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Does regional integration enhance value chains on the African continent?

Honours Long Paper

Abbreviations

AfCFTA – African Continental Free Trade Area

AU – African Union

COMESA – Common Market for Eastern and Southern Africa

EAC East African Community

EU – European Union

GVC – Global Value Chain

LDC – Least Developed Country

LLDC – Land Locked Developing Country

LPI – Logistics Performance Index

OLS – Ordinary Least Squares

PPML – Poisson Pseudo-Maximum Likelihood

PTA – Preferential Trade Agreement

REC – Regional Economic Community

RVC – Regional Value Chain

SA – South Africa

SSA – Sub Saharan Africa

SADC – Southern African Development Community

TFTA – Tri-Partite Free Trade Agreement

TPP – Trans-Pacific Partnership

TTIP – Trans-Atlantic Trade and Investment Partnership

SIDC – Small Island Developing Country

UK– United Kingdom

USA – United States of America's

WB WDI – World Bank World Development Index

WTO – World Trade Organization

Abstract

Regional integration is currently a topical issue, especially on the African continent. The emergence of large scale trade agreements in Sub-Saharan Africa such as the Tri-partite Free Trade Area and the African Continental Free Trade Area occurs at a time when other developed nations such as the United States of America and the United Kingdom are turning away from regional integration. This raises the important question: do regional trade agreements benefit or harm its members? More specifically, this paper investigates whether integration helps countries to integrate into the global production chains characteristic of the twenty-first century.

Utilizing a gravity model of trade, this paper finds a small but positive effect of regional integration on value chain participation. Notably this effect is larger for exporters in Sub-Saharan Africa. This suggests that regional integration is a legitimate strategy for African states to pursue, especially given the geographic and economic limitations faced by any individual African state. Further textual analysis is recommended to sufficiently differentiate between heterogenous trade agreements.

Key-words: deep trade agreements, regional integration, global value chains, gravity model

Introduction

Regional trading blocs are now common the world over. All World Trade Organisation (WTO) members are party to at least one preferential trade agreement (PTA), and some are members of two or more. Especially in the last thirty years, the number of regional agreements in force and notified to the WTO has rapidly increased. In 1990 there were 50 agreements in force, and this increased to 279 agreements by 2015 (Ruta, 2017).

Beyond capturing the interests of economists and political scientists, regional integration has actively guided policy decisions. At a national level, South African trade policy sees regional integration as a means of achieving structural transformation – this idea is known as 'developmental regionalism' (Ismail, 2018). At a continental level, the African Union (AU) describes the various Regional Economic Communities (RECs) on the continent as the building blocks of the AU's project. Notably, the AU's logo includes several interlocking rings, which represent the continent's RECs.

Recently, Africa has taken greater strides towards regional integration. In 2015, three pre-existing PTAs on the continent entered into negotiations to form one large Tri-Partite Free Trade Area (TFTA). Subsequently, in May 2019, the African Continental Free Trade Area (AfCFTA) entered into force after the requisite 22 countries ratified the agreement (Trade Law Centre, 2019). Since then, other countries have ratified the agreement as well. In fact, of the 55 African countries only Eritrea has yet to sign the AfCFTA (Trade Law Centre, 2019). Trading under the AfCFTA will commence in July 2020. Those against the continental PTA are concerned about how small African countries will be affected, whilst those in favour of it believe that it can help reduce Africa's dependence on the global North and celebrate the Pan-African sentiment expressed by the AfCFTA. But until countries begin trading under the agreement, this debate is hypothetical. One specific appeal of the AfCFTA is that it simplifies the complicated network of existing regional agreements on the continent (see Appendix C). The variety of different procedures and standards embodied in these agreements impose addition costs to trade (Ismail, 2018).

However, despite the last twenty-five years of rapid regional integration, some nations are re-evaluating the economic importance of regional agreements. Notably, the United Kingdom's (UK) decision via referendum to leave the European Union (EU) and the United States of America's (USA) reluctance to pursue regional 'mega-deals' are indications of this (Baier, Yotov and Zylkin, 2018). Namely, the USA outright withdrew from the Trans-Pacific Partnership (TPP) and has stalled Trans-Atlantic Trade and Investment Partnership (TTIP) negotiations.

Given the mixed views of regional integration and with an eye on the AfCFTA, this research conducts an *ex post* study of the pre-existing regional arrangements. In particular, the focus is on the effect that regional agreements have on trade in the Sub Saharan Africa (SSA) region. After

considering the effect of PTAs globally, impact of PTAs on the African continent will receive more focused attention. Based on results from the empirical model, it can be concluded that PTAs have a small but positive effect on trade between member-states. This effect is slightly larger for SSA exporters.

Literature on regional integration and value chains

Part 1: Preferential Trade Agreements

Broadly this paper investigates the effect of PTAs on international trade, both between member-states and between members and non-members. This is not a new endeavour. Theories of regional integration emerged as early as the 1950s. In particular, Viner (1950) argued that regional integration lead to a trade-off between *trade creation* and *trade diversion.* On the one hand, integration may lead to trade creation when low-cost trade with member-states displaces high-cost domestic production. On the other hand, regional integration may lead to trade diversion when low-cost trade with non-member countries is replaced with higher-cost trade within the PTA bloc (Ghosh and Yamarik, 2004). This suggests that a PTA does not necessarily guarantee welfare enhancements for member-states. Rather, depending on the magnitudes of the trade creation and diversion effects of that PTA, integration may not benefit member-states. If a PTA diverts more trade than it creates, then that PTA is not welfare enhancing. Thus, subsequent enquiry has attempted to empirically measure these trade creation and diversion effects identified in the theory.

The gravity model is an essential tool used in such empirical enquiries. An analogy exists between it and Newton's law of universal gravitation, which states that the gravitational force between two bodies positively depends on the masses of the bodies and negatively depends on the distance between the two bodies. In its original form, outlined by Tinbergen (1962) the gravity model similarly suggests that bilateral trade flows between countries *i* and *j* are a function of the relative sizes of the two economies as well as the distance between them. It has been subsequently improved to control for characteristics such as a common borders, currencies and languages. In an African context, the existence of colonial ties is also relevant (Head, Mayer and Ries, 2010).

