0294) | 0.293*** (0.0933) | 0.265*** (0.0757) | 0.229*** (0.0566) | 0.199*** (0.0492) | 0.175*** (0.0516) |
| HUM | -0.237*** (0.0746) | -0.00776 (0.0333) | -0.224** (0.112) | -0.230** (0.0930) | -0.237*** (0.0737) | -0.244*** (0.0664) | -0.249*** (0.0684) |
| Log(REER) | -0.308*** (0.0456) | -0.0588** (0.0240) | -0.209*** (0.0740) | -0.253*** (0.0597) | -0.312*** (0.0451) | -0.360*** (0.0401) | -0.399*** (0.0428) |
| FDI | 0.285 (0.184) | 0.102 (0.121) | 0.113 (0.372) | 0.190 (0.286) | 0.291 (0.178) | 0.376*** (0.109) | 0.443*** (0.103) |
| FINDEV | 0.00965 (0.0666) | 0.0542 (0.0372) | -0.0812 (0.112) | -0.0408 (0.0894) | 0.0130 (0.0655) | 0.0579 (0.0572) | 0.0931 (0.0619) |
| INST | -0.0365* (0.0190) | -8.02e-05 (0.0103) | -0.0363 (0.0324) | -0.0364 (0.0259) | -0.0365* (0.0186) | -0.0366** (0.0155) | -0.0366** (0.0160) |
| Log(POP) | 0.0491 (0.0876) | -0.0367 (0.0430) | 0.111 (0.139) | 0.0833 (0.114) | 0.0468 (0.0862) | 0.0164 (0.0751) | -0.00750 (0.0779) |
| Constant | -3.910*** (1.434) | 1.636** (0.672) | -6.654*** (2.214) | -5.436*** (1.833) | -3.809*** (1.416) | -2.452* (1.252) | -1.389 (1.305) |
| Observations | 1,330 | 1,330 | 1,330 | 1,330 | 1,330 | 1,330 | 1,330 |

Note: **p*-value<0.1; ***p*-value<0.05; ****p*-value<0.01. Robust standard errors are in parenthesis. (a) indicates the location parameters, and (b) refers to the scale parameters.

Table 4: Effect of AfT flows on forward participation in GVCs
Estimator. Method of Moments Quantile Regression (MMQR)

| Variables | Dependent variable: FGVC | | | | | | |
|--------------|--------------------------|--------------------------|------------------------|------------------------|------------------------|-------------------------|------------------------|
| | Location ^a | Scale ^b | Q10 th | Q25 th | Q50 th | Q75 th | Q90 th |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Log(AfTTOT) | 0.0163** (0.00703) | -0.00947*** (0.00366) | 0.0321*** (0.0115) | 0.0247*** (0.00922) | 0.0150** (0.00680) | 0.00770 (0.00593) | 0.00251 (0.00618) |
| Log(NAfTTOT) | -0.0406*** (0.0103) | 0.000765 (0.00554) | -0.0419*** (0.0159) | -0.0413*** (0.0128) | -0.0405*** (0.0101) | -0.0399*** (0.00995) | -0.0395*** (0.0109) |
| Log(GDPC) | 0.00953 (0.0429) | -0.0426* (0.0238) | 0.0808 (0.0705) | 0.0473 (0.0557) | 0.00396 (0.0416) | -0.0290 (0.0382) | -0.0524 (0.0411) |
| HUM | 0.0954 (0.0646) | -0.0439 (0.0365) | 0.169 (0.106) | 0.134 (0.0833) | 0.0896 (0.0629) | 0.0556 (0.0594) | 0.0315 (0.0648) |
| Log(REER) | 0.102*** (0.0371) | -0.0355* (0.0204) | 0.162*** (0.0622) | 0.134*** (0.0492) | 0.0977*** (0.0358) | 0.0702** (0.0315) | 0.0508 (0.0328) |
| FDI | 0.159** (0.0691) | -0.0578 (0.0353) | 0.256** (0.111) | 0.211** (0.0885) | 0.152** (0.0670) | 0.107* (0.0606) | 0.0755 (0.0632) |
| FINDEV | -0.0472 (0.0612) | 0.0808** (0.0339) | -0.183* (0.102) | -0.119 (0.0811) | -0.0367 (0.0593) | 0.0260 (0.0524) | 0.0702 (0.0549) |
| INST | -0.0605*** (0.0185) | 0.0223** (0.0101) | -0.0978*** (0.0317) | -0.0803*** (0.0248) | -0.0576*** (0.0178) | -0.0404*** (0.0151) | -0.0282* (0.0157) |
| Log(POP) | -0.193*** (0.0642) | 0.00800 (0.0374) | -0.207* (0.108) | -0.200** (0.0849) | -0.192*** (0.0621) | -0.186*** (0.0570) | -0.182*** (0.0619) |
| Constant | 1.903* (1.005) | 0.715 (0.574) | 0.707 (1.704) | 1.269 (1.329) | 1.996** (0.972) | 2.550*** (0.883) | 2.942*** (0.945) |
| Observations | 1,330 | 1,330 | 1,330 | 1,330 | 1,330 | 1,330 | 1,330 |

Note: **p*-value<0.1; ***p*-value<0.05; ****p*-value<0.01. Robust standard errors are in parenthesis. (a) indicates the location parameters, and (b) refers to the scale parameters.

