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The Determinant of Bilateral Trade in the East African Community: Application of the Gravity Model

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Abstract

This study examines the determinants of bilateral trade flows within the East African region using the Gravity model approach. Using a 40 year data obtained from the World Development Institute's data base, the Random Effects model is applied to empirically determine the variables that drive bilateral trade within the region.

The findings suggest that country size, contiguity, diaspora remittances and corruption index have a positive impact on the regions bilateral trade. On the other hand, foreign direct investment flows, net population effects and mobile subscription ratio have a negative impact on intra-trade flows among member states. Although not exhaustive, the study offers useful insights for policy makers to seek measures to spur the EAC intra-trade flows.

Keywords: determinants, bilateral trade, gravity model, Intra -trade flows

1. Introduction

1.1 Background

Since independence, the East African Community (EAC) countries, initially comprising of Kenya, Tanzania and Uganda (1967-1977, 1999-2007) and later increased to include Burundi and Rwanda in 2007, and South Sudan in 2016, have recognized the role of trade in their bid to foster rapid and sustained economic growth. Over the years, each country has embraced regional trade policies that encourage trade in order to create employment, investment and transfer productive capacity in their respective domestic economies.

This strong recognition of trade as a key driver of economic growth is manufest through the economic policies adopted shortly after independence and throughout the years to-date. Notably, early trade policies in the region leaned on mercantilist theory of trade (owing to their colonial history) that promoted an export oriented strategy of economic growth. Later on, the regions economies shifted into an import substitution and industrialization era (1960-1980), liberalization (1980-2000) and finally, regionalization and globalization (2000 to present).

1.2 Role of Trade in EAC Economic Development

Right from its inception, trade was meant to improve the economic welfare of the East African people through contribution to gross domestic product (GDP) of the trading partners and development of infrastructure, mainly road networks, railway lines, sea routes and air travel. Most importantly, it was meant to act as an integrative tool to harmonize the EAC economies into a cohesive economic development partners.

This could be realized through the generation of scarce foreign exchange reserves, attraction and share of new technologies and growth of related and associated industries. Trade exports can also cution domestic ecenomies against external economic shocks (Senhadji & Montenegro, 1999). Other welfare effects from trade include maintenance of harmonious and peaceful relations among trading partners, exchange of cultural values and beneficial virtues and development of communication channels and common languages.

1.3 Statement of the Problem

Several studies have been done to determine both inter and intra-country trade in East Africa. Ochieng' and Maxon (1992) posit that Kenya's percentage contribution to the total value of the EAC inter-territorial trade increased from 36.2 percent in 1945 to 65.7 percent in 1966, compared to a decrease from 41.0 percent to 23.7 percent and 22.8 percent to 10.6 percent for Uganda and Tanzania respectively. However, Ammon, Mjema, and Kilindo (2002) demostrates a reversal of this trade since 1997, with Tanzania's imports to exports ratio declining from 11.5 in 1996 to 2.52 in 2001.

Intra-African trade is still very low compared to intra-regional trade in other parts of the world. For the period 2004-2006, intra-African exports represents 8.7 per cent of total Africa's exports, while intra-African imports represents 9.6 per cent of total imports. This in comparative to 20.9 and 18.5 per cent for Developing America, 48.1 and 45.5 per cent for Developing Asia, and 68.1 and 71.4 per cent, respectively for Developed Europe. For the period 1960-2006, Africa has had on average a low proportion of intra-regional trade compared to other regions of the world (Economic Development Report in Africa, 2009).

Subramanian and Tamirisa (2001) indicate that the prime determinants of trade in Africa in general terms are income, geography and size. Similar views are shared by Foroutan and Pritchett (1993), Coe and Hoffmaister (1999) and Rodrik (1999). But the exact manner in which these factors, inter alia, drive bi-lateral trade in the EAC region are less clear.

1.4 The Objectives of the Study

The objectives are:

1) To determine the patterns and trends of bilateral trade in the EAC region.
2) To identify the problems that hinder bilateral trade in the EAC region.
3) Make policy recommendations on how to promote both inter and intra trade growth rates in the EAC region.

The study contributes to the body of knowledge by adducing new insights into the determinants of bilateral trade within the EAC region. Second, it delineates knowledge gaps on bilateral trade in the EAC and proffers conclusive and persuasive empirical evidence on the same. Third, the study utilizes empirical estimation procedures that integrates spatial and temporal approaches for the first time in the EAC region. Finally, it utilizes the longest data set thus far, spanning a 40 year period between 1970-2010.

The rest of the study is organized into four sections. Section two reviews the relevant literature and demonstrates the knowledge gap it seeks to address; Section three discusses the study methodology; Section four presents and discusses the study findings; while section five presents the conclusions.

2. Relevant Literature

2.1 Brief History of Trade in the EAC Region

Trade among the six EAC member states has fluctuated across time and space due to geopolitical and economic changes. Figure 1 tracks intra-trade flows in the region based on the World Bank data. Obviously, the figure demonstrates low levels of trade among EAC countries except for Kenya from 1990-2006.

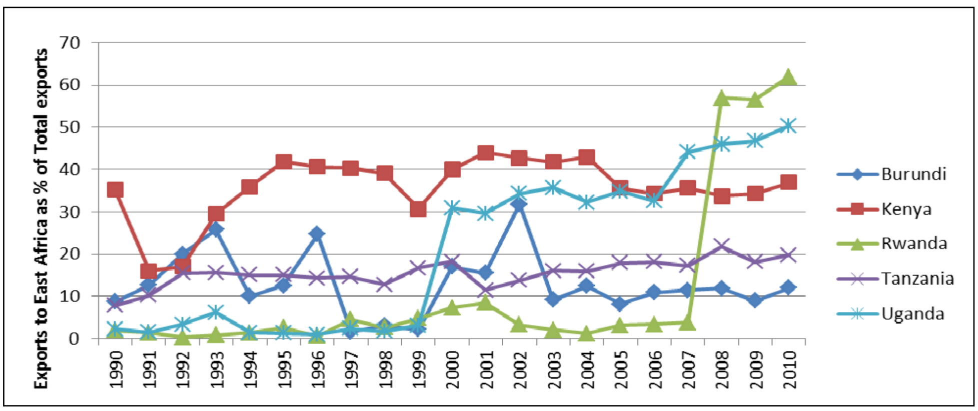


Figure 1. Merchandise exports to within East Africa region as a % of Total Exports (1990-2010)

Source: World Bank Data, World Development Indicators.

