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# Is Aid for Trade Related to Trade Inclusivity in African Countries?

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## Abstract

This article investigates the association (and not causality) between Aid for Trade (AfT) flows and trade inclusivity in African countries. Trade inclusivity is defined in terms of countries' catch-up with developed countries in terms of manufactured exports, and therefore, measured for different degrees of manufactures, including primary goods (PRIM); labor-intensive and resource-intensive manufactured exports (LAB); low-skill and technology-intensive manufactured exports (LOW); medium-skill and technology-intensive manufactured exports (MED); and high-skill and technology-intensive manufactured exports (HIGH). The analysis uses 32 African countries (of which 17 Least developed countries - LDCs) over the period from 2003 to 2021. It applies the Seemingly Unrelated Regression estimator that allows uncovering the short-term association (within-country association) and additional long-term equilibrium association (between-country association) between AfT flows and the indicators of trade inclusivity. The empirical findings indicate that over the full sample, AfT interventions are positively associated with LOW, MED, and PRIM, with their largest long-term positive association being on LOW, followed by MED and PRIM. However, the long-term associations between total AfT and the indicators of trade inclusivity are slightly different in LDC and NonLDC African countries. Moreover, AfT interventions are associated with a greater inclusivity in terms of low-skill/and medium-skill and technology-intensive manufactured exports in African countries that improve their productive knowledge, and face higher trade costs.

## 1. Introduction

Do Aid for Trade (AfT) flows make trade more inclusive in African countries? The present article aims to address this question.

The recent years' backlash against international trade and globalization (Walter, 2021) has made the concepts of "inclusive development[1]" and particularly "inclusive trade" (or ("trade inclusivity") more relevant than ever on the agenda of national policymakers. There is no consensus on the definition of "inclusivity" in the literature, as this concept is complex, multifaced and multidisciplinary (e.g., Gupta et al., 2021; Pouw and Gupta, 2017; UNESCAP, 2013). For example, according to UNESCAP (2013: p99), "Inclusivity" comprises "reduction of poverty and inequality, creation of decently paid jobs especially for those previously excluded, enhanced entrepreneurship, improved consumption choices, and quality of life in general." Likewise, the concept of "inclusive trade" has been considered in different ways in the literature (see the brief literature review provided by Gnangnon, 2024a). Some studies have considered "inclusive trade" through the lens of whether trade policies (trade openness or participation in international trade) are pro-poor or contribute to promoting inclusive growth (e.g., Dollar and Kraay, 2002; Engel et al., 2021; UNECLAC, 2014; UNESCAP, 2009, 2013). Other studies have considered that trade is inclusive if it helps reduce trade inequality among countries in the world, including by improving the participation of poorest countries in international trade (Garcia-Algarra et al., 2020) or by enhancing the participation of small and medium size enterprises in global trade (e.g., Goff, 2021; Hui, 2019). In the present analysis, the concept of "inclusive trade" is considered from the perspective of reducing inequality among countries in the international trade market, specifically in the market for manufactured goods. In particular, we consider that for a given country "*trade is inclusive*" *if this country is capable of catching-up with the major industrialized countries (in particular old-industrialized countries, i.e., countries known as industrialized countries in the past) in terms of manufactured exports*.

Developing countries face important structural obstacles - weak supply-side capacity and trade-related infrastructure[2] - that hinder their effective participation in international trade (e.g., Arvis et al., 2013; Hallaert and Munro, 2009; Hoekman and Nicita, 2011; Portugal-Perez and Wilson, 2009). To address these structural hinderances, WTO Members launched in 2005, the Aid for Trade (AfT) Initiative. According to WTO (2005), this initiative aims at helping developing countries build the supply-side capacity and trade-related infrastructure they need in order to benefit from WTO Agreements and improve their participation in global trade. The literature has well established that AfT flows help reduce trade costs in developing recipient countries (e.g., Busse et al. 2012; Calì and te Velde, 2011; OECD/WTO, 2015; Tadesse et al. 2017, 2019, 2021). This is particularly the case for African countries (e.g., Tadesse et al., 2021; 2022). In turn, lower trade costs (including through AfT interventions) contribute to significantly improving countries' trade competitiveness (e.g., Eckhardt et al., 2018; OECD/WTO, 2015; Pham and Oh, 2018), and promoting export sophistication, especially in low-income countries (many of which being African countries) (Weldemicael, 2014).

In light of the foregoing, one could question whether AfT interventions are associated with inclusive trade in developing countries. The present paper aims to address this question, which to the best of our knowledge, has received a little attention in the literature. We argue that by reducing trade costs and enhancing trade competitiveness, AfT interventions can be associated with greater countries' trade inclusivity. The analysis is carried out using an unbalanced panel dataset of 32 African countries (of which 17 LDCs) over the annual period from 2003 to 2021. It utilizes the Seemingly Unrelated Regression (SURE) estimator to uncover the short-term relationship (within-country association) and additional long-term equilibrium relationship (between-country association) between each regressor and trade inclusivity. It is important to emphasize that the analysis aims to uncover the association (and not a causation) between AfT flows and trade inclusivity in African countries. A key message from the analysis is that the association between total AfT flows and trade inclusivity are different in LDCs and NonLDCs among African countries. Meanwhile, over the full sample, and in the long-term, AfT interventions are positively associated with African countries' inclusivity in terms of low-skill/and medium-skill and technology-intensive manufactured export products, especially when those countries improve their productive knowledge, and experience higher trade costs.

The rest of the paper is organized around five sections. Section 2 discusses the issue of trade inclusivity, including in relation to the relevant literature. Section 3 considers the relationship between AfT interventions and trade inclusivity from the theoretical perspective. Section 4 presents the empirical strategy. Section 5 interprets empirical outcomes, and Section 6 concludes.

## 2. Trade inclusivity

As noted above, we consider "trade to be inclusive in a country" if this country is capable of catching-up with the major industrialized countries (in particular old-industrialized countries, i.e., countries known in the past as industrialized countries) in terms of manufactured exports. In the literature, a few studies

have considered whether trade is inclusive (e.g., Garcia-Algarra et al., 2020; Goff, 2021; Hui, 2019). For example, Hui (2019) has considered trade inclusivity from the perspective of whether e-commerce increases exports by smaller firms and sellers. The author has investigated the effect of the introduction of the United States' Global Shipping Program (GSP) on sales on eBay, one of the largest e-commerce platforms. The GSP reduces export entry costs by homogenizing the procedures of selling domestically and internationally on eBay. The analysis has revealed that the enrollment in the GSP has promoted the inclusivity of trade. It has increased essentially small sellers and small commercial sellers' export sales on eBay and especially at the extensive margin of exports (i.e., from new exporters or new destination countries). In addition, exports have increased to a larger extent for countries that are more distant and those that export differentiated products. This study, therefore, points out the importance of reducing export entry costs (e.g., if policymakers were to foster inclusive global trade through increasing the participation of small firms in global trade. These costs could include the startup cost of learning foreign demand, complying with customs regulations, building foreign warehouses, and establishing trust between firms and consumers. Garcia-Algarra et al. (2020) have used numerical simulations on the network international trade model to show that simple policies that foster the participation of poor economies (low-income countries) in international trade contribute to reducing trade inequality among countries in the world. In particular, the reduction in inequality in the international trade network is larger if trade agreements are concluded between underrepresented countries with no regional limitations than trade agreements concluded between countries in the same region. In other words, enhancing intraregional trade leads to a higher inequality because weaker countries' trade volume is so small that minor changes in the long tail distribution have a strong overall effect. Trade agreements that are not restricted to intra-regional trade (for the groups of Latin America and the Caribbean, Middle East and North Africa and Sub-Saharan Africa) lead to the reduction of the international trade inequality. Goff (2021) has used Nancy Fraser's three justice idioms (economic, cultural, and political dimensions of justice) to ascertain the inclusivity of trade agreements, that is, whether trade agreements (focusing on ostensibly products of Canada's inclusive trade agenda) yield more just outcomes for women, Indigenous peoples, workers, and small- and medium-sized enterprises.

Other studies (e.g., Bacchetta et al. 2019; Engel et al., 2021; Luke and Macleod, 2019) have looked at the inclusivity of trade through the lens of government policy choices that can improve the distribution of the gains from trade within countries. The report by Bacchetta et al. (2019) has discussed, inter alia, the design of appropriate adjustment policies to make globalization more inclusive (including by addressing concerns regarding the effects of trade on labour markets) and ensure a more equal distribution of the gains from trade within countries. Likewise, the report by Engel et al. (2021: Chap. 2) has examined government policies that help improve the distribution of the gains from trade across the economy by maximizing the benefits from trade, while minimizing the negative impacts of trade reforms for example on certain regions, industries, firms, and workers, within countries. These require policies that focus on three types of economic objectives, including fewer distortions and better functioning markets, lower trade costs, and faster labor market adjustment. Luke and Macleod (2019) have examined how the African Continental Free Trade Area (AfCFTA) can be effectively implemented to deliver inclusive trade in Africa. For example, the report has looked, *inter alia*, at what special and differential treatment provisions in the AfCFTA can help African less-developed countries gain meaningfully from the AfCFTA.

## 3. Aid for trade and inclusive trade

African countries' export performance is undermined by the prevalence of high trade costs, including both high on-the-border costs of trading and behind-the-border costs of trading (e.g., Ali and Milner, 2016; Christ and Ferrantino, 2011; Hoekman and Nicita, 2011; Hoekman and Shepherd, 2015; Portugal-Perez and Wilson, 2008, 2009). It is, therefore, critical to reduce trade costs in African countries if the latter were to reduce the anti-export bias (resulting among others form higher trade costs), improve their quality and cost competitiveness in the international trade market, and better integrate into the international trade market (e.g., Calì and te Velde, 2011; de Melo et al., 2024; Hoekman and Njinkeu, 2011). For example, reducing trade costs is particularly critical for African countries that are abundant in natural resources and face potentially the resource curse (Dutch Disease) problem. In fact, Porteous (2022) has reported that as African countries have a comparative advantage in agriculture, a decline in natural resource revenues can lead factors of production to shift into agriculture, making remote farmers to experience losses when trade costs make agricultural goods behave like non-tradables. The author has, therefore, shown that reducing trade costs and boosting agricultural productivity can help offset the lost income from oil. Likewise, lowering trade costs enhance competition (e.g., Crowley et al., 2024), improve the efficiency of resources allocation across sectors, including towards high productive plants, boost firms' productivity (e.g., Abeberese and Chen, 2022; Bernard et al., 2003; Ferreira and Trejos, 2011; Melitz, 2003) and lead firms to change their product mix (this is the so-called intra-plant reallocation - e.g., Bernard et al., 2006).

