

Prospective Impact of the Proposed Monetary Union in East African Community: Gravity Model Approach

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Abstract: Considering the significance of a monetary union, the five countries of East African Community have had a quest and interest of forming the union. The Theory of Optimum Currency Area (OCA) is the most instructive construct in the establishment of such a financial union. The theory has listed out several important criteria that need to be fulfilled before the establishment of monetary union. This study examined two aspects of the monetary union, that is, the suitability of the OCA theory as a basis for the feasibility of the proposed monetary union and the prospective impact of trade on economic growth in the context of the East African Community (EAC) countries. The study sought to determine: symmetry of monetary shocks; parity of inflation rates; parity of fiscal deficit, similarity of public debt, similarity of real gross domestic product and degree of openness; and the potential impact of monetary union of trade on economic growth among the five members of East African Community; Uganda, Burundi, Kenya, Rwanda and Tanzania. The research was exploratory by design. The target population were the five EAC countries. Panel data was employed using data on quarterly basis over the period 2000Q1-2016Q4. The study used Gravity model. The Gravity Model indicated monetary union could be formed by; Tanzania, Kenya, Uganda and Rwanda; Kenya, Uganda, Burundi and Rwanda; Tanzania, Kenya and Rwanda; Tanzania, Kenya and Burundi; and Kenya, Uganda and Burundi albeit negative elasticity indicating that monetary union reduced trade as compared to none union members. The previous per capita had a significant and positive impact of economic growth for the EAC countries that could form a monetary union. This study provided the insight of the possibilities of some EAC countries forming a monetary union. The policy makers in the EAC countries could concentrate in adapting unfulfilled macroeconomic convergence criteria; strengthening the cooperation in the monetary and exchange rate policy; increasing the intra-regional trade and regional policy co-ordinations in order to ensure a foreseeable monetary union in EAC.

Key words: Feasibility, Monetary Union, Convergence Criteria, Gravity Model, Kenya

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I. Introduction

A monetary union occurs when different countries agree to share the same currency. In many ways, it is similar to a fixed exchange rate regime, in which parties preserve their unique national currencies as they choose to modify the relative supply of money to establish a fair rate of exchange. The choice to establish a common financial system is usually one step towards economic integration. Sacrificing one's own monetary independence and sharing a common currency with several other countries should be considered separately from being unable to manage to print own currency and thus unilaterally letting circulate another country's currency. The proponents of monetary unions usually aver that such a move would stabilize exchange and inflation rates as well as lower interest rates, along with enhancing trade among parties. Lately, monetary union is attracting a lot of attention among economists and policy makers.

The origin and inception of monetary union, which has existed more than half a century, can be traced back to European thinking where the core objective was the attainment of sustainable peace in the continent after the World War II. European continent was the theatre of conflicts, which necessitated European leaders to come to the conclusion that only economic and political integration could guarantee peace across the entire region. As World War II raged on across Europe, there was increasing concern over economic matters in readiness for the post-war life.

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The theory of OCA, pioneered by Mundell (1961), Mckinnon (1963) and Kenen (1969), suggested abolishing the national currencies of an area consisting of more than one country and the area operates under a single currency. Upon achieving this, the area becomes a monetary union which is one of the final stages of economic integration. In Europe, the Maastricht Treaty of 1992 was established on the basis of the four grounds of low inflation, low interest rates, stable exchange rates and sound public finances. Gros and Thygesen (1998) note that monetary union concept is a comprehensive liberalization of capital transactions and full integration of banking and other financial markets together with the removal of exchange rate fluctuations and the irrevocable locking of exchange rate parties. According to Asante (2007), economic and political integration has been favored as a means of achieving higher growth and development, acceleration of poverty reduction and promoting national safety.

As posited by Geda and Kebret (2008) that monetary integration attempts should be assessed in the context of their objectives, and their political economic and institutional setups on which they operate, indeed monetary unions enter into signed agreements before they are established indicating their desire objectives. Provincial trade amalgamations, including that of a monetary union, have the potential to improve the living standards for members' citizens as well as promote economic development and alleviate suffering (United Nations Economic Commission for Africa, 2010).

