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# Impact of East African Community Integration on Trade: Gravity Model Approach


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**ABSTRACT:** East African community (EAC) is a regional economic bloc established to foster economic corporation between Kenya, Rwanda, Burundi, Uganda and Tanzania. Using gravity model the study explores the short run and long run effect of East African community (EAC) on trade using parametric, random effect and fixed effect estimation techniques. Secondly, the study investigates whether formation of EAC led to trade creation or trade diversion in the long run among the member countries of EAC. Lastly, the study establishes the effect of entry of Burundi and Rwanda to the economic bloc of EAC on trade. The study used panel data obtained from the five countries of EAC for the period 1985 to 2019. Breausch Pagan LM test for restrictions in the parametric model and Hausman test for endogeinity in the gravity model found out that fixed effect estimation technique produced accurate and plausible results than parametric and random effect estimation techniques. The empirical results of fixed effect model established that trade across EAC member countries rose by 1.6% in the short run while random effect and parametric models recorded 3.6% increase in trade in the short run. This effect was insignificant meaning that trade between EAC member countries did not expand considerably in the short run. In the long run, fixed effect indicate that EAC increased trade by 24.2% while random effect and parametric model each show that EAC increased trade by 16%. The coefficients are statistically significant at 5% ceteris paribus. Secondly, economic corporation of EAC led to trade creation in Burundi, Kenya, Rwanda and Uganda by 41.6%, 12.2%, 33.9% and 30.1% respectively and trade diversion by 4.2% in Tanzania. Thirdly, entry of Burundi and Rwanda to EAC increased trade of EAC countries by 19.6%. The coefficient is statistically significant at 5% level. The results of random effect and parametric model each indicate a growth in trade by 19.1%. The results of parametric, random effect and fixed effect estimation techniques are all consistent. Lastly, the study established that countries in EAC ought to foster greater growth in GDP, to encourage and strengthen use of common language and to reduce cross border restrictions in order to realize more growth in trade.



**KEYWORDS:** East African community, Trade, Parametric, Random Effect and Fixed Effect


## 1.0 INTRODUCTION

### 1.1 Research Background

The economic integration of East Africa started in 1927. It was comprised of three member countries of Kenya, Uganda and Tanzania. The regional bloc was formed to foster economic development and for political engagement. During that time, Kenya Uganda and Tanzania were under British East Africa protectorate. In 1967 these countries formed East African Community (EAC) to deepen economic development in the region and to foster strong political institutions and social engagement. However, this corporation was shut down in 1977 as a result of political and ideological differences between the member states.

According to Mc Carthy C. (1999), regional economic blocs were revived when countries in East Africa collaborated and pooled resources for a common course. This in the end enabled the establishment of regional economic corporations of SADC[1], ECOWAS[2] and COMESA[3]. The primary objective of these economic corporations was to promote trade between member countries through enactment and operationalization of collective trade policies. According to IFC, (2013) regional integration enhances trade between countries thereby promoting small and large scale business enterprises henceforth promoting economic growth and reducing poverty levels. In addition regional trading blocs are seen as the building blocks for strong

[1] SADC is south African Development Corporation

[2] ECOWAS is the Economic Corporation of West African States

[3] COMESA is Common Market for East and South Africa

economic and political corporations between countries. It is regarded as the engine for production and economic growth for African countries, COMESA (2013).

The signing of EAC treaty in 1999 by the heads of states of the former members of East African Community (EAC) revived the economic corporation. This led to renaissance of the economic corporation in the year 2000. Therefore, economic integration of East African Community (EAC) has been running for the last decade with new members joining the corporation in the year 2007 and 2016. Burundi and Rwanda joined the integration in the year 2007 while South Sudan became a member in the year 2016. EAC was formed to spur economic growth between member countries through collective economic policies aimed at promoting trade, production and regional development. In addition, EAC was not created only to solve economic matters but also to strengthen the member countries politically and socially.

Since its revival in the year 2000, this economic integration has been transformed through establishment of common market in the year 2010 to boost trade between members of the economic bloc. Other steps taken include the plan for the establishment of a common currency and common customs union which will revolutionize economic transactions between members of EAC. Further transformations include the establishment of common external tariff in the year 2005 applicable across member countries of EAC. The use of common external tariff (CET[4]) was aimed at cutting down on the possibility of double tariffs which impede trade across member countries of EAC. According to McIntyre M, (2005) imports and exports across countries in EAC were subjected to double tariffs at the border points of these countries before establishment of CET. This practice raised transaction costs and impeded trade within EAC. Some empirical evidence noted that before CET was put into practice in the year 2005, Uganda imported 65% of their edible palm oil and vegetable oil from Malaysia but this figure reduced to 45% after 2005. In regard to the use of CET in 2005, this policy enabled Uganda to shift 20% its imports of palm oil and vegetable oil from Malaysia to Kenya. This was as result of reduced external tariff from 15% to 8% subjected to EAC member countries, Khorana and Perdikis, (2007).

The challenge faced by regional integrations is the effects caused by overlapping memberships, UNECA, (2004). This is also evident in EAC because some members of the economic bloc are members of other economic corporations. Among the five members of EAC, four are members of COMESA, two are members of ECCAS and one is a member of SADC. Kenya, Uganda, Rwanda and Burundi are members of COMESA while Rwanda and Burundi are members of ECCAS[5] and Tanzania is a member of SADC. Overlapping effect is attributed to the differences existing between economic integrations.

