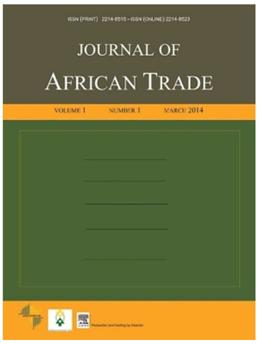

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Festus Eboturkson

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How well does observable trade data measure trade friction costs? Evidence from member countries within the Economic Community of West African States (ECOWAS)

Festus Ebo Turkson

Department of Economics, School of Social Science, College of Humanities, University of Ghana, Box LG57, Legon, Accra, Ghana

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Abstract

This paper is an empirical application of the micro-founded measure of trade costs by Head and Mayer (2004) and Novy (2013). The derived micro-founded measure, consistent with the Ricardian and heterogeneous firm's models of trade, captures all trade costs components that hitherto have been impossible to include in the gravity framework because of severe data limitations and the impracticability of measuring some of the trade cost components.

Based on bilateral trade and production data from the Trade, Production, and Protection database by Nicita and Olarreaga (2007) over the period 1980–2003, the micro-founded estimate of relative bilateral trade cost measure computed for ECOWAS clearly indicates lower trade costs among member ECOWAS countries compared with that for trade with other countries from SSA. With regard to accounting for variations in the computed measure of trade costs, the estimates obtained support the literature on the contribution of trade cost proxies to trade costs. Common non-tariff trade costs proxies explain over two-thirds of the variation in the trade costs estimates obtained for trade within the ECOWAS sub-region.

This paper argues for the need for policy makers within the sub-region to identify and reduce the trade barriers associated with trading within the ECOWAS sub-region. In addition, results from this paper, that bilateral transactions in a common currency reduces trade costs, suggest that current efforts at establishing a common currency, if successful, may improve intra-ECOWAS trade.

E-mail address: feturkson@ug.edu.gh.
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1. Introduction and motivation

Trade costs play an important role in determining the volume and direction of trade, in explaining the level of Foreign Direct Investment (FDI) or firm outsourcing and the increasing popularity and proliferation of trade agreements among nations. The importance of trade costs need not to be overemphasized, as they are large and variable, impose significant implications on welfare, are linked to policy, and matter for economic geography. Trade costs include all costs (other than the marginal cost of producing the good) incurred in getting a good from the producer to the final user. Within the trade literature, trade costs have been classified as arising mainly from two sources: natural and artificial sources; naturally, because of how countries are spread globally (i.e., geography), and artificially, as a result of public policy and other factors. Anderson and van Wincoop (2004) found that trade costs varied across countries and regions as well as across goods and sectors. Whereas tariff costs for highly industrialized countries was less than 5%, border costs with respect to tariffs barriers for developing countries averaged between 10% and 20% (with a few exceptions).

Comparisons of the levels of trade costs and flows among regions indicate that sub-Saharan Africa (SSA) has the highest level of trade costs and therefore lags behind any other region in terms of trade flows. The predominantly higher trade costs observed in SSA is confirmed by evidence produced by Portugal-Perez and Wilson (2008) indicating that transport costs in Africa to be about 2.5 times those of industrialized countries. Evidence from the World Bank's Doing Business 2013 database indicates that trading costs in SSA, in general, are the highest within the global trading system and about twice as high as those in high-income OECD countries, hence its marginal contribution to global trade. Studies such as Limao and Venables (2001), Mbabazi et al. (2006), and Wilson et al. (2008) have confirmed the reasons for the high trade cost in SSA to include non-tariff barriers (NTBs), poor infrastructure, higher transport costs, inefficient ports, technical standards, remoteness, and long overland distances. These pose as significant obstacles to both intra-African and the sub-regions' contributions to global trade; meaning the costs of exporting are relatively high among and from African countries.

Trade policy reforms and economic integration efforts have failed in SSA to substantially reduce trade cost because of data and measurement problems relating to most NTBs to trade within SSA. Data on many components of trade frictions as well as multilateral resistance in Africa are either not readily available or limited if available. Though this is not peculiar to SSA, data issues relating to absence or unavailability, the improper combination of available data with other fragmentary or missing data, and aggregation bias are more profound in the SSA case relative to other regions within the global trading system. As argued by Anderson and van Wincoop (2004), the seemingly simple question of "how high policy barriers to trade are" cannot be answered accurately for some goods in most countries and for many years mainly because of data limitation regarding availability, aggregation, and manipulation.

Recent developments within the trade literature to obviate the difficulties faced in obtaining accurate measures of trade costs have to a large extent been successful. The inference of trade costs indirectly from trade flows/volumes and from prices has been used to obtain as accurately as possible measures of trade cost. As indicated by Anderson and van Wincoop (2004), while the literature on inference about trade barriers from final goods' prices remains largely devoid of theory, inference from trade flows through the gravity framework provides the only main link between trade barriers, trade cost, and trade flows.

Despite being the workhorse of international trade, the empirical validity of the gravity framework or versions of it has been called to question mainly as a result of the underlying theoretical assumptions. Attempts made to address these issues have led to the emergence of a new strand of promising trade cost literature based on an approach by Novy (2013) that seeks to measure trade costs from easily observable time-varying trade data without imposing a trade cost function (with "questionable" assumptions). This measure of trade cost henceforth referred to as "micro-founded measure" of trade costs follows closely Head and Ries (2001), Engel (2002), and Head and Mayer (2004).

In a related study that makes use of the "micro-founded"[1] measure of trade costs, Turkson (2012) obtained estimates of average tariff equivalent trade cost for different regions based on bilateral trade data for the period 1980–2003. The estimates obtained indicate that on average, trade costs in SSA are relatively higher than other regions, confirming evidence that indicates trading costs in SSA to be the highest within the global trading system. Turkson (2012); although obtained estimates of average tariff equivalent the trade cost for SSA, the paper did not measure the average tariff equivalent trade costs for members within sub-regions to find out if belonging to an RTA within SSA reduces the level of trade costs. Very little is known about the level of intra-sub-regional trade costs in SSA and the extent of heterogeneity in the estimates of trade costs among sub-regional economic communities within SSA.