One of the most important papers on the correlation of optimum currency area with trade was observed by Rose (2000), when he used a gravity model to estimate the effects that a common currency union has on trade, was the ability to isolate the increase of trade that was solely caused by the introduction of a common currency union.

Eun and Resnick (2012) pointed out that the euro should be seen as a product of historical evolution toward an ever-deepening integration of Europe which started with the 1958 advent of the European Economic Community. Alinur (2015) posited that the creation of the European Monetary Union had political and economic motives; economic motive was based on Mundell's Optimum Currency Area Theory, while politically the Europeans wanted to integrate Europe.

Bucur and Dragomirescu (2013) analyzed the capacity of fiscal criteria to reflect the ability of EU Member States to achieve economic development for the union in the EMU and to comply strict fiscal policy determining its operations. They evaluated the monetary convergence methods in the European Union for sustainability. The results showed that until 2007 the EU economies were able, overall, to meet the budget deficit criteria, but due to the financial crisis and the prolonged slowdown in development, the monetary balance had an unfavorable transition since 2008, while the growth of the gross public debt had deteriorated gradually. As a result pressure situation on the sustainability of public finances, examining the implementation, utilization and administration of the monetary guidelines defined by the growth of the Fiscal Rule Index for the period 2000-2011, the importance of rules in the fiscal management of the Union and especially of the euro area appears increasingly noticeable.

According to Salvatici (2013), gravity model is one of the popular methods to test endogeneity of OCA criteria where it explores whether membership in a single currency union would increase the bilateral trade among potential members of monetary union. Gravity model for trade is similar to the Newton's gravity of physics. As posited by Riaz (2013), gravity model states that bilateral trade of countries would flow to the direction of economic mass which is often measured by GDP.

Oyeleke and Adebis (2014) posited that financial sustainability evaluation has become a vital part of macroeconomic stability assessment in every nation under a monetary integration. The issues surrounding monetary shortfalls are vital in attainment of monetary union; establishing a common central bank and common currency, which requires that each state's financial shortfalls should be sustainable.

Monetary Report (2012) noted that the overall result on the EMU and the debt crisis in Europe was that gross public debt in several countries increased to worrying levels. The reason as to why the public debt problems in certain countries became a crisis for the monetary union as whole was that uncertainty about the ability of some states to cover their loans in the long-term resulted in an adversity between banks and governments.

Bumtaia (2015) noted that many countries have been motivated to enter into a monetary union primarily because this would allow them to achieve overall macroeconomic stability. For instance, countries in West Africa with a history of high inflation used the entry into the monetary union (the West African Economic and Monetary Union, WAEMU) as an institutional device to commit to a lower inflation which West African countries were unable to do on their own.

Karakatsanidou (2017) upon testing twenty-four European countries for inflation convergence for the period 1974 to 2016 showed that evidence of conditional convergence among the states was present. In particular, when Germany benchmark was used as a benchmark, it was observed that the fundamental countries of the EU did not reveal evidence of convergence only before the launch of the euro, while when policy reference value benchmark was used, the results provided evidence of convergence even in the pre-euro period.

Following the adoption of the euro, all the categories of states showed signs of convergence based the two benchmarks.

Forming a monetary union leading to one economic block has been on progress in EAC region according to EAC (2010) with its main objective, among others, advancement of economic integration of the region so as to gain wealth and enhance competitiveness through increased production, trade and investment. The roadmap for achieving monetary union among EAC member countries requires member countries to undertake a number of tasks in accordance with a specified timetable. One of such steps is the peaceful coexistence of countries desiring to form a union.