Countries in EAC are encouraged to reduce trade barriers in order to improve trade between member countries. Empirical evidence show that if countries in EAC improve their commitment towards regional growth and ease of non-trade barriers, the region is projected to achieve increase in regional trade by 8.4%, Kugonza and Nsubuga, (2017). In addition, use of one stop border post to facilitate trade between countries in an economic integration improved trade within economic blocs, Zoellic, R,B, (2013). Empirical evidence show that when EAC adopted one stop border post, across the border clearing time for truckers reduced by 30% at Malaba border between Kenya and Uganda. This evidence correlates with the studies by Abedini and Peridy, (2008) which established a 20% growth in trade between the member countries of GAFTA[6].

**1.2 Problem Statement and Justification**

There has been growing concern on the impact of economic integration on trade. Countries in East Africa made tremendous efforts through creation of regional trading bloc in order to improve trade between the member countries. Economic integration of countries is aimed at reducing transaction costs that impede trade across these nations. Therefore, it is prudent to study the effect of the formation of EAC on trade to be able to know the extent to which the integration affected trade. The study on EAC is even more vital because it will help us measure the impact brought about by the entry of Rwanda and Burundi to the economic bloc in the year 2007. In addition, the study is also instrumental in establishing how EAC affected trade of the member countries. This is because EAC trade effect is more general than specific therefore, there is need to find out how this integration impacted trade of respective member countries. The need for this research is to establish the causal effect of EAC on trade in order to establish the economic impact of the integration on overall trade of EAC countries.

To achieve the above objectives this study employed three empirical techniques namely; parametric analysis, random effect estimation and fixed effect estimation technique on the gravity model. Using the three techniques ensures that the estimates obtained are accurate and plausible. However, to choose the most appropriate technique among the three, the study employed Breausch Pagan Langregian multiplier test for restrictions in the parametric model, Breausch and Pagan (1980). This diagnostic

[4] CET refers to common external tariff imposed on commodities sold across countries in EAC and universally used in these nations

[5] ECCAS is the Economic Community of Central African States

[6] GAFTA is the Grain and Trade Association group of countries

test aids selection of the best regression estimation model between parametric and random effect estimation. Secondly, to choose the best technique between random effect and fixed effect estimation the study employed Hausman test for endogeneity in the gravity model, Hausman and Taylor (1981). The differences between the random and fixed effect is the assumptions on how explanatory variables correlate with unobserved variables. Fixed effect estimation assumes that there exist unobserved explanatory variables that correlate with the observed explanatory variables in the model while random effect estimation negates this assumption. Hence, to evade any possibility of empirical results that are not BLUE[7], this study uses Breausch Pagan Langregian multiplier test for restrictions and Hausman test for endogeneity in the gravity model. The study will help us understand how EAC affected trade of the economic bloc in the short run and in the long run. Secondly, it will inform us how trade changed when Rwanda and Burundi joined EAC and lastly, the study will inform us how EAC affected trade of the individual member countries in the long run.

### 1.3 Objectives

This study aims as establishing the effect of EAC free trade area on bilateral trade between countries in the economic integration. To make this possible, the following specific objectives are pursuit;

1. To investigate the short run and long run effect of EAC on trade
2. To establish the impact of entry of Burundi and Rwanda to EAC on trade
3. To investigate whether formation of EAC led to trade creation and trade diversion in the long run.

### 1.4 Significance of the Study

In the last two decades, East African countries invested resources to revive the regional bloc and to ensure that the economic corporation is sustainable in the long run. EAC was formed to help the region to grow economically and socially and to foster strong political institutions in the region. This study focuses on the impact of this economic corporation on trade within the region. Trade is an economic component and it plays key role in economic growth. The study employed the widely used gravity model to explore this effect. This is because the model is rich in terms of variable composition and takes care of country specific effects suitable for the countries under study. The study is instrumental in establishing the extent to which EAC affected trade between the countries in the economic bloc in the short run and in the long run. Secondly, the study will assist in understanding how entry of Burundi and Rwanda in 2007 to the economic bloc affected trade. Lastly, the study will shed more light on how EAC affected trade of member countries in the long run in form of trade creation and trade diversion. The empirical results from this study will build on literature of related research and help policy makers in matters on regional economic corporations.

## 2.0 LITERATURE REVIEW

### 2.1 Theoretical Literature

The literature on bilateral trade tremendously transformed from traditional approach postulated by the mercantilist in the 18$^{th}$ and 19$^{th}$ century and by the classical economists the likes of Adam smith, (1776) and David Ricardo, (1817). Traditional trade theories placed more focus on trade between countries. Overtime, studies on bilateral trade between countries gained immense attention from many scholars owing to the growth in international trade. This is attributed to the expansion of global market and immense adoption of international trade agreements. International trade agreements eased trade between countries and regions. Traditional trade theories promoted exports over imports while classical economists of Adam Smith, (1776), Ricardo David, (1817) and Markusen, (1988) encouraged specialization of countries in production and trade. Countries were encouraged to deal in goods and services with comparative advantage and to import goods and services with comparative disadvantage. This idea was noble and instrumental in international trade.

This theory seemed rather challenging to due to varying costs of production across countries. Trade is meant to stimulate mutual gains for both importing and exporting countries but varying market prices disadvantages countries with high production costs compared with countries with relatively low costs of production. In the study on Heckscher-Ohlin model, Salvatore, (2004), established that varying costs of production across countries impedes international trade and places countries with comparatively high cost of production at the mercy of those countries with low cost of production. Therefore, mutual gain from trade will only be possible when markets are rationalized and countries are allowed to willingly produce, import and export goods and services from other countries. Export only initiatives widens disparity in trade and waters down any meaningful gains from bilateral trade. This is because countries have varied country specific characteristics and different level of factor endowments.