AfT interventions aim at helping developing countries, and specifically African ones, overcome the trade-related infrastructure and supply-side capacity constraints to their participation in international trade (e.g., Hallaert and Munro, 2009). One can expect that AfT projects would help African countries diversify their export product baskets away from primary goods exports and towards manufactured export products. For the sake of analysis, total AfT flows cover three different categories of the official development assistance (see OECD/WTO, 2011; UNECA, 2009). These are AfT interventions in support for building or strengthening economic infrastructure, AfT projects for building or fostering productive capacities, and AfT interventions related to trade policy and regulation. AfT flows for economic infrastructure aim to build hard infrastructure (e.g., transport, ports, roads, and railroads) as well as soft infrastructure (e.g., information and communication technology base). AfT flows in support for building productive capacities aim at improving the capacity of developing countries' firms to produce goods and services demanded in the world market. They cover a range of productive sectors, including banking and financial services, business and other services, agriculture, fishing, industry, mineral resources and mining, and tourism. AfT interventions relating to trade policy and regulation purport to achieve many objectives. First, these AfT resource flows serve to enhance the capacity of developing countries' government officials to participate effectively and defend their interests in trade negotiations, implement trade agreements, and design trade policies and trade-related institutions consistent with their trade and development objectives, as well as with WTO rules. Second, they also help facilitate trade at the border, including by assisting recipient countries in streamlining trade procedures through reducing the time, cost, and number of documents necessary for export and import. Finally, AfT interventions relating to trade policy and regulation can assist developing countries in meeting the adjustment costs implied by trade policy reform (e.g., balance of payment problems arising from tariff revenues losses or from of preferential market access erosion).

Several works have documented that AfT flows (especially AfT flows for economic infrastructure and AfT flows related to trade facilitation) help reduce trade costs in recipient countries (e.g., Busse et al. 2012; Calì and te Velde, 2011; de Melo and Wagner, 2016; Hoekman and Nicita, 2010; Lanz et al., 2016; OECD/WTO, 2015; Tadesse et al. 2017, 2019, 2021; Vijil and Wagner, 2012). This is particularly the case for African countries (e.g., Tadesse et al., 2021; 2022).

Reducing trade costs helps enhance the predictability and stability of the trading environment, and foster countries' participation in international trade (e.g., Ali and Milner, 2016; Hummels, 2007; Jacks et al., 2011; Khan and Kalirajan, 2011; Milner and McGowan, 2013; Shepherd, 2022). It improves the efficiency of resources allocation across sectors and enhances firms' productivity (e.g., Abeberese and Chen, 2022; Bernard et al., 2006; Melitz, 2003). Lower trade costs can also promote export product diversification (e.g., Dennis and Shepherd, 2011; Mora and Olabisi, 2024) and export sophistication, especially in low-income countries (Weldemicael, 2014).

In particular, lowering trade costs, through AfT interventions, help significantly improve countries' trade competitiveness (e.g., Eckhardt et al., 2018; OECD/WTO, 2015; Pham and Oh, 2018). A joint report by UNECA and the WTO (UNECA/WTO, 2019) has considered the link between AfT interventions and inclusive trade by discussing how AfT flows can be used to support efforts to reduce barriers to trade for women and young people and promote inclusive gains from trade following implementation of the Agreement Establishing the African Continental Free Trade Area. The report has conveyed a number of messages: (i) African countries are among the largest beneficiaries of AfT flows, which are used to support the build-up of productive capacity and economic infrastructure, especially transport and storage, energy generation and supply and agriculture; (ii) In this regard, AfT flows play a critical role in building African countries' trade capacity, alleviate supply-side constraints, and can be instrumental in supporting the effective implementation of African Continental Free Trade Area; (iii) As AfT interventions do not currently reflect economic empowerment priorities, action is required to increase the number of Aid for Trade projects that specifically target women and young people. Along the same lines, Asian Development Bank (ADB, 2022) has examined the role of AfT flows in promoting inclusiveness, that is, whether AfT interventions ensure the effectiveness of trade and digital agreements in promoting both trade and inclusive economic growth. The report has recommended, *inter alia*, that AfT interventions can be instrumental in fostering economic diversification while ensuring that sustainable and inclusive trade liberalization benefit poorer economies, small businesses, marginalized workers, women, and youth. Furthermore, AfT needs to be used to strengthen supply chain resilience, enhance firms' productive capacity, and improve trade facilitation measures.

Against this backdrop, one can surmise that by helping reduce trade costs, and improve countries' trade competitiveness (e.g., Eckhardt et al., 2018; OECD/WTO, 2015; Pham and Oh, 2018), AfT interventions can foster countries' inclusivity in the international trade market, especially in the manufactured goods markets. However, this effect may vary across different degrees of manufactures. Given the positive effect of trade costs reduction on export sophistication, especially in low-income countries (Weldemicael, 2014), one can additionally argue that African countries that endeavor to export relatively sophisticated products will likely enjoy a greater inclusivity in the manufactured goods markets, although this effect may vary across different types of manufactured goods. In particular, we bear in mind that countries characterized by a low technology level (which is the case for many African countries) tend to export relatively low value added (i.e., light) manufactured products (e.g., Hufbauer, 1970; Weldemicael, 2014).

These arguments are particularly grounded on the positive effect of AfT interventions on manufactured exports by African countries. For example, Lloyd et al. (2000) have examined the relationship between total development aid flows (of which AfT flows) provided by European donors to 26 African recipients on the bilateral trade flows over 1969-95. They have not found a compelling evidence that development aid creates trade. A voluminous studies[3] have reported a positive effect of AfT flows on export performance, especially on manufactured export performance in developing countries (e.g., Calì and te Velde, 2011; Vijil and Wagner, 2012), and a few number of works have investigated the effect of trade costs on export performance, including the structure of exports in African countries. Iwanow and Kirkpatrick (2009) have shown that both on-the-border and behind-the-border policies generate higher benefits in terms of manufacturing export performance in African countries than in the rest of the world. Lemi (2017) has found that total AfT flows stimulate the export of capital goods. Other studies have examined the effect of AfT flows on export product diversification in Africa. For example, Karingi and Leyaro (2009) have obtained that by reducing trade costs, AfT flows help promote export diversification and enhance trade competitiveness in African countries. Nathoo et al. (2023) have reported a positive effect of total AfT flows on export product diversification at both the intensive and extensive margins, although the categories of total AfT have differentiated effects on export product diversification in Africa.

### Hypotheses to be tested

Building on the above discussion, we formulate the following hypotheses.

### Hypothesis 1

AfT interventions can be positively associated with countries' inclusivity in the international trade market, especially in the manufactured goods markets (i.e., catch-up in terms of manufactured exports). However, the nature (including direction) of this relationship may vary across different degrees of the manufacturing of export products, notably in terms of magnitude, direction and statistical significance of the AfT flows effect.

### Hypothesis 2

In view of the importance of productive knowledge for trade inclusivity, we deepen the analysis by investigating the extent to which the effect of total AfT flows on trade inclusivity depends on the productive knowledge. We argue that African countries that endeavor to export relatively sophisticated products will likely enjoy a greater inclusivity in the manufactured goods markets, although this effect may not be the same for different degrees of manufactures.

### Hypothesis 3

This positive association between AfT flows and trade inclusivity can be larger in countries that face higher trade costs.

## 4. Empirical strategy

In this section, we first present the model specification (sub-section 1), and then discuss the econometric approach for estimating it (sub-section 4.2). Lastly, we present an analysis of data concerning the main variables of interest in the analysis (sub-section 4.3.).

# 4.1. Model specification

To test empirically hypotheses 1 and 2, we consider the following baseline model specification:

$$Log(INC)_{it} = \alpha_0 + \alpha_1 Log\,(AfT)_{it} + \beta\, X_{it} + \gamma_t + \mu_i + \epsilon_{it}$$

1

where *i* and *t* are subscripts respectively for a country and a year in the panel dataset, which is unbalanced and covers 32 African countries (of which 17 LDCs) over the period from 2003 to 2021. This dataset has been constructed on the basis of data available concerning the variables used in model (1).

The dependent variable "INC" is the indicator of trade inclusivity, - i.e., inclusivity in terms of manufactured exports - measured by the variables LAB, LOW, MED, HIGH and PRIM described below. We compute our index of inclusivity in terms of manufactured exports (i.e., manufactured export catch-up) by utilizing the catch-up index proposed by Kant (2019): $INC_{it} = \frac{R_{i,t}}{R_{i,2017}}$, where "INC" is the index of inclusivity in terms of manufactured exports for a country *i* in a year *t*.

$R_{i,2017}$ is the ratio of manufactured export value (constant 2017 US$) of country *i* in a base year (we choose 2017 as the base year) (denoted $EXP_{i,2017}$) to the manufactured export value of a benchmark country (or set of countries) (here, the average manufactured export values of old-industrialized[4] countries) using the same base year (denoted $EXP_{IND,2017}$). $R_{i,2017} = \frac{EXP_{i,2017}}{EXP_{IND,2017}}$ .