This paper is therefore motivated to carry out a micro-analysis of the SSA situation with specific reference to the Economic Community of West African States (ECOWAS) — one of the oldest and very stable economic communities within SSA. As a sub-region, ECOWAS presents a classic example of the SSA case with regard to trade costs. It is one of the sub-regions with the highest trade costs, and this has been touted as one of the main factors responsible for the persistently low level of intra-sub-regional trade. In most ECOWAS countries, though tariff rates have fallen considerably over the years, institutional bottlenecks and non-policy-induced trade friction costs continue to pose as the most significant hindrances to trade flows within the sub-region.

Exploiting the Novy (2013) approach, and following closely Turkson (2012), this paper proposes in a two-part analytical framework the following:

a) To obtain estimates of the micro-founded measure of bilateral trade costs for ECOWAS using observable trade data and without imposing an arbitrary trade cost function as is the case with the gravity framework.
b) To estimate the trade cost function for ECOWAS to find out whether the trade cost measure obtained is sensibly related to common trade cost proxies from the gravity literature.

The paper is organized as follows: Section 2 examines the trends in ECOWAS trade flows and trade costs. In Section 3, a review of the gravity literature on trade costs and a discussion of the analytical approach adopted by Novy (2013) in deriving the micro-founded trade cost measure are carried out. Section 4 deals with methodology and data description, and under Section 5, this paper presents a discussion of the estimation and analysis of results from the two-part estimation. Section 6 concludes the paper.

2. Trade flows and costs within ECOWAS

2.1. ECOWAS trade flows

There are wide disparities in the trade performance of countries within the various regional economic communities within SSA. Member countries belonging to SADC enjoy higher trade volumes than those of ECOWAS and Economic Community of Central African States (ECCAS). In the case of ECCAS, it is mainly due to the prolonged conflicts within the sub-region and the landlocked nature of most countries within Central Africa. Within ECOWAS, the landlocked nature of some countries has meant increased transport costs and, therefore, overall trade costs of trading with overseas markets. As shown in Table 1,

[1] As derived in Novy (2013)

Table 1
Contribution to global exports — sub-regions within SSA.

Total global exports	Annual average (US$ billions)			
	1995–1999	2000–2004	2005–2009	2010–2014
	5430.85	7109.14	13,034.80	18,019.66
	Contribution to global exports (%)			
Sub-Saharan Africa	1.51	1.54	2.06	2.30
ECOWAS (West Africa)	0.43	0.45	0.64	0.79
SADC (Southern Africa)	0.86	0.84	1.05	1.16
ECCAS (Central Africa)	0.23	0.29	0.56	0.62

Source: Compiled from UNCTAD Database.

the ECOWAS share of global merchandise exports remains below 1% in spite of the marginal increases since 1995. Over the period 1995–1999, the annual average contribution of ECOWAS to global exports was 0.43%, and this increased to 0.64% between 2005 and 2009, and further to 0.79% in between 2010 and 2014. The contribution of ECOWAS was lower than that of SADC but higher than that of ECCAS. In terms of the growth rates, ECOWAS contribution to global exports increased by 95% when annual average exports over the period 1995–1999 is compared with those from 2010–2014. This compares with a growth of 34% by SADC, 169% by ECCAS, and 57.6% by SSA.

The marginalization of ECOWAS in global trade is also manifested in its very low share of intra-regional exports in its total exports. As a share of total merchandise exports from ECOWAS, intra-ECOWAS exports, which was about 12% on average between 1995 and 1999, has since declined marginally to 10.18% and further down to about 9% over the periods 2000–2004, 2005–2009, and 2010–2014, respectively (Table 2). Over the five-year period between 2010 and 2014, intra-group ECOWAS exports declined significantly to less than an average of 8% yearly. Noticeably, while all other sub-regions have seen an increase in the annual average since 2000, it was only in the ECOWAS sub-region that a decline over the same period was seen.

Compared with those of other regions and economic communities within SSA, the share of intra-group trade for ECOWAS was one of the lowest within the global trading system. Table 2 indicates that annual average intra-group exports within ECOWAS, though relatively higher than the ECCAS, was significantly lower than the average for SSA, developed and developing countries, and within SSA lower than SADC, EAC, and IGAD. The relatively low intra-group exports within ECOWAS as

Table 2
Intra-Group Exports — sub-regions within SSA.

Region	Annual average (%)			
	1995–1999	2000–2004	2005–2009	2010–2014
ECOWAS (West Africa)	11.68	10.18	9.06	7.78
SADC (Southern Africa)	38.89	11.16	10.38	18.16
ECCAS (Central Africa)	1.32	1.07	1.14	1.77
EAC (East Africa)	17.01	18.12	18.39	20.22
IGAD (Horn of Africa)	11.92	10.96	8.82	13.08
Sub-Saharan Africa	28.40	13.01	12.63	16.97
Developing economies	41.85	42.79	49.28	56.78
Developed economies	74.65	75.78	73.03	67.30

Source: Compiled from UNCTAD Database.

compared with that from other economic communities within SSA give an indication of the relatively inconsequential impact of regional integration efforts in promoting trade within West Africa. According to Yang and Gupta (2007), although some annual increases in intra-regional trade flows have been recorded within SSA, especially for intra-ECOWAS trade, these increases have not been large enough to confirm that sub-regional integration efforts have been beneficial to all members.

2.2. ECOWAS trade costs

The relatively low levels of intra-sub-regional trade within ECOWAS have been largely attributed to the poor state or low levels of trade infrastructure and logistics. Most SSA countries incur high and rising costs in transporting and moving goods across borders (within the sub-region) mainly because of the poor state of existing roads and railway networks, inadequate air and sea transport, and poor communication. Others, including burdensome documentation requirements, time-consuming customs procedures, inefficient port operations, and inadequate transport infrastructure, have also lead to unnecessary costs and delays for trade across borders (Alaba, 2006).

The World Bank Doing Business Report 2015 indicates that in SSA, despite making the most improvements in trading across borders in 2009 and 2010, trade flows are still the slowest and the most expensive as of 2014. Appendix Table A1 indicates that the average cost of importing and exporting a container to and from SSA is estimated to amount to \$2904 and \$2183.50, respectively, which is higher compared with that of other developing regions including South Asia, East Asia & Pacific, Latin America & Caribbean, and Middle East & North Africa. Compared with that of OECD and EU, for all the indicators of trade costs as shown in Appendix Table A1, the trade costs of SSA were almost twice that of the EU and OECD. In addition to the cost of importing and exporting a container, it required 30.2 and 37.5 days to respectively export and import in SSA in 2014, and this was more than any other region within the global trading system.