[7] BLUE refers to estimations of econometric analysis that are best, linear and unbiased. BLUE estimators are efficient, accurate and suitable for use in economic interpretation of a phenomena under study

On contrary, new trade theories deviated from traditional trade theories by encouraging trade between industries and firms rather than trade between countries. This distinctive feature of new trade theory accords production responsibility to firms and industries and policy obligation to countries. Firms and industries are fortified to produce while countries are encouraged to formulate policies able to protect local production and to foster trade between countries. This idea attracted research in role of industrialization in trade. The levels of national incomes were found to have a positive effect on industrial growth and trade. According to Linder, (1961) countries in the same income range shared similar preference in trade and production. Studies by Montenegro and Soto, (2000) established similarities in the composition of products traded by countries in the same income group. Developed countries were found to trade in high quality goods compared with less developed countries, Markusen, 1988. Owing to the disintegration of industries into firms to improve output growth and the roles of firms in overall industrial growth, new trade theory further transformed to "new" new trade theory. This process of narrowing down of production processes to enhance industrial productivity and to cut down on costs of production improved the gains from trade, Melitz and Redding, (2013). These gains from trade revolutionized industrial growth. New firms and industries were attracted by the lucrative nature of global market and inefficient firms were faced out. Global market share was shaped by international trade policies and regional trade agreements.

**2.2 Empirical Literature**

Gravity model received overwhelming support in the study of international trade. This is due to the ability of the model to adapt to specific country characteristics and its capacity to produce plausible empirical results. According to this model, volume of trade between countries depend on a number of factors that include the size of country's national accounts, population, distance between countries and a set of country specific characteristics, Zarzoso and Lehmann, (2003). According to Kugonza and Nsubuga, (2017), from the year 1995 to 2016 member countries of EAC traded more with the rest of the world than with themselves.

The empirical evidence indicate that intra-EAC trade contributed USD 5.2billion worth of trade within the economic integration of EAC while trade between EAC with EU[8], APEC[9] and FTAA[10] amounted to USD 6.53 trillion, USD 11.2 billion and USD 2.88 trillion respectively. In the year 2016, EAC traded more with APEC at 69.87% followed secondly by EU at 61.73% and thirdly 45.99% with FTAA. In comparison with the recorded trade volumes in APEC, EU and FTAA, only 11.47% accounted for trade between member countries of EAC. These figures show that even after the establishment of EAC, countries within EAC still trade more with non-EAC members than it does with the members of EAC.

Another striking challenge of trade between members of EAC is the overlapping effect brought about by overcrowded memberships in economic blocs, UNECA, (2004). Members of EAC are also members of other economic blocs. Every economic bloc is unique with diverse, objectives, challenges and opportunities. Apart from being members of EAC, Kenya, Rwanda, Burundi and Uganda are also members of COMESA. Tanzania is a member of SADC while Rwanda and Burundi are members of ECCAS. According to Kugonza and Nsubuga, (2017), intra-EAC trade is projected to rise by 8.4% if the countries in EAC commit to strengthen the regional corporation and to improve across border trade through reduction in non-trade barriers.

Other positive developments that enhanced intra-regional trade within EAC include the common external tariff (CET) and use of one border post (OBP). Common external tariff was established in the year 2005 by Kenya, Uganda and Tanzania. CET tariff was applied after concerns were raised due to double tariffs subjected to cross border trade which inhibited trade between member countries of EAC, McIntyre M, (2005). Before the establishment of CET of 8% in 2005, countries in EAC subjected goods crossing their border to member countries to a tariff of 15%. In this regard, chances of double taxation were evident because countries applied this tariff discretely. This impeded trade between EAC countries and countries opted for cheaper imports from countries outside EAC. For instance, when CET tariff in EAC was 15%, Uganda imported 65% of its edible oils and palm oil from Malaysia and Indonesia. However, upon ratification of CET to preferential tariff of 8%, 20% of these imports were sourced from Kenya, Khorana and Perdikis, (2007).

In addition, use of one border post by countries in the same economic integration was found to facilitate trade across member countries. Empirical evidence show that when EAC adopted one stop border post, across the border clearing time for truckers reduced by 30% at Malaba border between Kenya and Uganda, Zoellic, R,B, (2013). Generally, countries in economic integration would realize increased trade volumes if universal policies that benefit the region are applied. Impediments of trade should also be solved amicably if meaningful gains are to be achieved. Other empirical evidence indicates that establishment of preferential trade area of GAFTA increased trade between member countries by 20%, Abedini and Peridy, (2008).

[8] EU refers to countries in European Union

[9] APEC refers to Asian Pacific Economic Corporation

[10] FTAA refers to Free Trade areas of Americas

## 3.0 METHODOLOGY

### 3.1 Research Design

The study uses panel data compiled from 35 years' time series data for the years 1985 to 2019. The data were obtained from five countries of EAC comprising of Kenya, Uganda, Tanzania, Rwanda and Burundi. Data for South Sudan was omitted to avoid biased results because it joined EAC in 2016. The data consist of 20 N*N country pair amounting to 700 observations. Structural breaks were applied to the data to ease determination of entry effect, short run effect and long run effect. The study applies the use of parametric model, random effect and fixed effect estimation to determine causal relationships between explanatory variables and the regressand.

### 3.2 Data Description, Data Source and Analysis

The study uses secondary data collected from the following sources. Volumes of trade were computed through compilation of import and export data collected from IMF (international monetary fund). Data for national accounts were collected from world economic indicators (World Bank) while the data country specific characteristics comprising of common border, language, landlocked and the size of countries land mass were collected from central intelligence agency (CIA). Dummy variable for countries in EAC were created to ease determination of causal effects for the various objectives. The data were compiled using excel and analyzed using Stata 16.