The regions' economy weathered the global economic crisis to register a positive real growth rate of 5.8 percent in 2009. Kenya remains the regional trade hub (Figure 2) and the transport link to the world for many of the EAC countries.

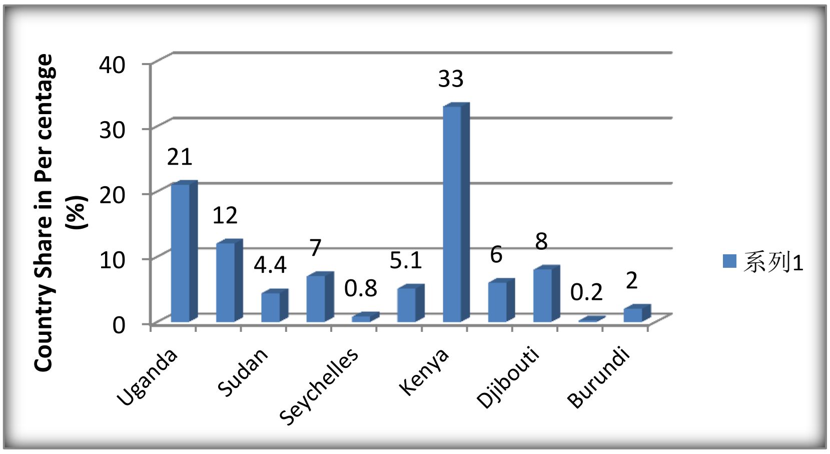


Figure 2. Percentage share of East African intra-regional trade by country

Source: IMF as reported in AfDB and ADF report, 2010.

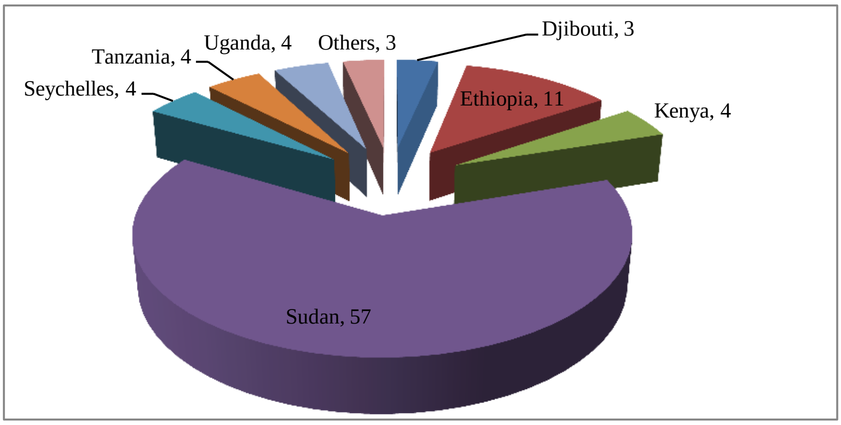
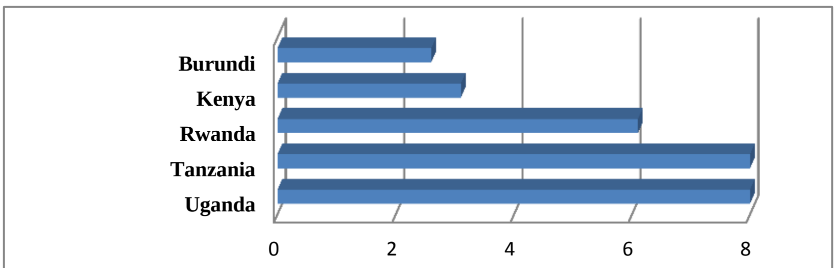


Figure 3. Foreign direct investment flows to East Africa by countries: annual averages (%) 2000-2008

Source: AfDB and ADF Report, 2010.

FDI flows into the region are very low probably due to instability and governance challenges. FDI flows to the individual countries in the region (figure 3), indicates that Sudan attracted the highest share (57 percent) mainly due to foreign investments in the oil sector, followed by Uganda (14 percent) and Ethiopia (11 percent). The shares of the other countries were limited to 4 percent or below.



	Uganda	Tanzania	Rwanda	Kenya	Burundi
% GDP Average growth rates	8	8	6.1	3.1	2.6

Figure 4. Average real GDP growth rates per EAC country 2000-2009 (%)

Source: AfDB Development Data Platform – August 2010.

Figure 4, demostrates disparities in GDP, economic growth and economic structures as a likely obstacle to integration in the EAC. Since independence, EAC has highly dependent on agriculture, nearly accounting for three fifths of its total product, particularly coffee, cotton, sisal and recently horticultural products and tropical fruits. Despite improvements in agricultural productivity, per capita income remains low.

2.2 Empirical Application of Gravity Models

The Gravity model has widely been used to empirically investigate patterns of bilateral trade. It is premised on the "Law of Universal Gravitation" advanced by Isaac Newton in 1687. He argued that the attractive force F between two objects i and j is given by:

$$F_{ij} = G\frac{M_iM_j}{D_{ij}^2} \tag{1}$$

Where:

F is the "attractive force," M are the masses, D the distance between the objects, and G the gravitational constant defined by the units of measurement for mass and force. Jan Tinbergen (1962) proposed a similar form to explain trade flows:

$$F_{ij} = G\frac{M_i^{\alpha}M_j^{\beta}}{D_{ij}^{\theta}} \tag{2}$$

Where:

F_{ij} is the trade flows from i to j; M_i and M_j are "economic masses" (Size); D_{ij} is the distance between the two locations; and G is a constant (equal to Newton's law if α = β = 1and θ = 2).

Taking the logs of this equation gives the following estimable but linearized equation:

$$InF_{ij} = \alpha InM_i + \beta InM_j - \theta InD_{ij} + InG + \varepsilon_{it} \tag{3}$$

Given ε is a classical error term, then the equation can be estimated using ordinary least squares (OLS).