In particular, Anderson (1979) and Anderson and van Wincoop (2003) augment the gravity model by including a multilateral resistance term, which measures trade resistance faced by country *i* with *all* its trade partners and by country *j* and its trade partners. The presence of a multilateral resistance term is important because the decision for a firm in *i* to export to *j* is not only affected by the characteristics of *i* and *j*, but also by the relationship between *i* and all its trade partners (and *j* and

their trade partners). This may be particularly true in a context where production is fragmented across state borders into value-chains.

To put the point differently, trade between countries *i* and *j* can reasonably be affected by the characteristics or actions of some third-party state (Adam and Cobham, 2007). For example, the United Kingdom's decision to strengthen trade relations with South Africa is not determined only by the characteristics of the UK and SA (South Africa). Rather, in the face of an impending 'hard' Brexit, the UK is expecting its trade relations with a third party, the EU, to deteriorate in the near future and is looking to double-down on existing trade relations.

Usually, the effect of a PTA on trade is incorporated into the gravity model as a binary variable equal to one if trade occurs under an existing PTA. Generally, the literature has found mixed positive results for the effect of PTAs. Silva and Tenreyero (2006) conclude that PTAs had a small positive effect on trade. Foster *et al* (2010) also identify a positive effect of PTAs on gross exports. Similarly, Baier, Yotov and Zylkin (2018) find that PTAs have a positive effect on trade, however they also find that this positive effect is heterogenous, both between PTAs and for country-pairs within PTAs.

Enquiry into the effects of PTAs in Africa have yielded similarly mixed results. Carrère (2004) concludes that regional agreements in Africa have succeeded in enhancing intra-regional trade, however the author finds that African currency unions are trade creating, whereas free trade agreements on the continent are trade diverting. By contrast, Yang and Gupta (2005) find that African PTAs have had a small or insignificant effect on intra-African trade. More recently, Riedel and Slany (2019) evaluated the Tripartite Free Trade Area (TFTA): a trading bloc consisting of the Common Market for Eastern and Southern Africa (COMESA), the East African Community (EAC) and the Southern African Development Community (SADC). The authors findings suggest that the effects of African PTAs are heterogenous. Whilst the EAC had a significant positive effect on trade, the effects of COMESA and SADC are small or negligible.

However, two concerns are apparent when conducting *ex post* empirical analysis of PTA effects. Firstly, trade policy, including the decision to enter into a PTA, is not determined exogenously. Rather, countries likely select endogenously into PTAs for unobserved reasons. For example, countries with historical strategic and political alliances may be more likely to enter into PTAs. Baier and Bergstrand (2007) discuss the issue of endogeneity and propose using panel data as one solution. Once self-selection is controlled for, the PTA effect increases significantly. In other words, cross-sectional analysis under-estimates the PTA effect. More recently, the WTO (2011) has reaffirmed the importance of PTAs in boosting trade.

Secondly, the use of a PTA dummy variable assumes that various PTAs affect trade in similar ways. This approach understands PTAs as conceptually 'flat'. More recent research acknowledges the heterogeneity of PTAs by distinguishing relative 'depths' of agreements.

One approach is to consider the extent of tariff liberalization made in PTAs. From this perspective, a deeper agreement is one with greater tariff concessions. However, since the 1990s, the scope of regional agreements has grown. Whereas the first regional agreements were mainly concerned with tariff elimination, contemporary regional agreements cover a much wider range of issues such as investment, intellectual property, competition and dispute settlement (Ruta, 2017). Sometimes these provisions are legally enforceable. In this way, modern regional agreements are extremely diverse or heterogenous, and considering tariff liberalization only does not accurately capture the differences between PTAs. Baier, Yotov and Zylkin (2018) suggest that the large PTA estimates from previous research cannot be wholly due to tariff-elimination, implying modern PTAs go far beyond simple tariff reductions.

From a different angle, Vicard (2010) breaks PTAs into four sub-categories of increasing depth: Preferential Arrangements, Free Trade Agreements, Customs Unions and Common Markets. This categorization closely follows David Viner's linear approach to integration in the 1950s. Viner theorized that countries who desire to integrate should follow a linear path of tariff liberalization starting with a free trade area, then a customs union, then a common market and finally an economic union (Ismail, 2018). In his econometric study, Vicard (2010) does find a generally positive PTA effect on trade. However, by sub-category these effects are statistically similar: the institutional design of regional agreements does not determine its ability to create trade among members.

Subsequent inquiry focused on a textual analysis of trade agreements. In particular Hofmann, Osnago and Ruta (2017) consider the presence of various provisions in trade agreements. They construct a database of 279 PTAs, containing information on the inclusion of 52 policy areas and whether these provisions are legally enforceable or not. Their methodology is based on research by Horn, Mavoridis and Sapir (2010), and is used by the WTO (2011). One can distinguish between provisions in various ways. Some provisions fall under the existing mandate of the WTO, such as tariff schedules, customs regulation and export taxes. These are referred to as 'WTO plus or WTO+' provisions, whereas issues falling outside the current WTO mandate are referred to as 'WTO extra or WTO-X' provisions, which include competition policy, environmental co-operation and so on. Hofmann, Osnago and Ruta (2017) also distinguish between core and non-core provisions. Core provisions are those identified as most meaningful economically. This includes all WTO+ provisions and four WTO-X provisions. See Appendix B for a full list of the provisions, sorted by WTO+/WTO-X and core/non-core.