We define $R_{i,t}$ as the ratio of manufactured export value (constant 2017 US$) of country *i* in a year *t* (denoted $EXP_{i,t}$) to the manufactured export value (constant 2017 US$) of the benchmark country (or set of countries) (here, the average value of manufactured export of old-industrialized countries) in year *t* (denoted $EXP_{IND,t}$). $R_{i,t} = \frac{EXP_{i,t}}{EXP_{IND,t}}$, with *t* being each of the year in the panel dataset that contains 32 African countries over the period from 2003 to 2021. Higher values of the index "INC" indicate a greater trade (including export) inclusivity, i.e., an improvement in a country's catch-up in terms of manufacturing exports.

The index "INC" has been computed by degree of manufactures, namely inclusivity in terms of labor-intensive and resource-intensive manufactured exports ("LAB"); inclusivity in terms of low-skill and technology-intensive manufactured exports ("LOW"); inclusivity in terms of medium-skill and technology-intensive manufactured exports ("MED"); and inclusivity in terms of high-skill and technology-intensive manufactured exports ("HIGH"). For the completeness of the analysis on inclusivity in terms of goods exports, we also compute the indicator of catch-up for primary exports, denoted "PRIM". To compute all these indicators, we collect data on manufacturing export (current US$) from the UNCTAD Database[5]. Data on the real manufactured exports (constant 2017 US$) have been computed by deflating the indicator capturing the value of manufacturing exports (current US$) by the United States' Consumer Price Index[6].

The variable "AfT" represents the real gross disbursement of total Aid for Trade flows (constant 2020 US$). It can be the indicator of total AfT flows (denoted "AfTTOT"), or one of its three main components, namely AfT flows for the buildup of economic infrastructure (defined as "AfTINF"), AfT flows for building productive capacities (defined as "AfTPR"), and AfT flows relating to trade policies and regulation (defined as "AfTPOL"). We have applied the natural logarithm to all AfT indicators to reduce their skewed distribution.

$X_{it}$ is a vector of control variables largely drawn from the literature on the conventional well-known determinants of export performance. The variables included in this vector of variables are as follows. The first variable is the human development (denoted "HDI"), which acts here as a proxy for the development level. We expect that a country with a higher development level would experience a higher degree of trade inclusivity than a country with a relatively lower development level. Other control variables include the productive knowledge, denoted "ECI", measured by the indicator of economic complexity; the real effective exchange rate (denoted "REER"); an indicator of financial development (denoted "FD"); the share of net foreign direct investment inflows (FDI) in GDP (denoted "FDI"); an indicator of institutional and governance quality[7] (denoted "INST"); the terms of trade (denoted "TERM") and the total population size (denoted "POP"). We have applied the natural logarithm to the variable "POP" to reduce its skewed distribution.

We expect that a depreciation of the real exchange rate could enhance countries' trade inclusivity, while an appreciation of the real exchange rate can be associated with a lower trade inclusivity. On the other hand, the productive knowledge (or productive capabilities) (that reflects the technical know-how/the set of capabilities incorporated into a country's productive structure[8]) is critical for improving trade inclusivity, in particular for producing higher value-added (i.e., sophisticated) goods. Therefore, we expect that countries with a higher productive knowledge would enjoy a greater trade inclusivity. Likewise, higher FDI inflows, the improvement in the institutional and governance quality, and a better access to credit to finance export activities can help promote trade inclusivity. An improvement in the terms of trade may contribute to enhancing trade inclusivity if it provides incentives to invest in the production and export of higher value-added products. An increase in the population size can provide countries with access to cheap labor force (especially if the population is educated) that can reduce production costs and promote trade inclusivity. All these being noted, the above-mentioned associations between control variables and trade inclusivity may be different, depending on the manufactured product category considered (i.e., the inclusivity in terms of manufactured exports for varying degrees of manufacture).

The index of human development, extracted from the United Nations Development Programme database[9], is a composite index that has several dimensions of development (long and healthy life, being knowledgeable and having a decent standard of living). The indicator of economic complexity reflects the diversity and sophistication of a country's export structure and is obtained from the Massachusetts Institute of Technology (MIT) Observatory of Economic Complexity[10] (see Hausmann and Hidalgo, 2009). The indicator of the real exchange rate is collected from the Bruegel Database[11] (see Darvas 2012a, 2012b). Higher values of this indicator reflect an appreciation of the REER. Data on the share of FDI inflows in GDP and the share of domestic credit to the private sector by banks in GDP (as a proxy for financial development) are collected from the WDI, and divided by 100 (i.e., not expressed in percentage) for the sake of analysis. The indicator of terms of trade (net barter terms of the trade index – 2000 = 1) is obtained from the WDI and divided by 100 for the sake of analysis (as it is expressed at base 2000 = 100 in the WDI database). The indicator of the total population size was obtained from the WDI. The indicator "INST" has been computed as the first principal component (based on factor analysis) of the six indicators of governance and institutional quality developed by the World Bank Governance Indicators (WGI[12]) developed by Kaufmann and Kraay (2023).

The descriptive statistics relating to all variables used in the analysis are provided in Appendix 1, and the list of the 32 countries of the full sample, of which the 17 LDCs, is presented in Appendix 2.

$\beta$ is a vector of parameters associated with each variable contained in the vector of variables X. $\gamma_t$ are time dummies that represent global shocks affecting together all countries' trade inclusivity patterns. $\mu_i$ are countries' time invariant specific effects, and $\epsilon_{it}$ is a well-behaving error term.

Inspired by the work of Calì and te Velde (2011) on the link between Aid for Trade flows, trade costs and export performance in developing countries, we conjecture that AfT flows affect trade inclusivity with a certain lag, including a one-year lag. This is because it takes time for AfT interventions to translate into the build-up of economic infrastructure (so as to reduce trade costs), as well as into the strengthening of productive capacities, and the improvement in trade policy and regulation. We, additionally, mitigate endogeneity concerns by using in model (1) all control variables (except for "TERMS" and "POP") with a one-year lag. This approach also helps mitigate the endogeneity concern arising from the bi-directional causality between the dependent variable and the "INC" indicator, and control variables, excluding the terms of trade and the population size. This does not signify that our estimates represent causal effects of regressors. Rather, they represent associations between the regressors – of which AfT flows - and the dependent variable.

To get a first insight into the relationship between AfT flows and trade inclusivity indicators, we present in Figs. 1 to 3, the cross-plot between AfT flows and indicators of trade inclusivity, respectively over the full sample, and the sub-samples of LDCs and NonLDCs, using annual data from 2003 to 2021. Over the full sample, total AfT flows are negatively correlated with PRIM and HIGH, but positively correlated with MED (see Fig. 1). In the meantime, over the full sample, the correlation pattern between total AfT flows and LAB on the one hand, and with LOW, on the other hand, are unclear. For LDCs, we find positive correlation patterns between total AfT flows and each of the following indicators, namely LAB, MED and HIGH. However, total AfT flows are negatively correlated with PRIM and LOW (see Fig. 2). On the other hand, in NonLDCs, LOW and MED are positively correlated with total AfT flows, while the correlation between the other trade inclusivity indicators and total AFT flows are negative (see Fig. 3).

## 4.2. Econometric approach

In view of the high correlation between the export products across different sectors in the economy, we follow Gnangnon (2024b) and use the Seemingly Unrelated Regression (SURE) estimator of Zellner (1962) to estimate a system of a hybrid form of equations[13] (1) where dependent variables are all indicators of the variable "INC". The SURE estimator helps account for contemporaneous correlations, and generates greater efficiency of parameters (e.g., Judge et al. 1988). Small-sample statistics have been computed and heteroscedasticity in the residuals have been accounted for in the regressions. What does the hybrid form of Eq. (1) mean? Bartelsman et al. (1994) and Egger and Pfaffermayer (2004) have proposed a hybrid model that helps uncover both short run and long run effects of regressors when the panel data has a short-term dimension, is unbalanced (with missing values), and especially when variables exhibit larger between-country variations than the within-country variations (e.g., Carpa and Martínez-Zarzoso, 2022). Such a panel dataset is not appropriate for the estimation of an appropriate dynamic model specification with lags and leads of the variables. This is the case for our unbalanced panel dataset, which includes a few number of countries (32 countries) and covers a relatively short time of period (i.e., 20 years). The hybrid model approach involves introducing in Eq. (1) the average over time (i.e., time average per country) of each of these regressors, in addition to the original form of each regressor (see also Allison, 2009). Hence, for short-term effect and additional long-term equilibrium effect of each time-variant regressor are respectively the within-country effect, and the between-country effect. In other words, in model (1), the short-term effect of each regressor is measured by the coefficients $\alpha_0$, $\alpha_1$, and the vector of coefficients $\beta$. Bartelsman et al. (1994) have noted that the cross-sectional elements are likely to reflect equilibrium values once various factors have adjusted, while within-country changes are likely to be more representative of adjustments in the short term. The overall estimated long-run effect of each regressor is obtained by summing the short-run and the additional long-run parameters (Egger and Url, 2006; Mundlak, 1978; Pirotte, 1999). It is important to note that we would have used other econometric approaches, such as the two-step system Generalized Method of Moments (GMM) estimator of Blundell and Bond (1998), to estimate (separately for each indicator of trade inclusivity) a dynamic form of Eq. (1) (i.e., Eq. (1) with the lag of the dependent variable as regressor). However, this is not possible because the GMM is suitable for panel datasets characterized by a short-time dimension and a large cross-sectional dimension.

At this stage of the analysis, it is important to point out that while the SURE approach is used to estimate a system of hybrid models where AfT flows and other possible endogenous regressors (endogeneity due to reverse causality problem) are introduced with a certain lag in the equations, this approach does not fully address the possible endogeneity of some regressors, of which of indicators of AfT flows. Therefore, our estimates do not capture causal effects of regressors, but rather an association between regressors and the trade inclusivity indicators.

Overall, we test hypotheses 1 and 2, using the SURE estimator to estimate the system of hybrid form of Eq. (1), with each trade inclusivity indicator as dependent variable (other studies that used the same such approach include for example Carpa and Martínez-Zarzoso, 2022; Egger and Url, 2006; Gnangnon,

2024b; and Martínez-Zarzoso et al. 2014). For the sake of brevity, we report only outcomes concerning the main variables of interest in the analysis (i.e., AfT variables). The estimates relating to control variables can be obtained upon request.