According to the signed protocol of EAC (2013), the main objective is to foster a closer cooperation in political, economic, social, and cultural fields. Article 6 of the protocol indicates that the five-member states set out a process including macroeconomic convergence criteria, legal and institutional framework for the use of a single area of currency. The protocol laid groundwork for a monetary union which allowed the EAC member states to progressively converge their currencies into a single currency in the Community. The macroeconomic convergence criteria which shall be undertaken by the partner states are inflation, fiscal deficit, public debt and reserve ratio. Here, the focus is on price stability, sustainable fiscal deficit, sound management of public debt and maintaining desirable levels of foreign exchange reserves. Article 18 (2) provides that the partner states shall undertake to adopt a single currency which shall be adopted by at least three partner states that meet the macroeconomic convergence criteria of monetary union. Article 18 (3) specifies that the partner states which adopt the single currency shall form the currency area.

While the question of a monetary union has been discussed in the political arena there has been few corresponding empirical studies on the achievability and the potential impact of trade on economic growth of such a union in EAC countries. Forming a common currency union is based on certain factors which are linked to the economic integration of the countries involved as put forward by OCA Theory. EAC member states are required to attain a sufficient degree of macro-economic convergence, and financial integration among them ahead of the union in order to realize the full force and limit the costs of a currency union.

The importance of a monetary union and the significant efforts made by the EAC towards establishing a currency union impels researchers in evaluating the ultimate viability towards the establishment of such integration. This study therefore sought to investigate the feasibility and the prospective impact of trade on economic growth of the proposed monetary union in East African community. This research investigated economic variables only, since these tend to influence political variables as well. Hawkins and Masson (2003) argued that the decisions to forgo national currencies for regional currencies lead to both political and economic stability in the long run.

The main objective of the study was to analyze the feasibility and prospective impact of trade on economic growth of the proposed monetary union in East African Community. Specifically, the study sought to establish the prospective impact of monetary union of trade on economic growth in the context of the proposed EAC monetary union

II. Data and Research Methodology

Panel data is a single set that rails a given sample of subjects for a given duration, and thus supplies multiple observations on each individual in the sample (Hsiao, 2003). With panel data, variations across individuals and across time periods are accounted for.

Gravity Model has been found to be a particularly good predictor of trade flows. The Gravity Model in its simplest form predicts bilateral trade flows on the basis of the sizes, measured by their GDP, of the respective economies and the distance between them. Following Newton's gravitation theory, gravitational attraction between two bodies that the gravitational force F_{ij} between two objects i and j is directly related to the masses of the objects (M_i and M_j) and inversely proportional to the distance between them (D_{ij}). Trade is assumed to depend positively on the sizes of the two economies and negatively on the distance. These variables, GDP and distance, are the main ingredients of all standard gravity models. Gravity Model can be stated in mathematical terms as:

$$F_{ij} = \frac{M_i M_j}{D_{ij}} \dots\dots\dots 3.7$$

Translating equation 3.7 in the gravity model of international trade as defined above and taking log the model where gravity models relate bilateral trade to the mass of these two countries, commonly measured as the economic size (GPD) of the countries involved and the distance that separates them will become:

$$\ln F_{ijt} = \ln \frac{GDP_{it} GDP_{jt}}{D_{ijt}} \dots\dots\dots 3.8$$

Equation 3.8 can be re-written as:

$$\ln F_{ijt} = \ln GDP_{it} + \ln GDP_{jt} - \ln D_{ijt} \dots\dots\dots 3.9$$

Where F_{ijt} corresponds to trade flows (exports or imports) from country i and country j at time t ; GDP_{it} and GDP_{jt} is the gross domestic product of countries i and j at a time t ; D_{ijt} is the distance between the two countries.

The concept behind the basic gravity model in equation 3.9 is that the larger the size of the countries i and j , as measured by their GDPs, the more trade between them and the farther apart they are, as measured by the distance between them, the less trade is between them. With respect to transnational trade patterns, the gravity model states that the magnitude of trade-flows between two parties is defined by supply conditions at the departure point, demand conditions at the destination and catalytic factors in-between these two parties (Serlenga and Shin, 2007).