The logic of gravity models is that the larger an economy is, the larger it is likely to spend on imports due to its high average income levels. Conversely, due to its' high productive capacity, a large economy is likely to attract a large share of spending from other countries because it's bound to have a wide variety of manufactured products. Thus, trade between any two countries is larger, the bigger either economy is. If trade volumes between any two countries differ from the predictions of Gravity models, the economists find an explanation for such anomalies.

For instance, Krugman and Obstfeld (2006) find trade between three European countries (Ireland, Netherlands and Belgium) and the United States (US) to be higher than what is predicted by gravity models. They argue that the economic reason for such a trade anomaly would be cultural affinity for trade flows between Ireland and the US since millions of Americans are of Irish descent. In the case of Netherlands and Belgium, the reason could be due to geography and transport since both countries are located near the mouth of Rhine, Western Europe's longest river that runs past the Germany's industrial heartland.

Deardorff (2001) argues for unobservable trading costs rather than factor endowments and technology as important explanatory variables for international trdae flows while Anderson (2001) posits that informal trade barriers could explain the existence of large trade volumes for similar countries like is the case between the US and Canada. McCallum (1995) confirms the esistence of informal trade barriers as good expanatory factors for home bias or border effect in trade. Obstfeld and Rogoff (2000) argues for the case of unobserved trade costs in explaining some of the puzzles in international economics.

Anderson and Van Wincoop (2000) demonstrates that gravity models can be used to compute the impact of borders on both intra-national trade (within a country) and international trade. Serlanga and Shin (2007) argues that gravity models have widely been applied to explain the movement of goods and services across national and regional bounderies since the early 1940s. Futher, the gravity model is a good fit for trade policy analysis, explanation of currency unions and varied trade distortions (Bougheas, Demetriades, & Morgenroth, 1999; De Grauwe & Skudelny, 2000; Glink & Rose, 2002; De Sousa & Disdier, 2002).

However, despite the wide empirical application of the gravity model, it has historically been criticised as to lack a strong theoretical underpinnings (Serlanga & Shin, 2007). But Anderson (1979) explain that the Ricardian models, Heckscher-Olin (H-O) models and increasing returns to scale (IRS) models of the New Trade Theory provide a good theoritical foundation for the gravity model.

Okubo (2006) successfully applied the economic gravity model analysis to examine the border effects on Intra –

Empire versus Extra –Empire trade for the Japanese Empire that includes Mainland Japan, Korea and Formosa (Taiwan) with her 24 non- Empire countries namely; India, the Netherlands, Indies, China, Russia, the United Kingdom, Canada, Australia, New Zealand, Norway, Denmark, Sweden, Switzerland, Italy, German, France, Belgium, Spain, Argentina, Brazil, Mexico, the United States, Chile and Peru based on data for 1915, 1920, 1925, 1930, 1935 and1938.

Serlanga and Shin (2007) applied the gravity model to analyze bilateral trade flows among the fifteen European countries. They find that the impact of the GDP variables, similar relative size of trading partners, differences in relative factor endowments and common border to be significant and positive. The impact of distance and foreign population are found to be significantly negative. Egger and Pfaffermayr (2002) analyzes the impact of distance on bilateral exports and outward FDI and finds distance to non-trivialy affect both exports and outward FDI.

Longo and Sekkat (2001) applies the gravity model to examine obstacles to intra-African trade (IAT). In addition to the traditional gravity models variables (income, income per capita, GDP, distance and surface area), they include trade policy; inadequate infrastructure; currency inconvertibility; diversity in ethnicity, culture and language; and political instability. They confirm that the economic size of a country, incomes and level of development impacts trade flows. As expected, distances and country dimension are found to negatively affect trade flows. Infrastructure, sound economic policies and political instability are found to have a significant efects on trade flows.

Villoria (2008) uses gravity modelling to explore the amount of missing intra-African trade for manufacturers. He estimates that of the 54 member states bilateral trade transactions, about 41 percent were missing. Besides, it is predicted that the regions manufacturing exports are worth about 300 million USD, but only 2.5 percent is formally documented.

Eita and Ashipala (2008) used the Gravity model to examine the determinants of export flows in Namibia. They find increases in importerting country's GDP and domestic GDP to have positive effects on Namibian exports. On the other hand, the Importing country's GDP per capita had a negative effect on exports, while domestic GDP per capita and real exchange rates were insignificant. As expected, distance was associated with a decrease in exports. Overall, membership in SADC, EU and border sharing had positve impacts on exports.

2.3 Gravity Models and Intra–African Trade

Empircal evidence on intra-African trade suggests that flows could be enhanced if obstacles that impede it are removed. The main obstacle is high trading costs arising from transport, border and behind border costs. Econometric estimates suggest transport costs in Africa are 136 per cent more than in other parts of the world largely due to poor infrastructure (Amjadi & Yeats, 1995; Limao & Venables, 2001).

Limao and Venables (2001) estimate that if the median for tranpsot costs was doubled, trade volumes could be reduced by 45 per cent. For land locked countriessuch costs would be 50 per cent more and trade volumes 60 per cent less. Border costs include breakdowns of the electronic systems, poor coordination during inspections, inadequate working hours at ports of entry and delays in processing refunds for customs duty. These cumulatively increase cost of intra-African trade (Gad, 2009). Coulibaly and Fountagn'e (2005) estimates that it costs about 4 percent more to cross a transit territory irregardless of the distance covered.

Other constraints that impact trade negatively include corruption and lack of predictability (Longo & Sekkat 2004); missing or poor quality physical infrastructure (Gad, 2009; Limao & Venables, 2001; Ndulu, 2006); lack of efficient and reliable telecommunications, financial intermediation and logistics (Njinkeu, Wilson, & Fosso, 2008; Foster, 2008); and soft infrastructure like policy, regulatory environment and business administration. Improvements of this soft infrastructure are important for the realization of the benefits of better hard infrastructure (Portugal-Perez & Wilson, 2008).