Using this database, the above authors construct a measure of depth equal to the total number of provisions included in a regional agreement. One appeal of this depth approach is that it is consistent with the growing trend of 'deeper' regional agreements covering a wider range of issues. In particular Hofmann, Osnago and Ruta (2018) make use of their dataset identify this trend of

deepening agreements over time. Another appeal is that this approach provides a way of differentiating between different PTAs. This paper makes use of this depth dataset and combines it with recent value-added measures of trade flows, discussed below.

Part 2: Global value chains

Central to the above empirical investigations is how trade flows between countries *i* and *j* are measured. A broad distinction can be made between gross trade and value-added trade measurements. Gross trade data measures the value of goods as they cross borders and have historically been used in macroeconomic enquiry. This is appropriate in a context where entire production processes take place within national boundaries, such that a single nation is responsible for 100 percent of the value imbued in their exports. An early example of this is the nascent British textile and cloth industry of the eighteenth century.

In recent decades, domestic supply chains have transformed into global supply chains as cross-border trade between firms increases. Massive improvements in transportation and communication have enabled this process to take place, and the notion of global value chains (GVCs) is now commonplace in twenty-first century economic inquiry. As a concrete example, Morris and Fessehaie (2014) consider the chocolate industry: cocoa beans are grown in North-West African states such as Ghana and Côte d'Ivoire. These nations export raw cocoa beans to countries like Malaysia, Brazil and Mexico, who process beans into paste, cocoa butter and eventually chocolate.

In this brave new world of GVCs, gross trade measures can be misleading. Johnson (2014) discusses the risk of double counting when measuring trade in gross terms when GVCs are present. Double counting occurs because gross measures count the total value of a country's exports, even if that country is not wholly responsible for all the value-add embedded in its exports. In fact, this double counting problem has become more severe over time. Johnson (2014) calculates that world value-added exports was equal to 85 percent of world gross exports in the 1970s, whereas world value-added exports are worth only 70 percent of world gross exports today. As GVCs increase in importance, so does the severity of the double counting problem. Therefore, it is important that future research is done in value-added terms.

A related concept is Regional Value Chains (RVCs), which describe cross-border supply chains within a specific region. Ismail (2018) argues that insertion into RVCs can act as a stepping-stone to GVC participation. Regional integration creates regional markets which in turn lead to increasingly efficient resource use as states and firms enjoy greater economies of scale in this larger, integrated market. This facilitates economic development whilst still protecting firms from overseas industry. Over time, it is hoped that the twin benefits of scale and regional protection result in export

intensification and diversification which may increase international competitiveness of African goods, especially manufactures. In this way, regional markets are a means of bypassing the disadvantages of global markets.

Particularly on the African continent, robust regional value chains can enhance African firms' global competitiveness. Today, African economies are unfavourably integrated into the world economy: we export mainly raw materials whilst importing manufactured goods (Scholvin, 2018). Nascent industries in Africa cannot currently compete in global trade with pre-established industries from upper-income nations. This is partly due to the generally small economies and unfavourable geographic contexts of many African nations. Of the 55 African states, 34 are Least Developed Countries (LDCs). In addition to differing levels of development, many of these LDCs exist in geographically different contexts: 16 states are Land Locked Developing Countries (LLDCs) and 6 are Small Island Developing Countries (SIDCs) (Ismail, 2018).

Given these difficulties, one aim of this paper is to evaluate the extent to which African PTAs have succeeded in establishing regional markets. As discussed above, previous research is limited in two ways. Firstly, where trade is measured in gross terms, the issue of double counting may distort empirical results. Further, the use of a PTA binary variable is inappropriate, given the heterogeneity of PTAs. Therefore, in the empirical model discussed below, PTA depth is measured by the total number of provisions included, and bilateral trade is measured in value-added terms. These novel methodologies are then used to evaluate the effects of PTAs on the African continent. This is in line with research done by Laget *et al* (2018) who combine PTA depth data with value-added trade data. Notably, Laget *et al* (2018) confirm previous positive effects of PTA on bilateral trade: each additional provision included in a PTA is associated with an increase in value-added trade.

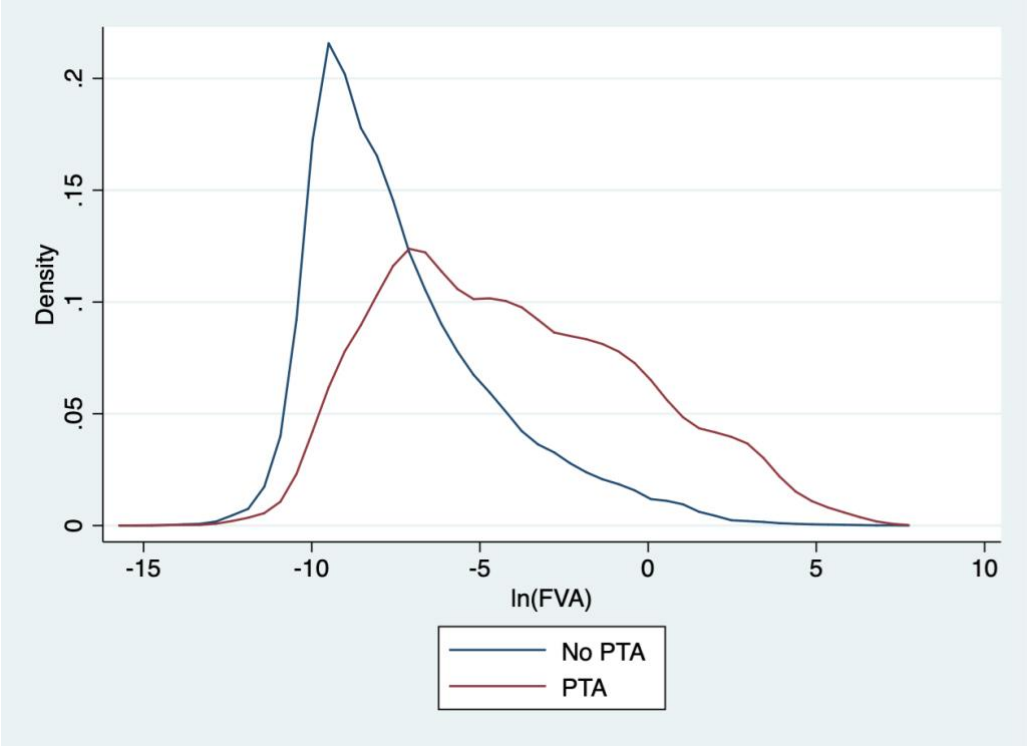
Data and model description

This research combines data from a wide range of sources. Data on value-added is obtained from the United Nations Conference on Trade and Development (UNCTAD) Eora Multi-Region Input-Output database. Value added is measured at the national level, and is not decomposed by sector. This database is used for GVC analysis in the World Investment Report (UNCTAD, 2018). Values are measured is current US dollars (USD).