III. Results and Discussion

3.1 Model Specification

According to Awa (2015), gravity model has been widely accepted in international trade literature as one of the most successful empirical tools applied in the prediction of bilateral trade flows between countries. The standard gravity model that follows the benchmark panel specification for the analysis of aggregate trade similar to that found in Rose (2000) was used. The model in a log linear form can be expressed as:

$$\ln T_{ijt} = \beta_0 + \beta_1 \ln(Y_i Y_j)_t + \beta_2 \ln \left[\frac{Y_i Y_j}{Pop_i Pop_j} \right] + \beta_3 \ln D_{ijt} + \beta_4 MU_{ijt} + \mu_{ijt} \dots\dots\dots 3.10$$

Where subscripts i , j and t refers to countries i , j and time period respectively.

Notation of the variables in the model, and the expectation regarding the relationship between the level of trade and each variable, are as follows:

T denotes the value of trade between any three countries; Y is real GDP of country i , j in year t . Larger economies are expected to trade more. Pop is population of country i or j in year t . Countries with larger populations are generally expected to trade less because of their larger domestic markets. D is the linear distance between capital cities of capitals of country i and country j . Distance is expected to have a negative association with trade level since it proxies transport and transaction costs. MU is a binary variable which equals 1 if i and j share a common currency (zero otherwise). Shared common currency is expected to increase trade links between countries.

The coefficients of the income β_1 and per capita income β_2 are expected to be positive. The idea is that higher income countries trade more in general. β_3 is expected to be negative which is explained by the trade impeding effects of distance such as transaction cost which causes inability to communicate. β_4 is expected to be positive since a common currency increases bilateral trade flows.

To establish whether trade flows within the EAC countries have any significant potential influence on economic growth of the region, panel estimation of the trade effect on the economic growth rates of the EAC countries was done. In this analysis, a cross-section empirical growth equation employed by Frankel and Romer (1999), Frankel and Rose (2002) and Durlauf *et al.* (2006) was employed:

$$\ln \left(\frac{y_{i,t}}{y_{i,0}} \right) = \alpha_0 + \alpha_1 \ln(y_{i,0}) + \sum_k \gamma_k X_{k,i} + \varepsilon_i \dots\dots\dots 3.11$$

Where y is the current per capita income; y_0 is the initial per capita income; X dependent variables; α_1 is the beta-convergence (speed of convergence) indicating the convergence coefficient, speed convergence.

The growth equation 3.44 states that per capita GDP (y) growth depends on the initial per capita GDP level (y_0) and other conditioning variables X that includes trade effect. The expected sign of α_1 is negative which

implies that the growth rate of per capita income of a country is negatively related to its initial level of per capita income.

Therefore, the panel estimation of the trade effect on the growth rates of the EAC countries can be obtained using dynamic panel data specification that followed beta convergence specified by Durlauf *et al.* (2006) was followed:

$$\ln\left[\frac{Y_{it}}{Pop_{it}}\right] = \beta_0 + \beta_1 \ln\left[\frac{Y_{it-1}}{Pop_{it-1}}\right] + \beta_2 \ln\left[\frac{T}{Y}\right]_{it} + \beta_3 \ln(n)_{it} + v_{it} \dots\dots\dots 3.12$$

Where the dependent variable, Y is the real GDP of a country i ; Pop is the total population; T is the total trade (exports plus imports); n is the rate of growth of population and v_{it} is the error term; β_2 measures the effect of trade on gross domestic product and β_3 measures the effect of population growth rate on per capita income.

The coefficients, β_2 which is the main interest of this study is expected to be positive while β_3 is expected to be negative. The coefficient of lagged dependent variable in equation 3.49 is now related to β_1 , the speed of convergence, in equation 3.50 as demonstrated as follows:

$$\alpha_1 = \exp(\beta_1 \psi) \dots\dots\dots 3.13$$

Where ψ is the time interval where the expected sign of α_1 is positive since the expected sign of β_1 is negative.