Although the ECOWAS sub-region has a lower trade cost in terms of importing and exporting a container than the average for SSA, compared with that of other regions, the ECOWAS average was higher. With regard to the number of documents and the time (in days) it takes to export and import, ECOWAS had a lower trade costs than that of South Asia and the rest of Europe and Central.

Trade costs apart from being high in ECOWAS, are also variable across various ECOWAS countries. On average landlocked ECOWAS countries experienced a higher trade costs than those West African countries with a coastline. For instance, as shown in Appendix Table A1, the cost of shipping a container for exports and imports was over two and a half times as high for the landlocked compared with that for the coastal countries within the sub-region.

3. Literature review

Ever since the seminal study by Tinbergen (1962), most studies that have sought to infer trade costs indirectly have mainly focused on estimating various versions of the gravity model to infer bilateral trade costs. These studies have either adopted the conditional or the unconditional general equilibrium frameworks. The conditional general equilibrium approach (an endowment-based model) assumed that production and therefore consumption decisions as given and that each country specialized wholly in the production of its own good, which for each country is produced exogenously. The unconditional general equilibrium approach recognized the absence of "separability" of production and consumption decisions from bilateral trade decisions by making the roles of technology and market structure more explicit (Bergstrand and Egger, 2011).

With regard to the conditional general equilibrium framework, the "traditional" and "theory-based" versions of the gravity equations have been estimated. The traditional gravity equation to infer unobservable trade costs following from Tinbergen (1962) and Anderson (1979) is of the form:

$$X_{ij} = Y_i^{\varphi_1}.Y_j^{\varphi_2}.Z_{ij}^{\varphi_3}.\eta_{ij} \quad (1)$$

where X_{ij} is the bilateral exports from country i to j; Y_i and Y_j are the economic size (nominal GDP) of country i and j respectively; Z_{ij} is a set of observables to which bilateral trade frictions/barriers are related and which impose trade costs (including tariff and NTBs.), and η_{ij} is the disturbance term. φ_1, φ_2, and φ_3 are unknown parameters to be estimated. An underlying assumption made in deriving Eq. (1) was that prices are unitary across producers implying symmetry in trade costs.

Motivated to find an answer to the highly overstated impact of national borders on bilateral trade as found by McCallum (1995), Anderson and van Wincoop (2003) argued that the "traditional" gravity model failed to account for the impact of multilateral trade resistance (i.e., the average trade resistance between a country and its trading partners with the rest of the world) on bilateral trade costs. Multilateral trade resistance captures the bilateral countries average international trade barriers with all their trading partners.

Anderson and van Wincoop (2003) were therefore motivated to provide a theoretical refinement of the traditional gravity model (henceforth, "theory-based" gravity model) to include multilateral trade resistance variables. The various studies that have made use of the "theory-based" gravity model (an enhanced conditional general equilibrium model) have estimated in different ways the gravity equation of the form:

$$x_{ij} = \frac{y_i y_j}{y^w}\left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma} \quad (2)$$

Where, $$t_{ij} = \sum_{m=1}^{M}\left(z_{ij}^{m}\right)^{\gamma m} \quad (3)$$

where x_{ij} is nominal exports from country i to j; y_i and y_j is the nominal income (GDP) of exporter i and importer j respectively; y^w is nominal world income (total world GDP); t_{ij} is the bilateral trade costs; σ is the elasticity of substitution among goods; Π_i and P_j are outward and inward multilateral resistance variables respectively. In addition, z_{ij}^m (m = 1…M) is a set of observables to which bilateral trade frictions/barriers are related. γ is a vector of unknown parameters to be estimated.

Both the "traditional" and "theory-based" gravity equations have continued to achieve empirical success in explaining bilateral flows[2], and this explains why the gravity framework of trade is recognized as the workhorse in explaining bilateral trade flows. Studies that have estimated versions of the "traditional" gravity equation have sought to measure the impact of national border costs (McCallum, 1995; Wei, 1996; Evans, 2003), currency barrier costs (Rose, 2000; Rose and van Wincoop, 2001; Jacks et al., 2008; Barro and Tenreyro, 2007; Alesina et al., 2002), and information barrier costs (Portes and Rey, 2005; Gould, 1994; Head and Ries, 1998) on bilateral trade flows.

Head and Ries (2001), Eaton and Kortum (2002), and Anderson and van Wincoop (2003) also estimated in various ways versions of the "theory-based" gravity equation to measure trade barrier costs. With regard to aspects of physical infrastructure, logistics, and more generally, trade facilitation,

[2] In fact, Gravity models have also been used to explain various types of inter-regional and international flows (including labor migration, commuting, customers, hospital patients, and international trade) and served as a baseline model for estimating the impact of a variety of policy issues, including regional trading groups, currency unions, political blocs, patent rights, and various trade distortions.

Bougheas et al. (1999), Limao and Venables (2001), Clarke et al. (2004), Hummels (1999), Wilson et al. (2004), Francois and Manchin (2006), Djankov et al. (2006), Wilson et al. (2008), Hoekman and Nicita (2008), Behar and Manners (2008), and Turkson (2011) estimated versions of the "theory-based" gravity equation to provide empirical evidence to the effect that an improvement in physical infrastructure, trade facilitation, and logistics reduces trade costs significantly especially in developing countries.

The criticisms questioning the empirical validity of using gravity equations to measure trade costs relate to the omission of the non-tradable sector in the trade cost function, symmetric assumption about outward and inward multilateral resistance, the inclusion of time invariant proxies, and the omission of important frictions to trade in the trade cost function. Attempts to address these criticisms have led to the emergence of a new strand of promising trade cost literature. By building on Anderson and van Wincoop's (2003) theory-based gravity equation with trade costs, Novy (2013) following from Engel (2002) and Head and Mayer (2004) allows for trade costs to be inferred from easily observable time-varying data without imposing trade cost function (with "questionable" assumptions). The motivation for Novy's approach was to overcome the drawbacks that were associated with the theory-based gravity framework by Anderson and van Wincoop (2003) especially with regard to the multilateral trade resistance variables and bilateral trade cost formulation.