Columns [1] to [5] of Tables 1 and 2 report the estimations' outcomes that allow testing hypothesis 1 over of the full sample, and where AfT variables (total AfT and each of its three main components) are introduced with a one-year lag in the regressions. For robustness check, columns [6] to [10] of the same Tables present the estimations' outcomes that allow testing hypothesis 1 over the full sample, but where AfT variables are introduced with a two-year lag in the regressions. Columns [1] to [5] of Table 3, and columns [6] to [10] of the same Table provide the estimations' outcomes respectively over LDCs and NonLDCs, where the variable "AfT" is measured only by total AfT flows, and introduced with a one-year lag.

Table 1
Association between AfT flows and trade inclusivity_Over the Full Sample **Estimator**: SURE-approach applied to the system of hybrid models

| | *Outcomes with the one-year lag of indicators of Aid variables* | | | | | *Outcomes with the two-year lag of indicators of Aid variables* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Variables** | **Log(PRIM)** | **Log(LAB)** | **Log(LOW)** | **Log(MED)** | **Log(HIGH)** | **Log(PRIM)** | **Log(LAB)** | **Log(LOW)** | **Log(MED)** | **Log(HIG** |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| $Log(AfTTOT)_{t-1}$ | 0.0201 | 0.0479 | -0.104 | -0.0905** | -0.104** | 0.00613 | -0.0221 | 0.00183 | -0.0798* | -0.0195 |
| | (0.0360) | (0.0426) | (0.0882) | (0.0459) | (0.0487) | (0.0389) | (0.0436) | (0.0687) | (0.0427) | (0.0488) |
| $Ave[Log(AfTTOT)_{t-1}]$ | 0.202*** | -0.230*** | 0.776*** | 0.331*** | 0.0389 | 0.208*** | -0.181** | 0.634*** | 0.320*** | -0.0245 |
| | (0.0676) | (0.0792) | (0.174) | (0.0996) | (0.0874) | (0.0708) | (0.0766) | (0.145) | (0.0915) | (0.0862) |
| Observations | 449 | 449 | 449 | 449 | 449 | 432 | 432 | 432 | 432 | 432 |
| R-squared | 0.649 | 0.492 | 0.614 | 0.669 | 0.620 | 0.641 | 0.467 | 0.601 | 0.656 | 0.603 |
| F-statistic | 21.85 (0.0000) | 8.64 (0.0000) | 11.45 (0.0000) | 14.31 (0.0000) | 15.75 (0.0000) | 20.62 (0.0000) | 7.46 (0.0000) | 10.89 (0.0000) | 12.90 (0.0000) | 13.62 (0.0000) |
| BP test[a] | 143.757 (0.0000) | | | | | 133.712 (0.0000) | | | | |

*Note: *p-value < 0.1; **p-value < 0.05; ***p-value < 0.01. Robust standard errors are in parenthesis. Time dummies and countries' unobservable specific time invariant effects have been included in the regressions. (a): "BP test" refers to the Breusch-Pagan test of independence. We provide here the Chi-square statistic and the related p-value in brackets.* Small-sample statistics have been computed and heteroscedasticity in the residuals have been accounted for i *the regressions.*

Table 2

Association between AfT flows and trade inclusivity over the full sample of African countries **Estimator**: SURE-approach applied to the system of hybrid moc

| | *With the one-year lag of AfT for economic infrastructure* | | | | | *With the two-year lag of AfT for economic infrastructure* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Variables** | **Log(PRIM)** | **Log(LAB)** | **Log(LOW)** | **Log(MED)** | **Log(HIGH)** | **Log(PRIM)** | **Log(LAB)** | **Log(LOW)** | **Log(MED)** | **Log(HIC** |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| $Log(AfTINF)_{t-1}$ | -0.0156 | -0.00846 | -0.119** | -0.0191 | -0.0302 | -0.0142 | -0.0488** | -0.0494 | -0.0408* | 0.00612 |
| | (0.0190) | (0.0250) | (0.0552) | (0.0249) | (0.0270) | (0.0211) | (0.0240) | (0.0469) | (0.0247) | (0.0285 |
| $Ave[Log(AfTINF)_{t-1}]$ | 0.208*** | -0.166** | 0.721*** | 0.243*** | -0.0239 | 0.201*** | -0.139** | 0.605*** | 0.258*** | -0.0402 |
| | (0.0566) | (0.0669) | (0.143) | (0.0831) | (0.0694) | (0.0574) | (0.0634) | (0.126) | (0.0783) | (0.0686 |
| Observations | 446 | 446 | 446 | 446 | 446 | 429 | 429 | 429 | 429 | 429 |
| R-squared | 0.646 | 0.494 | 0.618 | 0.666 | 0.610 | 0.638 | 0.474 | 0.600 | 0.656 | 0.593 |
| F-statistic | 20.10 (0.0000) | 8.84 (0.0000) | 11.92 (0.0000) | 14.19 (0.0000) | 14.70 (0.0000) | 19.59 (0.0000) | 7.39 (0.0000) | 10.63 (0.0000) | 13.06 (0.0000) | 12.75 (0.0000 |
| BP test[a] | 135.363 (0.0000) | | | | | 130.444 (0.0000) | | | | |
| | **With the one-year lag of AfT for productive capacities** | | | | | **With the two-year lag of AfT for productive capacities** | | | | |
| **Variables** | **Log(PRIM)** | **Log(LAB)** | **Log(LOW)** | **Log(MED)** | **Log(HIGH)** | **Log(PRIM)** | **Log(LAB)** | **Log(LOW)** | **Log(MED)** | **Log(HIC** |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| $Log(AfTPR)_{t-1}$ | 0.0250 | 0.0529 | 0.0148 | -0.0742* | -0.0309 | -0.0178 | -0.00709 | 0.0197 | -0.0744** | -0.0720 |
| | (0.0344) | (0.0366) | (0.0722) | (0.0425) | (0.0439) | (0.0339) | (0.0438) | (0.0621) | (0.0367) | (0.0458 |
| $Ave[Log(AfTPR)_{t-1}]$ | 0.192*** | -0.236*** | 0.661*** | 0.320*** | -0.0200 | 0.225*** | -0.189** | 0.607*** | 0.314*** | 0.0220 |
| | (0.0674) | (0.0767) | (0.162) | (0.0954) | (0.0875) | (0.0687) | (0.0758) | (0.133) | (0.0892) | (0.0888 |
| Observations | 449 | 449 | 449 | 449 | 449 | 432 | 432 | 432 | 432 | 432 |
| R-squared | 0.650 | 0.493 | 0.612 | 0.668 | 0.616 | 0.641 | 0.467 | 0.601 | 0.656 | 0.605 |
| F-statistic | 21.82 (0.0000) | 8.82 (0.0000) | 11.10 (0.0000) | 13.98 (0.0000) | 15.77 (0.0000) | 20.27 (0.0000) | 7.48 (0.0000) | 10.96 (0.0000) | 12.94 (0.0000) | 13.59 (0.0000 |
| BP test[a] | 145.350 (0.0000) | | | | | 133.528 (0.0000) | | | | |
| | **With the one-year lag of AfT for trade policy and regulation** | | | | | **With the two-year lag of AfT for trade policy and regulation** | | | | |
| **Variables** | **Log(PRIM)** | **Log(LAB)** | **Log(LOW)** | **Log(MED)** | **Log(HIGH)** | **Log(PRIM)** | **Log(LAB)** | **Log(LOW)** | **Log(MED)** | **Log(HIC** |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| $Log(AfTPOL)_{t-1}$ | 0.0138* | 0.00976 | -0.00314 | -0.0328*** | -0.0106 | 0.0142 | -0.0172 | -0.0483* | -0.0241 | -0.0429 |
| | (0.00768) | (0.0115) | (0.0263) | (0.0105) | (0.0224) | (0.0153) | (0.0189) | (0.0287) | (0.0182) | (0.0219 |
| $Ave[Log(AfTPOL)_{t-1}]$ | 2.732*** | -2.684*** | 8.590*** | 3.160*** | -0.593 | 1.958*** | -1.981*** | 5.651*** | 2.283*** | -0.434 |
| | (0.870) | (0.934) | (1.905) | (1.160) | (0.965) | (0.646) | (0.673) | (1.265) | (0.838) | (0.707) |
| Observations | 433 | 433 | 433 | 433 | 433 | 418 | 418 | 418 | 418 | 418 |
| R-squared | 0.654 | 0.505 | 0.614 | 0.666 | 0.612 | 0.631 | 0.478 | 0.601 | 0.655 | 0.593 |
| F-statistic | 19.35 (0.0000) | 8.27 (0.0000) | 11.14 (0.0000) | 15.24 (0.0000) | 16.06 (0.0000) | 18.49 (0.0000) | 8.50 (0.0000) | 10.39 (0.0000) | 13.18 (0.0000) | 13.45 (0.0000 |
| BP test[a] | 141.734 (0.0000) | | | | | 117.980 (0.0000) | | | | |

*Note: *p-value < 0.1; **p-value < 0.05; ***p-value < 0.01. Robust standard errors are in parenthesis. Time dummies and countries' unobservable specific time invariant effects have been included in the regressions. (a): "BP test" refers to the Breusch-Pagan test of independence. We provide here the Chi-square statistic and the related p-value in brackets. Small-sample statistics have been computed and heteroscedasticity in the residuals have been accounted for in the regressions.*