2.4 Modification of the Theoretical Gravity Model for Empirical Estimation of EAC Trade

Often the Gravity Model has been criticized on the grounds of mis-specification and inability to deal with heterogeneity. Thus, a panel or longitudinal based approach is desirable since heterogeneity problems can be addressed by the inclusion of country-pair "individual" effects. Matyas (1997) however advocates for a "triple-way model", as the correct econometric specification in which time, exporter and importer effects are defined as fixed and unobservable. But, Egger and Pfaffermayr (2002) demostrates that the extension of Matays' triple-way model to include bilateral trade interaction effects reduces it to a two-way conventional model with time and bilateral effects only.

Serlanga and Shin (2007) observe that even though the pooled OLS, the Fixed and Random Effects Models have been widely used in varied situations,most studies reject the assumption of unobserved individual effects to be uncorrelated with all the regressors. Therefore, the Fixed Effects (FE) estimation is considered as more acceptable (Cheng & Wall, 2002). However, it fails to take into account time invariant variables like distance, border effects or common language dummies which are important in the EAC region.

Cheng and Wall (2002) opine that we could ignore potential correlation between individual specific variables and (unobserved) individual effects and simply estimate individual effects of specific variables by OLS. But doing so would result in biased estimates. Thus, a plausible proposition to resolve the problem is to use the Hausman and Taylor (1981, hereafter referred to as HT) instrumental variable estimation technique as exemplified by Brun, Carrere, Guillaumont, and De Melo (2002).

2.5 Model Specification and Control for Biased Estimates

Serlanga and Shin (2007) outlines the following typical gravity equation of international trade:

$$y_{hft} = \alpha_0 + \theta_t + \beta_{1t}X_{hft} + \beta_{2t}X_{ht} + \beta_{3t}X_{ft} + \beta_{4t}Z_{hf} + \mu_{hft} \quad (4)$$

for h = 1, ...,N, f = 1, ...,N, h $\neq$ f, t = 1, ..., T,

where y_{hft} is the dependent variable (say, the volume of trade from home country h to target country f at time t), X_{hft} are explanatory variables with variation in all the three dimensions (say, exchange rates between local currencies), X_{ht}, X_{ft} are explanatory variables with variation in h or f and t (say, GDP or population), Z_{hf} are explanatory variables that do not vary over time but vary in h and f (say, distance between the capital cities of the respective east African member countries), and the disturbance terms μ_{hft} are assumed to be *iid* with zero mean and constant variance across all *h, f, t*.

Equation (4) is estimated by the cross-section OLS for each year, where α_0 and θ_t cannot be separately identified. However, this cross-section OLS ignores any heterogeneous characteristics related to bilateral trade relationship. For instance, Kenya could export different amounts of the same product to Rwanda and Tanzania even if their GDPs are identical and they are equidistant from Kenya. Thus, the cross-section OLS estimates are likely to suffer from substantial heterogeneity bias.

To address heterogeneity, we include country-pair “individual” effects. Imposing $\beta_{jt} = \beta$ for all t and j = 1,.....4, and θ_t= 0 in (4), we obtain the following pooled panel data model:

$$y_{hft} = \alpha_0 + \beta_1 X_{hft} + \beta_2 X_{ht} + \beta_3 X_{ft} + \beta_4 Z_{hf} + \mu_{hft} \quad (5)$$

Matyas (1997) observed that the gravity model based on the pooled specification (5) may essentially be mis-specified, and hence proposed that the proper econometric specification of the gravity model should be a three-way model:

$$y_{hft} = \alpha_0 + \alpha_h + \gamma_f + \theta_t + \beta_1 X_{hft} + \beta_2 X_{ht} + \beta_3 X_{ft} + \beta_4 Z_{hf} + \mu_{hft} \quad (6)$$

where one dimension is time-specific effect (θ_t), and the other two are time invariant export and import country-specific effects (α_h and γ_f).

For the EAC region, these unduly strict restrictions could be specified as $\alpha_h = \gamma_f = \theta_t = 0$ for all h, f, and t are imposed in (5). Whilst estimating both models (5) and (6), Matyas found a statistically significant evidence against restrictions, $\alpha_h = \gamma_f = \theta_t = 0$. Similarly, Egger and Pfaffermayr (2002) showed that when the Matyas model (6) is expanded to include bilateral trade interaction effects such as those observed in the EAC region, it can be extended to reflect the following equation:

$$y_{hft} = \alpha_0 + \alpha_h + \gamma_f + \theta_t + \alpha_{hf} + \beta_1 X_{hft} + \beta_2 X_{ht} + \beta_3 X_{ft} + \beta_4 Z_{hf} + \mu_{hft} \quad (7)$$

then, as pointed out by Serlanga and Shin (2007), this generalized three way specification is identical to a two way model with time and bilateral effects only. Thus, Matyas’ model (6) is still likely to be mis-specified as it fails to display the whole vector space of possible treatments of explaining variations in bilateral trade.

Cheng and Wall (2002) focuses on the issue of heterogeneity bias and proposed the following fixed effects model (FEM):

$$y_{hft} = \alpha_0 + \alpha_{hf} + \theta_t + \beta_1 X_{hft} + \beta_2 X_{ht} + \beta_3 X_{ft} + \beta_4 Z_{hf} + \mu_{hft} \quad (8)$$

The main characteristic that sets it apart from Matyas’ model specified above is the inclusion of country-pair effects that are allowed to differ accordingly with the direction of trade, i.e. $\alpha_{hf} \neq \alpha_{fh}$.

Thus, (6) could be viewed to be a special case of (8), where the ad hoc cross-country restrictions on the country-pair effect are imposed, i.e. $\alpha_{hf} = \alpha_h + \gamma_f$. Cheng & Wall (2002) also consider the Symmetric Fixed Effect (SFE) and the Difference Fixed Effect model (DFE) models. The former imposes a restriction of symmetric country-pair effects, i.e. $\alpha_{hf} = \alpha_{fh}$, whilst the latter uses first differencing to (8) in order to eliminate the fixed effects. Available empirical evidence suggests that the restrictions imposed in (5), symmetry restriction on country-pair effects and those needed to obtain DFE specification are all rejected. Thus, Cheng and Wall (2002) conclude that the FEM (8) is likely to be the most robust version of gravity model applicable in studies of international trade flows.