Table 5: Effect of AfT flows on the position in GVCs
Estimator. Method of Moments Quantile Regression (MMQR)

| Variables | Dependent variable: GVCPOS | | | | | | |
|--------------|----------------------------|--------------------------|--------------------------|-------------------------|-------------------------|-------------------------|--------------------------|
| | Location ^a | Scale ^b | Q10 th | Q25 th | Q50 th | Q75 th | Q90 th |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Log(AfTTOT) | -0.00164 (0.00122) | -0.00168** (0.000704) | 0.000991 (0.00165) | -0.000176 (0.00138) | -0.00175 (0.00123) | -0.00318** (0.00138) | -0.00425*** (0.00164) |
| Log(NAfTTOT) | -0.0116*** (0.00256) | -0.00178 (0.00121) | -0.00881*** (0.00315) | -0.0100*** (0.00274) | -0.0117*** (0.00257) | -0.0132*** (0.00283) | -0.0144*** (0.00321) |
| Log(GDPC) | -0.0243** (0.0111) | -0.0204*** (0.00488) | 0.00769 (0.0130) | -0.00648 (0.0115) | -0.0256** (0.0112) | -0.0430*** (0.0126) | -0.0560*** (0.0139) |
| HUM | 0.0450*** (0.0161) | -0.000227 (0.00622) | 0.0453*** (0.0175) | 0.0452*** (0.0162) | 0.0450*** (0.0162) | 0.0448** (0.0179) | 0.0446** (0.0200) |
| Log(REER) | 0.0482*** (0.00904) | -0.00623 (0.00399) | 0.0579*** (0.0102) | 0.0536*** (0.00918) | 0.0478*** (0.00908) | 0.0425*** (0.0102) | 0.0385*** (0.0117) |
| FDI | -0.0146 (0.0263) | 0.0210 (0.0146) | -0.0474** (0.0196) | -0.0329* (0.0198) | -0.0133 (0.0270) | 0.00455 (0.0368) | 0.0179 (0.0451) |
| FINDEV | -0.0166 (0.0129) | 0.0141** (0.00621) | -0.0387** (0.0152) | -0.0289** (0.0134) | -0.0157 (0.0129) | -0.00370 (0.0147) | 0.00531 (0.0170) |
| INST | -0.00375 (0.00377) | 0.00132 (0.00171) | -0.00581 (0.00394) | -0.00490 (0.00363) | -0.00367 (0.00380) | -0.00254 (0.00448) | -0.00170 (0.00520) |
| Log(POP) | -0.0444*** (0.0162) | 0.0151** (0.00698) | -0.0680*** (0.0195) | -0.0575*** (0.0175) | -0.0434*** (0.0162) | -0.0305* (0.0173) | -0.0209 (0.0196) |
| Constant | 0.938*** (0.268) | 0.0214 (0.109) | 0.905*** (0.326) | 0.920*** (0.289) | 0.940*** (0.267) | 0.958*** (0.281) | 0.972*** (0.308) |
| Observations | 1,330 | 1,330 | 1,330 | 1,330 | 1,330 | 1,330 | 1,330 |

Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust standard errors are in parenthesis. (a) indicates the location parameters, and (b) refers to the scale parameters.

Table 6: Effect of the **components** of **total AfT** flows on the participation in GVCs_Over the full sample
Estimator. Method of Moments Quantile Regression (MMQR)