### 3.3 Gravity Model

It is one of the most useful models for studying international trade. The name is derived from Newton's law of gravity which states that the forces of attraction between neighboring objects is proportional to products of their masses and relates inversely to the squire distance between them. Mathematically the model takes the form;

$$F_{ij} = g.(M_i * M_j)D_{ij}^{-2} \quad (1)$$

Where $i\ and\ j$ represent respective objects, $F$ is the forces of attraction, $M$ represent mass, $D$ represent distance between objects while $g$ is the gravitation force.

The model was first applied by Tinbergen (1962) and Poyhonen (1963) and did not receive much attention until 1970 when researchers based on international trade realized that the gravity model was a goldmine. The model helped shape international trade due to its richness in the form of variable composition. This eased studies on the effect of bilateral trade on economic growth because it was during this era that international trade was in the limelight. The model did not only ease empirical analysis and determination of causal effects but also it provided international trade researchers with wide scope on variable composition and limits.

The model was further shaped through empirical studies. Anderson, (1979), Helpman and Krugman, (1985) proved the suitability of gravity model using product differentiation technique and results were commendable. These positive results led to global use of gravity model in the studies on international trade, foreign direct investments and in demographic transitions.

The variable composition of widely used gravity model includes population size, level of national accounts, land areas, distance between trading countries and country specific characteristics. Country specific characteristics include landlocked, shared border, shared language and other country related characteristics.

Due to its plausibility in research, this model was tested and modified based on evidence obtained by different researchers. The theoretical foundation of the model was put to test using trade data between countries by Bergstrand, (1985) and the model was found to be useful in the determination of trade effects. In addition, the model produced precise results during the determination of monopoly effect on international trade, Bergstrand, (1985).

Due to its applicability in international trade the gravity model was further refined to enrich its usefulness. Matyas, (1997), Chen and Wall, (1999) and Egger (2000) contributed to the econometric transformation of the gravity model through improvement of model specification. Problems of variable composition was solved by Helpman, (1987), Wei, (1996), Limao and Venable, (1999) through series of tests to various predictors in the gravity model. This improved the plausibility of variables used in the model.

Further, Deardorff, (1995) tested the use of distance between trading partners and the volume of national accounts in the determination of trade flows between countries. Countries with bigger national accounts and close to each other were found to trade more and the reverse was true. In addition, Deardorff, (1995) indicated that gravity model is able to take more control variable as long as the causal effect does not deviate from theoretical and empirical proofs. Common border between trading countries was found to have causal relationship on trade, Anderson and Wincoop, (2001). This proved suitability of this regressor in gravity model.

Gravity model is therefore suitable for use in this study. The model was transformed in order to accommodate for the country specific characteristics and to be able to achieve the objectives of this study. The transformed gravity model used in this study is given as;

$$Trade_{ij} = A.[(Y_{it})^{\beta_1} * (Y_{jt})^{\beta_2}]D_{ij}^{-\beta_3} \quad (2)$$

Where; $i$ *and* $j$ represent exporting and importing country respectively. $A$ , $\beta_1$, $\beta_2$ $\beta_3$ represent constant of proportionalities. $Trade$ is the volume of trade between country $i$ and country $j$ while $Y_{it}$ and $Y_{jt}$ are respective national income of country $i$ and country $j$ at time t. $D_{ij}^{-1}$ is the inverse distance between trading partners.

Transforming equation (2) into a logit form yields a linear econometric function that eases econometric analysis and interpretation of causal relationship between variables.

$$logTrade_{ij} = A + \beta_1 logY_{it} + \beta_2 logY_{jt} - \beta_3 D_{ij} + \mu_{ijt} \quad (3)$$

Where $A$ is a constant term, $\beta_1$, $\beta_2$ and $\beta_3$ are coefficients factors of regressors $Y_{it}$ , $Y_{jt}$ and $D_{ij}$ respectively while $\mu$ is the disturbance term that represent unobserved exogenous variables affecting the regressand in the model.

**The Augmented Gravity Model**

This study adopted gravity model of Reuven Glick and Andrew K. Rose,(2015) and Rose (2000) and modified it to suit the objectives of the study. Model (4) below is the modified model suitable for this study.

$$lnT_{ijt} = \vartheta + \beta lnZ_{ijt} + \delta_{ijt} + \gamma\omega_{ijt} + \varepsilon_{ijt} \quad (4)$$

Where; $i$ and $j$ represent exporting and importing countries respectively while $t$ denote time. $ln$ is natural logs, $T$ is trade volume between country $i$ and country $j$, $Z$ is cross-country set of vector controls, $\delta$ is country-specific-effect, $\omega$ denote the objective factor and $\gamma$ is the factor coefficient. $\vartheta$ *and* $\beta$ are vector coefficients and $\varepsilon$ represent unobserved regressors not included in the model but affect the regressand.

This version of gravity model has been extensively used to determine causal effect of economic corporations and monetary unions on bilateral trade, Chaney, (2013). In regard, augmented gravity model developed from equation (4) that is suitable for this study is given as;

$$lntrade_{ijt} = \beta_0 + \beta_1 lnexpgdp + \beta_2 lnimpgdp + \beta_3 lnpop + \beta_4 lnProdlandarea + \beta_5 landlocked + \beta_6 partiallandlocked + \beta_7 commonlanguage + \beta_8 border + \gamma\omega + \varepsilon_{ijt} \quad (5)$$

Where; $ln$ represent natural logs, $trade$ is the regressand and exporting country GDP, importing country GDP, population, product of land area respectively are cross-country set of vector variables. The remaining variables are dummies. $landlocked$ represents trade between landlocked countries, $partiallandlocked$ represent trade between landlocked country and a country that is not landlocked, $commonlanguage$ represent countries that share common language, $border$ represent countries that share border and $\omega$ denote the factor variables for determining the causal effects stated by the study objectives. The right choice of variables is used for each objective to eliminate problems of collinearity.

