International Journal of Development and Sustainability
ISSN: 2186-8662 – www.isdsnet.com/ijds
Volume 13 Number 3 (2024): Pages 150-173
ISDS Article ID: IJDS23060101

International trade and migration linkages between Africa and its trading partners

Nicholas Ngepah *, Mody Iliassa Barry, Mduduzi Biyase, Charles Shaaba Saba

School of Economics, College of Business and Economics, University of Johannesburg, Auckland Park Kingsway Campus, Johannesburg, South Africa

Abstract

Although there has been a good deal of research investigating the immigration-trade nexus in developed countries, very few studies have been conducted for Africa and its trading partners. This paper employs a panel data on migrant stock and trade flows to investigate the extent to which migration impacts trade on a set of 52 African countries and 116 trading partners. Employing the Poisson Pseudo-Maximum Likelihood (PPML) to estimate the Gravity Model on trade, we find that migration (sending and receiving migrants) has a positive and significant impact on all trade components (export, import, and total trade). Like many other studies, our findings show that migration impacts more exports than imports and total trade.

Keywords: Trade; Migration; Gravity Model; Africa

Classification Code: C23; F10; F22; O55

Cite this article as: Ngepah, N., Barry, M.I., Biyase, M. and Saba, C.S. (2024), "International trade and migration linkages between Africa and its trading partners", *International Journal of Development and Sustainability*, Vol. 13 No. 3, pp. 150-173.

* Corresponding author. *E-mail address:* sabacharlesshaaba@yahoo.com

1. Introduction

International migration from developing countries (especially sub-Saharan countries) has increased substantially over the past years. An estimated 272 million people (3.5% of the world population) are living outside their country of birth, representing an increase of 179 million over 59 years (from 93 million in 1960 to 272 million in 2019). According to the IOM (2019), migration in Africa involves approximatively equal numbers of migrants moving either within or out of the continent. In 2019, there were about 21 million Africans living in another African country which represents an increase of 2.5 million for the last five years (2015-2019), while the number of Africans living outside the continent grew from 17 million in 2015 to almost 19 million representing an increase of 2 million people during the same period (IOM, 2019).

In terms of intra-African migration, in 2017, countries like South Africa and Côte d'Ivoire were the leading destinations for African migrants with 2.2 million and 2.1 million migrants respectively, while countries such as Uganda, Ethiopia, Nigeria, and Kenya, received more than one million migrants (UNCTAD, 2018). Even if the number of African migrants living outside the continent is lower than those of migrants living in Africa, there is an increase in the number of migrants living in other parts of the world. Most of the African migrants living outside the continent reside in Europe (10.6 million), Asia (4.6 million), and North America (3.2 million). Egypt, Morocco, South Sudan, Somalia, Sudan and Algeria have the largest number of immigrants. The number of migrants born outside Africa and living on the continent is still small and unchanged, standing at 2 million migrants during the period 2015-2019. These migrants are mainly from Europe and Asia (IOM, 2019).

The increase in international migration has prompted a great deal of debate about the economic impact of migration. Some work focuses on migration-growth nexus (see Barro and Sala-i-Martin, 1992), the effect of immigration on wage inequality (see Card, 2009), and the migration-poverty link (Cattaneo, 2005). While the impact of migration on these issues has secured a fair amount of consensus among economists, it is only recently that the migration-trade nexus, usually traced back to the pioneering work of Gould (1994), has become a topic of interest among economists.

Research on the impact of migration on trade has generally found a positive and significant relationship between these variables. Specifically, international migration is found to positively influence trade between migrant sending and receiving countries (Gould 1994; Head and Ries 1998; Girma and Yu 2002). While many studies in this field point to a positive impact of migration on trade (see Hatzigeorgiou, 2010; Tadesse and White, 2011; Bratti et al., 2014; Tadesse and White, 2013), there is limited consensus among scholars (i.e. the estimates vary depending on the sample of countries, method employed, and the period) regarding the size of the impact and — export/import elasticities, suggesting a need for further research in this field. Thus, the aim of this study is to investigate the migration-trade nexus on a set of 52 African countries and 116 of their trading partners for the period 1995 to 2017. The sample of countries included in this analysis is based on data availability.

Unlike previous studies, we employ all three measures of trade (import, export and total trade). These measures offer nuanced insight regarding the effect that migration might have on trade in the countries in question. The contribution of this analysis is two-fold. 1) Use all three measures of measures of trade (import, export and total trade) not commonly used in the existing literature. 2) the study employs Pooled (OLS), the Fixed Effect (LSDV) and Poisson Pseudo-Maximum Likelihood (PPML) to account for both heteroscedasticity and zero-trade flows at the same time. The remaining parts of this study are structured as follows: Section 2

reviews the existent literature while sections 3, 4, 5 and 6 present the methodology, discuss the empirical results, the study's limitations and the conclusion respectively.

2. Literature review

The existing empirical literature on the immigration-trade nexus was prompted by Gould (1994) with his influential work entitled "Immigration Links to the Home Nation: Empirical Implications for US Bilateral Trade Flows". Since Gould's (1994) seminal work, many scholars have investigated the impact that immigration/migration may have on trade flows between countries (see, for example, Head and Rises, 1998; Partridge and Furtan, 2008; Hunt and Gauthier-Loiselle, 2010; Ozgen et al., 2012; Egger et al., 2012; Rashidi and Pyka, 2013). Two key channels through which migrants affect trade have been identified in the literature. "First, there is an information effect in that migrant networks help reduce transaction costs in trade by mitigating information asymmetries and inadequate contract reinforcement. Second, there is a demand effect as immigrants help stimulate trade by demanding goods from their country of origin" (Lin and Yang, 2017:2). These channels are premised on an important theoretical contribution of Markusen (1983) who took a strong view against conventional belief that international migration is not good for trade. Fundamental to his theoretical contribution is the idea of "home market effects," where he persuasively argue that the arrival of migrants' immigrants helps to influence demand for goods from the country of origin, thereby increasing trade. Moreover, he argues that multinational corporations that have a global footprint can influence resources to facilitate cross-border trade. Thus, Markusen's theoretical contribution offers a nuanced viewpoint, underscoring the manner in which international migration can bring about openings for bigger economic exchange instead of restraining it.

These channels plus other migration related factors influence the size of the import and export effects of migration (see Nijkamp et al., 2011 for detailed account of these factors). Of course, the degree to which they influence trade depends very much on the migrant characteristics i.e. their skills levels and how long they plan to stay (see Ching and Chen, 2000; Rauch and Trindade, 2002).

Table 1 presents a summary of the study's literature review showing the relationship between trade and migration. It reveals that elasticities tend to vary from one study to another, with some studies reporting higher export elasticities than import elasticities (see Gould, 1994; Helliwell, 1997; Girma and Yu, 2002; Piperakis et al., 2003; Blanes, 2006; Faustino and Peixoto, 2013; Briant et al., 2014). Specifically, the average elasticity impact of migration stock on exports, imports and total trade is about 0.2, 0.29 and 0.27 respectively. For studies finding that migration impacts more on exports than on imports, the average elasticity is about 0.27, while those finding that migration impacts more on imports have an average elasticity of 0.4.

In his 1994 paper, Gould investigated the relationship between trade and migration, employing panel data covering the USA and their 47 trading partners from 1970 to 1980. The study considers two fundamental mechanisms for this link. Firstly, migrants bring their preferences for their home-country products and secondly, they bring information from foreign markets and their connection which implies the possibility of decreasing transaction costs. Estimating the natural logarithm of trade on migration, the Gould (1994) findings demonstrate that imports are less affected by migration than exports. Similarly, Girma and Yu (2002) employ the gravity model to assess the trade-migration linkages between the UK and its 48 trading partners covering 13 years. Their findings demonstrate that migration impacts more on exports than on imports. Other studies

report opposite estimates (see Head and Ries, 1998; Wagner et al., 2002; Bryant et al., 2004; Tai, 2009; Mundra, 2010; Hatzigeorgiou, 2010; Tadesse and White, 2011; Bratti et al., 2014; Tadesse and White, 2013). Using data from Switzerland, Tai (2009) assesses the extent to which migration impacts trade, while considering product differentiation. The study employs the gravity model estimated with PPML and OLS. The results demonstrate a positive relationship between migration and trade, showing that a 10% increase in the migrant stock raises exports and imports by 2.69% and 3.03% respectively.