| | Variables | Location^a | Scale^b | Q10th | Q25th | Q50th | Q75th | Q90th |
|---|------------------|-----------------------------|--------------------------|-------------------------|--------------------------|--------------------------|---------------------------|---------------------------|
| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| <i>Effect of AfT flows for economic infrastructure on "BGVC"</i> | | | | | | | | |
| (1) | Log(AfTINF) | 0.0184*** (0.00430) | -0.000662 (0.00245) | 0.0196*** (0.00683) | 0.0190*** (0.00540) | 0.0184*** (0.00427) | 0.0178*** (0.00418) | 0.0174*** (0.00474) |
| (3) | Log(NAfTTOT) | 0.0557*** (0.0127) | -0.0175*** (0.00641) | 0.0852*** (0.0193) | 0.0714*** (0.0157) | 0.0551*** (0.0126) | 0.0400*** (0.0120) | 0.0291** (0.0132) |
| | Observations | 1,328 | 1,328 | 1,328 | 1,328 | 1,328 | 1,328 | 1,328 |
| <i>Effect of AfT flows for economic infrastructure on "FGVC"</i> | | | | | | | | |
| (8) | Log(AfTINF) | 0.00134 (0.00393) | -0.00417** (0.00210) | 0.00829 (0.00634) | 0.00494 (0.00504) | 0.000857 (0.00383) | -0.00245 (0.00348) | -0.00473 (0.00372) |
| (10) | Log(NAfTTOT) | -0.0345*** (0.0102) | -0.00258 (0.00543) | -0.0302* (0.0160) | -0.0323** (0.0127) | -0.0348*** (0.00997) | -0.0369*** (0.00954) | -0.0383*** (0.0103) |
| | Observations | 1,328 | 1,328 | 1,328 | 1,328 | 1,328 | 1,328 | 1,328 |
| <i>Effect of AfT flows for economic infrastructure on "GVCPOS"</i> | | | | | | | | |
| (15) | Log(AfTINF) | -0.00164** (0.000733) | -0.000597 (0.000386) | -0.000705 (0.000932) | -0.00112 (0.000797) | -0.00166** (0.000734) | -0.00218*** (0.000821) | -0.00256*** (0.000963) |
| (16) | Log(NAfTTOT) | -0.0115*** (0.00252) | -0.00226* (0.00119) | -0.00800** (0.00312) | -0.00956*** (0.00271) | -0.0116*** (0.00252) | -0.0136*** (0.00276) | -0.0150*** (0.00312) |
| | Observations | 1,328 | 1,328 | 1,328 | 1,328 | 1,328 | 1,328 | 1,328 |
| <i>Effect of AfT flows for productive capacities on "BGVC"</i> | | | | | | | | |
| (21) | Log(AfTPR) | 0.0302*** (0.00747) | -0.00732* (0.00422) | 0.0428*** (0.0118) | 0.0369*** (0.00929) | 0.0297*** (0.00741) | 0.0236*** (0.00741) | 0.0191** (0.00843) |
| (23) | Log(NAfTTOT) | 0.0505*** (0.0131) | -0.0133** (0.00666) | 0.0734*** (0.0201) | 0.0627*** (0.0163) | 0.0498*** (0.0130) | 0.0386*** (0.0125) | 0.0304** (0.0137) |
| | Observations | 1,329 | 1,329 | 1,329 | 1,329 | 1,329 | 1,329 | 1,329 |
| <i>Effect of AfT flows for productive capacities on "FGVC"</i> | | | | | | | | |

| | | | | | | | | |
|--|---------------------------|--------------------------|---------------------------|--------------------------|--------------------------|--------------------------|-------------------------|--------------------------|
| (28) | Log(AfT _{PR}) | 0.0202*** (0.00720) | -0.0137*** (0.00382) | 0.0432*** (0.0116) | 0.0325*** (0.00921) | 0.0186*** (0.00707) | 0.00762 (0.00661) | 0.000353 (0.00699) |
| (29) | Log(NAfT _{TOT}) | -0.0429*** (0.0104) | 0.00458 (0.00553) | -0.0506*** (0.0158) | -0.0471*** (0.0128) | -0.0424*** (0.0102) | -0.0387*** (0.0101) | -0.0363*** (0.0111) |
| | Observations | 1,329 | 1,329 | 1,329 | 1,329 | 1,329 | 1,329 | 1,329 |
| <i>Effect of AfT flows for productive capacities on "GVCPOS"</i> | | | | | | | | |
| (34) | Log(AfT _{PR}) | -0.00112 (0.00129) | -0.00172** (0.000736) | 0.00158 (0.00180) | 0.000388 (0.00149) | -0.00118 (0.00130) | -0.00270* (0.00141) | -0.00383** (0.00166) |
| (36) | Log(NAfT _{TOT}) | -0.0117*** (0.00255) | -0.00164 (0.00121) | -0.00917*** (0.00307) | -0.0103*** (0.00269) | -0.0118*** (0.00256) | -0.0132*** (0.00286) | -0.0143*** (0.00329) |
| | Observations | 1,329 | 1,329 | 1,329 | 1,329 | 1,329 | 1,329 | 1,329 |
| <i>Effect of AfT flows related to trade policy and regulation on "BGVC"</i> | | | | | | | | |
| (41) | Log(AfT _{POL}) | 0.0168*** (0.00346) | -0.00293* (0.00177) | 0.0214*** (0.00510) | 0.0194*** (0.00423) | 0.0166*** (0.00344) | 0.0141*** (0.00338) | 0.0123*** (0.00375) |
| (42) | Log(NAfT _{TOT}) | 0.0438*** (0.0115) | -0.0150*** (0.00576) | 0.0678*** (0.0163) | 0.0575*** (0.0138) | 0.0429*** (0.0115) | 0.0300*** (0.0115) | 0.0207 (0.0128) |
| | Observations | 1,269 | 1,269 | 1,269 | 1,269 | 1,269 | 1,269 | 1,269 |
| <i>Effect of AfT flows related to trade policy and regulation on "FGVC"</i> | | | | | | | | |
| (47) | Log(AfT _{POL}) | 0.0111*** (0.00268) | -0.00705*** (0.00146) | 0.0230*** (0.00399) | 0.0169*** (0.00316) | 0.0104*** (0.00268) | 0.00460* (0.00277) | 0.000592 (0.00309) |
| (49) | Log(NAfT _{TOT}) | -0.0311*** (0.00953) | -0.00181 (0.00554) | -0.0281* (0.0153) | -0.0296** (0.0118) | -0.0313*** (0.00936) | -0.0328*** (0.00924) | -0.0338*** (0.0104) |
| | Observations | 1,269 | 1,269 | 1,269 | 1,269 | 1,269 | 1,269 | 1,269 |
| <i>Effect of AfT flows related to trade policy and regulation on "GVCPOS"</i> | | | | | | | | |
| (54) | Log(AfT _{POL}) | -0.000455 (0.000712) | -0.00112*** (0.000326) | 0.00136 (0.000865) | 0.000534 (0.000749) | -0.000502 (0.000715) | -0.00148* (0.000796) | -0.00220** (0.000901) |
| (56) | Log(NAfT _{TOT}) | -0.00911*** (0.00234) | -0.00244** (0.00114) | -0.00517* (0.00301) | -0.00696*** (0.00256) | -0.00921*** (0.00234) | -0.0113*** (0.00255) | -0.0129*** (0.00291) |
| | Observations | 1,269 | 1,269 | 1,269 | 1,269 | 1,269 | 1,269 | 1,269 |

Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust standard errors are in parenthesis. (a) indicates the location parameters, and (b) refers to the scale parameters.

Table 7: Effect of **total AfT** flows on the participation in GVCs for varying levels of the trade costs
Estimator. Method of Moments Quantile Regression (MMQR)

| | Variables | Location ^a | Scale ^b | Q10 th | Q25 th | Q50 th | Q75 th | Q90 th |
|--|-----------------------------|------------------------|-------------------------|------------------------|-----------------------|------------------------|------------------------|------------------------|
| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| <i>Effect of Total AfT flows on "BGVC" for varying levels of the overall trade costs</i> | | | | | | | | |
| (1) | [Log(AfTTOT)]*[Log(TRCOST)] | -0.0825*** (0.0283) | -0.0116 (0.0147) | -0.0630 (0.0424) | -0.0722** (0.0343) | -0.0834*** (0.0280) | -0.0929*** (0.0277) | -0.100*** (0.0309) |
| (3) | Log(AfTTOT) | 0.499*** (0.159) | 0.0622 (0.0835) | 0.395* (0.238) | 0.444** (0.192) | 0.503*** (0.158) | 0.554*** (0.157) | 0.594*** (0.176) |
| (5) | Log(TRCOST) | 1.692*** (0.533) | 0.194 (0.281) | 1.368* (0.806) | 1.520** (0.650) | 1.707*** (0.528) | 1.865*** (0.520) | 1.988*** (0.581) |
| | Observations | 1,289 | 1,289 | 1,289 | 1,289 | 1,289 | 1,289 | 1,289 |
| <i>Effect of Total AfT flows on "FGVC" for varying levels of the overall trade costs</i> | | | | | | | | |
| (10) | [Log(AfTTOT)]*[Log(TRCOST)] | -0.0245 (0.0219) | -0.0226** (0.0112) | 0.0129 (0.0336) | -0.00410 (0.0275) | -0.0269 (0.0215) | -0.0448** (0.0201) | -0.0581*** (0.0216) |
| (13) | Log(AfTTOT) | 0.156 (0.124) | 0.121* (0.0634) | -0.0440 (0.191) | 0.0469 (0.156) | 0.169 (0.122) | 0.264** (0.114) | 0.336*** (0.122) |
| (15) | Log(TRCOST) | 0.501 (0.416) | 0.335 (0.216) | -0.0523 (0.651) | 0.199 (0.530) | 0.537 (0.407) | 0.802** (0.375) | 0.999** (0.400) |
| | Observations | 1,289 | 1,289 | 1,289 | 1,289 | 1,289 | 1,289 | 1,289 |
| <i>Effect of Total AfT flows on "GVCPOS" for varying levels of the overall trade costs</i> | | | | | | | | |
| (20) | [Log(AfTTOT)]*[Log(TRCOST)] | 0.0104* (0.00584) | -0.00543** (0.00243) | 0.0188*** (0.00717) | 0.0153** (0.00639) | 0.0101* (0.00584) | 0.00546 (0.00609) | 0.00188 (0.00679) |
| (22) | Log(AfTTOT) | -0.0599* (0.0330) | 0.0293** (0.0137) | -0.106*** (0.0403) | -0.0868** (0.0360) | -0.0583* (0.0330) | -0.0334 (0.0345) | -0.0141 (0.0384) |
| (24) | Log(TRCOST) | -0.205* (0.110) | 0.0847* (0.0464) | -0.337** (0.135) | -0.282** (0.120) | -0.200* (0.110) | -0.128 (0.115) | -0.0725 (0.129) |
| | Observations | 1,289 | 1,289 | 1,289 | 1,289 | 1,289 | 1,289 | 1,289 |
| <i>Effect of Total AfT flows on "BGVC" for varying levels of tariffs and nontariff costs</i> | | | | | | | | |
| (30) | [Log(AfTTOT)]*[Log(TARIFF)] | -0.431** (0.186) | -0.177* (0.107) | -0.139 (0.301) | -0.267 (0.240) | -0.442** (0.183) | -0.596*** (0.175) | -0.695*** (0.194) |