**3.4 Empirical Analysis**

**3.4.1 Parametric Estimation**

This model is highly recognized by researchers due to the robust nature of the technique. Use of parametric technique in empirical analysis gained confidence among many researches because of its robustness. The model was put into use by Fisher, (1925) and later became the most preferred technique in empirical analysis involving determination of causal effect, Singh, (2006). The robustness of this model relate to its ability to determine causal effect while factoring in the effect of known and unknown explanatory variable. Using this model makes it easier for researchers to control for unobserved regressors without making for assumptions. In addition, the model is also suitable in cases where the data are not randomly distributed. However, this study uses random data that are identically distributed.

**3.4.2 Random and Fixed Effect Estimation**

In comparison with fixed effect estimation method, random effect model is not widely used because the model is unable to control for time invariant unobserved variables. This property makes random effect less attractive compared with fixed effect because the model is incapacitated when there are unobserved heterogeneous variables that affects the model. However, it is not sufficient to use fixed effect model alone, hence use of both models is appropriate, Salvatici, (2012). Therefore, this study employs both random and fixed effect model to control for this effect. In addition, the study uses Hausman test for endogeinity in the gravity model, Hausman and Taylor (1981). One of the effects of unobserved explanatory variables is that it can cause omitted variable bias if not taken care during econometric analysis. Therefore, Hausman test makes it easier to control for this bias in the gravity model. Hence, Fixed effect estimation is considered the most appropriate model in econometric analysis, Baier and Bergstrand(2004).

Consider the fixed effect model;

$$lntrade_{it} = \beta Z_{it} + \delta_i + \varepsilon_{it} \ , \delta_i > 0 \quad (6)$$

Where $lntrade_{it}$ denote trade for country $i$ at time t, $Z_{it}$ denote set of regressars for country $i$ at time t, $\delta_i$ denote time invariant unobserved regressors affecting the model, $\varepsilon_{it}$, is error factor and $\beta$ is fixed effect factor. The time invariant unobserved regressors are considered strictly independent, uncontrolled and correlated with observed regressors.

The random effect model takes the form;

$$lntrade_{it} - \overline{lntrade_i} = \beta(Z_{it} - \overline{Z}_i) + (\delta_i - \bar{\delta}_i) + (\varepsilon_{it} - \bar{\varepsilon}_i)$$

Where, the interactions of the time invariant variables $\delta_i - \bar{\delta}_i$ eliminate fixed effect leading to more restrictive model $\ddot{lntrade}_{it} = \beta \ddot{Z}_{it} + \ddot{\varepsilon}_{it}$ that omits effects caused by unobserved heterogeneity in the model.

### 3.5 Diagnostic Tests

#### 3.5.1 Test for Endogeneity across Panels

Endogeity test of the gravity model reduces assumption bias that occurs when there exist unobserved heterogeneous variables that cannot be controlled but affects the model. This can be solved through Hausman and Taylor (1981) test for endogeneity in the gravity model. This helps eliminate omitted variable bias in the model hence making the estimates of regression analysis plausible.

$$lntrade_{it} = \beta Z_{it} + \delta_i + \varepsilon_{it}$$

Where $lntrade_{it}$ denote trade for country $i$ at time t, $Z_{it}$ denote set of regressars for country $i$ at time t, $\delta_i$ denote time invariant unobserved regressors affecting the model, $\varepsilon_{it}$, is error factor and $\beta$ is fixed effect factor. In fixed effect, the $\delta_i$ term is statistically different from zero while random effect assumes the reverse.

#### 3.5.2 Test for Restrictions in Parametric Model

Test for restrictions in the parametric model is important especially in empirical analysis where random effect model is used. Overtime, Wald and likelihood ratio (LR) was used when testing for restrictions in the parametric model. However, due to its inability to include parameters outside parameter space Lagrangian Multiplier (LM) test commonly referred as Breausch and Pagan (1980) test became the most preferred test, Greene and McKenzie (2012). In LM test, the slope estimator imposes restrictions on parametric model making it possible to identify the most preferred model between parametric and random effect models that fits the study.

Consider the unrestricted gravity model $L = f(r, y)$ faced by the constraint, $r = r^0$. The slope estimator is imposed on the lagrangian model to apply restrictions on the parametric model.

$$L = f(r, y) - \lambda(r - r^0)$$

$\frac{\partial L}{\partial r} = \lambda$, Therefore $\lambda = s(r^0, y)$ because $r = r^0$

Hence this study applies Breausch and Pagan (1980) test for restrictions in the gravity model to ease selection of appropriate model between parametric and random effect model.

#### 3.5.3 Test for Heteroscedasticity

Presence of heteroscedasticity renders test statistics of regression analysis to be biased. Therefore, when F-test, t-test and standard errors are biased the estimated coefficients will no longer be accurate. This study uses correctly specified gravity model with the right functional form. In addition, the study employs the use of clustered robust suggested by Richard W. (2020) available in stata 16 to correct for heteroscedasticity present in the panel data. Therefore the results obtained are plausible.

#### 3.5.4 Test for Serial Correlation

Serial correlation is common in panel data with time series over 30 years, Reyna, (2007). Since this study uses panel data developed from time series data covering 35 years, the data is tested for serial correlation according to Wooldridge J. (2002). In addition, the study uses robust output generated using stata 16 software.