Within the new framework of value-added trade data, many different statistics may be calculated. This paper focuses on one measure: foreign value added. More specifically, it considers the value added by country *i* contained in the exports of country *j*. This can be understood as a form of backward integration, whereby firms from country *j* incorporate intermediate goods from country *i* in their production process.

Following previous studies, the effect of PTAs is measured by a binary variable. Figure 1 below graphs the distribution of ln(FVA) for trade occurring between two countries in the presence or absence of a PTA. The distribution of FVA shifts to the right when trade occurs under a PTA. At first glance, this suggests that PTAs enhance backward linkages of country *j* with country *i.*

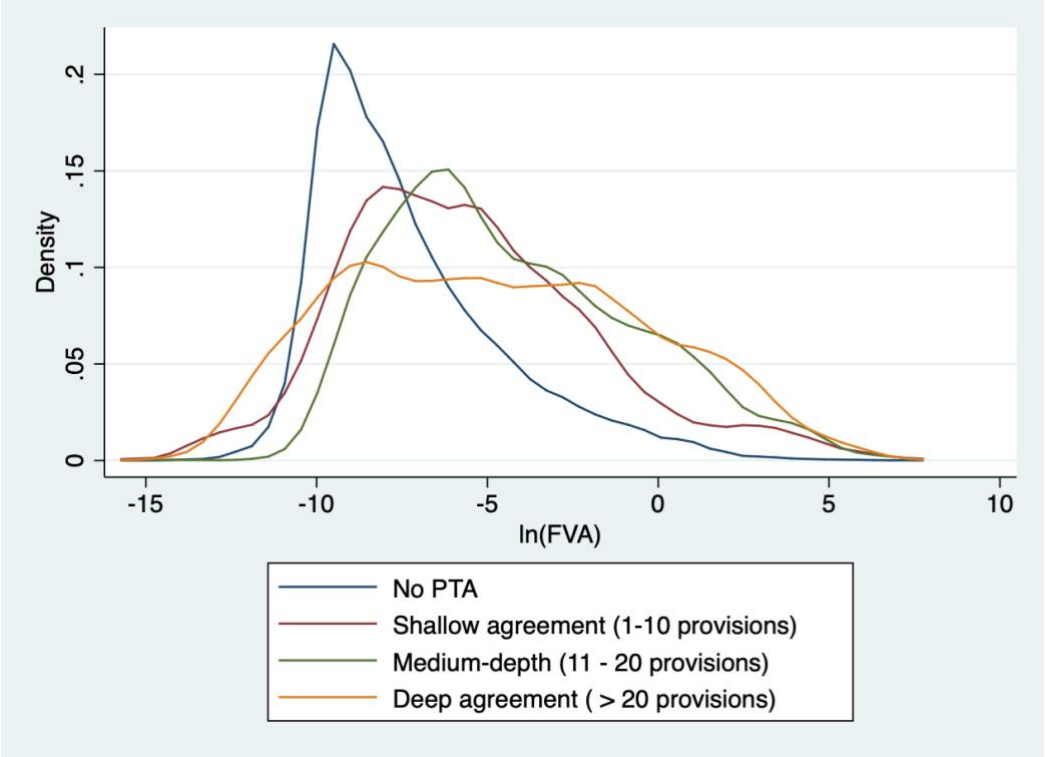
Figure 1: Distribution of FVA by PTA



Sources: UNCTAD Eora data base and WB Content of Deep Trade Agreements database

Beyond a PTA dummy, one further step is taken by estimating the PTA effect using a new measure of depth pioneered by Horn, Mavoridis and Sapir (2010). Using their methodology, Hofmann, Osnago and Ruta (2017) construct a database including 279 regional agreements entered into force between 1958 and 2015. For each PTA, the presence or absence of the 52 provisions (listed in Appendix B) are recorded based on textual analysis of the agreement itself. For a full description of each provision, see Hofmann, Osnago and Ruta (2017). Figure 2 graphs the distribution of ln(FVA) for varying PTA depths, as measured by the total number of provisions included in the PTA. This figure motivates the use of PTA depth for further empirical analysis. Not only does the presence of a PTA enhance backwards linkages (Figure 1), but this effect is more prominent for deeper agreements. In Figure 2, as the depth of the agreement increases, the distribution of FVA shifts to the right.

Figure 2: Distribution of FVA by total depth of PTA



Sources: UNCTAD Eora data base and WB Content of Deep Trade Agreements database

Hofmann, Osnago and Ruta (2017) distinguish between total depth and core depth. Whereas total depth is simply a count of provisions included in an agreement, core depth is a count of core, economically significant provisions included. In this paper, PTA depth is measured by summing the total number core of provisions for each RTA. There are 18 core economic provisions: all 14 WTO+ provisions, as well as competition policy, movement of capital, investment measures and intellectual property rights. The decision to measure core depth is supported by Laget *et al* (2018), who find that the effect of one additional core provision is larger than the effect of one additional (non-core) provision. It makes sense that a chapter on competition policy will more directly affect trade compared to provisions covering other issues such as environmental policy or cultural cooperation. Core depth is thus a discrete variable between 0 and 18.