Table 1. Elasticity of export and import to immigrants

Authors	Immigrants		Data	Immigrant elasticity	
	Host	Home		Export	Import
Gould (1994)	USA	47 Countries	Panel data (1970-1986)	0.02%	0.01%
Helliwell (1997)	9 Canadian Provinces	49 US states	Cross-sectional data	0.34%	0.06%
Head and Ries (1998)	Canada	136 Countries	Panel data (1980-1992)	0.1%	0.3%
Dunlevy and Hutchinson (1999)	USA	17 Countries	Panel data (1870-1910)	0.08%	-
Girma and Yu (2002)	UK	48 Countries	Panel data (1981-1991)	0.16%	0.10%
Wagner et al. (2002)	Canadian Provinces	160 Countries	Panel data (1992-1995)	0.08%	0.25%
Rauch and Trindade (2002)	120 Countries	China	Panel data (1980-1990)	0.21%-0.47%	-
Blanes (2003)	Spain	40 Countries	Panel data (1981-1998)	0.23%	0.03%
Piperakis et al. (2003)	Greece	60 Countries	Panel data (1981-1991)	0.2%	-0.04%
Bryant et al. (2004)	New Zealand	170 Countries	Panel data (1981-2001)	0.05%	0.19%
Herander and Saavedra (2005)	50 US states	36 Countries	Panel data (1993-1996)	0.18%	-
Dunlevy (2006)	50 US states	86 Countries	Cross-Sectional data	0.24%-0.47%	-
Blanes (2006)	Spain	83 Countries	Panel data (1995-2003)	0.35%	0.23%
Lewer (2006)	16OECD Countries	125 Countries + 16 OECD Countries	Panel data (1991-2000)	0.131% total trade flows	
Blanes and Martin-Montaner (2006)	Spain	48 Countries	Panel data (1988-1999)	0.47% total trade	
Felbermayr and Toubal (2008)	Unspecified	28 EU members	Cross-Sectional data	0.29% - 0.15% total trade	
Bandyopadhyay et al. (2008)	50 US states	29 Countries	Panel data (1990-2000)	0.27%	-
Tai (2009)	Switzerland	105 Countries	Panel data (1995-2000)	0.27%	0.3%
Hatzigeorgiou (2010)	Sweden	180 Countries	Panel data (2002-2007)	0.6%	0.9%

Table 1. *Cont.*

Authors	Immigrants		Data	Immigrant elasticity	
	Host	Home		Export	Import
Peri and Requena-Silvente (2010)	50 Spain Provinces	77 Countries	Panel data (1995-2008)	0.05%-0.1%	-
Mundra (2010)	USA	63 Countries	Panel data (1991-2000)	0.27%	0.48%
Tadesse and White (2011)	110 Countries	131 Countries	Cross-Sectional data	0.14%	0.17%
Tadesse and White (2013)	110 Countries	43 African countries	Cross-Sectional data	0.132%	0.259%
Faustino and Peixoto (2013)	Portugal	27 EU members	Dynamic & Static data analysis	0.624%	0.56%
Briant et al. (2014)	France	94 French Dep.	Panel data (1998-2000)	0.25%	0.14%
Bratti et al. (2014)	Italy	187 Countries	Cross-sectional data	0.5%	0.8%
Metulini et al. (2018)	232 countries	232 countries	Panel data (1960-2000)	0.113%	-

Reaching a similar conclusion, Tadesse and White (2013) found that migration impacts more on imports than on exports. They investigated the effect of African migrants on their host and home countries' trade. Employing the Tobit estimator on a sample of 43 African countries with migrant stock residing in 110 host countries, they find that 1% growth in the African migrants in a particular host country increases that country's imports and exports by 0.259% and 0.132% respectively. In his recent paper Ekakkararungroj et al. (2022), used a static panel gravity model covering the period 1990 to 2020, investigating how migration influences trade. In particular, looking at exports, imports, and intra-industry trade—across the 10 ASEAN member countries. They found evidence to suggest that immigration positively influence import while refuting the existence of a pro-export immigrant effect. Groizard and Martín-Montaner (2023) study investigated the relationship between immigration and trade utilizing Spanish province data. They found that migrants bring about an increase shipment, mostly owing to formal institutions, whereas it reduces average shipment values irrespective of importing countries' regulations.

Diverse elements can explain the variation of elasticity estimates in the trade-migration literature. To estimate the impact of migration on trade for different countries, authors use different econometric techniques, specifications and datasets covering different periods. Host countries' immigration and trade policies may cause this variation. The migration impact on trade is lowered for homogenous goods since the impact of migrant preferences is expected to be less. The analysis of the prevailing studies reveals consistent trends and underscores a rather enthralling inconsistencies that appear to typify many studies in this field. Although most studies point to a positive relationship between migration and trade, the nuanced incongruities in elasticities reveal different dimensions of complexity to this relationship. The discrepancies concerning the methods employed across studies, dataset sources, sample of countries and different control variables suggest a definite need for a more refined and comprehensive analysis. There is also a noticeable emphasis on developed

countries and single-country analyses, leaving a rather gripping gap for studies that incorporates both poor and relatively rich nations and employs a continuum of econometric approaches. Our study will attempt to contribute to this extant literature by investigating the migration-trade nexus in Africa and its trading partners, tackling methodological nuances, and presenting insights into the implications for trade dynamic forces.

3. Methodology

The gravity model is the basic functional framework for the analysis of trade and migration flows. It is largely applied to analyse the determinants of trade and bilateral migration flows (Ngepah and Udeagha, 2019). The preference for the gravity model resides in the clarity and simplicity of its practical application (see Baier and Bergstrand, 2007; Ngepah and Udeagha, 2019). Some authors have shown the different merits of the gravity model. For instance, Learner and Levinsohn (1995) demonstrated that contrary to other models, the gravity model is less associated with omitted variable biases and simultaneity biases. However, the empirical derivation of the gravity model requires consistent datasets to estimate bilateral migration and trade flows (see Martinez-Zarzoso, 2003; Ngepah and Udeagha, 2019).

3.1. The basic gravity model

Based on the migrant-trade relationship literature, we used a variant of the gravity model where bilateral trade activities (TR_{ijt}: export, import, or total trade) existing between migrants' host countries (*j*) and their origin countries (*i*) are defined as a positive relationship between countries' economic mass or GDP (Y_i Y_j) and a negative link with the geographical remoteness (D_{ij}) separating country pairs (Anderson and Van Wincoop, 2004). This model is illustrated by equation (1):

$$TR_{ijt} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} D_{ij}^{\beta_3} \quad (1)$$

where β_1, β_2 and β_3 are coefficients which capture the effect of our independent variables and β_0 is the intercept.

3.2. The Augmented Gravity Model

Following Anderson and Van Wincoop (2004) and Ngepah and Udeagha (2019), we applied the natural logarithm on equation (1) to which we added the error term ε_{ijt} (independently and identically distributed) and got equation (2).

$$\ln TR_{ijt} = \beta_0 + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_3 \ln D_{ij} + \varepsilon_{ijt} \quad (2)$$

Estimating equation (2) was not without challenges, including the omitted variables bias which generally arises from ignoring the multilateral trade resistance (MTR) terms (Koch and LeSage, 2015). According to Anderson and Van Wincoop (2003), the traditional least square estimates of the gravity model are biased as the multilateral trade resistance terms were ignored. To account for the MTR terms in the gravity model equations two methods are employed (see Head, 2003; Anderson and Van Wincoop, 2004; Ngepah and Udeagha, 2019). The first technique consists of computing the suitable economic remoteness term. At time *t*, the economic remoteness (*Rem*) existing between countries *i* and *j* is computed as follows (see Tadesse et al. 2013, Ngepah and Udeagha, 2019):

$$\mathrm{Rem_{it}} = \sum_{\mathrm{i}} \frac{\mathrm{Dist_i}}{\mathrm{GDP_{it}}/\mathrm{GDP_w}} \quad (3)$$

where Dist_i represents the distance separating the two countries' capital cities. GDP_w represents the world gross domestic product, and GDP_i is the country *i* gross domestic product. The second technique consists of modelling the multilateral trade resistance by computing exporter-time and importer-time dummies when dealing with panel data or simply as exporter and importer dummies when it comes to cross-sectional data. In this study, we estimated the multilateral trade resistance by employing the first technique.

Adding both Multilateral Trade Resistance terms (MRT) and our variables of interest M_{ij} and M_{ji} which are the migrant stock in both trading partners *i* and *j* and other control variables to equation (2) we obtained equation (4) below:

$$\ln TR_{ij} = \beta_0 + \beta_1 \ln \mathrm{Y_{it}} + \beta_2 \ln \mathrm{Y_{jt}} + \beta_3 \ln \mathrm{D}_{ij} + \beta_4 \ln \mathrm{Pop_{it}} + \beta_5 \ln \mathrm{Pop_{jt}} + \beta_6 \ln \mathrm{Open_{it}} + \beta_7 \ln \mathrm{Open_{jt}} + \beta_8 \ln \mathrm{M_{ij}} + \beta_9 \ln \mathrm{M_{ji}} + \beta_{10} \mathrm{Rem_i} + \beta_{11} \mathrm{Rem_j} + \beta_{12} \mathrm{Comlang_{ij}} + \beta_{13} \mathrm{Border_{ij}} + \beta_{14} \mathrm{Llocked_i} + \beta_{15} \mathrm{Llocked_j} + \varepsilon_{ijt} \quad (4)$$

where:

$\ln(\mathrm{TR}_{ij})$:	Stands for bilateral trade (export, import or total trade) between countries *i* and *j.*
β_0:	Represents the intercept of the equation.
$\ln(\mathrm{Y}_{it})$:	Denotes the logarithmic form of the exporting country's GDP for a given period (*t*).
$\ln(\mathrm{Y}_{jt})$:	Stands for the logarithmic form of the importing country's GDP for a given period *(t).*
$\ln(\mathrm{D}_{ij})$:	Is the geographical distance separating exporting country *(i)* to importing country *(j)*
$\ln(\mathrm{Pop}_{it})$:	Stands for the exporting country's population size expressed in its logarithmic form.
$\ln(\mathrm{Pop}_{jt})$:	Represents the importing country's population expressed under its logarithmic form.
$\ln(\mathrm{Open}_{it})$:	Denotes the logarithmic form of the exporting country *(i)* trade openness.
$\ln(\mathrm{Open}_{jt})$:	Stands for the logarithmic form of the importing country *(j)* trade openness.
$\ln(\mathrm{M}_{ij})$:	Is the logarithmic form of the migrant stock from country *(i)* residing in country *(j)*
$\ln(\mathrm{M}_{ji})$:	Is the logarithmic form of the migrant stock from country (j) residing in country (i).
$\ln(\mathrm{Rem}_{it})$:	Represents the logarithmic form the exporting country's economic remoteness.
$\ln(\mathrm{Rem}_{jt})$:	Represents the logarithmic form of the importing country's (j) economic remoteness.
$\mathrm{Comlang}_{ij}$:	Dummy variable taking the value 1 when country (i) and country (j) have a common official language, 0 otherwise.
Border_{ij}:	Dummy variable taking the value 1 when two countries share borders, 0 otherwise.
$\mathrm{Llocked}_i$:	Dummy variable taking the value 1 when country i is land-locked, 0 otherwise.
$\mathrm{Llocked}_j$:	Dummy variable taking the value 1 when country j is land-locked, 0 otherwise.
ε_{ijt}:	Stands for the error term which is independently and identically distributed.

Based on equation (4), the estimated equations representing export, import and total trade are specified as follow:

$$\ln X_{ij} = \beta_0 + \beta_1 \ln \mathrm{Y_{it}} + \beta_2 \ln \mathrm{Y_{jt}} + \beta_3 \ln \mathrm{D}_{ij} + \beta_4 \ln \mathrm{Pop_{it}} + \beta_5 \ln \mathrm{Pop_{jt}} + \beta_6 \ln \mathrm{Open_{it}} + \beta_7 \ln \mathrm{Open_{jt}} + \beta_8 \ln \mathrm{M_{ij}} + \beta_9 \ln \mathrm{M_{ji}} + \beta_{10} \mathrm{Rem_i} + \beta_{11} \mathrm{Rem_j} + \beta_{12} \mathrm{Comlang_{ij}} + \beta_{13} \mathrm{Border_{ij}} + \beta_{14} \mathrm{Llocked_i} + \beta_{15} \mathrm{Llocked_j} + \varepsilon_{ijt} \quad (5)$$

$$\ln IM_{ij} = \beta_0 + \beta_1 \ln \mathrm{Y_{it}} + \beta_2 \ln \mathrm{Y_{jt}} + \beta_3 \ln \mathrm{D}_{ij} + \beta_4 \ln \mathrm{Pop_{it}} + \beta_5 \ln \mathrm{Pop_{jt}} + \beta_6 \ln \mathrm{Open_{it}} + \beta_7 \ln \mathrm{Open_{jt}} + \beta_8 \ln \mathrm{M_{ij}} + \beta_9 \ln \mathrm{M_{ji}} + \beta_{10} \mathrm{Rem_i} + \beta_{11} \mathrm{Rem_j} + \beta_{12} \mathrm{Comlang_{ij}} + \beta_{13} \mathrm{Border_{ij}} + \beta_{14} \mathrm{Llocked_i} + \beta_{15} \mathrm{Llocked_j} + \varepsilon_{ijt} \quad (6)$$

$$\ln Tr_{ij} = \beta_0 + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_3 \ln D_{ij} + \beta_4 \ln Pop_{it} + \beta_5 \ln Pop_{jt} + \beta_6 \ln Open_{it} + \beta_7 \ln Open_{jt} + \beta_8 \ln M_{ij} + \beta_9 \ln M_{ji} + \beta_{10} Rem_i + \beta_{11} Rem_j + \beta_{12} Comlang_{ij} + \beta_{13} Border_{ij} + \beta_{14} Llocked_i + \beta_{15} Llocked_j + \varepsilon_{ijt} \quad (7)$$

where X_{ij}, IM_{ij} and Tr_{ij} stand for export, import, and total trade respectively. Equations 5, 6, and 7 are estimated by the PPML, the Ordinary Least Square (OLS), and the Fixed Effects (LSDV). Keeping in mind that the OLS and the Fixed Effect (LSDV) would be the benchmark to which the PPML would be compared.

3.3. Data sources and variables

In this study, the dependent variables were the bilateral trade flows (export, import and total trade) between exporting country_*i* and the importing country_j expressed in their logarithmic forms and covering a 23-year period (1995-2017). These trade data (export and import) are from the United Nations Conference on Trade and Development (UNCTAD) database, while total trade (export + import) was computed. The independent variables came from different institutions and bodies.

Table 2. Data Variables and Sources

Variables	Proxy	Description	Source
TR_{ijt}	Trade flows (export, import, total trade)	The total trade volumes between countries *i* and *j*.	UNCTAD
GDP_exp	Gross Domestic Product	Exporter's GDP	WB
GDP_imp	Gross Domestic Product	Importer's GDP	WB
Pop_exp	Population	Exporter's Population size	WB
Pop_imp	Population	Importer's Population size	WB
Distw	Geographical distance	Geographical distance between trading partners	CEPII
Rem_exp	Economic Remoteness	Control for exporter's MTR	CEPII
Rem_imp	Economic Remoteness	Control for importer's MTR	CEPII
Open_exp	Trade Openness	Share of trade in exporter's GDP	UN
Open_imp	Trade Openness	Share of trade in importer's GDP	UN
M_ij(ji)	Migrant stock	Migrant stock from country i(j) living in country j(i)	UN
Comlangij	Common language	Dummy, equal to 1 if partners use the same language, 0 otherwise	CEPII
$Border_{ij}$	Contiguity	Dummy, equal to 1 if partners have the same border, 0 otherwise	CEPII
Llocked i(j)	Land locked	Dummy, equal to 1 if country i(j) is landlocked, 0 otherwise	CEPII

The *Centre d'Etudes Prospectives et d'Informations Internationales* (CEPII) database and the World Bank (WB) database provided an exhaustive data on populations and GDP for all countries of the world, while migrant stock and trade openness are from the United Nations (UN). The dataset covers a period of 23 years starting from 1995 to 2017. Table 2 reports a summary of variables and provides a concise description. The list of the countries used for this study can be found in Table 7 at the appendix.

3.4. Estimation methods

Scholars traditionally employ cross-sectional data to estimate the gravity equation. However, this technique does not adequately account for heterogeneity among trading partners which is not the case when panel data

is employed to estimate the gravity model. Nowadays, an increasing volume of the literature on gravity is estimated using panel data (Bobkova, 2012).

Many techniques have been applied to estimate the Gravity Model. Since Tinbergen's seminal work in the early 1960s, the OLS estimator is the most employed technique to estimate different versions of the gravity model equation. The main drawback of the OLS technique lies in the fact that it does not consider information containing zero trade flows. These observations are generally abandoned when the value of trade is changed into logarithm form (Yotov et al., 2016). As an econometric solution to the presence of zero trade flows, Eaton and Tamura (1995) and Martin and Pham (2015) suggest the Tobit estimation technique. Theoretically, the gravity model does not say anything about the Tobit estimation technique, which creates a disconnection between the theory and the empirical estimation. The Tobit model only works when small values of trade flows are rounded to zero, or the current zero trade flows represent chosen negative trade (Yotov et al., 2016).

According to Santos-Silva and Tenreyro (2006), applying ordinary OLS leads to inconsistent coefficients estimates. To address this issue, authors like Frankel and Wei (1993) applied the Non-linear Least Square (NLS). However, scholars are unanimous that the NLS technique has shown inefficiency in the presence of heteroscedasticity generally caused by the quality of the data since less developed countries have lower quality data compared to developed countries (Ngepah and Udeagha, 2019).Among all the techniques that we employed LSDV permits for the control of unobserved individual or time-specific factors that may be correlated with both the dependent variable and the endogenous regressors, thus mitigating endogeneity concerns.

Our preferred specification is PPML. The PPML presents the most suitable characteristics to estimate gravity models. A comparison with the OLS and LSDV estimators shows that the PPML deals better with the heteroscedasticity in the error term existing in the gravity model form of a logarithm (Santo-Silva and Tenreyro, 2006). The PPML is popular among scholars and is employed to study international trade and migration flows. It has been demonstrated that the PPML produces consistent estimates under the assumption that the conditional variance should be proportional to the conditional mean $V(y_i|x) \propto E(y_i|x)$ (see Santo-Silva and Tenreyro, 2006; Ngepah and Udeagha 2019). According to Santo-Silva and Tenreyro (2006), the usage of the PPML is straightforward since we have econometric programs that permit estimation of the Poisson regression even if the dependent variables are not integers. However, it must be acknowledged that the PPML does not account for the heteroscedasticity in the model since the assumption that the conditional variance should be proportional to the conditional mean $V(y_i|x) \propto E(y_i|x)$ is unlikely to hold. To handle this issue, the inference must be based on the Eicker-White robust covariance matrix estimator (Santos-Silva and Tenreyro, 2006).