Novy (2013) derived an explicit analytical solution for the multilateral trade resistance variables and with that solved the trade cost function. This approach relies on the argument that changes in trade barriers not only affect international trade but also domestic trade. In practice, when a country phases out or reduces trade tariffs, some goods that are produced for domestic consumption are shipped to foreign countries, implying that trade barriers impact on domestic trade as well. By specifying the theory-based gravity equation in domestic trade terms and explicitly solving for the multilateral resistance variables and bilateral trade costs from the general equilibrium model, Novy (2013) obtained the tariff equivalent total trade costs (τ_{ij}) by taking a geometric mean of trade costs in both directions minus one as:[3]

$$\tau_{ij} = \left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)^{1/2} - 1 = \left(\frac{X_{ii}X_{jj}}{X_{ij}X_{ji}}\right)^{1/2(\sigma-1)} - 1 \tag{4}$$

where τ_{ij} is the total trade cost (i.e., measures bilateral trade costs relative to domestic trade costs); $t_{ij}t_{ji}$ is the bilateral trade costs of countries i and j, and $t_{ii}t_{jj}$ is the domestic trade costs of countries i and j.

Intuitively, Eq. (4) indicates that when bilateral trade costs decrease relative to domestic trade costs; total trade costs (τ_{ij}) will decrease, making it easier for countries i and j to trade relative to domestic trade. This will therefore imply that bilateral trade flows will increase relative to domestic trade flows. Similarly, if bilateral trade flows increase relative to domestic trade flows, one can infer that it has become easier for the two countries to trade (possibly because bilateral trade costs have declined relative to domestic trade cost), and this will be reflected in a decline in total trade costs. The micro-founded measure of trade cost as in Eq. (4) therefore captures what makes international trade costly over and above domestic trade.

This approach relies on the argument that changes in trade barriers do not only affect international trade but domestic trade as well. In practice when a country phases out or reduces trade tariffs, some goods that are produced for domestic consumption are shipped to foreign countries, implying that trade barriers impact on domestic trade as well. Novy (2013) showed that the micro-founded trade cost function is not specific to the endowment model but that it can be derived from unconditional

[3] See Appendix B for the derivation of this equation.

general equilibrium trade models such as the Ricardian model by Eaton and Kortum (2002) and the heterogeneous firm's models by Chaney (2008) and Melitz and Ottaviano (2008).

In an application of the derived measure (i.e., "micro-founded" measure) of trade costs, Novy (2013) showed that U.S. trade costs with major trading partners had declined on average by about 40% between 1970 and 2000, with Mexico and Canada experiencing the biggest reductions. This was consistent with the significant improvements that had occurred in transportation and communication technology and the formation of the North America free trade agreements (NAFTA).

4. Empirical strategy

4.1. Analytical framework

The empirical approach adopted in this paper is to estimate a two-part analytical framework. In the first part, this paper seeks to estimate a trade cost equation to obtain the tariff equivalent trade cost measure for ECOWAS countries that expresses the trade cost parameters as a function of observable trade data, derived in (4) as:

$$\tau_{ij} = \left(\frac{X_{ii}X_{jj}}{X_{ij}X_{ji}}\right)^{1/2(\sigma-1)} - 1 \tag{5}$$

where τ_{ij} is the tariff equivalent trade cost (i.e., measures domestic trade relative to bilateral trade); X_{ii} and X_{jj} are the domestic trade of countries i and j respectively; X_{ij} and X_{ji} are the bilateral trade of countries i and j respectively, and σ is the elasticity of substitution.

The elasticity of substitution between varieties measures the extent by which products are differentiated, and this determines the relative impact of trade costs on trade flows. As argued by Chaney (2008), trade barriers have a strong impact on trade flows when the elasticity of substitution between varieties of goods is high, or when goods are highly substitutable. If goods are more differentiated and therefore the elasticity of substitution is low, consumers are willing to buy foreign varieties even at a higher cost, and this implies that trade barriers have little impact on bilateral trade flows. The choice of a value for the elasticity of substitution (σ) is therefore very important in the estimation of the trade cost measure. Survey estimates of σ in Anderson and van Wincoop (2004) indicates that σ typically falls in the range of 5 to 10. Novy (2013) followed closely Anderson and van Wincoop (2004) in setting $\sigma = 8$, indicating that it corresponds to the Frechet (ϑ) and productivity (γ) distribution parameters of Eaton and Kortum (2002) and Chaney (2008) respectively[4]. This study will set $\sigma = 8$ in line with previous studies.

In the second part, a trade cost function for ECOWAS is estimated to find out whether the trade cost measure obtained in the first part of the analytical framework is sensibly related to common trade cost proxies from the gravity literature. Following from Eq. (3), the trade cost function to be estimated is of the form

$$\ln(\tau_{ij}) = \alpha_0 + \alpha_1 \ln(d_{ij}) + \alpha_2 ADJ_{ij} + \alpha_3 LLK_{ij} + \alpha_4 COLO_{ij} + \alpha_5 Comcur_{ijt} + \alpha_6 LANG_{ij} + \epsilon_{ij} \tag{6}$$

As noted in Eq. (6), bilateral trade costs, τ_{ij} is specified to be a function natural trade frictions including the distance between countries (d_{ij}), sharing of common border (ADJ_{ij}), and number of landlocked countries (LLK_{ij}); and artificial frictions to trade including common language ($LANG_{ij}$), colonial link or ties ($COLO_{ij}$), common currency ($Comcur_{ij}$), and a well-behaved error term ($\epsilon\epsilon_{ij}$).

[4] Estimate of $\vartheta = \gamma = 7$.

4.2. Data

Data for the analysis are obtained from two sources. Data for estimating the tariff equivalent trade cost measure will be constructed from the Trade and Production Database as used by Nicita and Olarreaga (2007) and published by CEPII[5]. Information at the country level consists of geographic data used for the estimation of gravity equations published by CEPII, and data on GDP from the World Development Indicators database published by the World Bank.

The database used for the study contains information on 13,174 bilateral country-years, covering about 128,000 observations for 24 years over 1980–2003. The analysis focuses on the production and trade in manufactures only. The dataset also contains geographic information that allows us to divide the bilateral country-years into different economic blocs/regions. By this information, we will be able to carry out regional analyses, making it easier for us to identify the differences that exist between bilateral trading partners from different economic blocs/regions.