## 4.0 EMPIRICAL RESULTS

### 4.1 Short-Run and Long-Run Effect of EAC on Trade

#### 4.1.1 Model Selection

**Table 1: Breausch Pagan and Hausman Test**

| Period | Test | $chi^2$ | $p\_values$ | Significance level | Decision |
|---|---|---|---|---|---|
| Short Run | Breausch Pagan | $x^2 = 30.64$ | 0.0000 | 1% | $H_1$ |
| | Hausman | $x^2 = 28.76$ | 0.0007 | 1% | $H_1$ |
| Long Run | Breausch Pagan | $x^2 = 15.06$ | 0.0001 | 1% | $H_1$ |
| | Hausman | $x^2 = 35.17$ | 0.0001 | 1% | $H_1$ |

Breaush Pagan lagrangian multiplier (LM) test indicate that random effect is better than parametric model both in the short run and in the long run. However Hausman test for endogeneity in the panel data suggest that fixed effect is better than random effect model. Therefore, the study uses estimated coefficients of explanatory variables obtained through fixed effect because they are accurate and plausible. The empirical results from the fixed effect model will be used in all the econometric interpretations for this study.

#### 4.1.2 Short Run Effect of EAC on Trade

**Table 2: Parametric, Random Effect and Fixed Effect model**

| | Parametric<br>lntrade<br>b/p | Random Effect<br>lntrade<br>b/p | Fixed Effect<br>lntrade<br>b/p |
|---|---|---|---|
| lngdpexp | 1.525*** | 1.525*** | 1.010*** |
| | (0.000) | (0.000) | (0.000) |
| lngdpimp | 1.286*** | 1.286*** | 1.293*** |
| | (0.000) | (0.000) | (0.000) |
| lnpop | -0.426* | -0.426 | 0.395 |
| | (0.042) | (0.058) | (0.333) |
| lnproductlandarea | -0.623*** | -0.623*** | -0.649*** |
| | (0.000) | (0.000) | (0.000) |
| landlocked | -0.917*** | -0.917*** | -0.999*** |
| | (0.000) | (0.000) | (0.000) |
| partiallandlocked | -0.344*** | -0.344*** | -0.386*** |
| | (0.000) | (0.000) | (0.000) |
| commonlanguage | 0.268*** | 0.268*** | 0.221*** |
| | (0.000) | (0.000) | (0.000) |
| border | -0.106* | -0.106* | -0.016 |
| | (0.038) | (0.018) | (0.752) |
| eac_short_run | 0.037 | 0.037 | 0.016 |
| | (0.401) | (0.439) | (0.736) |
| Constant | -16.597*** | -16.597*** | -17.205*** |
| | (0.000) | (0.000) | (0.000) |
| R2 | 0.753 | | 0.713 |
| df_res | 649 | | 645 |
| BIC | 835.3 | . | 809.1 |
| AIC | 790.4 | . | 764.2 |

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

According to table 2, the effect of EAC on trade is positive for the three models in the short run. However, this effect is not statistically significant because the p-values are above 5% significant level. The empirical result of fixed effect model suggests that trade across EAC member countries rose by 1.6% in the short run. This effect was nonetheless insignificant. This shows that trade between EAC member countries did not expand considerably in the short run.

The coefficients of GDP for exporting country and GDP for importing country are positive and statistically significant at 5% level. The empirical result indicate that in the short run, exporting country GDP and importing country GDP increased trade by 1.01% and 1.29% respectively. This implies that rise in GDP by 1% increased trade by more than 1% signifying increasing returns to scale. This shows that economic activities in EAC that encouraged growth in GDP contributed to increased trade in the short. In addition, the coefficient of common language is positive and statistically significant at 5% level. The coefficient shows that countries with shared language experienced 22.1% increase in trade compared with countries that did not share common language. Hence, countries in EAC should foster more growth in GDP and encourage common language in order to boost trade with EAC members.

The coefficient of population in the short run is positive and statistically insignificant. Although, population has positive effect on trade, this effect is insignificant because the p-value is more than 5% significance level. The coefficients of products of land area, landlocked and partial landlocked are negative and statistically significant at 5% level. This implies that in the short run,

countries with big land areas recorded 0.65% decrease in trade compared with countries of relatively smaller land areas. Trade between landlocked countries was 99.9% lower compared with trade between countries that are not landlocked. Landlocked countries trade less by approximately 100% compared with countries that are not landlocked. Hence, the economic corporation of EAC should foster trade between countries to reduce this effect.

Trade between landlocked countries of EAC with member country of EAC that is not landlocked resulted in decrease in trade by 38.6%. This shows that when one country is landlocked and the trading partner is not landlocked, this specific country effect reduces trade between these countries. However, when one of the trading partners is landlocked and the other country is not landlocked this cuts decrease in trade by 61.3%. Thus, landlocked countries in EAC are encouraged to trade more with countries that are not landlocked in order to gather significant increase in trade. This is because when a country is landlocked, it is unable to trade freely compared with countries that are not landlocked.

The coefficient of border is negative and statistically insignificant. The direction of this effect indicates that borders inhibited trade in the short run. Therefore, countries within EAC should reduce border controls by establishing cross border management system that encourages trade across borders.