Time-varying country characteristics such as GDP, GDP per capita and population are drawn from the World Bank World Development Index (WB WDI). GDP and GDP per capita are also measured in current USD. In addition, business costs are drawn from the WDI. The cost of doing business is measured by the number of days required to start a business, the number of procedures required to start a business and a general measurement of the cost of starting a business. These control variables are important as they affect a country's export ability.

In addition, measures of logistics capacity are included from the WB WDI. This is measured by the Logistics Performance Index (LPI), which is an index of trade facilitation. The LPI is a weighted average of six sub-components, which include measures of 'soft' infrastructure such as customs procedure efficiency and digital technology usage, as well as 'hard' infrastructure such as roads, railways and ports. Since 2007, the WB has published LPI scores every two years. Host, Skender and Zaninovic (2019) include the LPI in an empirical gravity model, and find that logistic performance and trade are positively correlated: countries with seamless customs processing, substantial transport infrastructure and generally competent logistics services tend to engage in higher levels of trade. Logistics are particularly important in the context of GVCs, as intermediate goods cross borders multiple times in the production process. In the absence of a derived multilateral resistance term, these monadic control variables serve as a proxy for multilateral resistance, since they are measures of a country's capacity to trade with *all* of its trading partners.

Finally, various dyadic control variables for each trading country pair are included in the below model. This includes physical factors such as contiguity and distance, as well as socio-cultural factors such as common languages and religions. These are drawn from the CEPII GeoDist database. There is a trend in the literature to control for these dyadic factors, and various studies have found that they are significant determinants of trade between two countries (Silva and Tenreyero, 2006; Baier and Bergstrand, 2007; Vicard, 2010; Baier, Yotov and Zylkin, 2018). Common colonial ties are also included. Particularly in an African context, the existence of historical colonial ties between two nations is an important determinant of trade (Head, Mayer and Ries, 2010). Appendix A contains a full description of the variables included and their sources.

Using the above variables, PTA performance is evaluated using a gravity model of trade, which models bilateral trade flows between countries *i* and *j* for all *i* and *j* such that $i \neq j$. In total, 188 countries are included in the sample. The specification is as follows:

$$FVA_{ijt} = exp(\beta_1 GDP_{it} + \beta_2 GDP_{jt} + \beta_3 distance_{ij} + \beta_4 PTA_{ijt} + \delta_{ij} + \delta_{ijt} + \delta_{it} + \delta_{jt}) + \varepsilon_{ijt}$$

where FVA_{ijt} is the value added in exports by *j* originating in country *i*. As discussed, this is a measure of backward GVC linkage. The original gravity model includes GDP of countries *i* and *j* as well as the distance between *i* and *j* as dependent variables. In addition, this specification includes various dyadic and monadic control variables discussed above. PTA_{ijt} is the main independent variable of interest, and is measured either as a dummy variable or by total depth. δ_{ij} and δ_{ijt} are dyadic time-invariant and time varying controls respectively. δ_{it} and δ_{jt} are monadic, time-varying controls for countries *i* and *j*. This is done for a sample of the whole world and for a sub-sample of SSA countries only. When a pair of countries belongs to more than one PTA, only the most recent PTA is considered.

This paper estimates the above model using Poisson Pseudo-Maximum Likelihood (PPML). Traditionally, gravity models are estimated using Ordinary Least Squares (OLS) (Anderson, 1979; Anderson and van Wincoop, 2003; Baier and Bergstrand, 2007). When using OLS the above specification is log-linearized so that the parameters are interpreted as elasticities. However, Silva and Tenreyero (2006) identify two issues with OLS in the context of gravity models. Firstly, heteroskedasticity is a concern in trade data because smaller trade values tend to exhibit more variation than large trade values (Arvis and Shepherd, 2011). Unfortunately, in the presence of heteroskedasticity, parameters estimated by OLS are inconsistent. Secondly, log-linearization results in observations with zero trade values being automatically dropped, since *ln(0)* is undefined. This is particularly important when analysing trade data, since zero trade between two countries is common (Arvis and Shepherd, 2011). There is a disanalogy here with Newtonian gravitational force, which can be very small but never zero. In addition to the potential presence of heteroskedasticity, estimating the gravity model in its multiplicative form (as above) retains zero trade observations, and so is preferred over OLS. Thus, Silva and Tenreyero (2006) suggest estimating the multiplicative form of the gravity equation using PPML.

The decision to enter into a PTA is not exogenous (Baier and Bergstrand, 2007). Rather countries may likely self-select into PTAs for unobserved reasons. Cross-sectional gravity estimations will thus underestimate the PTA effect, as discussed in the previous section. Therefore, following Baier and Bergstrand (2007), this paper uses panel data to correct for this endogeneity problem. The model is estimated from 2008 to 2018, including only every second year. Two-year intervals are used so that trade flows are given time to adjust to the establishment of PTAs. Laget *et al* (2018) use three-year intervals for the same reason.

Specifically, the panel data is estimated using random effects. One disadvantage of random effects gravity models is that they require multilateral resistance to be normally distributed, but economic theory is silent on this issue (Shepherd, 2016). In the absence of a rigorously derived multilateral resistance term, this research includes variables related to logistics and firm operation as a proxy for multilateral resistance. These controls have a larger degree of between variation than within variation for each country pair, and this is one reason in favour of a random effects approach. Practically, another advantage of random effects over fixed effects is that time-invariant variables are not omitted from the regression. Empirical research has applied random effects in the context of a gravity model (Egger, 2002; Carrère; 2006). This enables the effects of economically interesting variables such as distance and common colonial history to be analysed.

Results and discussion

Table 1 reports the results for the four specifications of the model above. Models (1) and (2) include the full sample, whereas models (3) and (4) only include observations in which the origin country (country *i)* is in SSA. Models (1) and (3) measure the PTA effect on FVA with a dummy variable, while models (2) and (4) measures PTA core depth. All coefficients are estimated with robust standard errors.