| | | | | | | | | |
|--|------------------------------|------------------------|-----------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| (32) | [Log(AfTTOT)]*[Log(NTARIFF)] | -0.0687*** (0.0248) | -0.00529 (0.0129) | -0.0600 (0.0366) | -0.0639** (0.0301) | -0.0691*** (0.0246) | -0.0737*** (0.0246) | -0.0766*** (0.0273) |
| (34) | Log(AfTTOT) | 0.437*** (0.134) | 0.0421 (0.0696) | 0.368* (0.196) | 0.399** (0.162) | 0.440*** (0.133) | 0.477*** (0.134) | 0.500*** (0.149) |
| (35) | Log(TARIFF) | 6.366* (3.349) | 3.348* (1.934) | 0.844 (5.392) | 3.273 (4.309) | 6.573** (3.313) | 9.497*** (3.204) | 11.36*** (3.567) |
| (37) | Log(NTARIFF) | 1.469*** (0.441) | 0.111 (0.240) | 1.286* (0.670) | 1.366** (0.547) | 1.476*** (0.437) | 1.573*** (0.435) | 1.635*** (0.484) |
| | Observations | 1,235 | 1,235 | 1,235 | 1,235 | 1,235 | 1,235 | 1,235 |
| Effect of Total AfT flows on "FGVC" for varying levels of tariffs and nontariff costs | | | | | | | | |
| (42) | [Log(AfTTOT)]*[Log(TARIFF)] | 0.829*** (0.279) | -0.368*** (0.116) | 1.443*** (0.426) | 1.162*** (0.355) | 0.794*** (0.274) | 0.494** (0.228) | 0.292 (0.216) |
| (44) | [Log(AfTTOT)]*[Log(NTARIFF)] | -0.0109 (0.0211) | -0.00563 (0.0106) | -0.00154 (0.0313) | -0.00585 (0.0257) | -0.0115 (0.0209) | -0.0161 (0.0204) | -0.0192 (0.0220) |
| (46) | Log(AfTTOT) | -0.000686 (0.111) | 0.0592 (0.0558) | -0.0994 (0.162) | -0.0542 (0.133) | 0.00497 (0.110) | 0.0532 (0.109) | 0.0857 (0.119) |
| (48) | Log(TARIFF) | -15.95*** (5.065) | 7.633*** (2.114) | -28.68*** (7.749) | -22.84*** (6.463) | -15.22*** (4.984) | -8.996** (4.133) | -4.810 (3.907) |
| (50) | Log(NTARIFF) | 0.244 (0.393) | 0.0862 (0.199) | 0.100 (0.593) | 0.166 (0.484) | 0.252 (0.387) | 0.323 (0.374) | 0.370 (0.402) |
| | Observations | 1,235 | 1,235 | 1,235 | 1,235 | 1,235 | 1,235 | 1,235 |
| Effect of Total AfT flows on "GVCPOS" for varying levels of tariffs and nontariff costs | | | | | | | | |
| (55) | [Log(AfTTOT)]*[Log(TARIFF)] | 0.144*** (0.0341) | -0.0329** (0.0164) | 0.195*** (0.0456) | 0.173*** (0.0393) | 0.143*** (0.0340) | 0.114*** (0.0350) | 0.0895** (0.0399) |
| (57) | [Log(AfTTOT)]*[Log(NTARIFF)] | 0.00963* (0.00536) | -0.00331 (0.00239) | 0.0147** (0.00669) | 0.0126** (0.00587) | 0.00954* (0.00536) | 0.00660 (0.00567) | 0.00417 (0.00648) |
| (59) | Log(AfTTOT) | -0.0670** (0.0291) | 0.0196 (0.0128) | -0.0972*** (0.0364) | -0.0844*** (0.0319) | -0.0664** (0.0291) | -0.0491 (0.0306) | -0.0347 (0.0348) |
| (61) | Log(TARIFF) | -2.565*** (0.629) | 0.731** (0.300) | -3.694*** (0.850) | -3.214*** (0.732) | -2.543*** (0.629) | -1.895*** (0.637) | -1.359* (0.722) |
| (63) | Log(NTARIFF) | -0.196** (0.0960) | 0.0568 (0.0436) | -0.284** (0.119) | -0.247** (0.105) | -0.195** (0.0961) | -0.144 (0.103) | -0.103 (0.118) |
| (65) | Observations | 1,235 | 1,235 | 1,235 | 1,235 | 1,235 | 1,235 | 1,235 |

Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust standard errors are in parenthesis. (a) indicates the location parameters, and (b) refers to the scale parameters.