#### 4.1.3 Long-Run Effect of EAC on Trade

According to table 1 model selection indicate that fixed effect is most appropriate for empirical analysis of EAC on trade in the long run. Hence the coefficient of variables from this model is accurate and plausible.

| | Parametric<br>lntrade<br>b/p | Random Effect<br>lntrade<br>b/p | Fixed Effect<br>lntrade<br>b/p |
|---|---|---|---|
| lngdpexp | 1.544*** | 1.544*** | 1.110*** |
| | (0.000) | (0.000) | (0.000) |
| lngdpimp | 1.131*** | 1.131*** | 1.285*** |
| | (0.000) | (0.000) | (0.000) |
| lnpop | -0.712** | -0.712** | -0.603 |
| | (0.003) | (0.003) | (0.202) |
| lnproductlandarea | -0.496*** | -0.496*** | -0.644*** |
| | (0.000) | (0.000) | (0.000) |
| landlocked | -0.867*** | -0.867*** | -1.002*** |
| | (0.000) | (0.000) | (0.000) |
| partiallandlocked | -0.317*** | -0.317*** | -0.388*** |
| | (0.000) | (0.000) | (0.000) |
| commonlanguage | 0.277*** | 0.277*** | 0.222*** |
| | (0.000) | (0.000) | (0.000) |
| border | -0.116* | -0.116** | -0.014 |
| | (0.020) | (0.009) | (0.773) |
| eac_long_run | 0.170** | 0.170** | 0.242*** |
| | (0.001) | (0.001) | (0.000) |
| Constant | -14.604*** | -14.604*** | -11.072*** |
| | (0.000) | (0.000) | (0.000) |
| R2 | 0.756 | | 0.720 |
| df_res | 649 | | 645 |
| BIC | 825.2 | . | 793.6 |
| AIC | 780.3 | . | 748.7 |

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In the long run, the coefficient of EAC is positive and statistically significant at 5% ceteris paribus. The empirical result indicates that formation of EAC increased trade by 24.2% in the long run. Formation of economic integration of EAC enhanced trade in the long run signifying positive effect of the corporation between the five east African countries. GDP of exporting country and importing country indicate positive effect of these variables to EAC trade in the long run. The coefficients are statistically significant at 5% level. The coefficients show that increase in GDP for exporting and importing country by 100% will increase trade by 111% and 128.5% respectively. This shows that GDP plays significant role in the growth of trade between EAC countries.

In the long run, increase in population is found to have detrimental impact on trade. In addition, border point has negative effect on trade. However, the empirical results of population and common border are statistically insignificant. The coefficients of product of land areas, fully landlocked countries and partially landlocked countries are negative and statistically significant at 5% level. Countries with bigger land areas contribute trade by less than 0.644% compared with countries with smaller land areas. Countries with smaller land mass. EAC countries that are completely landlocked contribute 100.2% less trade compared with countries that are not landlocked. However, countries that are partially landlocked contribute 38.8% less trade compared with countries that are not landlocked. These figures signify a decrease in trade loss by 61.4% when a landlocked country trades with a country that is not landlocked. According to these empirical results, countries in EAC will enhance trade if landlocked countries trade more with countries that are not landlocked.

Countries that share common language trade more compared with countries that do not share language. The coefficient of common language is positive and statistically significant at 5% level at ceteris paribus. Common language increases trade in EAC by 22.2% in the long run. Therefore, to increase trade EAC countries should encourage use of common language to foster trade across borders.

**4.2 Effect of EAC on Member Country's Trade in the Long Run**

This involves determining the extent to which formation of EAC economic bloc affected trade of individual member countries in the long run. In this regard, the study tries to find out whether formation of EAC resulted in trade creation or trade diversion among the countries in the regional bloc in the long run.

**Fixed Effect**

| | **Burundi** | **Kenya** | **Rwanda** | **Tanzania** | **Uganda** |
|---|---|---|---|---|---|
| | lntrade | lntrade | lntrade | lntrade | lntrade |
| | b/p | b/p | b/p | b/p | b/p |
| lngdpexp | 2.404** | -1.081 | 1.142 | 0.479 | 5.485** |
| | (0.003) | (0.099) | (0.082) | (0.753) | (0.008) |
| lngdpimp | 0.939*** | 1.265*** | 2.327*** | -0.080 | 0.505 |
| | (0.000) | (0.000) | (0.000) | (0.742) | (0.052) |
| lnpop | -0.684 | 1.732 | -2.955 | 2.894 | -7.464 |
| | (0.423) | (0.088) | (0.129) | (0.342) | (0.062) |
| lnproductlandarea | -0.585*** | -0.232** | -1.814*** | 0.843*** | -5.243*** |
| | (0.000) | (0.003) | (0.000) | (0.000) | (0.000) |
| landlocked | -0.638*** | | -0.893*** | | -8.160*** |
| | (0.000) | | (0.000) | | (0.000) |
| Eac_long_run | 0.416*** | 0.122 | 0.339* | -0.042 | 0.301 |
| | (0.001) | (0.174) | (0.023) | (0.766) | (0.056) |
| Constant | -20.348*** | -9.679*** | 5.388 | -33.794*** | 54.940*** |
| | (0.000) | (0.000) | (0.494) | (0.000) | (0.000) |
| R2 | 0.726 | 0.851 | 0.811 | 0.669 | 0.842 |
| df_res | 126 | 131 | 130 | 115 | 124 |
| BIC | 119.5 | 17.2 | 147.0 | 158.6 | 185.5 |
| AIC | 99.3 | -0.3 | 126.6 | 141.8 | 165.4 |

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The long run effect of EAC on trade is positive for Burindi, Kenya, Rwanda and Uganda while it is negative for Tanzania. This means that in the long run the economic corporation of EAC enhanced trade creation in Burindi, Kenya, Rwanda and Uganda and trade diversion in Tanzania. The coefficients are statistically significant for Burundi and Rwanda and statistically insignificant for Kenya, Uganda and Tanzania. Therefore, regional integration of EAC raised trade in Burundi by 41.6% and in Rwanda by 33.9%. The empirical results show that EAC play important role in trade growth for Rwanda and Burundi. In addition, EAC led to trade increase by 12.2% in Kenya and 30.1% in Uganda in the long run. However, empirical results recorded 4.2% decrease in trade in Tanzania. The results indicate that EAC enhanced trade for EAC member countries hence there is need to strengthen the economic corporation.