Table 3

Effect of total AfT flows on trade inclusivity over the sub-samples of LDCs and NonLDCs **Estimator**: SURE-approach applied to the system of hybrid models

| | *Over LDCs (17 countries)* | | | | | *Over NonLDCs (15 countries)* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Variables** | **Log(PRIM)** | **Log(LAB)** | **Log(LOW)** | **Log(MED)** | **Log(HIGH)** | **Log(PRIM)** | **Log(LAB)** | **Log(LOW)** | **Log(MED)** | **Log(HIG** |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| $Log(AfTTOT)_{t-1}$ | -0.0361 | -0.0284 | -0.399** | 0.0172 | -0.121 | 0.0689* | 0.117*** | 0.0915 | -0.0713 | -0.172** |
| | (0.0760) | (0.0996) | (0.157) | (0.0828) | (0.122) | (0.0363) | (0.0352) | (0.0839) | (0.0467) | (0.0457) |
| $Ave[Log(AfTTOT)_{t-1}]$ | 0.440*** | 0.0216 | 1.205*** | 1.094*** | 0.339** | 1.033*** | 0.557*** | 1.494*** | 1.476*** | -0.647** |
| | (0.0846) | (0.155) | (0.236) | (0.135) | (0.158) | (0.146) | (0.211) | (0.364) | (0.281) | (0.210) |
| Observations | 196 | 196 | 196 | 196 | 196 | 253 | 253 | 253 | 253 | 253 |
| R-squared | 0.561 | 0.559 | 0.750 | 0.726 | 0.628 | 0.732 | 0.575 | 0.562 | 0.662 | 0.691 |
| F-statistic | 8.90 (0.0000) | 6.09 (0.0000) | 12.17 (0.0000) | 17.96 (0.0000) | 18.78 (0.0000) | 25.96 (0.0000) | 10.60 (0.0000) | 7.68 (0.0000) | 10.89 (0.0000) | 16.12 (0.0000) |
| BP test[a] | 72.783 (0.0000) | | | | | 147.515 (0.0000) | | | | |

*Note: *p-value < 0.1; **p-value < 0.05; ***p-value < 0.01. Robust standard errors are in parenthesis. Time dummies and countries' unobservable specific time invariant effects have been included in the regressions. (a): "BP test" refers to the Breusch-Pagan test of independence. We provide here the Chi-square statistic and the related p-value in brackets. Small-sample statistics have been computed and heteroscedasticity in the residuals have been accounted for in the regressions.*

Table 4 contains outcomes that help test hypothesis 2 over the full sample. These outcomes are obtained by estimating a system of hybrid models (1) (with each of the trade inclusivity indicators as dependent variable) in which we introduce the interaction between the indicator "ECI" (with a one-year lag) and each of the AfT indicators (also with a one-year lag).

Table 4
Association between total AfT flows and trade inclusivity for different level of productive knowledge _Over the full sample **Estimator**: SURE-approach applied to the system of hybrid models

| | *Effect of the one-year lag of total AfT flows on trade inclusivity for different level of productive knowledge* | | | | |
|---|---|---|---|---|---|
| **Variables** | **Log(PRIM)** | **Log(LAB)** | **Log(LOW)** | **Log(MED)** | **Log(HIGH)** |
| | (1) | (2) | (3) | (4) | (5) |
| $[Log(AfTTOT)_{t-1}]*ECI_{t-1}$ | 0.0464 | 0.00646 | -0.183** | -0.0348 | -0.154*** |
| | (0.0478) | (0.0457) | (0.0856) | (0.0502) | (0.0490) |
| $Ave([Log(AfTTOT)_{t-1}]*ECI_{t-1})$ | 0.569 | 2.434** | 9.183*** | 6.530*** | 0.371 |
| | (0.558) | (1.064) | (1.122) | (0.682) | (1.430) |
| $ECI_{t-1}$ | -0.849 | -0.0980 | 3.661** | 0.835 | 2.703*** |
| | (0.861) | (0.826) | (1.594) | (0.893) | (0.870) |
| $Ave(ECI_{t-1})$ | -12.06 | -50.80** | -186.3*** | -134.2*** | -6.890 |
| | (11.29) | (21.84) | (22.81) | (13.86) | (29.40) |
| $Log(AfTTOT)_{t-1}$ | 0.0631 | 0.0539 | -0.274*** | -0.123** | -0.246*** |
| | (0.0502) | (0.0529) | (0.103) | (0.0512) | (0.0620) |
| $Ave[Log(AfTTOT)_{t-1}]$ | 0.280* | 0.188 | 2.445*** | 1.475*** | 0.172 |
| | (0.146) | (0.208) | (0.321) | (0.187) | (0.265) |
| Observations | 449 | 449 | 449 | 449 | 449 |
| R-squared | 0.651 | 0.492 | 0.619 | 0.669 | 0.626 |
| F-statistic | 21.66 (0.0000) | 8.66 (0.0000) | 11.50 (0.0000) | 14.03 (0.0000) | 15.14 (0.0000) |
| BP test[a] | 146.442 (0.0000) | | | | |
| | **Effect of the one-year lag of AfT flows for economic infrastructure on trade inclusivity for different level of productive knowledge** | | | | |
| **Variables** | **Log(PRIM)** | **Log(LAB)** | **Log(LOW)** | **Log(MED)** | **Log(HIGH)** |
| | (1) | (2) | (3) | (4) | (5) |
| $[Log(AfTINF)_{t-1}]*ECI_{t-1}$ | 0.0437 | 0.0366 | -0.0204 | -0.0272 | -0.0882** |
| | (0.0309) | (0.0348) | (0.0674) | (0.0360) | (0.0378) |
| $Ave([Log(AfTINF)_{t-1}]*ECI_{t-1})$ | 0.528 | 1.500** | 6.525*** | 4.538*** | 0.237 |
| | (0.384) | (0.703) | (0.774) | (0.489) | (0.996) |
| $ECI_{t-1}$ | -0.813 | -0.656 | 0.668 | 0.689 | 1.441** |
| | (0.529) | (0.610) | (1.212) | (0.620) | (0.640) |
| $Ave(ECI_{t-1})$ | -10.70 | -30.96** | -127.8*** | -90.52*** | -4.196 |
| | (7.464) | (14.01) | (15.16) | (9.549) | (19.90) |
| $Log(AfTINF)_{t-1}$ | 0.0234 | 0.0241 | -0.138* | -0.0434 | -0.109*** |
| | (0.0257) | (0.0312) | (0.0706) | (0.0331) | (0.0400) |
| $Ave[Log(AfTINF)_{t-1}]$ | 0.197*** | -0.150** | 0.889*** | 0.367*** | 0.0295 |
| | (0.0643) | (0.0716) | (0.153) | (0.0903) | (0.0779) |
| Observations | 446 | 446 | 446 | 446 | 446 |
| R-squared | 0.649 | 0.495 | 0.618 | 0.667 | 0.614 |
| F-statistic | 20.01 (0.0000) | 8.90 (0.0000) | 11.76 (0.0000) | 14.00 (0.0000) | 14.49 (0.0000) |

*Note: *p-value < 0.1; **p-value < 0.05; ***p-value < 0.01. Robust standard errors are in parenthesis. Time dummies and countries' unobservable specific time invariant effects have been included in the regressions. (a): "BP test" refers to the Breusch-Pagan test of independence. We provide here the Chi-square statistic and the related p-value in brackets.* Small-sample statistics have been computed and heteroscedasticity in the residuals have been *accounted for in the regressions.*

| | *Effect of the one-year lag of total AfT flows on trade inclusivity for different level of productive knowledge* | | | | |
|---|---|---|---|---|---|
| BP test[a] | 137.991 (0.0000) | | | | |
| | **Effect of the AfT flows for productive capacities on trade inclusivity for different level of productive knowledge** | | | | |
| **Variables** | **Log(PRIM)** | **Log(LAB)** | **Log(LOW)** | **Log(MED)** | **Log(HIGH)** |
| | (1) | (2) | (3) | (4) | (5) |
| $[Log(AfTPR)_{t-1}]*ECI_{t-1}$ | 0.0711* | 0.0216 | -0.206*** | 0.0152 | -0.0851* |
| | (0.0371) | (0.0379) | (0.0723) | (0.0447) | (0.0447) |
| $Ave([Log(AfTPR)_{t-1}]*ECI_{t-1})$ | 0.515 | 1.589** | 6.906*** | 4.710*** | 0.333 |
| | (0.413) | (0.744) | (0.836) | (0.507) | (1.041) |
| $ECI_{t-1}$ | -1.232* | -0.360 | 3.929*** | -0.0295 | 1.423* |
| | (0.634) | (0.657) | (1.301) | (0.759) | (0.788) |
| $Ave(ECI_{t-1})$ | -10.75 | -32.66** | -135.8*** | -94.43*** | -6.088 |
| | (8.067) | (14.88) | (16.45) | (9.964) | (20.86) |
| $Log(AfTPR)_{t-1}$ | 0.0962** | 0.0746 | -0.192** | -0.0590 | -0.116* |
| | (0.0469) | (0.0520) | (0.0846) | (0.0484) | (0.0616) |
| $Ave[Log(AfTPR)_{t-1}]$ | 0.251* | 0.0567 | 2.102*** | 1.215*** | 0.0918 |
| | (0.131) | (0.173) | (0.288) | (0.171) | (0.224) |
| Observations | 449 | 449 | 449 | 449 | 449 |
| R-squared | 0.655 | 0.493 | 0.620 | 0.668 | 0.619 |
| F-statistic | 21.94 (0.0000) | 8.86 (0.0000) | 11.19 (0.0000) | 13.78 (0.0000) | 14.92 (0.0000) |
| BP test[a] | 152.44 (0.0000) | | | | |
| | **Effect of AfT flows related to trade policy and regulation on trade inclusivity for different level of productive knowledge** | | | | |
| **Variables** | **Log(PRIM)** | **Log(LAB)** | **Log(LOW)** | **Log(MED)** | **Log(HIGH)** |
| | (1) | (2) | (3) | (4) | (5) |
| $[Log(AfTPOL)_{t-1}]*ECI_{t-1}$ | -0.00616 | 0.0220 | -0.0360 | 0.00410 | -0.0167 |
| | (0.0172) | (0.0212) | (0.0357) | (0.0217) | (0.0286) |
| $Ave([Log(AfTPOL)_{t-1}]*ECI_{t-1})$ | -1.518*** | 1.848*** | -3.860*** | -1.030* | 0.409 |
| | (0.455) | (0.544) | (1.016) | (0.625) | (0.580) |
| $ECI_{t-1}$ | 0.0390 | -0.322 | 0.677 | 0.122 | 0.211 |
| | (0.251) | (0.288) | (0.536) | (0.324) | (0.416) |
| $Ave(ECI_{t-1})$ | 23.03*** | -29.84*** | 60.03*** | 14.67 | -5.968 |
| | (7.214) | (8.632) | (16.00) | (9.871) | (9.200) |
| $Log(AfTPOL)_{t-1}$ | 0.00594 | 0.0378 | -0.0490 | -0.0276 | -0.0318 |
| | (0.0211) | (0.0283) | (0.0411) | (0.0281) | (0.0345) |
| $Ave[Log(AfTPOL)_{t-1}]$ | 1.165*** | -0.808** | 4.649*** | 2.078*** | -0.131 |
| | (0.396) | (0.405) | (0.877) | (0.505) | (0.461) |
| Observations | 433 | 433 | 433 | 433 | 433 |
| R-squared | 0.654 | 0.506 | 0.615 | 0.666 | 0.613 |
| F-statistic | 18.92 (0.0000) | 7.93 (0.0000) | 10.86 (0.0000) | 15.20 (0.0000) | 15.80 (0.0000) |