The pairing of the countries was carried out using the gravity model where, the trade between any two pairs of the EAC countries was calculated as the total of the imports and exports between two countries, the combined GDP was the product of the individual GDPs and together with the population of the countries, the per capital income of the combined economies was calculated by taking the combined GDP and dividing it by the combined populations of the two countries. In addition, the distance between the countries capital cities in kilometers was included as well as the dummy variable for the existence of a common currency or not.

Considering that there were five countries being assessed within the EAC community, the combinations of any 3 pairs of the countries yielded 10 pairs (non-repetitive). This meant that there were 10 gravity models to be assessed without repetition of the pairs. The notion of the combinations or pairings meant that any three nations or countries in the EAC could form a potential monetary union. The dependent variable is the combined trade, that is, the sum of the imports and exports between two countries which was termed as the trade flow between the countries.

Gravity models were developed based on the EAC treaty indicating that any three countries in the EAC could form a monetary union. This means that the base number of countries per model is three. This in essence does not restrict more than three countries forming a monetary union. In developing the gravity model, the following factors are usually considered: The trade between countries representing the trade flow, the country specific GDPs, the population of the countries, the distance between the capital cities of the countries. Furthermore, in this study, the dummy variable for the common currency. Further, the GDP and population are used to compute the per capital income of the countries. The distance is considered as the economic distance between the countries noting that it is assumed that the capital cities of the countries form the economic hub or center of the country. Note that the distance is constant or unchanging unless in rare cases where the capital city in a given country is shifted to another within the same country. Common currency among the countries is not time variant. In this case, the panels were not used in the models noting that the datasets have been aggregated and augmented to capture all the variables required in the gravity model. In addition, there were a total of ten possible combinations that were not duplicated with; six combinations comprising of Tanzania, three combinations comprising of Kenya and one combination comprising of Uganda pairing with any two of the other four countries without repetition.

3.2 Effects of Prospective MU by All the Five EAC Countries on Trade

In this section, analysis was done for all the five EAC countries in forming the EAC monetary union. This meant that there was only one model to be assessed and the result is presented in table 3.14.

Table 3.14: Gravity Model Results for Combinations of All the Five EAC Countries

DepVar	Taz_Ken_Uga_Rwa_Bur	
	lgTazKenUgaRwaBur_Tra	
	Betas (SE)	Sig.
Independent variables		
$Log(GDP_i)(GDP_{jk})$	1.425** (0.63)	0.058
$Log(PCI_i)(PCI_{jk})$	-1.543** (0.81)	0.097
$LogD_{i(jk)}$	Omitted	
$LogMU_{i(jk)}$	0.24 (0.22)	0.299
_Const.	-95.46** (47.79)	0.086
Model statistics		
F	24.09	
Prob > F	0.001	
R-squared	0.912	
Adj. R-squared	0.874	
Numbers in parentheses are the standard errors of the estimates; Asterisks ** indicate significant at the 10% level while <i>Omitted</i> was because of collinearity. <i>PCI</i> is the Per Capita Income, that is, the product of the real GDP for country <i>i</i> and country <i>j</i> divided by the product of the respective populations at a given period.		

Source: Author 2018

The model of a potential impact of monetary union on trade among all the five countries was assessed using the gravity model. In this model, Tanzania, Kenya, Uganda, Rwanda and Burundi are all placed in the model and assessed. The model depicted R-squared value of 0.912 indicating that the model accounted for 91.2% of the variation in the combined trade among the three countries and the model is significant in explaining the change in the combined trade, $p=0.001 < 0.05$, at 5% level of significance. The model delivered a β_0 intercept estimate of -95.46 which was a positive ($e^{-95.46} = 6.64 \times 10^{-42} \approx 0.00$) which was very low tending to zero and significant at 10% level of significance. According to Everitt (2002), the intercept is the parameter in an equation derived from a regression analysis corresponding to the expected value of the response variable when all the explanatory variables are zero. From the above regression equation, it was revealed that holding GDP, per capita income, distance and monetary union to a constant zero; the intercept coefficient showed that most of the variables were captured in the model determined trade within the five EAC countries under study.