Appendix 1: Definition and Source of variables

| Variables | Definition | Source |
|----------------|---|--|
| BGVC and BGVC1 | <p>"BGVC" is the first indicator of the participation in the global value chains. It is the backward participation in global value chains (Backward GVC). It reflects a country's engagement in GVCs as "seller", and captures the foreign value-added that is embodied in gross exports. In other words, it represents the share of the value added of foreign (imported) goods (that are used as intermediate inputs to produce output for exports) in gross exports. The formula used to calculate the indicator "BGVC" is: $BGVC = \frac{DVX}{GE}$, where "DVX" is the foreign value-added that is embodied in gross exports. "GE" is the indicator of gross exports.</p> <p>An increase in the values of this index reflects greater backward participation in GVCs.</p> <p>"BGVC1" is the transformed indicator of "BGVC" by applying the method proposed by Baum (2008). The transformation is as follows: $BGVC1 = \text{Logit}(BGVC)$.</p> | <p>Author's calculation based on data from the UNCTAD-Eora Global Value Chain Database. It is available online at: https://worldmrio.com/unctadgvc/</p> |
| FGVC and FGVC1 | <p>"FGVC" is the second indicator of the participation in the global value chains. It is the forward participation in global value chains (Forward GVC). It reflects a country's participation in GVCs as "buyer", and captures the domestic value added (used as intermediate input) in other countries' value-added exports. It is calculated as the share (in gross exports) of the exports of intermediate goods that are used by another country as inputs for the production of goods exported to third countries.</p> <p>The formula used to calculate the indicator "FGVC" is: $FGVC = \frac{FVA}{GE}$, where "FVA" is the domestic value added that is used in the export of third countries. "GE" is the indicator of gross exports. An increase in the values of this index reflects greater backward participation in GVCs.</p> <p>"FGVC1" is the transformed indicator of "FGVC" by applying the method proposed by Baum (2008). The transformation is as follows: $FGVC1 = \text{Logit}(FGVC)$.</p> | <p>Author's calculation based on data from the UNCTAD-Eora Global Value Chain Database. It is available online at: https://worldmrio.com/unctadgvc/</p> |
| GVCPOS | <p>This is the indicator of the position of a country within the GVCs. Following Koopman et al. (2014), it is calculated for a given country in a given year as the share of forward GVC participation relative to the share of backward GVC participation:</p> $GVCPOS = \text{Ln} \left(1 + \frac{DVX}{GE} \right) - \text{Ln} \left(1 + \frac{FVA}{GE} \right)$ <p>where "DVX", "DVA" and "GE" are as defined above. The symbol "Ln" is the natural logarithm.</p> | <p>Author's calculation based on data from the UNCTAD-Eora Global Value Chain Database. It is available online at: https://worldmrio.com/unctadgvc/</p> |

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|--|--|--|
| | <p>In other words, "GVCPOS" reflects a nation's supply of intermediate goods used in other nations' exports relatively to this country's use of imported intermediate goods in its own production.</p> <p>Higher values of the index "GVCPOS" for a given country provide the indication that its forward participation is higher than its backward participation. This signifies that the country is engaged in upstream activities in the production network, that is, it is located in the first stages of production where it exports a lot of intermediate products abroad. Conversely, lower values of the indicator "GVCPOS" for a given country show that the country's forward participation is lower than its backward participation. As a result, the country is situated more downstream in the value chain, that is, it is specialized in the last stages of production where it imports a lot of intermediate products from foreign countries.</p> | |
| <p>AfTTOT, AfTINF, AfTPR, AfTPOL</p> | <p>These are the indicators of AfT flows. "AfTTOT" is the real gross disbursement of total Aid for Trade. It includes the real gross disbursement of Aid for Trade allocated to the buildup of economic infrastructure ("AfTINF"); the real gross disbursement of Aid for Trade for building productive capacities ("AfTPR"), and the real gross disbursement of Aid allocated for trade policies and regulation ("AfTPOL"). All four AfT variables are expressed in constant prices 2020, US Dollar.</p> | <p>Author's calculation based on data extracted from the OECD statistical database on development, in particular the OECD/DAC-CRS (Organization for Economic Cooperation and Development/Donor Assistance Committee)-Credit Reporting System (CRS). Aid for Trade data cover the following three main categories (the CRS Codes are in brackets):</p> <p>Aid for Trade for Economic Infrastructure ("AfTINF"), which includes transport and storage (210), communications (220), and energy generation and supply (230);</p> <p>Aid for Trade for Building Productive Capacity ("AfTPR"), which includes banking and financial services (240), business and other services (250), agriculture (311), forestry (312), fishing (313), industry (321), mineral resources and mining (322), and tourism (332); and</p> |