The sample initially covers 155 countries out of which 39 are African countries. In order to focus on ECOWAS, this paper concentrates on bilateral trade relations involving countries within the ECOWAS sub-region. There are 12 countries from the ECOWAS sub-region in the sample; however, to prevent composition bias resulting from missing data for some countries and in some years, the paper focuses on six out of the 15 countries that make up ECOWAS namely, Ghana, Nigeria, Cote d'Voire, Niger, Senegal, and Benin.

Bilateral exports (X_{ij} and X_{ji}) are gross exports valued at F.O.B. and denominated in thousands of US dollars. Domestic trade or internal flows for the exporting (i.e., X_{ii}) and importing (i.e., X_{jj}) country is defined as total production minus total exports of manufactures. This is also denominated in thousands of US dollars. Measures of economic size (GDP) are valued at current US dollars. Distance between trading partners is measured as the weighted distance between countries i and j. The other controls, indicating whether the two countries are contiguous (share a common border), share a common language, common currency, landlocked, colonial link etc., are binary dummy variables.

5. Analysis of results

5.1. Micro-founded measure of trade costs in ECOWAS

The results obtained in this section relate to our estimate of the tariff equivalent trade cost measure, which is obtained from estimating Eq. (5) with an elasticity of substitution (σ) set equal to 8. The choice of $\sigma = 8$ follows closely Anderson and van Wincoop's (2004) conclusion from a survey of the gravity literature that σ was likely to be in the range of five to ten, and that an intermediate value of 8 was ideal.

A decline (an increase) in our estimate of the tariff equivalent trade cost implies that bilateral trade flows have increased (decreased) relative to domestic trade flows, and this would be because of a decrease (an increase) in bilateral trade costs relative to domestic trade cost.

5.1.1. Overall average bilateral trade costs

The overall average bilateral relative trade costs is the ad-valorem tariff equivalent bilateral trade costs over the entire period 1980–2003 with regard to trade flows between countries in each bloc with all trading partners. The results in Appendix Table A2 are estimates of the overall average tariff equivalent relative trade cost measures obtained for various regions over the period 1980–2003. As shown in Appendix Table A2, the cost of trading within SSA was the highest at an average tariff equivalent of

[5] Centre d'Etudes Prospectives et d'Informations Internationales (French Centre for Research in International Economics)

Table 3
Estimates of tariff equivalent overall average relative trade cost — SSA RECs.

Year	Region/Bloc				
	SSA	ECOWAS	SADC	EAC	ECCAS
	Period Averages (%)				
1980–84	259.0	252.4	261.5	273.3	252.1
1985–89	264.3	269.0	253.6	274.5	279.4
1990–94	276.2	280.9	268.7	278.0	292.0
1995–99	276.1	271.5	274.8	279.5	286.4
2000–03	280.3	272.2	270.1	300.0	327.2
1980–2003	271.5	268.2	265.7	279.1	282.8

Author's computation.

271.5% confirming data from the World Bank's Doing Business database, which clearly indicates trading costs in SSA to be the highest within the global trading system.

To find out if our estimate of average trade costs differs significantly across blocs within SSA, this paper computes the relative bilateral trade costs for each of the regional economic communities. Table 3 and Appendix Table A3 show estimates of the average and annual relative bilateral trade costs for the four main regional economic communities in SSA between 1980 and 2003 respectively. As shown in Table 3, the average relative bilateral trade costs for SADC countries with all trading partners was the lowest at 265.7%, while countries within ECCAS had the highest of 282.8%. Average bilateral trade costs for ECOWAS was the least after SADC at 268.2%.

Compared to the average for SSA, the *t*-test results in Table 4 shows the average for SADC to be significantly lower, averages for ECCAS and EAC higher, and the averages of ECOWAS and other SSA countries not significantly different from the SSA average.

Table 5 shows results of the test of difference in the micro-founded tariff-equivalent average relative trade cost of ECOWAS (i.e., at 268.2%) compared with the trade costs of other regional trading partners of ECOWAS. The tests results indicate that ECOWAS trade costs are significantly higher than that of the EU, North America, and East Asia and Pacific. As shown in Table 5, within SSA, overall average bilateral relative trade costs of ECOWAS countries were significantly lower than that of countries from the ECCAS, East African Community, and other SSA economies. The results however indicate that statistically, there is no difference between the trade cost of ECOWAS and SADC.

5.1.2. Average bilateral relative trade costs among ECOWAS countries

Within SSA, overall bilateral relative trade costs of countries belonging to a bloc is computed to be lower than trading partners who do not belong to the same bloc. As can be seen from Table 6, the average

Table 4
Test for difference in overall average trade costs for SSA relative to RECs (1980–2003).

Sub-region	τ_{ij} (Relative index)	Sub-Saharan Africa (Mean = 2.715)		
		Difference	Std. error	*t*-Stats
ECOWAS	2.682	0.034	0.023	1.472
ECCAS	2.826	−0.110***	0.032	−3.442
SADC	2.657	0.058***	0.020	2.842
EAC	2.791	−0.075***	0.025	−2.953
Other SSA	2.771	−0.055	0.037	−1.483

Author's computation. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; Figures under column 2 refer to the tariff equivalent trade cost (τ_{ij}) index for that region. That is, trade costs of the region with partners in the rest of the world.

Table 5
Test for difference between overall average bilateral trade costs of ECOWAS and trading partners (1980–2003).

Region/Bloc	ECOWAS (Mean = 2.682)			
	Difference	Std. error	*t*-Statistic	Welch's .f. ratio
European Union (=1.939)	0.742***	0.021	35.640	3337.36
North America (=1.856)	0.826***	0.025	33.628	5597.96
East Asia & Pacific (=2.152)	0.530***	0.022	24.538	3851.33
ECCAS (Central Africa) (=2.828)	−0.144**	0.037	−3.942	2518.25
East African Community (=2.791)	−0.109***	0.031	−3.523	4793.75
SADC (Southern Africa) (=2.657)	0.024	0.027	0.909	6630.32
Other SSA (=2.771)	−0.089**	0.041	−2.158	1219.46

Author's computation. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; Figures in parenthesis refer to the tariff equivalent trade cost (τ_{ij}) index for that region.

bilateral relative trade cost measure computed from Eq. (4) for bilateral trade partners belonging to ECOWAS, ECCAS, SADC, and EAC stands at 174.4, 177.0, 174.3, and 153.1% respectively.