The model delivered combined trade, β_1 estimate of 1.425 which was approximately ($e^{1.425} \approx 4.11$) which was positive and significant at 10% level of significance. This implied that a pair of the five countries in EAC that trade with each other would increase output by over four times much with each other, holding per capita income, distance and common currency constant.

The results also indicated that combined per capita income had a negative and significant effect, $p = 0.097 < 0.05$ (SE = 0.807), at 10% level of significance. This showed that a pair of the five countries of EAC with combined per capita income would reduce trade by over 2% times much with each other, holding combined output, distance and common currency constant.

The results depicted that the presence of a common currency would not have any significant impact on trade among the pairing of the five EAC countries. Article 18 (2) of the EAC (2013) provides that at least three partner states that meet the macroeconomic convergence criteria of monetary union shall undertake to adopt a single currency. Therefore, this necessitated a further analysis in order to test whether there were any combinations of countries which could benefit from increased trade upon having a common monetary union within EAC countries.

3.3 Effects of Prospective MU by any Four EAC Countries on Trade

In this section, analysis was done for any four EAC countries where pairing was performed without repetition in forming the EAC monetary union. The most important columns were the coefficients and standard error column. Coefficient is the point estimate of the coefficient for the gravity regression. The Std. Err. column indicates the standard error of our estimate, which indicates how precisely we were able to estimate it. Standard errors are used to test for statistical significance and to construct confidence intervals.

In pairing the countries, there were four pairs comprising of Tanzania pairing with any three of the other four countries and one pair comprising of Kenya pairing with Uganda, Rwanda and Burundi, without repetition. This meant that there was a total of five models to be assessed. The results for four pairs comprising of Tanzania pairing with any three of the other four countries is presented in table 3.15 and table 3.16.

Table 3.15: Gravity Model Results for Combinations of any Four of the EAC Countries

Dependent Var	Taz_Ken_Uga_Rwa		Taz_Ken_Bur_Rwa		Taz_Ken_Uga_Bur	
	lgTazKenUgaRwa_Tra Betas (SE)	Sig.	lgTazKenBurRwa_Tra Betas (SE)	Sig.	lgTazKenUgaBur_Tra Betas (SE)	Sig.
Independent Variables						
$Log(GDP_i)(GDP_{jk})$	3.22* (0.94)	0.01	0.69 (0.77)	0.405	-0.43 (0.94)	0.657
$Log(PCI_i)(PCI_{jk})$	-3.642* (1.16)	0.02	-0.53 (0.97)	0.604	0.81 (1.25)	0.532
$LogD_{i(jk)}$	Omitted		Omitted		Omitted	
$LogMU_{i(jk)}$	-0.77* (0.31)	0.04	-0.43 (0.23)	0.101	-0.34 (0.39)	0.402
_Const.	-188.34*(58.65)	0.02	-29.55 (47.05)	0.550	41.08 (56.37)	0.487
Model statistics						
F	35.06		41.38		4.96	
Prob > F	0.000		0.000		0.031	
R-squared	0.938		0.947		0.650	
Adj. R-squared	0.911		0.924		0.519	
Numbers in parentheses are the standard errors of the estimates; Asterisks * indicate significant at the 5% level while <i>Omitted</i> was because of collinearity. PCI is the Per Capita Income, that is, the product of the real GDP for country <i>i</i> and country <i>j</i> divided by the product of the respective populations at a given period.						