| | | |
|---------|---|--|
| | | Aid for Trade policy and regulations ("AfTPOL"), which includes trade policy and regulations and trade-related adjustment (331). |
| NAFITOT | This is the indicator capturing the development aid flows allocated to other sectors in the economy than the trade sector. It has been computed as the difference between the gross disbursements of total ODA and the gross disbursements of total Aid for Trade, both being expressed in constant prices 2020, US Dollar. | Author's calculation based on data extracting from the OECD/DAC-CRS database. |
| TRCOST | This is the indicator of the average comprehensive (overall) trade costs has been calculated for a given country in a given year, as the average of the bilateral overall trade costs on goods across all trading partners of this country. Data on bilateral overall trade costs has been computed by Arvis et al. (2012, 2016) following the approach proposed by Novy (2013). Arvis et al. (2012, 2016) have built on the definition of trade costs provided by Anderson and van Wincoop (2004), and considered bilateral comprehensive trade costs as all costs involved in trading goods (agricultural and manufactured goods) internationally with another partner (i.e., bilaterally) relative to those involved in trading goods domestically (i.e., intranationally). Hence, the bilateral comprehensive trade costs indicator captures trade costs in its wider sense, including not only international transport costs and tariffs but also other trade costs components discussed in Anderson and van Wincoop (2004), such as direct and indirect costs associated with differences in languages, currencies as well as cumbersome import or export procedures. Higher values of the indicator of average overall trade costs indicate an increase in the overall trade costs. Detailed information on the methodology used to compute the bilateral comprehensive trade costs could be found in the short explanatory note accessible online at: https://www.unescap.org/sites/default/d8files/Trade%20Cost%20Database%20-%20User%20note.pdf | Author's calculation using the indicator of the overall trade costs developed by the ESCAP-World Bank Trade Cost Database. Accessible online at: https://www.unescap.org/resources/esca-p-world-bank-trade-cost-database |
| TARIFF | This is the indicator of the average tariff costs. It is the tariff component of the average overall trade costs. We have computed it, for a given country in a given year, as the average of the bilateral comprehensive tariff costs across all trading partners of this country. Data on the bilateral tariff costs indicator has been computed by Arvis et al. (2012, 2016). As the bilateral tariff costs indicator is (like the comprehensive trade costs) bi-directional in nature (i.e., it includes trade costs to and from a pair of countries), Arvis et al. (2013) have measured it as the | Author's computation using the ESCAP-World Bank Trade Cost Database. Detailed information on the methodology used to compute the bilateral tariff costs could be found in Arvis (2012, 2016), as well as in the short explanatory note |

| | | |
|---------|--|---|
| | geometric average of the tariffs imposed by the two partner countries on each other's imports (of agricultural and manufactured goods). Higher values of the indicator of the average tariff costs show an increase in the average tariffs costs. | accessible online at: https://www.unescap.org/sites/default/d8files/Trade%20Cost%20Database%20-%20User%20note.pdf |
| NTARIFF | This is the indicator of the average nontariff costs. It represents the second component (i.e., nontariff component) of the comprehensive trade costs. This is the indicator of the comprehensive trade costs, excluding the tariff costs. We have computed it, for a given country in a given year, as the average of the bilateral comprehensive nontariff costs (i.e., the comprehensive trade costs, excluding the tariff costs) across all trading partners of this country. Data on the bilateral nontariff costs indicator has been computed by Arvis et al. (2012, 2016), following Anderson and van Wincoop (2004). Comprehensive trade costs excluding tariff encompass all additional costs other than tariff costs involved in trading goods (agricultural and manufactured goods) bilaterally rather than domestically. Higher values of the indicator of average nontariff costs reflect a rise in nontariff costs. Detailed information on the methodology used to compute the bilateral nontariff costs could be found in Arvis (2012, 2016), as well as in the short explanatory note accessible online at: https://www.unescap.org/sites/default/d8files/Trade%20Cost%20Database%20-%20User%20note.pdf | Author's computation using the ESCAP-World Bank Trade Cost Database. Detailed information on the methodology used to compute the bilateral nontariff costs could be found in Arvis (2012, 2016), as well as in the short explanatory note accessible online at: https://www.unescap.org/sites/default/d8files/Trade%20Cost%20Database%20-%20User%20note.pdf |
| REER | This is the measure of the real effective exchange rate (based on the consumer price index), computed using a nominal effective exchange rate based on 66 trading partners. An increase in the values of this index indicates an appreciation of the real effective exchange rate, i.e., an appreciation of the home currency against the basket of currencies of trading partners. | Bruegel Datasets (see Darvas 2012a, 2012b). The dataset can be found online at: http://bruegel.org/publications/datasets/real-effective-exchange-rates-for-178-countries-a-new-database/ |
| GDPC | Per capita Gross Domestic Product (constant 2015 US\$). | WDI |
| HUM | This is the indicator of human capital. It is measured by the number of years of schooling and returns to education. | Penn World Tables PWT 10.0 (see Feenstra et al., 2015). |
| FINDEV | This is the indicator of financial development. It is the share of domestic credit to the private sector in GDP. Missing values have been replaced by the values of the share of the domestic credit offered by banks to the private sector in GDP. To ease results' interpretation, we have re-scaled this variable (i.e., by dividing it by 100). | Author's calculation based on data from WDI |