Focusing on Models (1) and (2), the traditional gravity variables are significant and the expected sign. Economy size has a positive effect on FVA, and this effect is roughly equivalent for origin (*i)* and destination (*j)* countries. Furthermore, distance has a significant negative effect on trade. Although previous gravity models estimate GDP coefficients closer to 1 (Foster *et al*, 2010), measuring trade in value added terms, including various controls and estimating the equation using PPML reduces the upward bias of GDP coefficients (Silva and Tenreyero, 2006). Interestingly, whether PTA membership is measured as a dummy or as core depth, the magnitude of GDP coefficients are similar between models 1 and 2. Wald tests for (1) and (2) suggest that the model as a whole is significant.

In model 1, the PTA dummy is positive and significant, but small. This corresponds with the findings of Baier, Yotov and Zylkin (2018) and Silva and Tenreyero (2006). However the PTA coefficient is much smaller than that found in Head, Mayer and Ries (2010) and Baier and Bergstrand (2007). One reason for this may be due to the fact that in the sample, only 8 percent of trade takes place under PTAs. This is because countries have many trading partners, but enter into regional agreements with only a few of them.

Similarly, the core depth measure in model (2) is positive, significant and small in line with Laget *et al* (2018). Each additional core provision added to a PTA only has a small marginal effect on value-added trade. This highlights a flaw with the PTA depth measure used in this paper: in the same way that the PTA dummy conceptually flattens PTAs, core depth places equal value on all provisions. In reality, it might be the case that specific provisions will have a larger effect on trade. Further research could try to identify the provisions that are most important to regional integration

Otherwise, most other control variables are significant and of expected sign. The logistics capability of both origin and destination countries has a positive effect on trade, but the logistics performance of the destination country is much more important than for the origin country. Common language and contiguity also have significant positive effects on trade. Unusually, shared colonial history is negatively correlated with GVC linkages. A far cry from causation, this may simply reflect the extent to which former colonial states are still dependent on North-South trade. Models (3) and

Table 1: Gravity Model Regression Output

Dependent variable: FVA_{ijt} (Value added in exports by d originating in country o USD Bill)	(1)	(2)	(3)	(4)
$\ln(GDP_{it})$	0.760***	0.761***	0.697***	0.697***
	(0.02)	(0.02)	(0.09)	(0.09)
$\ln(GDPj_{t})$	0.766***	0.767***	0.905***	0.907***
	(0.02)	(0.02)	(0.08)	(0.08)
$\ln(distance_{ij})$	-0.691***	-0.692***	-0.382	-0.404
	(0.03)	(0.03)	(0.30)	(0.30)
PTA_{ijt}	0.081***		0.558***	
	(0.02)		(0.16)	
$coreprovisions_{ijt}$		0.004***		0.043***
		(0.00)		(0.01)
$\ln(gdpcap_{it})$	0.431***	0.430***	0.798***	0.795***
	(0.02)	(0.02)	(0.15)	(0.15)
$\ln(area_{i})$	0.053***	0.053***	0.122	0.109
	(0.01)	(0.01)	(0.09)	(0.09)
$entry\_time_{it}$	0.007***	0.007***	0.000	0.000
	(0.00)	(0.00)	(0.01)	(0.01)
$entry\_cost_{it}$	-0.002	-0.002	0.004*	0.004*
	(0.00)	(0.00)	(0.00)	(0.00)
$entry\_proc_{it}$	0.015**	0.015**	-0.058	-0.057
	(0.01)	(0.01)	(0.05)	(0.04)
$LPIscore_{it}$	0.340***	0.340***	0.700***	0.697***
	(0.05)	(0.05)	(0.19)	(0.19)
$\ln(gdpcap_{jt})$	0.244***	0.243***	-0.033	-0.035
	(0.02)	(0.02)	(0.12)	(0.12)
$\ln(area_{j})$	-0.129***	-0.129***	-0.191***	-0.192***
	(0.01)	(0.01)	(0.04)	(0.04)
$entry\_time_{jt}$	-0.003*	-0.003*	0.005*	0.005*
	(0.00)	(0.00)	(0.00)	(0.00)
$entry\_cost_{jt}$	0.006***	0.006***	0.002	0.002
	(0.00)	(0.00)	(0.01)	(0.01)
$entry\_proc_{jt}$	-0.000	-0.000	-0.048	-0.048
	(0.01)	(0.01)	(0.03)	(0.03)
$LPIscore_{it}$	1.138***	1.137***	1.652***	1.647***
	(0.05)	(0.05)	(0.30)	(0.30)
contig	0.681***	0.683***	1.752*	1.795*
	(0.07)	(0.07)	(0.81)	(0.81)
comlang	0.310***	0.314***	-0.087	-0.087
	(0.05)	(0.05)	(0.16)	(0.16)
comcol	-0.387***	-0.385***	-1.013*	-1.005*
	(0.10)	(0.10)	(0.48)	(0.48)
comcur	0.220***	0.218***	0.449	0.504
	(0.07)	(0.07)	(1.47)	(1.47)
tdiff	0.006	0.005	-0.025	-0.023
	(0.01)	(0.01)	(0.04)	(0.04)
comrelig	-0.309***	-0.309***	0.388	0.404
	(0.07)	(0.07)	(0.47)	(0.47)
Number of observations	93 561	93 561	21 361	21 361
Wald Test ($\ln(\alpha)$	-0.767***	-0.765***	-4.254	-4.499
	(0.04)	(0.04)	(2.65)	(3.44)
Random Effects?	Yes	Yes	Yes	Yes
Sample	World	World	country *i* in SSA	country *i* in SSA

Clustered standard errors at the country pair level in parentheses.
* p<0.05, ** p<0.01, *** p<0.001

(4) only include observations where the origin country is in SSA. Since FVA measures the value added by country *i* in country *j*'s exports, (3) and (4) consider only value-added originating on the African continent. This allows for a more focused study of SSA's backward linkages with itself and the rest of the world. Economy size is correlated with trade on the African continent as well, but to a lesser extent. Logistic performance similarly enhances trade capabilities. This confirms the importance of trade facilitation, as discussed by Host, Skender and Zaninovic (2019).