However, thre still exist a challenge to establish the right measure of economic distance and control for contiguity (e.g., considering Kenya and Tanzania, Rwanda and Uganda, Ethiopia and South Sudan are all equivalently contiguous pairs). Thus, it would be necessary to regress the (estimated) individual effects on individual-specific variables by the OLS (Cheng & Wall, 2002; Martinez-Zaroso & Nowak-Lehmann, 2003).

But still, this approach may still be dogged by rpoblems of likely correlation between individual specific variables and (unobserved) individual effects. To include time-varying, time-invariant and unobserved individual effects, the HT instrumental technique is used.

However, the triple index model (8) may not the only way to represent panel data for EAC Gravity Model. A conventional double index-based panel data could still be used combine the characteristics of trading partners as explanatory variables e.g. Egger (2001) and Glink and Rose (2002). Thus, Serlanga & Shin (2007) consider the following double index panel data model:

$$y_{it} = \beta X_{it} + \gamma Z_i + \alpha_i + \theta_t + \varepsilon_{it},\ \text{i = 1,….,N, T = 1,….,N} \tag{9}$$

where an index i represents each country-pair *hf* such that $\alpha_i = \alpha_{hf} = \alpha_h + \gamma_f$ as in Cheng and Wall (2002). Notice that variables in X_{it} are defined as a combination of features of the countries in each pair, but importantly embrace variables, X_{hft} that vary in all the three dimensions, and variables, X_{ht} and X_{ft} that vary only with one partner of trade and time, respectively. Time invariant regressors such as distance, common language and common borders dummies are now included in Z_i that coincide with Z_{hf}.

De Sousa and Disdier (2002) use (9) explores the role of consumer's preferences, tariff and non-tariff barriers in explaining border effects on trade flows among Hungary, Romania, Slovenia, European Union (EU) and Central European Free Trade Agreement (CEFTA) countries. They use the HT estimation to examine the effects of individual country's characteristics such as distance, common border or language.

From the foregoing, we may conclude that the FEM together with the HT is the best suitable techniques to analyse EAC trade flows.

2.6 The Haussmann-Taylor Estimation in Heterogeneous Panels with Time-specific Factors in EAC Region

Since both triple and double index versions of the gravity model of trade, (8) and (9), can be expressed as a conventional double index panel-data model, we begin with

$$y_{it} = \beta X_{it} + \gamma Z_i + \varepsilon_{it},\ \text{i =1,…..,N, t =1,….,T} \tag{10}$$

And noting that,

$$\varepsilon_{it} = \alpha_i + \theta_t + \mu_{it} \tag{11}$$

where the error term ε_{it} is composed of three parts; namely, α_i is an individual effect that accounts for the effect of all possible time invariant determinants and could be correlated with some of the explanatory variables X_{it} and Z_i, θ_t is the time-specific effects common to all cross section units that is meant to correct for the impact of all the individual invariant determinants such as potential trend or business cycle, and μ_{it} is a zero mean idiosyncratic random disturbance uncorrelated across cross section units and over time periods. The conventional assumptions are that these three components are independent of each other in the EAC setting.

It is now possible to generalize (11) such that the individual responses to variations of the common time-specific effects are heterogeneous. Thus (11) can be extended to

$$\varepsilon_{it} = \alpha_i + \lambda_i f_t + \mu_{it} \tag{12}$$

Where λ_i capture heterogeneous responses that trade flows between trading countries might have with respect to the time-specific common factors, f_t. Therefore, the pooled or FE estimation of β and γ in (10) may be less efficient without properly accommodating the error component structure given by (12). Most importantly, where some or all of the regressors in X_{it} are likely to be correlated with f_t, the uncorrected estimator could be severely biased. Recently, a number of panel studies have used (12) explicitly, i.e., Ahn, Lee, and Schmidt (2001), Bai and Ng (2002), Pesaran (2002) and Phillips and Sul (2002).

To account for this potentially important issue, it is prudent to combine (10) and (12). Here, two cases are considered as a way of taking account of the unique settings observed in the EAC region. First, we simply assume that all of the time-specific common effects are observable in which case we have:

$$y_{it} = \beta X_{it} + \gamma Z_i + \lambda_i f_t^* + \varepsilon_{it},\ \text{i=1,…,N, t=1,…T} \quad (13)$$

$$\varepsilon_{it} = \alpha_i + \mu_{it} \quad (14)$$

Where f_t^* are observed multiple time-specific factors. The unique and probably most revealing features of the above model are: (i) it considers explicitly the impacts of time-specific factors f_t^* instead of the conventional fixed time effects to investigate the business cycle or the globalization issues; and (ii) it does not impose the homogeneous restriction on the coefficients on f_t^*.

Considering that f_t^* usually measure the common macro shocks or policies likely to be rampant in EAC, it is natural to expect that bilateral trade responses will be different from each other in the region. Secondly, in the case of both observed and unobserved common time-specific effects, it is wise to pursue a Pooled Correlated Common Effect (PCCE) estimation approach advanced by Pesaran (2002), and hence extend the model (13) to:

$$y_{it} = \beta X_{it} + \gamma Z_i + \lambda_i f_t + \alpha_i + \mu_{it},\ \text{i=1,….,N, t=1,….,T} \quad (15)$$

where we assume that there is a single unobserved time-specific common effect in ε_{it} and then f_t is the augmented set including f_t^* and the cross sectional averages of y_{it} and X_{it}, that is, $\overline{y_t} = N^{-} \sum_{i=1}^{N} y_{it}$ and $\overline{X_t} = N^{-1} \sum_{i=1}^{N} X_{it}$.