This study incorporated three estimators: Pooled OLS (POLS), Least Squares Dummy Variables (LSDV), and Poisson Pseudo-Maximum Likelihood (PPML) in order to deepen the investigation and to cope with various difficulties associated with estimations in this field. This study commences with POLS which serve as a baseline, followed by LSDV which accounts for individual and time-specific effects, thereby offering a more nuanced appreciation of the relationship between migration and trade. The study ends off with PPML, tailor-made for count data and heteroscedasticity prevailing in gravity models. Using all the three methods helps to enable a broad investigation, promising robustness through diverse methods, tackling different data features.

4. Findings

4.1. Descriptive statistics

Before undertaking any empirical assessment of how migration impacts trade between African countries and their trading partners, the patterns and distribution of the dataset were analysed. The descriptive statistics in Table 3 present the patterns and distribution of the variables without considering their logarithmic form (a logarithmic form of the descriptive statistics is presented in the appendix (see Table 6).

Table 3 reveals that exporting African countries have a mean export value of US$ 35,999 million over the period 1995-2017, that the average import value is around US$ 36,747 million and the average exporter GDP is about US$ 26,728 million. The population average shows about 18.3 million inhabitants and the migrant stock (sending and receiving) are about 2,852 and 1,641 migrants, respectively.

Importers' average GDP and population size are respectively US$ 312,486 million and 38.8 million inhabitants. While the average distance separating countries is about 6,466 km, 2.23% of the countries in the sample share common borders and almost 23% of the countries in the sample have the same common official language. The standard deviations for annual imports and exports are US$ 277,876 and US$ 409,630 million respectively showing an important variation. The standard deviation for the distance separating trading partners is 3,475 km, exporter's and importer's GDP are US$ 62,804 million; US$1,273,721 million respectively, while exporter's and importer's population; 26.1 million and 138 million inhabitants respectively. Lastly, almost 29% of the exporting countries are landlocked, while only 21% of importing countries are landlocked.

Table 3. Descriptive Statistics

Variable	Obs	Mean	Std. Dev	Min	Max
Import (millions)	200,928	36,747.240	277,875.500	0	16,000,000
Export (millions)	200,928	35,998.700	409,630.400	0	33,700,000
Total trade (millions)	200,928	72,745.940	601,041.200	0	40,400,000
Exporters' Population	200,928	18,300,000	26,100,000	75,304	191,000,000
Importers' Population	200,928	38,800,000	138,000,000	69,670	1,390,000,000
Exporters' GDP (millions)	200,928	26,728.220	62,803.660	34	568,498.900
Importers' GDP (millions)	200,928	312,485.900	1,273,721	34	19,400,000
Distance (kilometres)	200,928	6,466.491	3,475.305	162.182	19,384.720
Contiguity	200,928	0.022	0.148	0	1
Common Language	200,928	0.227	0.419	0	1
Landlocked Exporters	200,928	0.288	0.453	0	1
Landlocked Importers	200,928	0.213	0.409	0	1
Exporters economic remoteness	200,928	2,145,647	2,769,168	50,355.570	41,700,000
Importers economic remoteness	200,928	62,700,000	172,000,000	18,366.900	5,550,000,000
Exporters trade openness	200,928	0.735	0.465	0.019	5.317
Importers trade openness	200,928	0.869	0.548	0.000	5.317
Immigrant_ij	200,928	2,852.131	33,908.070	0	3,811,120
Immigrant_ji	200,928	1,640.675	26,690.250	0	3,811,120

Table 4. Pairwise correlations

Variable	lnM	lnX	lnTr	lnPopi	lnPopj	lngdpi	lngdpj	lnDij	Cont	Lang	locki	lockj	lnRei	lnRej	lnOpi	lnOpj	lnM_ij	lnM_ji
lnM	1.00																	
lnX	0.53*	1.00																
lnTr	0.90*	0.83*	1.00															
lnPopi	0.22*	0.22*	0.24*	1.00														
lnPopj	0.35*	0.29*	0.36*	0.00*	1.00													
lngdpi	0.30*	0.30*	0.33*	0.75*	0.02*	1.00												
lngdpj	0.52*	0.36*	0.49*	0.02*	0.69*	0.08*	1.00											
lnDij	-0.09*	-0.07*	-0.12*	-0.06*	0.07*	-0.04*	0.24*	1.00										
Cont	0.12*	0.06*	0.12*	0.05*	0.03*	0.05*	-0.05*	-0.38*	1.00									
Lang	0.03*	0.05*	0.07*	-0.01*	-0.08*	0.01*	-0.14*	-0.23*	0.14*	1.00								
locki	-0.11*	-0.07*	-0.09*	0.09*	-0.00*	-0.13*	0.00	0.02*	0.01*	0.03*	1.00							
lockj	-0.18*	-0.12*	-0.16*	-0.00	-0.06*	0.00*	-0.24*	-0.13*	0.04*	-0.00*	-0.01*	1.00						
lnRei	-0.24*	-0.26*	-0.27*	-0.33*	-0.01*	-0.76*	-0.04*	0.00*	-0.02*	-0.04*	0.28*	-0.00	1.00					
lnRej	-0.59*	-0.40*	-0.55*	-0.02*	-0.70*	-0.04*	-0.94*	0.06*	-0.07*	0.07*	0.01*	0.21*	0.02*	1.00				
lnOpi	-0.01*	0.02*	0.02*	-0.30*	0.01*	0.02*	0.03*	0.04*	-0.01*	0.00	-0.07*	0.00	-0.16*	-0.00	1.00			
lnOpj	-0.01*	-0.05*	-0.02*	0.01*	-0.40*	0.03*	-0.09	0.03*	-0.03*	0.00	0.00	0.04*	-0.02*	0.12*	0.01*	1.00		
lnM_ij	0.43*	0.35*	0.42*	0.16*	0.25*	0.13*	0.16*	-0.33*	0.29*	0.34*	-0.08*	-0.06*	-0.11*	-0.35*	-0.07*	-0.18*	1.00	
lnM_ji	0.20*	0.14*	0.20*	0.12*	0.06*	0.05*	-0.03*	-0.29*	0.33*	0.18*	0.03*	-0.02*	0.02*	-0.12*	-0.10*	-0.05*	0.52*	1.00

*Denotes the significance at 10% level

4.2. Pairwise correlations

In Table 4, the pair correlations between the dependent variables (import, export, and total trade) and the different explanatory variables employed in the empirical analysis are presented. In empirical literature, pairwise correlations are employed to assess the theoretical assumptions and to describe the relationships that may exist between variables. Table 4 shows that all the explanatory variables have the expected theoretical signs. From the Table, it can be seen that the basic gravity model explanatory variables (distance and GDP) meet the theoretical expectation. The pairwise correlation shows a negative relationship between distance and trade (import, export, and total trade), which was theoretically expected as distance as a proxy for transport costs impedes trade between countries. The results show a weak correlation between distance and trade components. The highest correlation is recorded for total trade with a correlation coefficient of -0.1205 (r= -0.1205). The results indicate that the exporter and importer GDPs are positively correlated with our trade components, along with exporter and importer population.

Migration, our main explanatory variable, is positively correlated with trade as was expected. However, the results predict that sending migrants (lnM_ij) has higher correlation coefficients with trade components than receiving them (lnM_ji). Besides that, border and language have the expected positive correlation with trade, while explanatory variables like exporter and importer landlock, and exporter and importer economic remoteness have a negative sign. Contrary to theoretical expectation, only exporter trade openness is positively correlated with trade (export and total trade). The variables are all significant at the 10% level.

4.3. Estimated results

To empirically determine the extent that migration impacts trade between Africa and its main trading partners, we used three estimation techniques: the Pooled OLS, the LSDV and the PPML. However, both Pooled OLS and LSDV were used as benchmarks. The impact of migration on import, export, and total trade between Africa and its trading partners using the different estimation techniques of the gravity model, is reported in Table 5. In this table, the three first columns present the Pooled OLS estimation results using the logarithm form of imports, exports, and total trade as dependent variables. The following three columns present the Fixed Effects (LSDV) estimates results using the logarithm form of our dependent variables (imports, exports, and total trade). The last three columns report the PPML estimation results for imports, exports, and total trade. From Table 5, we find that for most of our estimate results, the gravity model performs according to the theoretical expectation.

4.3.1. PPML results: Impact of geographical distance

Our result interpretation will commence with our preferred specification (PPML) results. Looking at the last three columns in Table 5, it can be seen that as expected, the geographical distance separating two trading partners impedes trade. Geographical distances decrease imports and total trade by 0.37% and 0.24% respectively, while the impact on exports is positive but insignificant. This positive albeit insignificant relationship between distance and export for the PPML is explained by the fact that most African countries' trading partners are not located on the African continent (Jordaan, 2015). The main trading partners of countries such as South Africa, Nigeria, Côte d'Ivoire, Angola, Algeria, Morocco, Botswana, Ethiopia are European Union members, other than the USA, China and Japan.