Source: Author (2018)

The findings showed that the model for Tanzania, Kenya, Uganda and Rwanda was significant and explained 93.8% of the variation in the combined trade. The model delivered a β_0 intercept estimate of -188.34 which was negative and statistically significantly, $p = 0.02 < 0.05$, at 5% level of significance. This implied that other variables not captured in this study had elasticity of -188.34, which could reduce trade for Tanzania, Kenya, Uganda and Rwanda countries. This depicted that the variables in the study accounted for most of the determinants of Tanzania's trade with Kenya, Uganda and Rwanda countries by $100\% [(1 - e^{-188.34}) \times 100\% = 100]$. The intercept is the parameter in an equation derived from a regression analysis corresponding to the expected value of the response variable when all the explanatory variables are zero (Everitt, 2002). From the above regression equation, it was revealed that holding GDP, per capita income, distance and monetary union to a constant zero; the intercept coefficient was negative meaning the study accounted for most of the determinants of Tanzania's trade with Kenya, Uganda and Rwanda.

The model of interest in this study β_4 delivered an estimate of -0.77 which was negative and statistically significant, $p = 0.04 < 0.05$, at 5 % level of significance. This meant that formation of a monetary union by Tanzania, Kenya, Uganda and Rwanda would have a negative and significant effect of a *MU* elasticity of 0.77 indicating that *MU* would reduce trade by 54% $[(1 - e^{-0.77}) \times 100 = 54]$ as compared to none union members. In other words, Tanzania, Kenya, Uganda and Rwanda countries sharing a common currency would trade 59% less than when they had their separate currencies. This study contradicted Rose (2000) who had observed that the effect of monetary union on bilateral trade was positive and significant in both economic and in statistical terms whereby currency union could increase trade by approximately 300 percent.

The results also showed that the model produced a coefficient of trade of β_1 estimate of 3.22 which was positive elasticity and statistically significant at 5% level of significance. This indicated that elasticity for GDP was 3.22, meaning that GDP would increase Tanzania's trade when trading with Kenya, Uganda and Rwanda by 2390% $(e^{3.22} - 1 = 2390)$ as compared to when they were trading individually. In other words,

Tanzania’s trade when trading with Kenya, Uganda and Rwanda countries who would trade 2490% compared to when they were not trading together.

The results also showed that the model produced a coefficient of per capita of β_2 estimate of -3.642 which was negative and statistically significant at 5% level of significance. This indicated that elasticity for GDP was -3.642 meaning that per capita income would reduce Tanzania’s trade when trading with Kenya, Uganda and Rwanda by 97% $[(1 - e^{-3.642}) \times 100 = 97]$ as compared to members trading separately. In other words, Tanzania’s trade when trading with Kenya, Uganda and Rwanda countries who would trade 3% less than when they were trading individually. Additionally, the other two pairings of EAC countries is presented in table 3.16.

Table 3. 16: Results for Combinations of any Four of the EAC Countries

Dependent Variable	Taz_Bur_Rwa_Uga		Ken_Uga_Bur_Rwa	
	lgTazBurRwaUga_Tra		lgKenUgaRwaBur_Tra	
	Betas (SE)	Sig.	Betas (SE)	Sig.
Independent Variables				
$Log(GDP_i)(GDP_{jk})$	-0.003 (0.93)	0.998	3.78* (0.72)	0.001
$Log(PCI_i)(PCI_{jk})$	0.58 (1.24)	0.649	-4.43*(0.89)	0.002
$LogD_{i(jk)}$	Omitted		Omitted	
$LogMU_{i(jk)}$	0.23 (0.42)	0.597	-0.85* (0.24)	0.010
_Const.	5.94 (54.92)	0.916	-216.12* (43.44)	0.002
Model Statistics				
F	35.62		41.76	
Prob > F	0.000		0.000	
R-squared	0.907		0.947	
Adj. R-squared	0.881		0.924	
Numbers in parentheses are the standard errors of the estimates; Asterisks * indicate significant at the 5% level while <i>Omitted</i> was because of collinearity. <i>PCI</i> is the Per Capita Income, that is, the product of the real GDP for country <i>i</i> and country <i>j</i> divided by the product of the respective populations at a given period.				