*Note: *p-value < 0.1; **p-value < 0.05; ***p-value < 0.01. Robust standard errors are in parenthesis. Time dummies and countries' unobservable specific time invariant effects have been included in the regressions. (a): "BP test" refers to the Breusch-Pagan test of independence. We provide here the Chi-square statistic and the related p-value in brackets.* S*mall-sample statistics have been computed and heteroscedasticity in the residuals have been accounted for in the regressions.*

| | *Effect of the one-year lag of total AfT flows on trade inclusivity for different level of productive knowledge* |
|---|---|
| BP test[a] | 141.808 (0.0000) |

*Note: *p-value < 0.1; **p-value < 0.05; ***p-value < 0.01. Robust standard errors are in parenthesis. Time dummies and countries' unobservable specific time invariant effects have been included in the regressions. (a): "BP test" refers to the Breusch-Pagan test of independence. We provide here the Chi-square statistic and the related p-value in brackets. Small-sample statistics have been computed and heteroscedasticity in the residuals have been accounted for in the regressions.*

Finally, Table 5 displays the outcomes that allow testing hypothesis 3, that is, whether the relationship between total AfT flows and trade inclusivity is mediated by trade costs. Outcomes in Table 5 are uncovered by estimating a system of hybrid models (1) (with each of the trade inclusivity indicators as dependent variable) that contain an indicator of trade costs, along with the interaction between the trade cost indicator (introduced with a one-year lag) and the indicator of total AfT flows (also introduced with a one-year lag). Our indicator of trade costs is the average of the comprehensive (overall) trade costs, 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. Data on bilateral overall trade costs are from Arvis et al. (2012, 2016) who have used the approach proposed by Novy (2013) and the definition of trade costs by Anderson and van Wincoop (2004) to compute them. The bilateral comprehensive trade costs cover 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 a 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.

Table 5
Association between total AfT flows and trade inclusivity mediated by trade costs_Over the full sample **Estimator**: SURE-approach applied to the system of hybrid models

| **Variables** | **Log(PRIM)** | **Log(LAB)** | **Log(LOW)** | **Log(MED)** | **Log(HIGH)** |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| $[Log(AfTTOT)_{t-1}]*[Log(COST)_{t-1}]$ | -0.00960 | 0.291 | -0.255 | -0.108 | 0.288 |
| | (0.143) | (0.196) | (0.418) | (0.210) | (0.211) |
| $Ave([Log(AfTTOT)_{t-1}]*Log(COST)_{t-1}]$ | 0.367 | 0.962* | 5.541*** | 4.081*** | 0.278 |
| | (0.360) | (0.583) | (0.781) | (0.427) | (0.938) |
| $COST_{t-1}$ | -6.778 | -18.27 | -114.4*** | -83.54*** | -4.370 |
| | (7.357) | (12.14) | (15.74) | (8.780) | (19.58) |
| $Ave(COST_{t-1})$ | -0.678 | -7.426** | 4.463 | 1.857 | -6.242 |
| | (2.698) | (3.723) | (8.213) | (4.004) | (4.127) |
| $Log(AfTTOT)_{t-1}$ | 0.0742 | -1.589 | 1.358 | 0.555 | -1.733 |
| | (0.811) | (1.115) | (2.381) | (1.205) | (1.207) |
| $Ave[Log(AfTTOT)_{t-1}]$ | -1.854 | -5.645* | -30.80*** | -22.98*** | -1.659 |
| | (2.027) | (3.291) | (4.372) | (2.397) | (5.303) |
| Observations | 405 | 405 | 405 | 405 | 405 |
| R-squared | 0.687 | 0.551 | 0.610 | 0.723 | 0.648 |
| F-statistic | 323.58 (0.0000) | 8.67 (0.0000) | 9.91 (0.0000) | 17.88 (0.0000) | 27.12 (0.0000) |
| BP test[a] | 124.723 (0.0000) | | | | |

*Note: *p-value < 0.1; **p-value < 0.05; ***p-value < 0.01. Robust standard errors are in parenthesis. Time dummies and countries' unobservable specific time invariant effects have been included in the regressions. (a): "BP test" refers to the Breusch-Pagan test of independence. We provide here the Chi-square statistic and the related p-value in brackets. Small-sample statistics have been computed and heteroscedasticity in the residuals have been accounted for in the regressions.*

## 5. Results' interpretation

We find from Tables 1 to 5 that there is a significant correlation between the error terms of the equations contained in the system of equations estimated to test hypotheses 1 to 3. This is exemplified by the p-values (and related statistics) of the Breusch-Pagan $\chi 2$ test of independence error terms (these p-values are close to 0, i.e., lower than the 10% level of statistical significance - see Tables 1 and 2). This shows the relevance of utilizing the "SURE" estimator in the analysis. For the interpretation of estimates in Tables 1 to 5, we consider as significant coefficients only those coefficients that are significant at least at the 5% level.

We note from columns [1] to [5] of Table 1 that in the short term, total AfT flows are associated with lower MED and HIGH, but have no significant relationship with the other trade inclusivity indicators. Total AfT flows have the largest positive association with LOW, followed by MED and LAB. In contrast, in the long-term, total AfT flows are positively related to PRIM, LOW and MED, but negatively associated with LAB. There is no significant correlation between total AfT flows and HIGH in the short-term. The overall long-run association (sum of short and long-term associations) between total AfT flows and trade inclusivity indicators is negative for LAB and HIGH, but positive for the three other trade inclusivity indicators. Results in columns [6] to [10] concerning the long-term association between total AfT flows (two-year lag) and trade inclusivity confirm those in columns [1] to [5], although with different magnitudes of the estimates. However, short-term correlations between the two-year lag of total AfT flows and trade inclusivity are not significant, and are therefore slightly different from those observed in columns [1] to [5]. In economic terms, we find that in the long-term, an increase in total AfT flows by 1 percentage is associated with an increase in the indices PRIM, LOW, and MED respectively by 0.20 percentage, 0.78 percentage and 0.33 percentage. Likewise, a 1 percentage increase in total AfT flows is associated with a decrease in LAB by 0.23 percentage, the same magnitude as the increase in PRIM.

We deduce that in the long-term, total AfT flows are positively associated with the inclusivity in terms of primary goods exports, and more importantly the inclusivity in terms of low-skill and medium-skill and technology-intensive manufacturing exports. Total AfT flows have their largest positive association with LOW, followed by MED and PRIM in the long-term. However, in the short-term, these resource flows undermine the inclusivity in terms of medium and high skill and technology-intensive manufacturing exports, but have no significant correlation with the other trade inclusivity indicators.

Regarding outcomes in Table 2, we observe that the use of either a one-year lag of the components of total AfT flows or a two-year lag of each of these components to examine their relationship with trade inclusivity yields similar findings, although with different estimates (see columns [1] to [5] versus columns [6] to [10]). We notice across the columns of Table 2 that, in the short-term, there is almost no significant association between each of the three components of total AfT and trade inclusivity, except for the negative correlation between AfT flows for economic infrastructure and LOW (see column [3]), and for the negative association between AfT flows for productive capacities (see column [9] of the analysis based on the two-year lag of the AfT indicator) and AfT flows related to trade policy and regulation and MED (see column [4] of the analysis based on the one-year lag of the AfT indicator). In the long-term, AfT components have no significant relationship with HIGH, but show a negative correlation with LAB, but a positive and significant effect on PRIM, LOW, and MED. These findings are similar to the ones observed in Table 1, although with different estimates. In line with the findings in Table 1, we observe here as well that the largest positive association between AfT component and trade inclusivity appears to be with LOW, followed by MED and PRIM. These suggest that AfT interventions tend to be positively related to African countries' inclusivity in terms of low-skill and technology intensive manufactured exports, but negatively with the inclusivity in terms of labour and resource intensive manufactured goods. In the meantime, AfT interventions also enhance the inclusivity in terms of medium-skill and technology intensive manufactured exports, and in terms of primary goods exports, but to a greater extent for the former than for the latter. Overall, the findings in Tables 1 and 2 confirm hypothesis 1.

When it comes to LDCs, we find from Table 3 that total AfT flows are negatively associated with LOW in the short-term, but not significantly with the other trade inclusivity indicators. In the long-term, AfT interventions are not significantly related to LAB, but are positively associated with the other trade inclusivity indicators, with the magnitude of this positive correlation being the largest for LOW, followed by MED, PRIM and HIGH. In terms of the magnitude of the correlation between AfT flows and LOW, we observe that a 1 percentage increase in total AfT flows is associated with an increase in the index LOW by 1.2 percentage. Concurrently, total AfT flows are positively and significantly linked with all trade inclusivity indicators, with the exception of a negative correlation between these resource flows and HIGH. The positive association between total AfT flows and trade inclusivity indicators appears to be the largest with LOW and MED, followed by PRIM and LAB. LOW and LAB are notably manufactured export products in which many developing countries have comparative advantages.