Table 5. Regression results

Estimation Techniques									
	OLS			FE(LSDV)			PPML		
VARIABLES	**lnImport**	**lnExport**	**lnTr**	**lnImport**	**lnExport**	**lnTr**	**Import**	**Export**	**Tr**
ln(Exporter's Population)	0.008	0.008	-0.076	-0.753**	0.000	-0.980***	-0.145***	-0.628***	-0.366***
	(0.085)	(0.129)	(0.088)	(0.299)	(0.036)	(0.289)	(0.029)	(0.043)	(0.028)
ln(Importer's Population)	0.048	-0.261**	0.075	0.043*	-0.376	0.052**	0.084***	-0.220***	-0.036
	(0.074)	(0.113)	(0.075)	(0.022)	(0.347)	(0.021)	(0.025)	(0.034)	(0.023)
ln(Exporter's GDP)	0.436***	0.474***	0.509***	0.226	0.717***	0.520***	0.686***	1.314***	0.972***
	(0.109)	(0.168)	(0.110)	(0.143)	(0.047)	(0.135)	(0.031)	(0.056)	(0.034)
ln(Importer's GDP)	0.449***	0.314*	0.489***	1.061***	0.147	1.004***	0.262***	0.017	0.167***
	(0.142)	(0.187)	(0.122)	(0.085)	(0.098)	(0.076)	(0.037)	(0.056)	(0.037)
ln(Distance)	-0.628***	-0.023	-0.570***	-1.491***	-0.253**	-1.292***	-0.366***	0.008	-0.240***
	(0.151)	(0.201)	(0.135)	(0.093)	(0.113)	(0.085)	(0.044)	(0.065)	(0.043)
Contiguity	0.588**	0.119	0.469**	0.314***	0.799***	0.101*	0.466***	-0.248**	0.165**
	(0.236)	(0.356)	(0.218)	(0.060)	(0.096)	(0.058)	(0.065)	(0.115)	(0.067)
Common Language	0.781***	0.361*	0.718***	0.906***	0.452***	0.890***	0.445***	0.077	0.270***
	(0.142)	(0.207)	(0.135)	(0.041)	(0.069)	(0.040)	(0.037)	(0.053)	(0.035)
Landlocked exporter	0.382**	0.304	0.345*	-0.515	0.388***	0.741	0.756***	0.537***	0.673***
	(0.188)	(0.265)	(0.181)	(0.364)	(0.072)	(0.553)	(0.073)	(0.112)	(0.061)
Landlocked importer	-0.284	0.080	-0.264	-0.464***	-4.283	-0.427***	-0.210***	0.099	-0.052
	(0.177)	(0.294)	(0.185)	(0.050)	(2.708)	(0.048)	(0.049)	(0.087)	(0.053)
ln(Exporter's Remoteness)	-0.484***	-0.429***	-0.412***	-0.152	-0.287***	0.103	-0.207***	0.163***	-0.016
	(0.106)	(0.148)	(0.101)	(0.156)	(0.043)	(0.147)	(0.035)	(0.045)	(0.032)
ln(Importer's Remoteness)	-0.463***	-0.504***	-0.291**	0.032	-0.148	0.136*	-0.295***	-0.746***	-0.465***
	(0.144)	(0.195)	(0.127)	(0.082)	(0.095)	(0.074)	(0.033)	(0.056)	(0.034)
ln(Exporter's Openness)	0.049	0.370*	0.142	0.050	0.532***	0.106	0.502***	0.572***	0.518***
	(0.154)	(0.198)	(0.151)	(0.069)	(0.064)	(0.066)	(0.061)	(0.086)	(0.058)
ln(Importer's Openness)	0.478***	-0.105	0.378***	0.515***	0.202*	0.375***	0.041	-0.304***	-0.130**
	(0.127)	(0.197)	(0.128)	(0.045)	(0.106)	(0.042)	(0.050)	(0.077)	(0.056)
ln(Immigrant_ij)	0.087***	0.089***	0.094***	0.058***	0.058***	0.073***	0.103***	0.140***	0.114***
	(0.025)	(0.033)	(0.023)	(0.008)	(0.013)	(0.008)	(0.014)	(0.016)	(0.011)
ln(Immigrant_ji)	0.018	0.071**	0.039	-0.007	0.003	0.024***	0.067***	0.090***	0.084***
	(0.026)	(0.036)	(0.025)	(0.009)	(0.013)	(0.009)	(0.010)	(0.017)	(0.010)
Constant	16.140***	16.168***	12.548***	19.227***	16.115***	13.787***	10.576***	17.662***	13.650***
	(3.066)	(4.105)	(2.854)	(3.805)	(5.946)	(3.678)	(0.858)	(1.384)	(0.840)
N	14,140	12,323	14,571	14,140	12,323	14,571	15,219	15,219	15,219
R^2	0.529	0.348	0.509	0.584	0.480	0.574	0.666	0.571	0.681

Robust standard errors are in parentheses. ***, ** and * denote significant at 1%, 5% and 10% level

The practical significance of our findings is that the positive but insignificant effect of exports derive from the fact that countries in the African continent typically buy and sell goods to countries mostly in the European Union. What this means is that distance does indeed matter in trade, influencing the amount of goods that African countries are willing and able to buy and sell from trading partners.

4.3.2. Impact of language and being a landlocked exporter

Having the same official language enhances trade between countries, while neighbouring countries tend to trade more than those who do not have common borders. Having the same official language increases imports and total trade by 56% and 31% respectively, while its impact on exports is positive but insignificant (8%). Sharing borders enhance imports and total trade by 59% and 18% respectively, while it impedes exports by 22%. Contrary to theoretical expectation, being a landlocked exporter enhances imports, exports, and total trade by 113%, 71%, and 96% respectively.

The positive relationship between landlocked exporter countries and trade components is confirmed by Santos-Silva and Tenreyro (2006) and Warr (2007). However, being a landlocked importer impedes imports by 19% but does not have a significant impact on exports and total trade. The positive coefficients for landlocked exporting countries are explained by the fact that some landlocked countries (especially some African countries) are naturally endowed with strategic minerals (uranium, gold, diamonds, oil) while some landlocked European countries like Switzerland and Austria are specialised in the export of high-value goods like scientific instruments, watches and clocks or specialised services (Warr, 2007). As expected, having access to a coast-line is crucial for trade relationships between countries. Generally, these results have practical meaning, suggesting that language, proximity, and coastal access does matter insofar as trade relationships between countries.

4.3.3. Impact of GDP

The GDP of exporting countries had a positive impact on all our trade components (import, export, and total trade). In contrast, the GDP of importers had a positive and significant impact on imports and total trade, which is not the case for exports. Moreover, importer's GDPs have a positive and significant impact on trade (imports, exports, and total trade). We can see that a 1% increase in exporters' GDP enhances imports, exports, and total trade by 0.7%, 1.3%, and 1% respectively. In contrast, the same increase rate in importers' GDP enhances imports and total trade by 0.27% and 0.2% respectively. However, it does not have a significant impact on exports. Importers' and exporters' GDPs coefficients are in line with the gravity model theoretical expectation (Kareem et al., 2016). These results reveal that if a country experiences an increase in GDP, it trades more. These percentages highlight the connection between economic strength and trade relationships, consistent with anticipated patterns.

4.3.4. Impact of population and multilateral trade resistance (MRT)

Contrary to the theoretical expectation, exporters' populations impede imports, exports, and total trade. Importers' populations positively impact imports but significantly impede exports, which is not the case for total trade. A 1% increase in the population of exporting countries population decreases imports, exports, and total trade by 0.1%, 0.6%, and 0.4% respectively. However, a 1% increase in the population of importing countries increases imports by 0.08% and impedes exports by 0.2%.

Our findings on the negative relationship between importers' and exporters' population and trade components are in line with those of Karimi-Hosnijeh (2008) and Nuroglu (2010). Economic remoteness or multilateral trade resistance (MRT), is, as expected, negatively related to trade, which is not the case for exports. The economic remoteness of some exporters negatively impacts on imports, and while it enhances exports, it does not have a significant impact on total trade. Exporters' remoteness impedes imports by 0.2% and enhances exports by 0.16%. Importers' economic remoteness impedes import, export, and total trade by 0.3%, 0.7%, and 0.5% respectively, which is in line with the findings of Tadesse and White (2013), and Jordaan (2015).

4.3.5. Impact of trade openness and migration

When it comes to trade openness, we found that exporters' trade openness has a positive impact on imports, exports, and total trade. However, importers' trade openness does not have a significant impact on imports but impedes both export and total trade in such a way that a 1% increase in importers' trade openness decreases exports and total trade by 0.3% and 0.13% respectively. In contrast, exporters' trade openness enhances imports, exports, and total trade by 0.5%, 0.6%, and 0.5% respectively, (see Gulzar, 2016; Pastpipatkul et al., 2020).

For our two variables of interest (Immigrant_ij and Immigrant_ij), results from the PPML suggest that migration has a positive relationship with trade. The results show that migration stock from both country_i to country_j and from country_j to country_i has a positive impact on trade between Africa and its trading partners. A 1% increase in the migration stock from Africa to its trading partners increases African countries' imports, exports, and total trade by 0.1%, 0.14%, and 0.11 %. Similarly, the same 1% increase in migration stock from Africa's trading partners enhances imports, exports, and total trade between Africa and its trading partners by 0.07%, 0.09%, and 0.08% respectively. The key finding that emerges from this discussion is that when migrants move between their continent of origin and their trading partners, it brings about an increase in trade. While the precise change is not as big as we would like it to be, it indications that migrants moving across borders does positively influence trade and business between these places.