Pesaran (2002) shows that the PCCE estimation (also called the generalised within estimator) will provide the consistent estimator of β, though it does not provide a consistent estimator of γ. Serlenga and Shin (2007) work on (15) without loss of generality. They begin by recognizing that the notations; $X_{it} = (x1_{it}, x2_{it}, \ldots, xk_{it})$ is a k x 1 vector of variables that vary over individuals and time periods. They also note that $Z_i = (z1_i, z2_i, \ldots, zg_i)$ is a g x 1 vector of individual-specific variables, $f_t = (f1_t, f2_t, \ldots, fl_t)$ is an l x 1 vector of time-specific variables, and $\beta = (\beta_1, \beta_2, \ldots, \beta_k)$, $\gamma = (\gamma_1, \gamma_2, \ldots, \gamma_g)$, $\lambda = (\lambda 1_i, \lambda 2_i, \ldots, \lambda l_i)$ are conformably defined column vectors of parameters, respectively. They follow HT and rewrite (15) as:

$$y_{it} = \beta_1 x_{1it} + \beta_2 x_{2it} + \gamma_1 z_{1i} + \gamma_2 z_{2i} + \lambda_i f_t + \alpha_i + \mu_{it} \quad (16)$$

where $X_{it} = (x1_{it},\ x_{2it})$, $Z_i = (z1_i,\ z_{2i})$, $x1_{it},\ x_{2it}$ are k_1- and k_2 -vectors, $z1_i,\ z_{2i}$ are g_1- and g_2-vectors, and $\beta_1,\ \beta_2,\ \gamma_1,\ \gamma_2$ are conformably defined column vectors. The following assumptions are then made:

a) $\mu_{it} \sim iid(0, \sigma_\mu^2)$

b) $\alpha_i \sim iid\ (\alpha, \sigma_\alpha^2)$

c) $E(\alpha_i \mu_{jt}) = 0$ for all i, j, t.

d) $E(X_{it}\mu_{js}) = 0$, $E(f_t \mu_{is}) = 0$, and $E(Z_i \mu_{jt}) = 0$ for all i, j, s, t, so all the regressors are exogenous with respect to the idiosyncratic errors, μ_{it}.

e) $x1_{it}$, $z1_i$ and f_t are uncorrelated with $\alpha_i$for all i, t, whereas x_{2it} and z_{2i} are correlated with α_i.

f) Both N and T are sufficiently large.

In particular, we need to use prior information to distinguish columns of x and z which are correlated with the individual unobservable effect, α_i and those which are not. Assumption (d) is necessary to consistently estimate (nuisance) heterogeneous parameters, λ_i.

Serlenga and Shin (2007), develop the estimation theory for all the parameters in (16), using a two step approach that involves two steps i.e. they first, rewrite (13) as

$$y_{it} = \alpha_i + \beta X_{it} + \gamma Z_i + \lambda_i f_t + \mu_{it},\ \text{i=1,…,N, t=1,…,T} \quad (17)$$

and then obtain the consistent estimator of β thereafter.

3. Methodology

3.1 Data Collection and Description

Data for this study was obtained from the World Development Institute (WDI). Table 1 presents the definition of terms used to model in the study while Table 2 presents the summary statistics of the data. The panel data was analysed using the simple OLS regression and Random Effects methods. Instrumental and dummy variables were introduced to solve the problem of unobserved data with all efforts necessary undertaken to avoid the dummy variable trap.

Table 1. Definition of variables used in modeling

Variable	Definition/description of variable
E	Export values in millions of US dollars (US$) that signify trade flows across borders
GDP_i	Gross Domestic Product of exporting country in billions of US dollars (US$)
GDP_j	Gross Domestic Product of importing country in billions of US dollars (US$)
$GDPc_i$	GDP per capita of exporting country in US dollars (US$)
$GDPc_j$	GDP per capita of importing country in US dollars (US$)
Sc	Trading partners that shared the same colonial master dummy
Bs	Trading partners that share a border dummy
D	The distance between the capital cities of the trading partners in Kilometres
Ad	The physical distance between the main trading centres of trading partners
Gd	The gravity distance and/or contiguity that proxy trading costs associated with distances between the main trading centres of trading partners
Cl_i	Existence of a coast line for the exporting county dummy
Cl_j	Existence of a coast line for the importing county dummy
FDI_i	The annual average foreign direct investment flows in billions of US dollars (US$) of exporting country
FDI_j	The annual average foreign direct investment flows in billions of US dollars (US$) of importing country
P_i	The population of exporting country in millions
P_j	The population of Importing country in millions
Rc_i	Exporting country membership into a regional trading block dummy
Rc_j	Importing country membership into a regional trading block dummy
Mp_i	Number of mobile phone subscriptions of exporting country in millions
Mp_j	Number of mobile phone subscriptions of importing country in millions
W_i	Value of diaspora remittances in exporting country in US dollar millions (US$)
W_j	Value of diaspora remittances in importing country in US dollar millions (US$)
CI_i	The corruption index of the exporting country
CI_j	The corruption index of the importing country
Lc	Sharing a common language between trading partners dummy

Table 2. Data summary and descriptive statistics

	Descriptive statistics				
Variable	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs**
E	23.5246	70.6192	0.0000	727.11	840
GDP_i	5.6581	5.4671	0.2854	31.3600	840
GDP_j	5.5923	5.4185	0.2854	31.3600	840
$GDPc_i$	341.4388	257.6441	57.642	999.000	840
$GDPc_j$	324.2341	239.3187	57.642	999.000	840
Sc	0.4274	0.4950	0.0000	1.0000	840
Bs	0.8095	0.3929	0.0000	1.0000	840
D	-897.4048	356.8202	-1427.000	-177.000	840
Ad	897.4048	356.8202	177.0000	1457.0000	840
Gd	0.0016	0.0014	0.0007	0.0057	840
Cl_i	0.4286	0.4952	0.0000	1.0000	840
Cl_j	0.3810	0.4869	0.0000	1.0000	840
FDI_i	7.4600	1.6600	-1.1900	9.3600	840
FDI_j	7.3900	1.6600	-1.1900	9.3600	840
P_i	16.3765	10.5481	3.522	43.095	840
P_j	15.9798	10.2563	3.522	43.095	840
Rc_i	0.3226	0.4678	0.0000	1.0000	840
Rc_j	0.3226	0.4678	0.0000	1.0000	840
Mp_i	788428.6	2810626	0.0000	1.9400	840
Mp_j	760623.6	2732004	0.0000	1.9400	840
W_i	4.9300	1.4700	999.0000	7.7800	840
W_j	5.4600	1.5400	999.0000	7.7800	840
CI_i	2.4033	0.3807	1.8000	3.3000	183
CI_j	2.3985	0.3673	1.8000	3.3000	206
Lc	0.4274	0.495	0.0000	1.0000	840

From table 2, the mean export for the country pairs is US$ 23.5 million with a standard deviation of US$ 70.6 million. This statistics confirms the relative low intra trade flows among the EAC member states. The mean GDP for the exporting and importing trading partners is US$ 5.6 billion with a standard deviation of US$ 5.4 billion. This depicts the fact that the exports of one member state are the imports of the other trading partner.