In the case of ECOWAS trade with non-member countries within SSA, the computed average bilateral relative trade cost measure based on ECOWAS trade with ECCAS, SADC, EAC, and other non-SSA member countries stood at 223.7, 349.7, 407.1, and 271.8% respectively. A similar trend is observed for the other blocs. The test for the statistical significance of the difference indicates that intra-ECOWAS trade costs is significantly lower compared with the costs of ECOWAS member countries trade with other countries from SSA. A similar trend was observed for other RECs (see Table 6).

The implication is that within ECOWAS (as in other RECs), bilateral trade cost relative to domestic trade costs was significantly lower for member countries within the sub-region compared with that of bilateral trade with non-member countries from SSA. This is indicative of increased trade within the sub-region among members relative to trade with outside. This is entirely consistent with the evidence from the literature indicating that regional integration does reduce trade costs and thereby creates increased trade among member countries.

5.1.3. Estimates of trade cost function — ECOWAS

Table 7 presents the regression results obtained by estimating Eq. (6). The dependent variable is the logarithmic of the bilateral relative trade cost measure, $\ln(\tau)$ obtained from computing Eq. (5) in the first part of the analytical framework. Columns 1, 3, and 5 report the results for the 1980s, 1990s, and the full sample period 1980–2003 respectively. These pooled OLS regression results do not include additional fixed effects to control for multilateral resistance.

Table 6
Test for differences in within-region and between-region average bilateral relative trade costs in SSA (1980–2003).

Sub-region	ECOWAS	ECCAS	SADC	EAC
	Mean = 1.744	Mean = 1.770	Mean = 1.743	Mean = 1.531
ECOWAS (West Africa)		−0.467*** (0.174)	−1.755*** (0.140)	−2.540*** (0.171)
ECCAS (Central Africa)	−0.493*** (0.109)		−1.644*** (0.215)	−1.754*** (0.135)
SADC (Southern Africa)	−1.754*** (0.135)	−1.617*** (0.251)		−2.327*** (0.154)
EAC (East Africa)	−2.327*** (0.154)	−2.419*** (0.247)	−0.576*** (0.101)	
Non-SSA	−0.974*** (0.058)	−1.087*** (0.150)	−0.963*** (0.070)	−1.283*** (0.096)

Author's computation. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$; Standard errors are shown in parenthesis. Figures are differences in relative index. The figures are the differences in the within-region and between-region trade costs, with standard errors in parentheses. The mean values on top of columns 2 to 5 represent the average bilateral relative trade cost within that region.

Table 7
Pooled OLS estimates of the trade cost function — ECOWAS.

Trade costs proxies	1980–89		1990–1999		Full sample	
	(1)	(2)	(3)	(4)	(5)	(6)
Log of distance *ij*	0.183***	0.221**	0.139**	0.161**	0.133***	0.168**
	(0.065)	(0.093)	(0.067)	(0.064)	(0.044)	(0.074)
Landlockedness *ij*	0.027	0.042	0.144*	0.164***	−0.06	−0.004
	(0.057)	(0.065)	(0.078)	(0.049)	(0.046)	(0.096)
Contiguity (adjacency) *ij*	−0.077	−0.273***	−0.09	−0.056	−0.115*	−0.392**
	(0.077	(0.07)	(0.119)	(0.051)	(0.067)	(0.17)
Common language *ij*	−0.111	0.119	−0.208	−0.262***	−0.208***	−0.229***
	(0.105)	(0.225)	(0.126)	(0.054)	(0.071)	(0.09)
Common currency *ij*	−0.135	−0.322**	−0.227	−0.402***	−0.146	−0.325***
	(0.115	(0.158)	(0.168)	(0.099)	(0.113)	(0.087)
Common legal origin *ij*			−0.367***	−0.260**	−0.036**	−0.043**
			(0.134)	(0.117)	(0.015)	(0.018)
Constant	−0.577	−0.987	0.603	−0.331	−0.289	−0.696
	(0.438)	(0.691)	(0.497)	(0.436)	(0.306)	(0.51)
Country and time fixed effects	No	Yes	No	Yes	No	Yes
R-squared	0.213	0.728	0.196	0.714	0.148	0.74
N	104	104	82	82	206	206

The dependent variable is the logarithmic tariff equivalent bilateral trade costs $\ln(\tau_{ij})$. Robust standard errors are given in parentheses. Country and time fixed effects in columns 2, 4, and 6 not reported for brevity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

For completeness, columns 2, 4, and 6 reports pooled regression results after controlling for country and time fixed effects. This increases the R^2 from a range 15–21% to about 74% for the full sample. The high explanatory power gives an indication that over two-thirds of the variations in the estimates of the computed relative average trade cost obtained for ECOWAS member countries are explained by observed trade cost proxies. The high explanatory power also gives an indication of the low impact of tariffs on trade costs within the sub-region. It is however unclear whether the country and time fixed effects have picked up trade cost elements that are difficult to observe such as corruption, red tapeism, and product and/or technical barriers to trade.

As shown in Table 7, the trade cost proxies (i.e., regressors) have the expected signs whenever they are significant. Bilateral distance is positively related to trade costs, whereas adjacency lowers trade costs within the ECOWAS sub-region.

In addition, trading relationships involving landlocked countries within the sub-region was associated with higher trade costs over the period 1990–1999 since those countries do not access to the sea and traditionally tend to rely on road and rail transport for international commerce. The use of a common currency and language lowers trade costs within ECOWAS. This is so because common currency and language facilitate bilateral transactions and often reflect common colonial heritage between the trading pair of countries within the sub-region. Common legal origin included here as a proxy for institutional trade costs is found to lower trade costs within ECOWAS, giving an indication that trading pair of ECOWAS countries with the same colonial background trade at a lower cost (see Table 7).