4.3.6. Pooled OLS, the LSDV and the PPML estimates

Comparing the PPML results to those of two other estimation techniques (OLS and the Fixed Effects (LSDV)), we notice that migration stock from country_i to country_j (Immigrant_ij) and from country_j to country_i (Immigrant_ji) coefficients are higher for the PPML estimate results than those of the OLS estimates. In contrast, the Fixed Effect (LSDV) estimate results are lower than those of the OLS estimates. From these figures, one concludes that migration (sending and receiving migrants) enhances trade relationships between African countries and their trading partners.

In line with the findings of Gould (1994), Helliwell (1997), Girma and Yu (2002), Blanes (2003), Piperakis et al. (2003), Blanes (2006), Faustino and Peixoto (2013), and Briant et al. (2014), the results demonstrate that migration between African countries and their trading partners provokes more trade and shows that migration impacts more on exports than on imports.

As expected, geographical distance (trade costs) separating trading partners impedes trade between countries, with coefficients ranging from 0.023 to almost 1.5. The coefficient of the geographical distance is negative but insignificant for the OLS. A positive but insignificant relationship between distance and export for the PPML is explained by the fact that most of the African countries' trading partners are out of the continent, Jordaan (2015). Countries like South Africa, Nigeria, Cote D'Ivoire, Angola, Algeria, Morocco, Botswana, Ethiopia main trading partners are European Union members, the USA, China and Japan. Having the same official language enhance trade between countries, while neighbour countries tend to trade more than those who do not have common borders.

The exporting country's GDP enhanced trade since as expected it has positive, significant, and high coefficients going from 0.44 to 1.3. While the importing country's GDP contrary to the theoretical expectation is lower than unity and even insignificant for the PPML with the dependent variable export. However, justifications for importer and exporter's elasticity coefficients of GDP to be higher or below 1 exist in the literature (see Kareem et al., 2016).

The population variable is positive but insignificant for only the OLS (import and export). Contrary to theoretical expectation, the exporter's population has a negative impact on trade (import, export, and total trade). Karimi-Hosnijeh (2008) who finds negative coefficients for the exporter and the importer countries populations explained this relationship by the fact that when a country population increases, its tendency to export decreases due to the need for more products for local consumption. According to Nuroglu (2010), this negative relationship resides in the fact that a higher population will decrease the GDP per capita, which in return will decrease the need for both exports and imports. However, the importers' population does not meet the theoretical gravity expectations for both the OLS and the PPML estimation techniques by negatively impacting trade (export). As expected, having access to the coast seems to be crucial for trade relationships between countries. The negative coefficients of the landlocked variables demonstrate that landlocked countries tend to trade less due to higher transportation costs when compared to countries with access to the ocean (Santos-Silva and Tenreyro, 2006). However, positive coefficients landlocked exporting countries are explained by the fact that some landlocked countries (especially some African countries) are naturally endowed with strategical minerals (uranium, gold, diamonds or oil) while some landlocked countries like Switzerland and Austria are specialised in the export of high-value goods like scientific instruments, watches and clocks or specialised services (Warr, 2007).

The MRT under the form of economic remoteness (importer's and exporter's remoteness), as expected, is detrimental to trade relationships between countries. The economic remoteness decreases import, export, and total trade under the OLS estimate results. At the same time, economic remoteness does not impact significantly import under the FE (LSDV) estimate while the case is witnessed for total trade under the PPML. However, contrary to the theoretical expectation, it increases export under PPML estimates (see Santos-Silva and Tenreyro, 2006). The positive relationship between the MTR and export resides in the fact that most of the raw material importers are located outside Africa in such a way the further the countries, the more African countries trade with those distant trading partners (see Tadesse and White, 2013; Jordaan, 2015).

5. Study limitations

Like any empirical research, this study has some limitations primarily related to data, conceptual issues, and endogeneity. These limitations are discussed in this section.

The first limitation of this study is related to data. It is crucial to note that data on African trade and migration can be erroneous because both trans-border migration and trade among neighbouring African states are often either under-recorded or simply not recorded at all. This issue leads to biased empirical results, a situation this study is not exempt. Many studies have demonstrated that in some African countries, the unrecorded trans-border trade is more important than what is recorded (Azam, 1990; Barad, 1990; Deardorff and Stolper, 1990). This poor recording is due to two reasons: the use of artificial prices while assessing trade flows and intentional under-or over-invoicing by customs officials leading to discrepancies between the trading partners' records and those of trade reporters. According to Yeats (1990), the average differences between exports and imports in sub-Saharan African countries match 1982-1983 values but are currently higher by 65. Unrecorded trans-border trade flows are also due to different factors like government subsidies, higher tariffs, exchange rate and local industry protection policies (Davies, 1996).

The most prominent conceptual limitation of this study involves the empirical model utilised to assess the impact of migration on trade between African countries and their partners. The equation that analyses the impact of migration on trade is not directly derived from economic agents' behavioural optimisation, and it is clear that according to its theoretical underpinnings, the gravity model is not a good economic model (see Krugman, 1980; Bergstrand, 1989; Anderson and Wincoop, 2001; Bernard et al., 2003; Melitz, 2003; Helpman et al., 2008). To assess the impact of migration on trade between African countries and their partners, we employed a model on which theoretical expectations are formulated. The fact that we chose to form conditional expectations based on crude shares makes the gravity model a limited model to predict the impact of migration on trade flows. It may be admissible to employ an alternative more sophisticated model which is empirically credible in predicting the impact of migration on trade flows. However, many studies have demonstrated that the findings obtained from the gravity model are empirically relevant. Until a better econometric model to estimate bilateral trade flows is proposed, the gravity model will be considered the best empirical technique available in the trade-migration literature.

The third limit of this study is related to endogeneity. Like many studies in trade and migration literature, this study may suffer from endogeneity. Baier and Bergstrand (2007) note that GDP may be a source of endogeneity. Considering the possibility of endogeneity bias created by simultaneity, the GDP as a function of net export, is potentially endogenous to bilateral trade flows. Besides the endogeneity that may occur with trade variables, endogeneity is associated with migration. Steingress (2018) demonstrates that endogeneity occurs because migrants' decisions to settle in a particular country are generally correlated with variables like preferences and income and employment opportunities, and these variables are correlated with trade. Another cause of endogeneity appears in the form of reverse causality: for instance, migrants coming from a particular country are more likely to settle in host countries that trade more with their home country (Steingress, 2018).

Considering the abovementioned shortcomings, one deduces that using official trade and migration statistics will lead scholars to underestimate the real value of both African migration and trade.

6. Conclusion

In the voluminous trade-migration literature, most studies conclude that migrants have a positive impact on trade. However, these studies are conducted in developed countries, with few studies conducted on Africa in order to assess the trade-migrant relationship. To conduct such a study, we employed bilateral migration stock and trade data from 52 African countries and their 116 trading partners covering a period of 23 years (1995-2017). In order to draw inferences on the impact of migration on trade (import, export, and total trade) the Eicker-White robust covariance PPML estimator was used. Previous studies have demonstrated that the PPML is superior to most of the usual nonlinear least square techniques when it comes to dealing with heteroscedasticity and data containing zero value (see Santos-Silva and Tenreyro, 2006).

Our findings demonstrate a positive and significant impact of migration on trade (export import, and total trade). A 10% increase in migration stock from African countries to their trading partners will increase imports, exports, and total trade by by 1%, 1.4% and 1.14% respectively. At the same time a 10% increase in migration stock from African countries' trading partners impacts imports, exports, and total trade by 0.67%, 0.9%, and 0.84% respectively. These results are in line with those of Gould (1994), Helliwell (1997), Girma and Yu (2002),

Blanes (2003), Piperakis et al (2003), Blanes (2006), Faustino and Peixoto (2013), and Briant et al. (2014) who found that migration enhances trade and demonstrated that it impacts more on exports than on imports.

The impact of migration on trade between African countries and their trading partners can be considered as high, but from our point of view it is possible to increase this effect by integrating migration policies through trade negotiations between African countries and trading partners. At the African level, countries must allow free movement of people and goods which will increase migration between African countries and increase intra-African trade volumes. In order to increase trade between African countries, common trade policies must be implemented. Developing intra African infrastructures associated with the signing of the agreement establishing the African Continental Free Trade Area (AfCFTA) and its implementation will foster the intra-African trade.

These and other policies aimed at improving economic cooperation, cultural exchange, and trade capacity growth, should be encouraged as they will help in facilitating sustainable development for the African continent. Needless to say, that the AfCFTA enactment offers a promising framework for realizing these goals with coordinated efforts and international support.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

Not applicable

References

Anderson, J.E. and Van Wincoop, E. (2001), "Borders, Trade and Welfare", NBER Working Paper No. 8515, National Bureau of Economic Research. Available at: https://www.nber.org/system/files/working_papers/w8515/w8515.pdf (access 29th January 2024).

Anderson, J.E. and Van Wincoop, E. (2003), "Gravity with gravitas: A solution to the border puzzle", *The American Economic Review*, Vol. 93 No. 1, pp. 170-192.