The mean per capita for the exporting and importing member states are US$ 341.4 and US$ 324.2 with standard deviations of US$ 257.6 and US$ 239.3 respectively. The relative small size of the EAC member states economies as measured by their GDPs and the relative small per capita's could be used to explain the relative low intra trade flows among themselves compared to other regions like the ASEAN and EU trading blocks.

The mean FDI for both exporting and importing member states is US$ 7.46 billion with a standard deviation of US$ 1.66 billion. The mean population for both exporting and importing member states is about 16.4 million with a standard deviation of 10.5 million, a minimum of 3.5 million and a maximum of 43.1 million people. Of this population, the mean for those with mobile subscriptions is a paltry 0.8 million people, with a standard deviation of 0.28 million subscribers. The mean for diaspora remmitances is US$ 4.9 million with a standard deviation of US$ 1.5 million.

In summary, this sub-section describes the data used for analysis in this study, confirms some of the trade facts presented in the background and literature sections and offers some intuition into the expected results.

4. Estimation Results and Discussions

4.1 Preliminary Simple OLS Estimations Results

First, the study estimates a simple OLS regression for the variables selected to provide a snap shot view of the expected findings from randomised gravity model. The simple OLS equation is modelled along equation (4) for the selected variables as presented in equation 18:

$$E_{ijt} = \alpha_0 + \theta_t + \beta_1 GDP_{it} + \beta_2 GDP_{jt} + \beta_3 FDI_{it} + \beta_4 FDI_{jt} + \beta_5 P_{it} + \beta_6 P_{jt} + \beta_7 Rc_{it} + \beta_8 Rc_{jt} + \beta_9 Mp_{it} + \beta_{10} Mp_{jt} + \beta_{11} W_{ijt} + \beta_{12} Sc_t + \beta_{13} Bs_t + \mu_{ijt} \quad (18)$$

Table 3. Preliminary simple OLS regression results

Baseline Results			
Variable	**β's**	**t-stats**	**Std. err**
GDP_i	19.9390***	(8.77)	2.2737
GDP_j	8.1120***	(3.93)	2.0627
Sc	19.5663*	(1.71)	11.4375
Bs	141.1508***	(8.12)	17.3811
FDI_i	-1.2700***	(-6.80)	1.8600
FDI_j	-5.2000***	(-2.92)	1.7000
P_i	-5.7009***	(-3.90)	1.4627
P_j	-1.9285	(-1.48)	1.3085
Rc_i	-29.4052*	(-1.89)	17.4451
Rc_j	-4.6971	(-0.26)	18.1586
Mp_i	-7.7700***	(-3.32)	2.3400
Mp_j	-3.1100	(-1.35)	2.3000
W_{ij}	0.0583***	(3.05)	0.0191
Constant	-107.5261***	(-5.19)	20.7231
R^2	0.697		
Adj. R^2	0.6809		

Note. *** means significant at 1%; ** means significant at 5%; * means significant at 10% confidence levels.

These estimates assume the existence of "frictionless" trade as propounded implicitly by the Heckscher-Ohlin trade model (Deardorff, 1995) and no impediments to trade outside the feasible range of OLS estimation. The geographical or spatial trade issues are captured via the border sharing dummy. Unlike in standard Gravity models where distance, location and size are explicitly specified, location in this approach is captured by a dummy variable equal to one, for countries sharing a border and zero for those that don't. Hence, it's simplistically and inherently assumed that this border sharing dummy captures all factors that influence transport costs, infrastructure and business services (Graner & Isaksson, 2002).

From table 3, unlike the Niringiye et al. (2010) study, the location variable coefficient is significant at 1 per cent levels of significance implying that contiguity as a proxy variable for distance, infrastructure and physical amenities plays a significant role in determining exports in the EAC region. This is consistent with earlier findings by Ackello-Ogutu and Echessa (1996) and (1998). Past colonial ties that proxy history is determined to weakly drive trade in the region at 10 per cent confidence level. Country size measured by a country's GDP levels are found to drive or significantly impact bilateral trade in the EAC region for both the exporting and importing country. This holds at 1% confidence levels and is consistent with the standard gravity model predictions.

Further results suggest that bilateral trade in EAC is negatively but significantly driven by FDI inflows into the exporting country. Whereas this finding seems to deviate from the norm, it can be explained away by the observation that most FDI inflows in the EAC region are into non regional exporting sectors of ICT, infrastructure and mining. Such investments have a sizeable time lag before they can positively impact bilateral trade. Moreover, where there is no time lag, most of the commodities extracted (oil and minerals) are exported outside the EAC region implying that the higher the FDI inflows the higher the trade diversion away from the EAC Regional Integration Schedule (RIS).

The net effect of population in the EAC region is negative but highly significant on the regional exports and also negative but statistically insignificant on the regional bilateral imports. Membership into a regional trading block has a negative and weak significant effect on trade flows for the exporting member state but a negative and insignificant impact for the importing country. This is in contrast to expectation under standard gravity models where countries entering into regional integration arrangements are expected to trade more. It is also in contrast with Eita and Ashipala (2008) findings for Namimbia. However, this may be explained by their multiple memberships into the various trading blocks and the existence of rampant practice of NTBs among member states that effectively hinder intra trade flows among them.

Finally, diaspora remittances appear to foster growth of both regional exports and imports in the EAC region. Notably, workers' remittances in the region are dominated by East Africans working in neighbouring countries and especially originating from Kenya's vibrant private sector pool of employees.