| | | |
|------|---|--|
| FDI | This is the share of net Foreign Direct Investment inflows in GDP. To ease results' interpretation, we have re-scaled this variable (i.e., by dividing it by 100). | WDI. |
| POP | Total Population | WDI |
| INST | <p>This is the variable capturing the institutional quality. It has been computed by extracting the first principal component (based on factor analysis) of the following six indicators of governance. These indicators are respectively: political stability and absence of violence/terrorism; regulatory quality; rule of law; government effectiveness; voice and accountability, and corruption.</p> <p>Higher values of the index "INST" are associated with better governance and institutional quality, while lower values reflect worse governance and institutional quality.</p> | <p>Data on the components of "INST" variables has been extracted from World Bank Governance Indicators developed by Kaufmann et al. (2010) and regularly updated. See online at: https://info.worldbank.org/governance/wgi/</p> |

Appendix 2: Descriptive statistics on variables used in the analysis over the full sample

| Variable | Observations | Mean | Standard deviation | Minimum | Maximum |
|----------|--------------|----------|--------------------|---------|-----------|
| BGVC | 1,330 | 0.188 | 0.091 | 0.021 | 0.537 |
| BGVC1 | 1,330 | -1.575 | 0.627 | -3.840 | 0.147 |
| FGVC | 1,330 | 0.285 | 0.117 | 0.069 | 0.817 |
| FGVC1 | 1,330 | -0.988 | 0.597 | -2.608 | 1.499 |
| GVCPOS | 1,330 | 0.077 | 0.141 | -0.294 | 0.488 |
| AfTTOT | 1,330 | 266.000 | 445.000 | 0.042 | 3950.000 |
| AfTINF | 1,328 | 160.000 | 306.000 | 0.024 | 3280.000 |
| AfTPR | 1,329 | 102.000 | 172.000 | 0.008 | 2020.000 |
| AfTPOL | 1,269 | 5.102 | 20.500 | 0.000 | 461.000 |
| NAfTTOT | 1,330 | 787.000 | 1140.000 | 12.200 | 22900.000 |
| TRCOST | 1,289 | 322.368 | 56.336 | 131.856 | 505.828 |
| TARIFF | 1,256 | 1.099 | 0.025 | 1.040 | 1.214 |
| NTARIFF | 1,235 | 278.540 | 54.349 | 104.488 | 458.940 |
| GDPC | 1,330 | 3606.326 | 3261.328 | 269.110 | 16088.000 |
| HUM | 1,330 | 2.202 | 0.554 | 1.128 | 3.570 |
| REER | 1,330 | 105.807 | 17.649 | 36.867 | 190.306 |
| FDI | 1,330 | 0.041 | 0.064 | -0.372 | 1.033 |
| FINDEV | 1,330 | 0.334 | 0.264 | 0.004 | 1.578 |
| INST | 1,330 | -1.103 | 1.299 | -4.549 | 2.991 |
| POP | 1,330 | 65.700 | 205.000 | 0.256 | 1400.000 |

Note: Statistics concerning development aid variables ("AfTTOT", "AfTINF", "AfTPR", "AfTPOL" and "NAfTTOT") are expressed in US\$ millions. Statistics relating to the variable "POP" are also expressed in million.

Appendix 3: List of countries used in the full sample

| Full sample | | | |
|--------------------------|--------------------|------------|----------------------|
| Albania | Dominican Republic | Lesotho | Paraguay |
| Algeria | Ecuador | Liberia | Peru |
| Angola | Egypt, Arab Rep. | Madagascar | Philippines |
| Argentina | El Salvador | Malawi | Rwanda |
| Armenia | Eswatini | Malaysia | Senegal |
| Bangladesh | Fiji | Maldives | Sierra Leone |
| Belize | Ghana | Mali | South Africa |
| Bolivia | Guatemala | Mauritania | Sri Lanka |
| Botswana | Haiti | Mauritius | Syrian Arab Republic |
| Brazil | Honduras | Mexico | Tajikistan |
| Burundi | India | Mongolia | Tanzania |
| Cambodia | Indonesia | Morocco | Thailand |
| Cameroon | Iran, Islamic Rep | Mozambique | Togo |
| Central African Republic | Iraq | Namibia | Tunisia |
| Chile | Jamaica | Nepal | Turkiye |
| China | Jordan | Nicaragua | Uganda |
| Colombia | Kazakhstan | Niger | Ukraine |
| Congo, Dem. Rep. | Kenya | Nigeria | Uruguay |
| Costa Rica | Kyrgyz Republic | Pakistan | Vietnam |
| Cote d'Ivoire | Lao PDR | Panama | Zambia |