*Thus, AfT flows are positively related to HIGH in LDCs, but negatively to HIGH in NonLDCs. In the meantime, AfT interventions exert no significant effect on LAB in LDCs, but promote LAB in NonLDCs. In both LDCs and NonLDCs, total AfT flows enhance LOW, MED and PRIM, and these positive associations are larger for NonLDCs than for LDCs, thereby reflecting the higher trade capacity of NonLDCs than LDCs. Focusing for example on the effect on LOW in NonLDCs, we find that a 1 percentage increase in total AfT flows is associated with an increase in the index LOW by 1.494 percentage.*

We now turn to estimates reported in Table 4. We observe that for both total AfT, AfT for economic infrastructure, and AfT for productive capacities, the coefficients of the multiplicative variable "Ave($[\text{Log}(\text{AfT})_{t-1}]$*$\text{ECI}_{t-1}$)" are positive and significant in columns [2] to [4], but are not statistically significant in columns [1] and [5]. We, therefore, conclude that total AfT flows (especially AfT interventions for the build-up of economic infrastructure, and AfT flows for productive capacities) are positively and significantly associated with LAB, LOW and MED, as countries improve their productive knowledge. The magnitude of these positive link is the largest on LOW, followed by MED, and finally LAB. In the meantime, there are no significant associations between total AfT flows (including these two types of components), HIGH and PRIM, as countries improve their productive knowledge. On the other hand, we observe that AfT flows related to trade policy and regulation foster LAB, but reduce LOW and PRIM (to a larger extent LOW than PRIM), as countries improve their productive knowledge. However, the relationship between this type of AfT intervention and the other trade inclusivity indicators does not depend on the level of productive knowledge.

*Overall, the findings indicate that, on the one hand, over the long-term, as countries improve their productive knowledge, total AfT flows (especially AfT for economic infrastructure, and AfT for productive capacities) tend to be positively associated with LAB, LOW and MED*, with the magnitudes of this positive association being larger on LOW than on MED, and LAB. On the other hand, as countries improve their productive knowledge, AfT flows related to trade policy and regulation are positively related to LAB, but negatively to LOW and PRIM.

In the short-term, the correlation between total AfT flows, as well as AfT for economic infrastructure on all trade inclusivity indicators (except HIGH) does not depend on the level of productive knowledge. However, as countries improve productive knowledge, total AfT flows and AfT for economic infrastructure reduce HIGH. The same reasoning applies to the short-term association between AfT flows productive capacities ad all trade inclusivity indicators, with the

exception of LOW with which the correlation is negative. Finally, the relationship between AfT related to trade policy and regulation and trade inclusivity indicators does not depend on the level of productive capabilities in the short-term.

Finally, we consider the outcomes reported in Table 5 that help test hypothesis 3. We observe that in the long-term, the coefficients of the multiplicative variable "[Log(AfTTOT)$_{t-1}$]*[Log(COST)$_{t-1}$]" are not statistically significant (not even at the 10% level) across all columns of the Table. These outcomes, therefore, suggest that in the short term, the relationship between total AfT flows and trade inclusivity is not mediated by countries' level of trade costs. At the same time, the coefficients of the multiplicative variable "Ave[Log(AfTTOT)$_{t-1}$]*Log(COST)$_{t-1}$]" are positive and significant at least at the 5% level in columns [3] and [4] (i.e., on LOW and MED), but not in the other columns. Interestingly, total AfT flows have their largest association (see coefficients in columns [3] and [4] of Table 5) with LOW, followed by MED. These outcomes indicate that trade costs act as a mediator in the long-term relationship between total AfT flows and LOW, as well as between total AfT flows and MED. In other words, higher total AfT flows (by helping reducing trade costs) are positively related to inclusivity in terms of low-skill/and medium-skill and technology-intensive manufactured export products in countries that face higher trade costs, with the magnitude of this positive association being larger on inclusivity in terms of low-skill and technology-intensive manufactured export products than on inclusivity in terms of medium-skill and technology-intensive manufactured export products. Finally, there is no significant association between total AfT flows and PRIM, LAB and HIGH, as trade costs increase (see columns [1], [2] and [5] of Table 5).

## 6. Conclusion

The present analysis considers, for the first time, the issue of trade inclusivity from the perspective of countries' catch-up with developed countries in terms of manufactured exports. The analysis focuses on 32 African countries (of which 17 LDCs) over the period from 2003 to 2021. The analysis has considered inclusivity in terms of manufactured exports for different degrees of manufactures, including primary goods (PRIM); labor-intensive and resource-intensive manufactured exports (LAB); low-skill and technology-intensive manufactured exports (LOW); medium-skill and technology-intensive manufactured exports (MED); and high-skill and technology-intensive manufactured exports (HIGH). Empirical results have shown an association between AfT indicators and trade inclusivity indicators, and not causal effects of AfT flows on inclusive trade. They suggest that over the full sample, total AfT flows are positively associated with LOW, MED, and PRIM, with their largest degree of association being on LOW, followed by MED and PRIM in the long-term. Similar findings, albeit with different magnitudes, are obtained for each component of total AfT, including AfT for economic infrastructure, AfT for productive capacities, and AfT related to trade policy and regulation. However, the long-term association between total AfT and trade inclusivity are slightly different in LDCs and NonLDCs among African countries. We observe that total AfT flows enhance HIGH in LDCs, but reduce it for NonLDCs. In the meantime, in the long-term, these resource inflows are not significantly related to LAB in LDCs, but are positively and significantly associated with it in NonLDCs. Finally, in both LDCs and NonLDCs, total AfT flows are positively related to LOW, MED and PRIM in the long-term, and these positive correlations are larger for NonLDCs than for LDCs, thereby reflecting the higher trade capacity of NonLDCs than LDCs.

The analysis has also revealed that the relationship between AfT interventions and trade inclusivity in African countries depends on countries' level of productive knowledge. We observe that as countries improve their productive knowledge in the long-term, total AfT flows (especially AfT for economic infrastructure, and AfT for productive capacities) tend to enhance LAB, LOW and MED, with the magnitudes of the effect being larger on LOW than on MED, and LAB. On the other hand, AfT flows related to trade policy and regulation foster LAB, but reduce LOW and PRIM as countries improve their productive knowledge.

Finally, we obtain that trade costs mediate the effect of total AfT flows on trade inclusivity, especially when the latter is measured by LOW and MED. In particular, higher total AfT flows foster LOW and MED (the effect being larger on LOW than on MED) in countries that face higher trade costs. It, therefore, appears that AfT interventions have their largest association with African countries' inclusivity, especially in terms of low-skill medium-skill and technology manufactured goods exports, which are manufactured export products in which many African countries have comparative advantages.

These findings add to the literature on the trade effect of AfT interventions by showing that AfT interventions are positively associated with countries' inclusivity in terms of low-skill/and medium-skill and technology-intensive manufactured export products in African countries, especially when those countries improve their productive knowledge, and experience higher trade costs.

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## Footnotes

1. The concepts of “inclusive development”, “inclusivity” or “inclusiveness” are used interchangeably in this paper.
2. Infrastructure is considered here in a large sense (Portugal-Perez and Wilson, 2012), and includes both hard infrastructure (such as highways, railroads, ports) and soft infrastructure (e.g., transparency, customs efficiency, institutional reforms that reduce the burdensome time-consuming border procedures).
3. See the literature survey provided by Benziane et al. (2022) as well as Cadot et al. (2014) and OECD/WTO (2013).
4. The list of “old-industrialized countries” used to compute the indicators of trade inclusivity includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States.
5. The database is available online at: https://unctadstat.unctad.org/datacentre/?lang=en
6. Data on the United States’ Consumer Price Index were collected from United States BLS Beta Labs accessible online at: https://beta.bls.gov/dataQuery/find?fq=survey:[cu]&s=popularity:D
7. The index of institutional quality is calculating by extracting the first principal component (based on factor analysis) of six indicators of governance, which are political stability and absence of violence/terrorism; regulatory quality; rule of law; government effectiveness; voice and accountability, and corruption (see Kaufmann and Kraay, 2023).
8. See for example, Albeaik et al. (2017a,b); Hausmann and Hidalgo (2009); Hausmann et al. (2014); Hidalgo et al. (2007); and Hidalgo (2021).
9. The data is available online at: https://hdr.undp.org/data-center/documentation-and-downloads
10. The indicator of economic complexity indicates the degree of diversity and ubiquity of the country’s export structure. It has been estimated using data connecting countries to the products they export, applying the methodology as described in Hausmann and Hidalgo (2009). Higher values of this index reflect greater economic complexity. The database is accessible online at: https://oec.world/en/rankings/eci/hs6/hs96
11. The dataset can be found online at: http://bruegel.org/publications/datasets/real-effective-exchange-rates-for-178-countries-a-new-database/
12. This database is accessible online at: https://info.worldbank.org/governance/wgi/
13. The system of (the same) hybrid form of Eq. (1) contains, therefore, five equations where the dependent variables are respectively the five indicators of trade inclusivity defined above, namely INCLAB, INCLOW, INCMED, INCHIGH and INCPRIM.