In conclusion and as noted earlier, these estimates are likely to be biased and thus the explicit random effects panel data model is applied to esteimate more robust results.

4.2 Random Effects Panel Data Estimation Results

A review of econometric literature suggests that the fixed effect model would seem to be more appropriate for our EAC analysis. However, the main problem with a fixed effects model in our case is that variables that do not change over time i.e. time invariant variables, cannot be estimated directly because the inherent transformation wipes out such variables. It is for this reason that a random effects model is preferred.

The estimation equation used for the Random Effects model is that proposed by Hausman and Taylor (1981) as defined by Serlanga and Shin (2007) and presented in equation (16). Applying the factors selected to estimate EAC trade flows, equation estimated is presented in 19.

$$E_{it} = \alpha_i + \beta_1 GDP_{it} + \beta_2 GDP_{jt} + \beta_3 FDI_{it} + \beta_4 FDI_{jt} + \beta_5 P_{it} + \beta_6 W_{it} + \beta_7 CI_{it} + \beta_8 CI_{jt} + \beta_9 Mp_{it} + \beta_{10} Mp_{jt} + \beta_{13} Cl_t + \beta_{11} Sc_t + \beta_{12} Bs_t + \mu_{it} \quad (19)$$

Table 4. Random effects panel data model results

Random Effects Model Results			
Variable	**β's**	**t-stats**	**Std. err**
GDP_i	10.2985***	(4.28)	2.4041
GDP_j	7.1277***	(4.63)	1.5403
Sc	30.1856	(0.92)	32.9244
Bs	126.8497***	(2.92)	43.382
Cl	87.3362	(1.64)	53.1981
FDI_i	-6.0200***	(-3.66)	1.6500
FDI_j	-2.7500*	(-1.93)	1.4300
P_i	-5.7122***	(-2.59)	2.2034
W_i	0.0921***	(3.01)	0.0306
CI_i	2.5203	(0.37)	6.7630

CI_j	15.1876**	(2.09)	7.2772
Mp_i	-5.4600	(-0.26)	2.0700
Mp_j	-4.9800***	(-2.86)	1.7500
Constant	-187.7988***	(-3.7)	50.7700
R^2 -within	0.6323		
R^2 -between	0.6718		
R^2 -overall	0.6773		

Note. *** means significant at 1%; ** means significant at 5%; * means significant at 10% confidence levels.

The results presented in table 4 reflect a more robust analysis of the EAC bilateral Trade flows. The congruency of these results with results obtained elsewhere is striking. For instance, country size- proxied by the GDP of both exporting and importing country pairs is found to impact trade significantly at the 1 percent levels of significance. This is similar to findings of the simple OLS model where both the GDP of the exporting and importing member states are found to positively drive trade.

These findings are not only broadly in agreement with economic theory but are also consistent with other research findings in the region. Eita and Ashipala (2008) and Simwaka (2006) find similar results for Namibia and Malawi. In both studies, the coefficients for the two variables are positive and statistically significant. Border sharing is positive and significant at 1 per cent levels just as in the Namibian study. The Malawian study however finds contiguity to be insignificant but this defies both theoretical and empirical expectations.

For the first time in the EAC region, the impact of corruption on bilateral trade flows is investigated. The results suggest that corruption has a positive but insignificant impact on exports within EAC region and a positive and significant impact at the 5 per cent level on imports. This implies that corruption may be driving imports for some of the EAC countries from their partners while at the same time driving the capacity to produce for exports. In some sense, corruption appears to act as an “incentive” for exports and imports. This would not be absolutely unexpected considering the findings of Ackello-Ogutu and Echessa (1996) and (1998). Intuitively, unrecorded trade flows across borders would be driven by corruption either to by-pass country specific NTB or evade customs and other duties on cross border trade.

Impact of diaspora remittances on exports is found to be positive and significant at the 1 percent confidence levels, while FDI inflows are found to impact exports negatively within the EAC region. These results are similar to those obtained in the simpler model. The model also determines that common language is highly correlated to one or more of the other regressors hence rejected.

Further findings suggest that sharing a colony and having a coast line have a positive but statistically insignificant impact of trade flows within the region. Mobile subscriptions have a negative effect on trade flows with the effect being statistically significant for imports. This probably suggests the high cost of calling within the region and low mobile penetration especially in the hinterlands limits the levels of trade within the EAC. Intuitively, this findings do not come as a surprise given that most production in the EAC region is agricultural based and often done at the subsistence level. Poor mobile connectivity and high cost of calling within the region would thus limit access to markets across borders.

Overall, the results of the random effects model remain consistent with the simple OLS estimates except for the same colony that now become statistically insignificant and for mobile subscriptions that reverse from negatively significant for exports to negative significant for imports and vice versa. The model explains up to 63.3, 67.2 and 67.7 within, between and overall variabilities respectively of the trade flows within the region.

5. Conclusion

The study empirically examnied various variables that affect international trade flows and tests their relevance and practical applicability among EAC member states. It concludes that country size, contiguity, diaspora remittances and corruption factors positively drive trade within the EAC region while FDI flows, net population effects and communication costs (proxied by mobile subscriptions) hinder trade flows among member states. However, intra trade flows within the region remain small in comparative terms to other trading blocks of the world.

These findngs and the conclusions thereof adduce important insights into the determinants of bilateral trade in the EAC region with practical policy propositions. First, the member states need to prioritize strategic infrastructural investments in the region to reduce distance between them and boost trade flows among themselves. Second, it’s plausible for member states to re-oriented FDI flows into the region from extraction of mineral resources towards expansion of industries and value addition into their agricultural outputs to enhance gains to trade. Third, diaspora remittances could be harnessed to expand the regions productive capacity and enhances gains to trade in the region. Finally, as envisioned in the EAC protocol, the member states must address the Non Trade Barriers that still exist in the individual member states to fully exploit benefits of integration.

It is thus incumbent on the member states to consistently seek to address the obstacle that impede trade among themselves to enhance their gains from international trade. Despite the insightful findings emanating from this study, it cannot be said to be exhaustive and thus there is need to explore the subject further in future studies.

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