6. Conclusion

This paper is an empirical application of the micro-founded measure of trade costs by Novy (2013). Following closely Turkson (2012), this paper concentrates on ECOWAS trade costs and its implication for member countries trade within the sub-region. The micro-founded measure captures all trade cost components that hitherto have been impossible to include in the gravity framework because of severe data limitations and the impracticability of measuring some of the trade cost components. This measure, consistent with leading trade theories such as the Ricardian and heterogeneous firm models, offered an enormous opportunity to expand the trade cost literature in SSA.

The empirical application to ECOWAS shows interesting results that are consistent with evidence from other related studies. The bilateral relative trade cost measure computed for ECOWAS clearly indicates that on average ECOWAS countries traded among each other at a lower cost than with bilateral trading partners from other SSA RECs probably because of the positive impact of regional trade integration efforts and promotion of intra-ECOWAS trade especially with regard to export of manufactures. This gives an indication of the trade creation impact of RTAs within SSA, and confirms the findings from other related studies on the potential impact of RTAs on bilateral trade flows within SSA.

With regards to accounting for variations in the computed measure of trade costs, the estimates obtained support the literature on the contribution of trade cost proxies to trade costs. Within the ECOWAS sub-region whereas distance is found to increase trade costs, the results indicate that artificial trade frictions such as common currency, language, and legal origin lower trade costs. Natural frictions such as adjacency and landlockedness are also found to lower trade costs.

For member countries of ECOWAS, the estimates obtained have two main implications for its trade within the sub-region and the rest SSA. First with regard to trade within SSA, the estimates obtained for ECOWAS countries give an indication that members will gain more in trading its manufactures within the ECOWAs sub-region than in trading with countries from elsewhere especially other sub-regions within SSA. Secondly, within ECOWAS trade costs with landlocked countries within the sub-region should be expected to be higher partly as a result of poor transport infrastructure and time-consuming customs procedures.

The results also show the need for policy makers within the sub-region to identify and reduce the trade barriers associated with trading within the ECOWAS sub-region, especially so because members trade at relatively lower costs with other former British and French colonies within the sub-region. Probably the ECOWAS commission can facilitate this process. In addition, the present results suggest that attaining a common currency may be beneficial for trade within the region. Of course, the effectiveness of the common currency in promoting trade within ECOWAS will depend crucially on the synchronization of monetary and fiscal policies within the sub-region.

Appendix A

Table A1
Trading across border costs — within ECOWAS and across regions in 2014.

Regional group	(US$/container) Cost to		Number of documents to		Time (days) to	
	Export	Import	Export	Import	Export	Import
ECOWAS	***1558.3***	***2087.8***	***7.2***	***8.6***	***26.1***	***31.2***
Landlocked ECOWAS	3073.3	4456.7	8.0	11.0	14.0	48.0
Coastal ECOWAS	1179.5	1495.6	7.0	7.9	22.3	27.0

(continued on next page)

Table A1 (*continued*)

Regional group	(US$/container) Cost to		Number of documents to		Time (days) to	
	Export	Import	Export	Import	Export	Import
SSA	**2183.5**	**2904.0**	**7.6**	**8.9**	**30.2**	**37.5**
OECD	1067.3	1097.0	3.8	4.4	10.4	9.7
European Union (EU)	1042.1	1079.5	4.1	4.6	11.6	10.6
Rest of Europe and Central Asia	2481.9	2821.9	7.6	8.7	26.2	28.9
E. Asia & Pacific	884.4	872.1	6.1	6.7	20.0	22.1
L. America & Caribbean	1378.6	1748.5	5.6	6.7	16.4	18.2
M. East & N. Africa	1166.4	1307.0	6.1	7.9	19.5	23.8
South Asia	1578.1	1784.4	7.8	9.3	28.4	30.1

Source: World Bank, Doing Business 2015.

Table A2
Estimates of tariff equivalent overall average relative trade cost.

Year	Region/Bloc							
	SSA	EU	NA	E&CA	EAP	LAC	SA	MENA
1980	254.3	192.5	202.7	242.7	221.6	261.5	235.8	232.1
1981	258.6	198.1	198.9	249.0	223.7	276.7	247.6	253.8
1982	265.6	198.8	199.0	253.8	223.3	269.5	250.3	254.5
1983	259.1	197.6	191.1	249.2	218.0	274.2	247.0	246.3
1984	257.5	196.7	190.8	243.4	217.1	267.7	252.4	234.4
1985	264.7	196.1	189.2	247.9	214.5	267.1	238.7	250.2
1986	261.7	196.2	190.3	254.8	222.4	261.5	251.6	257.2
1987	256.5	195.0	185.2	240.6	214.4	258.6	244.7	251.5
1988	264.1	192.9	180.5	236.8	212.1	259.9	233.5	246.1
1989	274.5	191.0	186.8	238.2	213.8	259.1	240.4	237.6
1990	270.4	193.5	186.8	237.5	213.2	259.3	235.4	249.7
1991	276.2	199.1	187.2	245.2	214.2	262.5	233.1	251.3
1992	278.2	201.7	179.3	269.6	217.2	261.6	228.2	249.0
1993	277.9	200.5	193.9	249.9	214.9	260.4	255.9	251.2
1994	278.1	198.6	187.8	242.0	213.6	254.4	247.4	259.7
1995	275.6	193.9	177.8	232.5	212.1	251.4	232.6	255.5
1996	270.1	194.1	183.2	229.1	207.3	255.2	222.7	254.6
1997	278.4	190.2	175.8	225.6	214.5	246.1	232.2	247.7
1998	279.9	192.7	175.8	220.8	221.0	249.8	229.3	252.3
1999	276.5	187.8	176.9	224.4	213.8	245.6	225.1	248.0
2000	286.6	188.9	175.2	231.6	210.8	243.5	209.9	251.2
2001	294.3	192.4	184.9	225.3	219.1	257.9	212.0	248.8
2002	282.3	185.1	183.9	229.7	208.6	252.7	229.6	232.5
2003	257.9	180.0	154.7	230.2	205.1	251.3	181.0	238.9
Period averages								
1980–84	259.0	196.7	196.5	247.6	220.7	269.9	246.6	244.2
1985–89	264.3	194.2	186.4	243.7	215.4	261.2	241.8	248.5
1990–94	276.2	198.7	187.0	248.8	214.6	259.6	240.0	252.2
1995–99	276.1	191.7	177.9	226.5	213.7	249.6	228.4	251.6
2000–03	280.3	186.6	174.7	229.2	210.9	251.4	208.1	242.9

SSA (Sub-Saharan Africa), EU(European Union), NA (North America), E&CA (Non-EU Europe and Central Asia), EAP (East Asia and the Pacific), LAC (Latin America and the Caribbean) and MENA (Middle East and North Africa).