**4.3 Entry Effect of Rwanda and Burundi on Trade**

| | Parametric<br>lntrade<br>b/p | Random Effect<br>lntrade<br>b/p | Fixed Effect<br>lntrade<br>b/p |
|---|---|---|---|
| lngdpexp | 1.509*** | 1.509*** | 0.987*** |
| | (0.000) | (0.000) | (0.000) |
| lngdpimp | 1.242*** | 1.242*** | 1.283*** |
| | (0.000) | (0.000) | (0.000) |
| lnpop | -0.470* | -0.470* | 0.290 |
| | (0.023) | (0.034) | (0.464) |
| lnproductlandarea | -0.589*** | -0.589*** | -0.642*** |
| | (0.000) | (0.000) | (0.000) |
| landlocked | -0.904*** | -0.904*** | -0.997*** |
| | (0.000) | (0.000) | (0.000) |
| partiallandlocked | -0.337*** | -0.337*** | -0.385*** |
| | (0.000) | (0.000) | (0.000) |
| commonlanguage | 0.271*** | 0.271*** | 0.222*** |
| | (0.000) | (0.000) | (0.000) |
| border | -0.109* | -0.109* | -0.016 |
| | (0.029) | (0.014) | (0.740) |
| entry_effect | 0.191*** | 0.191*** | 0.196*** |
| | (0.000) | (0.000) | (0.000) |
| Constant | -16.067*** | -16.067*** | -16.213*** |
| | (0.000) | (0.000) | (0.000) |
| R2 | 0.758 | | 0.721 |
| df_res | 649 | | 645 |
| BIC | 820.3 | . | 792.2 |
| AIC | 775.4 | . | 747.3 |

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The empirical results show that entry of Burundi and Rwanda to EAC increased trade of the economic corporation. The coefficients are statistically significant at 5% level at ceteris paribus. Fixed effect model estimated an increase in trade by 19.6% while random effect model and parametric model each predicted 19.1% increase in trade. The results show that entry of Burundi and Rwanda to EAC enhanced trade within the corporation.

The estimates of fixed effect model indicate that exporting country's GDP, importing country's GDP and common language increased trade within EAC by 0.987%, 1.283% and 22.2% respectively. The coefficients of product of land areas, landlocked, partial landlocked and common border are negative and statistically significant at 5% level. This indicates that countries with large country sizes traded less compared with countries with small land mass. In addition, trade between landlocked countries impedes trade by 99.7% compared with trade between countries that are not landlocked. Trade between landlocked country and a country that is not landlocked recorded 38.5% less trade compared with trade between countries that are not landlocked. This means that entry of landlocked countries of Burundi and Rwanda to EAC reduced loss of trade by 60.8% when they traded with Kenya and Tanzania. Shared border between countries in EAC reduced by 1.6% and increase in population raised trade by 0.29%. However, the coefficients of border and population are not statistically significant.

In summary, entry of Rwanda and Burundi enhanced trade within EAC member countries due to its substantive effect on trade. Furthermore, countries in EAC need to foster greater growth in GDP, to strengthen use of common language and to reduce cross border restrictions that impede trade between countries in the corporation.

## 5.0 CONCLUSION AND RECOMMENDATION

### 5.1 Conclusion

Breausch Pagan LM test for restrictions in the parametric model and Hausman test for endogeinity in the gravity model established that empirical result estimates for fixed effect model were suitable compared with the estimates from random effect model and parametric model. This model selection process is important because use of wrong models would lead to wrong estimates and inaccurate results.

The empirical results of fixed effect model established that formation of economic integration of EAC increased trade of member countries of EAC both in the short run and in the long run. In addition, parametric model and random effect model produced results consistent with that of fixed effect model. The direction of the effect is positive meaning that formation of EAC yielded positive effect on trade. However, this effect is nonetheless insignificant meaning that trade between EAC member countries did not expand considerably in the short run.

Fixed effect model established positive effect of EAC on trade in the long run. This means that the economic integration aided in the growth of trade within member countries of the trading bloc. Comparative analysis of the results obtained from random effect model and parametric model is consistent with that of fixed effect model. All the coefficients are statistically significant at 5% ceteris paribus.

It is also noted that in the long run, the economic corporation of EAC caused trade creation in Burundi, Kenya, Rwanda and Uganda. However, empirical results show that the economic bloc triggered trade diversion in Tanzania. Burundi and Rwanda recorded greater gains from trade through EAC compared with Uganda and Kenya. This means that upon entry of Burundi and Rwanda to EAC, the two countries traded more with Kenya, Uganda and Tanzania. This shows that countries are able to grow their trade volumes when they are in an economic integration than when they are not. This is because of favorable trade policies applied to countries in trading blocs.

Entry of Burundi and Rwanda to EAC increased trade of EAC member countries by significant levels. The coefficient for measuring this effect is positive and statistically significant at 5% level. The three models produced consistent results. This show how instrumental Rwanda and Burundi is to trade between countries in EAC. The study also established that in order for countries in EAC to achieve greater growth in trade, there is need for these nations to encourage more growth in GDP. Use of common language was found to have positive effect on trade while cross border restrictions impeded growth in trade between EAC.

Therefore, apart from strengthening the economic corporation of EAC, member countries of EAC need to encourage use of common language in order to enhance growth in trade. The level of GDP also influences trade between countries. Within EAC, countries that share border trade less compared with trade between countries that do not share border. This indicate that trade restrictions existing between neighboring countries have detrimental effect on trade.

### 5.2 Recommendation

From this study, countries in economic integration experiences growth in trade volume. In this regard, countries are encouraged to join an economic bloc in order to gain from trade. In addition, countries in economic block need to embrace common language, encourage GDP growth and to reduce trade restrictions that impede trade between neighboring countries.

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