Anderson, J.E. and Van Wincoop, E. (2004), "Trade costs", *Journal of Economic Literature*, Vol. 42 No. 3, pp. 691-751.

Azam, J.P. (1990), "Informal Integration Through Parallel Markets for Goods and Foreign Exchange» in The Long Term Perspective Study of Sub-Saharan Africa", *World Bank*, Washington, DC Agbodji.

Baier, S.L. and Bergstrand, J.H. (2007), "Do free trade agreements actually increase members' international trade?", *Journal of International Economics*, Vol. 71 No. 1, pp. 72-95.

Bandyopadhyay, S., Coughlin, C.C. and Wall, H.J. (2008), "Ethnic networks and US exports", *Review of International Economics*, Vol. 16 No. 1, pp. 199-21.

Barad, R. (1990). "Unrecorded transborder trade in Sub-Saharan Africa and its Implication regional economic integration", In: *The Long Term Perspective Study of Sub- Saharan Africa. Washington, D.C.: The World Bank.*

Barro, R.J. and Sala-i-Martin, X. (1992), "Convergence", *Journal of Political Economy*, Vol. 100 No. 2, pp. 223-251.

Bergstrand, J.H. (1989), "The Generalized gravity equation, monopolistic competition, and the factor-proportions theory in international trade", *The Review of Economics and Statistics*, Vol. 71 No. 1, pp. 143-153.

Bernard, A.B., Eaton, J., Jensen. J.B. and Kortum, S. (2003), "Plants and productivity in international trade", *The American Economic Review*, Vol. 93 No. 4, pp. 1268-1290.

Blanes, J.V. (2003), "The link between immigration and trade in Spain", Paper presented at*: xxviii Simposio de Analisis Economico*, Seville: Universidad Pablo de Olavide, December 11-13.

Blanes, J.V. (2006), "Immigrant's characteristics and their different effects on bilateral trade: Evidence from Spain", Working Paper No. 06.08, Universidad Pablo de Olavide, Department de Economica.

Blanes, J.V. and Martin-Montaner, J.A. (2006), "Migration flows and intra-industry trade adjustments", *Review of World Economics*, Vol. 142 No. 3, pp. 567-584.

Bobkova, B. (2012). "Gravity Model Estimation using Panel Data – is Logarithmic Transformation Advisable?", Master Thesis Charles University in Prague.

Bratti, M., De Benedictis., L. and Santoni., G. (2014), "On the pro-trade effects of immigration", *Review of World Economics*, Vol. 150 No. 3, pp. 557-594.

Briant, A., Combes, P.P. and Lafourcade, M. (2014), "Product complexity, quality of institutions and the protrade effect of immigrants", *The World Economy*, Vol. 37 No. 1, pp. 63-85.

Bryant, J., Genç, M., and Law, D (2004), "Trade and Migration to New Zealand, New Zealand Treasury", Working paper 04. 2004.

Card, D. (2009), "Immigration: How Immigration Affects U.S. Citie", In: Inman, R. ed. *Making Cities Work: Prospects and Policies for Urban America*. Princeton: Princeton University Press, pp. 158-200.

Cattaneo, C. (2005), "International migration and poverty: A cross country analysis", *Fondazione Eni Enrico Mattei, Italy*, pp. 2-31.

Ching, H.S. and Chen, L.L. (2000), "Links between emigrants and the home country: the case of trade between Taiwan and Canada", In: *Regional Cohesion and Competition in the Age of Globalisation*, edited by H. Kohno, P. Nijkamp and J. Poot. Edward Elgar. Cheltenham.

Davies, R. (1996), "Promoting regional integration in southern Africa: An analysis of prospects and problems from a South African perspective", *Africa Security Review*, Vol. 5 No. 5, pp. 27-38.

Deardorff, A.V. and Stolper, W.E. (1990), "Effect of smuggling under African conditions: A factual, institutional and analytic discussion", *Weltwirtschaftliches Archiv*, Vol. 126 No. 1, pp. 116-141.

Dunlevy, J. (2006), "The influence of corruption and language on the pro-trade effect of immigrants: evidence from the American states", *Review of Economics and Statistics*, Vol. 88 No. 1, pp. 182-186.

Dunlevy, J. and Hutchinson, W. (1999), "The impact of immigration on American import trade in the late nineteenth and twentieth centuries", *Journal of Economic History*, Vol. 59 No. 4, pp. 1043-1062.

Eaton, J. and Tamura, A. (1995), "Bilateralism and regionalism in Japanese and U.S. trade and direct foreign investment patterns", National Bureau of Economic Research, NBER Working Paper (4758).

Egger, P.H., Von Ehrlich, M. and Nelson, D.R. (2012), "Migration and trade", *The world economy*, Vol. 35 No. 2, pp. 216-241.

Ekakkararungroj, C., Ong, S.L. and Devadason, E.S. (2022), "Immigration-trade relationship in ASEAN: What does the evidence show?", *Malaysian Journal of Economic Studies*, Vol. 59 No. 1, pp. 131-151.

Faustino, H.C. and Peixotob., J. (2013), "Immigration, trade links: Evidence from Portugal", *Economic Research*, Vol. 26 No. 1, pp. 155-170.

Felbermayr, G.J. and Toubal, F. (2008), "Revisiting the trade-migration nexus: Evidence from new OECD Data", IZA Discussion Papers, (6975).

Frankel, J. and Wei, S. (1993), "Trade blocs and currency blocs", Working Paper (4335). Cambridge, MA: National Bureau of Economic Research.

Girma, S. and Yu, Z. (2002), "The link between immigration and trade: Evidence from the United Kingdom", *Weltwirtschaftliches Archiv*, Vol. 138, pp. 115-130.

Gould, D.M. (1994), "Immigrant links to the home country: Empirical implications for Us bilateral trade flows", The *Review of Economics and Statistics*, Vol. 72 No. 2, pp. 302-316.

Groizard, J.L. and Martín-Montaner, J. (2023), "Migrants, regulations, and trade", *Economic Modelling*, Vol. 120, p. 106186.

Gulzar, A. (2016), "Does trade openness have noteworthy effect on bilateral trade flows of ECO countries an empirical investigation", *Timisoara Journal of Economics and Business*, Vol. 9 No. 2, pp. 95-114.

Hatzigeorgiou, A. (2010), "Does immigration stimulate foreign trade? Evidence from Sweden", *Journal of Economic Integration*, Vol. 25 No. 2, pp. 376-402.

Head, K. (2003), "*Gravity for beginners*", mimeo, Vancouver, Canada: University of British Columbia. Available at: http://pioneer.netserv.chula.ac.th/~kkornkar/inter%20trade%20undergrad/term%20paper/gravity%202.pdf (Accessed on 29th January 2024).

Head, K. and Ries, J. (1998), "Immigration and trade creation: Econometric evidence from Canada", *Canadian Journal of Economics*, Vol. 31 No. 1, pp. 47-62.

Helliwell, J.F. (1997), "National borders, trade and migration", *Pacific Economic Review*, Vol. 3 No. 3, pp. 165-185.

Helpman, E., Melitz, M. and Rubinstein, Y. (2008), "Estimating trade flows: Trading partners and trading volumes", *Quarterly Journal of Economics*, Vol. 123 No. 2, pp. 441-487.

Hunt, J. and Gauthier-Loiselle, M. (2010), "How much does immigration boost innovation?", *American Economic Journal: Macroeconomics*, Vol. 2 No. 2, pp. 31-56.

IOM (2019), "World Migrant Report 2020", Geneva. Available from http://publications.iom.int/system/files/pdf/wmr_2020.pdf. (Accessed on 4 May 2020).

Jordaan, C.A. (2015), "The further the distance, the closer the ties", *Journal of Governance and Regulation*, Vol. 4 No. 1, pp. 35-46.

Kareem, F.O., Martinez-Zarzoso, I. and Brümmer, B. (2016), "Fitting the Gravity Model when Zero Trade Flows are Frequent: a Comparison of Estimation Techniques using Africa's Trade Data," GlobalFood Discussion Papers 230588, Georg-August-Universitaet Goettingen, GlobalFood, Department of Agricultural Economics and Rural Development.

Karimi-Hosnijeh, H. (2008), "Trade integration of agricultural products for Iran and Islamic Countries", *American-Eurasian Journal of Agriculture and Environmental Science*, Vol. 2 No. 1, pp. 124-130.

Koch, W. and LeSage, J.P. (2015), "Latent multilateral trade resistance indices: Theory and evidence. Scottish *Journal of Political Economy*, Vol. 62 No. 3, pp. 264-290.

Krugman, P. (1980), "Scale economies, product differentiation, and the pattern of trade", *The American Economic Review*, Vol. 70 No. 5, pp. 950-959.

Leamer, E.E. and Levinsohn, J. (1995), "International trade theory: the evidence", *Handbook of International Economics*, Vol. 3, pp. 1339-1394.

Lewer, J.J. (2006), "The Impact of Immigration on Bilateral Trade: OECD results from 1991-2000", *South-western Economics Review*, Vol. 33 No. 1, pp. 9-22.

Lin, X. and Yang, X. (2017), "From human capital externality to entrepreneurial aspiration: Revisiting the migration-trade linkage", *Journal of World Business*, Vol. 52 No. 3, pp. 360-371.