Distance is no longer significant for a SSA exporter sub-sample. In fact, there are several insignificant coefficients in models (3) and (4). Of greater concern is that one cannot to reject the Wald test's null hypothesis of overall insignificance. The specification of (3) and (4) is the same as (1) and (2), with the only difference being that the former two models restrict the sample to only include SSA origin countries. This drastically reduces the sample size, and this may affect the overall model. Another reason for the model's insignificance in this sub-sample may be the lack of variation in FVA for SSA origin countries. In the dataset, standard deviation of FVA world-wide is around 16, whereas the FVA standard deviation for SSA origin countries is only 1. Thus the lack of variation in the dependent variable may bias the coefficients in (3) and (4).

Both the PTA dummy and core depth coefficients are larger for SSA origin countries than for the whole sample. This lends a degree of credibility to the notion of developmental regionalism as outlined by Ismail (2018): regional integration, whether measured by a dummy or core depth, have a larger effect in SSA than for the rest of the world. This suggests that regional integration on the African continent may be a viable route towards structural transformation and specifically increased value-added trade in manufactures. However, one downfall of restricting the sample to SSA origin countries only is that the model cannot differentiate between PTAs within the continent and PTAs between African states and other continents. Restricting the sample to include only SSA origin *and* destination countries reduced the sample size too drastically, and this was not a viable route for estimation.

Two avenues of further research arise from this paper's results. Firstly, decomposing trade by sector may provide promising results. Laget *et al* (2018) opt for this route, and they find heterogenous effects of PTA depth by sector. Secondly, further textual analysis of the contents of PTAs could enrich the data further. Throughout this paper reference was made to PTA depth. Laget *et al* (2018) correctly identify the type of depth discussed here as 'horizontal depth', since only the number of provisions was considered, and not the actual content of each provision. Data on 'vertical depth' of PTA provisions may be gathered by analysing the contents of each provision. This would allow us to differentiate between similar provisions in different PTAs. Such detailed textual analysis may be difficult and timeous for humans to complete, but it is exactly the kind of problem that machine learning and neural network algorithms may be used for.

One final point is worth noting: with regards to GVC integration and PTA participation, Ruta (2017) question the direction of causation. Increasing regional integration has strengthened GVCs through the establishment of regional markets, but it is also possible that the proliferation of GVCs has created a further need for regional integration. As the production process becomes dispersed across national borders, this creates policy spill-overs which require inter-state agreements such as PTAs to address. An increasingly integrated global trading system puts pressure on states to regulate economic activity through formal agreements. In this way, GVC participation and regional integration are inherently related. Conversely, domestic supply chains and national protectionism are also complementary. Ruta (2017) characterizes this situation as an assurance game: if states can be sure that other nations are committed to GVC and PTA participation, then this is a reason for them to pursue those policies as well. However this is not the only equilibrium. There is an additional sub-optimal equilibrium where states turn away from both regional integration *and* GVCs. Both the USA and the UK have recently signalled their intention to move towards this sub-optimal, protectionist equilibrium, and the concern is that they may play the role of first movers, forcing the hand of other participants in the international trade system.

Conclusion

Using a gravity model of trade, this paper empirically measured the effect of regional integration on international trade. Although it is not a new idea, this research adds to the existing literature by employing novel methodologies. In particular, trade was measured in value-added terms, and PTA depth data was used to differentiate between heterogenous PTAs. The main contribution of this paper is to bring together the recent research on GVCs and PTAs. In addition, it verifies existing determinants of international trade, such as trade facilitation. Further research should expand on the textual analysis of PTAs by considering the differences between similar provisions in different PTAs. In addition, decomposing GVC data by sector is a promising route.

This study identifies a positive effect of PTAs on backwards linkages into GVCs. Regional integration allows states to address the policy spill-overs caused by the proliferation of GVCs. However this positive effect was small, and so no firm conclusions may be drawn. In spite of this, the effect of PTAs was slightly larger for SSA origin countries, which suggests that regional integration is an appropriate route for the African continent to pursue. This is a positive sign for the newly ratified AfCFTA which may enable the creation of RVCs and efficient regional markets on the continent by simplifying and harmonizing trade procedures and technical standards. This could then act as a stepping stone towards high-value added participation in GVCs.

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Appendices

Appendix A: Variable description

Name	Description	Type	Source
FVA_{ijt}	The value added in exports by *j* originating in country *i* (USD current) in year *t*	Monadic, time-varying (δ_{it} and δ_{jt})	UNCTAD EORA GVC database
GDP_{it}	Gross domestic profit (USD current) of country *i* in year *t*		World Bank World Development Indicators (WDI)
$gdpcap_{it}$	Gross domestic profit per capita (USD current) of country *i* in year *t*		World Bank WDI
$LPIscore_{it}$	Logistics Performance Index score of country *i* in period *t*		World Bank WDI
$entry\_time_{it}$	Time required to start a business (days) in country *i* in year *t*		World Bank WDI
$entry\_proc_{it}$	Start-up procedures to register a business (number) in country *i* in year *t*		World Bank WDI
$entry\_cost_{it}$	Cost of business start-up procedure (percent of GNI per capita) in country *i* in year *t*		World Bank WDI
$area_i$	Surface area of country *i*	Monadic, time-invariant	CEPII GeoDist database
PTA_{ijt}	Binary variable taking one if trade between *i* and *j* occurs in the presence of a PTA in year *t*	Dyadic, time-varying (δ_{ijt})	World Bank Content of Deep Trade Agreements database
$coredepth_{ijt}$	The total number of core economic provisions included in a PTA (if trade between *i* and *j* occurs within a PTA) – See Appendix B		World Bank Content of Deep Trade Agreements database
$comcur_{ij}$	Binary variable equal to 1 if *i* and *j* share a common currency	Dyadic, time-invariant (δ_{ij})	CEPII GeoDist database
$comrelig_{ij}$	Binary variable equal to 1 if *i* and *j* share a common religion		CEPII GeoDist database
$contig_{ij}$	Binary variable equal to 1 if *i* and *j* share a common border		CEPII GeoDist database
$comcol_{ij}$	Binary variable equal to 1 if *i* and *j* share a common colonizer		CEPII GeoDist database
$comlang_{ij}$	Binary variable equal to 1 if *i* and *j* share a common official language		CEPII GeoDist database
$dist_{ij}$	Distance between the capitals of country *i* and country *j*		CEPII GeoDist database
$tdiff_{ij}$	Time difference between *i* and *j*		CEPII GeoDist database