Table A3
Estimates of tariff equivalent overall relative trade cost — SSA RECs.

	Region/Bloc				
Year	SSA	ECOWAS	SADC	EAC	ECCAS
1980	254.3	244.5	267.3	258.7	244.6
1981	258.6	247.8	271.6	272.1	245.8
1982	265.6	260.2	264.7	291.5	254.9
1983	259.1	264.5	249.6	271.1	254.3
1984	257.5	246.8	252.9	273.5	264.6
1985	264.7	277.4	253.0	274.3	261.9
1986	261.7	262.1	252.0	274.5	284.6
1987	256.5	255.3	246.6	264.2	285.0
1988	264.1	269.1	258.9	261.2	294.9
1989	274.5	274.4	258.7	304.8	272.6
1990	270.4	265.8	264.8	276.0	283.9
1991	276.2	294.1	263.8	268.9	295.7
1992	278.2	291.3	260.3	295.2	293.6
1993	277.9	282.8	271.1	288.7	290.1
1994	278.1	272.3	280.9	274.7	297.7
1995	275.6	266.5	290.7	270.1	274.0
1996	270.1	268.0	263.2	274.7	300.0
1997	278.4	274.0	284.6	282.4	283.5
1998	279.9	275.0	279.8	288.0	276.0
1999	276.5	281.9	258.6	280.7	306.8
2000	286.6	282.0	274.5	296.7	331.6
2001	294.3	285.7	284.6	297.8	327.1
2002	282.3	286.8	253.0	310.4	322.1
2003	257.9	232.8	257.5	294.3	328.0
1980–2003	271.5	268.2	265.7	279.1	282.8

Appendix B. Derivation of micro-founded bilateral trade cost measure

The theory-based gravity equation, an enhanced conditional general equilibrium model, is of the form:

$$x_{ij} = \frac{y_i y_j}{y^w}\left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma} \quad \text{(i)}$$

Where, $$t_{ij} = \sum_{m=1}^{M}\left(z_{ij}^{m}\right)^{\gamma m} \quad \text{(ii)}$$

where x_{ij} is nominal exports from country i to j; y_i and y_j is the nominal income (GDP) of exporter i and importer j respectively; y^w is nominal world income (total world GDP); t_{ij} is the bilateral trade costs, σ is the elasticity of substitution among goods; Π_i and P_j are outward and inward multilateral resistance variables respectively. In addition z_{ij}^{m} (m = 1… M) is a set of observables to which bilateral trade frictions/barriers are related, and γ is a vector of unknown parameters to be estimated.

Following from Eq. (i), Novy specifies country i's domestic trade flow as:

$$X_{ii} = \frac{y_i^2}{y^w}\left(\frac{t_{ii}}{\Pi_i P_i}\right)^{1-\sigma} \quad \text{(iii)}$$

where x_{ii} and t_{ii} are domestic (intra-national) trade flows and trade costs respectively of country i. From Eq. (iii), the product of the multilateral resistance variables relative to domestic trade costs can be solved as:

$$\Pi_i P_i / t_{ii} = \left(\frac{X_{ii} / y_i}{y_i / y^w} \right)^{1/\sigma - 1} \tag{iv}$$

As indicated in Eq. (iv), if domestic trade flows in country i (t_{ii}) is known, then given nominal income in country i (y_{i}), world income (y^w), and the elasticity of substitution (σ), the multilateral trade resistance variables Π_i and P_i would be known. Similarly for country j:

$$\Pi_j P_j / t_{jj} = \left(\frac{X_{jj} / y_j}{y_j / y^w} \right)^{1/\sigma - 1} \tag{v}$$

Clearly, Eqs. (iv) and (v) show that, given the elasticity of substitution, multilateral trade resistance relative to domestic trade costs does not depend on time-invariant proxies but rather easily observable time-varying trade data. The explicit solution for the multilateral resistance variables can be used to solve for bilateral trade costs from the general equilibrium model. To do this, Novy (2013) obtained a bidirectional gravity equation by multiplying corresponding gravity equations for domestic/internal trade flows from opposite direction (i.e., $X_{ij}X_{ji}$).

That is:

$$X_{ij} X_{ji} = \frac{y_i y_j}{y^w} \left(\frac{t_{ij}}{\Pi_i P_j} \right)^{1-\sigma} \left[\frac{y_j y_i}{y^w} \left(\frac{t_{ji}}{\Pi_j P_i} \right)^{1-\sigma} \right] = \left(\frac{y_i y_j}{y^w} \right)^2 \left(\frac{t_{ij} t_{ji}}{\Pi_i P_i P_j \Pi_j} \right)^{1-\sigma} \tag{vi}$$

From Eqs. (iv)–(vi):

$$X_{ij} X_{ji} = \left(\frac{y_i y_j}{y^w} \right)^2 \left[\frac{t_{ij} t_{ji}}{\left[\left(\frac{X_{ii} / y_i}{y_i / y^w} \right)^{1/\sigma - 1} t_{ii} \right] \left[\left(\frac{X_{jj} / y_j}{y_j / y^w} \right)^{1/\sigma - 1} t_{jj} \right]} \right]^{1-\sigma} = X_{ii} X_{jj} \left(\frac{t_{ii} t_{jj}}{t_{ij} t_{ji}} \right)^{\sigma - 1} \tag{vii}$$

Re-arranged

$$\frac{t_{ij} t_{ji}}{t_{ii} t_{jj}} = \left(\frac{X_{ii} X_{jj}}{X_{ij} X_{ji}} \right)^{1/\sigma - 1} \tag{viii}$$

Taking a geometric mean of trade costs in both directions minus one, Eq. (viii) becomes:

$$\tau_{ij} = \left(\frac{t_{ij} t_{ji}}{t_{ii} t_{jj}} \right)^{1/2} - 1 = \left(\frac{X_{ii} X_{jj}}{X_{ij} X_{ji}} \right)^{1/2(\sigma - 1)} - 1 \tag{ix}$$

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