Markusen, J.R. (1983), "Factor movements and commodity trade as complements", *Journal of International Economics*, Vol. 14 No. 3-4, pp. 341-356

Martin, W. and Pham, C. S. (2015), "Estimating the gravity model when zero trade flows are frequent and economically determined", Policy Research Working Paper No. WPS 7308. World Bank Group.

Martinez-Zarzoso, I. (2003), "Gravity model: An application to trade between regional blocs", *Atlantic Economic Journal*, Vol. 31 No. 2, pp. 174-187.

Melitz, M.J. (2003), "The Impact of Trade on Intra-industry reallocations and aggregate industry productivity", *Econometrica*, Vol. 71 No. 6, pp. 1695-1725.

Metulini, R., Sgrignoli, P., Schiani, S. and Riccoboni, M. (2018), "*The network of migrants and international trade*", Springer International Publishing AG, pp. 763-785.

Mundra, K. (2010), "Immigrant networks and the U.S. bilateral trade: The role of immigrant income", IZA Discussion Paper (5237).

Ngepah, N. and Udeagha, M.C. (2019), "Supplementary trade benefits of multi-memberships in African regional trade agreements", *Journal of African Business*, Vol. 20 No. 4, pp. 505-524.

Nijkamp, P., Gheasi, M. and Rietveld, P. (2011), "Migrants and international economic linkages: A meta overview", *Spatial Economic Analysis*, Vol. 6 No. 4, pp. 359-376.

Nuroglu, E. (2010), "The impact of population on bilateral trade flows in the case of OIC", In: *Conference: 2nd International Conference on Islamic Economic Integration*, Available at: Nuroglu/publication/261000595_ The_Impact_of_Population_on_Bilateral_Trade_Flows_in_the_case_of_OIC/links/0f317532ff0e5cad96000

000/The-Impact-of-Population-on-Bilateral-Trade-Flows-in-the-case-of-OIC.pdf (Accessed 29th January 2024).

Ozgen, C., Nijkamp, P. and Poot, J. (2012), "Immigration and innovation in European regions", In: *Migration impact assessment: new horizons*, pp. 261-300. Northampton: Edward Elgar Publishing.

Partridge, J. and Furtan, H. (2008), "Immigration wave effects on Canada's trade flows", *Canadian Public Policy*, Vol. 34 No. 2, pp. 193-214.

Pastpipatkul, P., Boonyakunakorn, P. and Phetsakda, K. (2020), "The Impact of Thailand's openness on bilateral trade between Thailand and Japan: Copula-Based Markov switching seemingly unrelated regression model", *Economies 2020*, Vol. 8 No. 1, pp. 1-13.

Peri, G. and Requena-Silvente, F. (2010), "The trade creation effect of immigrants: evidence from the remarkable case of Spain", *The Canadian Journal of Economics*, Vol. 43 No. 4, pp. 1433-1459.

Piperakis, A.S., Milner, C. and Wright, P.W. (2003), "Immigration, trade costs, and trade: Gravity evidence for Greece", *Journal of Economic Integration*, Vol. 14 No. 4, pp. 750-762.

Rashidi, S. and Pyka, A. (2013), "Migration and innovation: A survey", FZID Working Paper, (77).

Rauch, J.E and Trindade., V. (2002), "Ethnic Chinese Networks in International Trade", *The Review of Economics and Statistics*, Vol. 84 No. 1, pp. 116-130.

Santos-Silva, J.M.C. and Tenreyro. S. (2006), "The log of gravity", *The Review of Economics and Statistics*, Vol. 88 No. 4, pp. 641-658.

Steingress, W. (2018), "The causal impact of migration on US trade: Evidence from political refugees", *Canadian Journal of Economics/Revue canadienne d'économique*, Vol. 51 No. 4, pp. 1312-1338.

Tadesse, B. and White, R. (2011), "Emigrant effects on trade: Re-examining the immigrant-trade link from home country perspective", *Eastern Economic Journal*, Vol. 37 No. 47, pp. 281-302.

Tadesse, B. and White, R. (2013), "Do African immigrants enhance their home nations' trade with their hosts?", *The Journal of Developing Areas*, Vol. 47 No. 2, pp. 199-228.

Tai, S.H.T. (2009), "Market structure and the link between migration and trade", *Review of World Economics*, Vol. 145 No. 2, pp. 225-249.

UNCTAD (2018), "Economic Development in Africa Report 2018. Migration for Structural Transformation", Available at: https://www.unctad.org/en/PublicationsLibrary/aldcafrica2018_en.pdf (Accessed on 3 April 2019).

Wagner, D., Head, K. and Ries, J. (2002), "Immigration and the Trade of Provinces", *Scottish Journal of Economy*, Vol. 49 No. 5, pp. 507-525.

Warr, P. (2007). LaoGEM: A general equilibrium model of the Lao economy", Australian National University, available at: https://devpolicy.crawford.anu.edu.au/acde/prc/pdf/LaoGEM_model.pdf (Accessed on 29th January 2024).

Yeats, A.J. (1990), "On the Accuracy of Economic Observations: Do Sub-Saharan Trade Statistics Mean Anything?", *The World Bank Economic Review*, Vol. 4 No. 2, pp. 135-156.

Yotov, Y. V., Piermartini, R., and Larch, M. (2016), "An advanced guide to trade policy analysis: The structural gravity model", WTO iLibrary.

Appendix

Table 6. Descriptive Statistics (logarithm form)

Variable	Obs	Mean	Std. Dev	Min	Max
ln(Import)	134,210	6.540	3.619	-6.908	16.587
ln(Export)	119,387	5.958	3.732	-6.908	17.333
ln(Tr)	153,630	6.924	3.666	-6.908	17.514
ln(Population exporter)	200,928	15.788	1.593	11.229	19.067
ln(Population importer)	200,928	15.962	1.727	11.151	21.050
ln(GDP exporter)	200,928	8.787	1.690	3.526	13.251
ln(GDP importer)	200,928	10.227	2.239	3.526	16.780
ln(Distance)	200,928	8.598	0.657	5.089	9.872
Contiguity	200,928	0.223	0.148	0	1
Language	200,928	0.267	0.419	0	1
landlocked exporter	200,928	0.885	0.453	0	1
landlocked importer	200,928	0.126	0.409	0	1
ln(Remoteness exporter)	200,928	14.003	1.149	10.827	17.547
ln(Remoteness importer)	200,928	16.093	2.120	9.818	22.436
ln(Openness exporter	200,928	-0.483	0.661	-3.984	1.671
ln(Openness importer)	200,928	-0.320	0.704	-8.468	1.671
ln(Immigrant_ij)	52,580	5.470	3.082	-16.273	15.153
ln(Immigrant_ji)	28,232	6.047	2.922	-16.273	15.153

Table 7. List of countries

Afghanistan	Comoros	Haiti	Mexico	Slovakia
Algeria	Congo Dem	Honduras	Mongolia	Slovenia
Albania	Congo Rep	Hungary	Morocco	Somalia
Angola	Costa Rica	Iceland	Mozambique	South Africa
Argentina	Côte d'Ivoire	India	Myanmar	Spain
Armenia	Croatia	Indonesia	Namibia	Sri Lanka
Australia	Cuba	Iran	Nepal	State of Palestine
Austria	Cyprus	Iraq	Netherlands	Sudan
Azerbaijan	Czechia	Ireland	New Zealand	Suriname
Bahrain	Danmark	Israel	Nicaragua	Swaziland
Bangladesh	Djibouti	Italy	Niger	Sweden
Belarus	Dominica	Jamaica	Nigeria	Switzerland
Belgium	Dominican Rep,	Japan	Norway	Syria
Belize	Ecuador	Jordan	Oman	Tajikistan
Benin	Egypt	Kazakhstan	Pakistan	Tanzania
Bhutan	El Salvador	Kenya	Panama	TFYR of Macedonia
Bolivia	Equatorial Guinea	Korea, Rep of	Papua New Guinea	Thailand
Bosnia & Herzegovina	Eritrea	Kuwait	Paraguay	Togo
Botswana	Estonia	Kyrgyzstan	Peru	Tunisia
Brazil	Ethiopia	Lao PDR	Philippines	Turkey
Brunei Darussalam	Fiji	Latvia	Poland	Turkmenistan
Bulgaria	Finland	Lebanon	Portugal	Uganda
Burkina Faso	France	Lesotho	Qatar	Ukraine
Burundi	Gabon	Liberia	Rep of Moldova	United Arab Emirates
Cambodia	Gambia	Libya	Romania	United Kingdom
Cameroon	Georgia	Lithuania	Russian Federation	United States of America
Canada	Germany	Luxembourg	Rwanda	Uruguay
Cape Verde	Ghana	Madagascar	Sao Tome & Principe	Uzbekistan
Central African Rep	Greece	Malawi	Saudi Arabia	Venezuela
Chad	Grenada	Malaysia	Senegal	Vietnam
Chile	Guatemala	Maldives	Serbia and Montenegro	Yemen
China	Guinea	Mali	Seychelles	Zambia
China, Hong Kong	Guinea Bissau	Malta	Sierra Leone	Zimbabwe
Colombia	Guyana	Mauritius	Singapore	