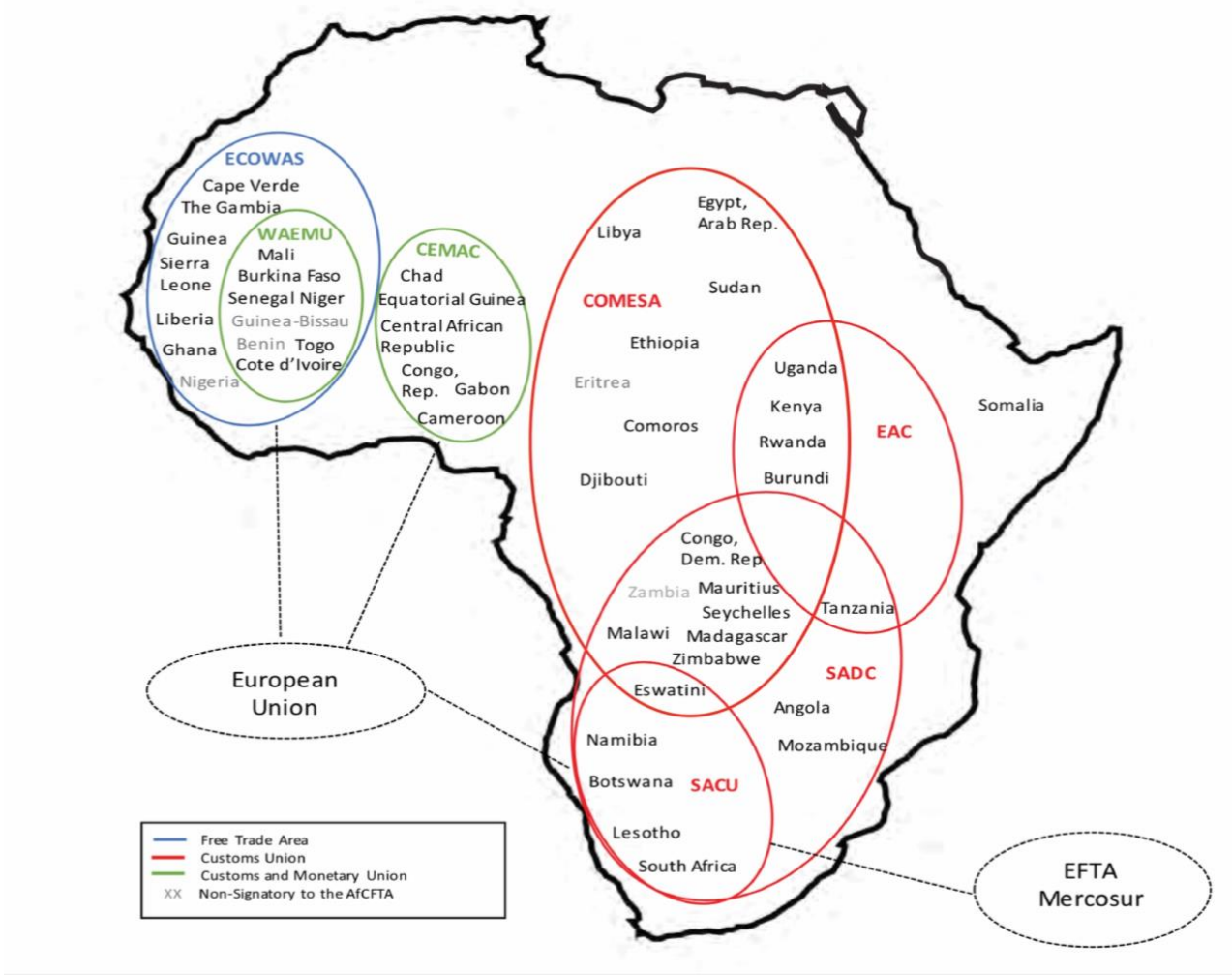
Appendix B: Categorization of PTA provisions: WTO plus and WTO extra *

WTO+ (14)	WTOx (38)
• **Tariffs– industrial goods** • **Tariffs– agricultural goods** • **Customs administration** • **Export taxes** • **SPS measures** • **State trading enterprises** • **TBT measures** • **Countervailing measures** • **Anti-dumping** • **State aid** • **Public procurement** • **TRIMS measures** • **GATS** • **TRIPS**	• Anti-corruption • **Competition policy** • Environmental laws • **Intellectual Property Rights** • **Investment measures** • Labour market regulation • **Movement of capital** • Consumer protection • Data protection • Agriculture • Approximation of legislation • Audio-visual • Civil protection • Innovation policies • Cultural cooperation • Economic policy dialogue • Education and training • Energy • Financial assistance • Health • Human rights • Illegal immigration • Illicit drugs • Industrial cooperation • Information society • Mining • Money laundering • Nuclear safety • Political dialogue • Public administration • Regional cooperation • Research and technology • SMEs • Social Matters • Statistics • Taxation • Terrorism • Visa and asylum

Source: Hofmann, Osnago and Ruta (2017)

*Core provisions are in bold

Appendix C: Map of RTA membership in Sub-Saharan Africa



Source: IMF, 2019