## Figures

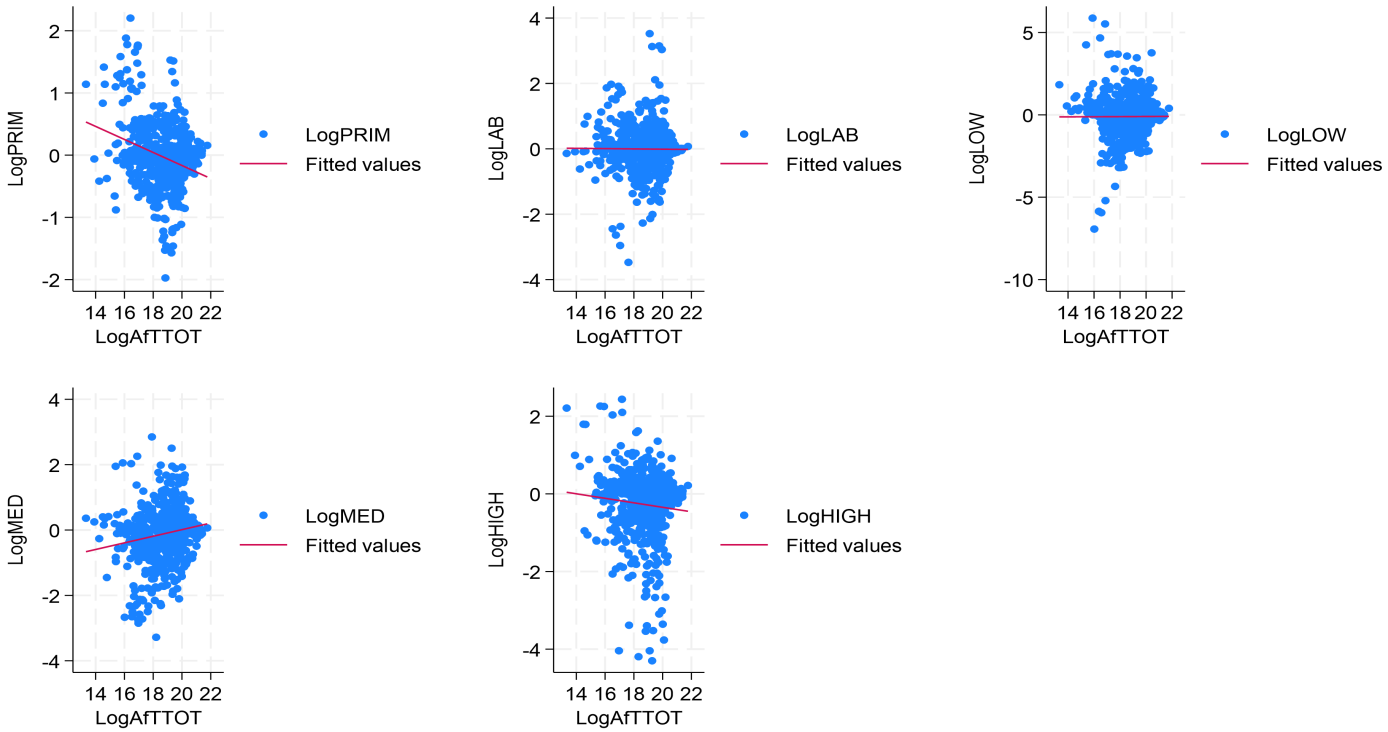



**Figure 1**

Cross Plot between AfT flows and indicators of trade inclusivity_Over the full sample

*Source: Author*

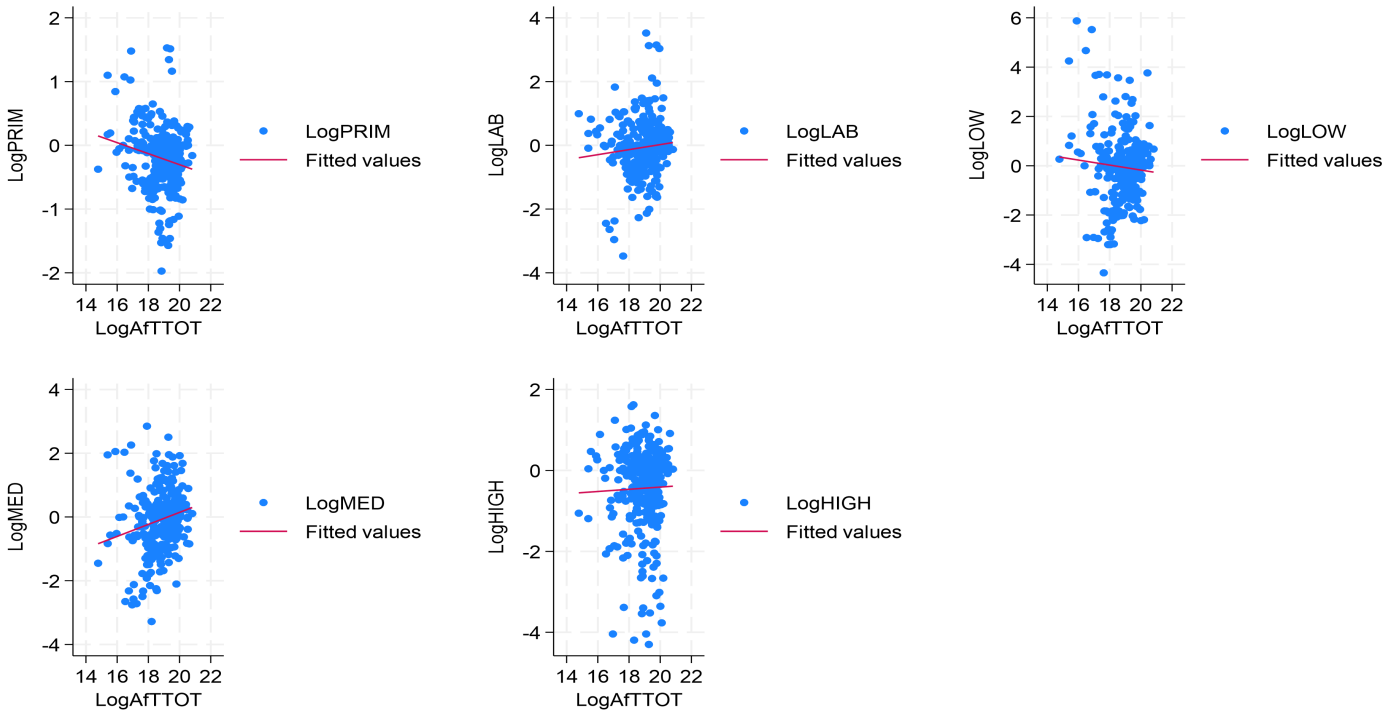



**Figure 2**

Cross Plot between AfT flows and indicators of trade inclusivity_Over sub-sample of LDCs

*Source: Author*

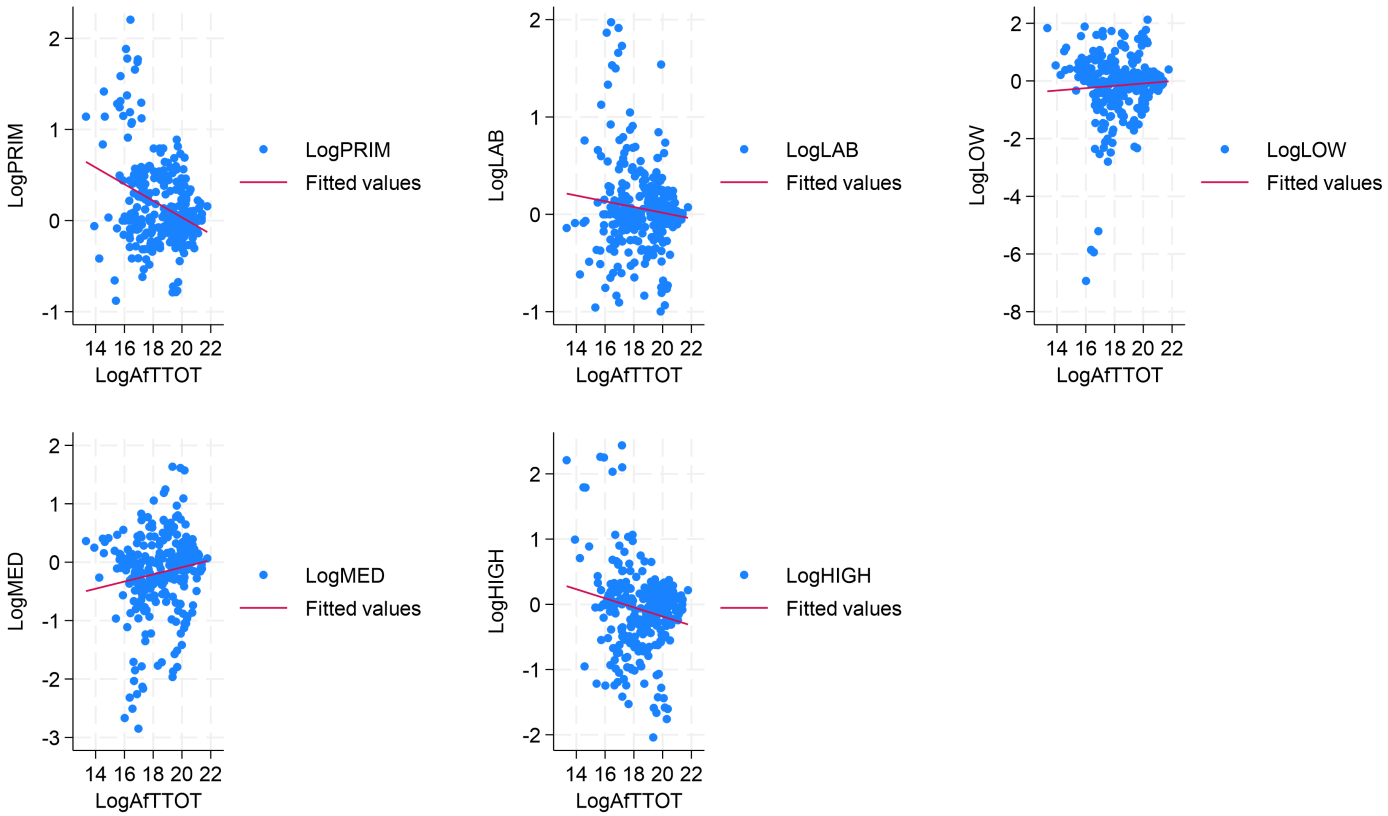



**Figure 3**

Cross Plot between AfT flows and indicators of trade inclusivity_Over sub-sample of NonLDCs

*Source: Author*

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Appendixs.docx