Source: Author (2018)

The model of a potential monetary union among for Kenya, Uganda, Burundi and Rwanda countries was also assessed using the gravity model. In this model, Kenya, Uganda, Burundi and Rwanda countries were all placed in the model and assessed. The model depicted R-squared value of 0.947 indicating that the model accounted for 94.7% of the variation in trade among the four countries and the model was significant in explaining the change in the combined trade, $p=0.001 < 0.05$, at 5% level of significance.

The model delivered a β_0 intercept estimate of -216.22 which was negative and statistically significantly, $p = 0.002 < 0.05$, at 5% level of significance. This was an indication that other variables not captured in this study had elasticity of -216.22, which could reduce trade for Kenya, Uganda, Burundi and Rwanda countries. This insinuated that other variables not captured in this study had elasticity of -216.22, which could reduce trade for Kenya, Uganda, Burundi and Rwanda countries. This intimated that the variables in the study accounted for most of the determinants of Kenya’s trade with Uganda, Burundi and Rwanda countries by 100% $[(1 - e^{-216.22}) \times 100 = 100]$. Therefore, from the regression equation, it was revealed that holding GDP, per capita income, distance and monetary union to a constant zero; the intercept coefficient was negative meaning the study accounted for most of the determinants of Kenya’s trade with Uganda, Burundi and Rwanda countries.

The coefficient of interest in the model in this study was β_4 which delivered an estimate of -0.85 that was negative and statistically significant, $p = 0.010 < 0.05$, at 5 % level of significance. This implied that a monetary union could be formed by Kenya, Uganda, Burundi and Rwanda countries despite the fact that a *MU* elasticity was -0.85 indicating that *MU* reduces trade by 57% $[(1 - e^{-0.85}) \times 100 = 57]$ as compared to none union members. In other words, Kenya, Uganda, Burundi and Rwanda countries sharing a common

currency would trade 43% less than when they have their separate currencies. This also contradicted Rose (2000) whose outcome of the currency union was positive and significant.

The model produced β_1 estimate of 3.78 which was positive and statistically significant, $p = 0.001 < 0.05$, at 5% level of significance. This indicated that an output elasticity of 3.78 implying that GDP would increase Kenya's trade with Uganda, Burundi and Rwanda by 426% $[(e^{3.78} - 1) \times 100 = 426]$ as compared to when they were not trading together.

The model produced a β_2 estimate of -4.43 which was negative and statistically significant, $p = 0.002 < 0.05$, at 5% level of significance. This indicated that a per capita income elasticity of -4.43, implying that per capita income would reduce Kenya's trade with Uganda, Burundi and Rwanda by 99% $[(1 - e^{-4.43}) = 99]$ as compared to when they were not trading together. In other words, Kenya's per capita income when not trading with Uganda, Burundi and Rwanda countries who would be 1%.

3.4 Effects of Prospective MU by any Three EAC Countries on Trade

Additionally, any three EAC countries can form a monetary union. In this section, pairing was done without repetition in forming the EAC monetary union. The combinations resulted in six pairs comprising of Tanzania pairing with any two of the other four countries; three pairs comprising of Kenya pairing with any other four excluding Tanzania and the last comprising of Uganda pairing with the other two countries Tanzania and Kenya excluded. This meant that there was a total of ten pairs or models to be assessed. The results of the six gravity models comprising of Tanzania pairing with any two of the other four countries without repetition is presented in table 3.17.

Table 3. 17: Tanzania Pairing with Any Two of the Other Four EAC Countries

	Taz_Ken_Uga	Taz_Ken_Rwa	Taz_Ken_Bur	Taz_Uga_Rwa	Taz_Uga_Bur	Taz_Rwa_Bur
DepVar	lgTazKenUga_Tra	lgTazKenRwa_Tra	lgTazKenBur_Tra	lgTazUgaRwa_Tra	lgTazUgaBur_Tra	lgTazRwaBur_Tra
	Betas (SE)	Betas (SE)	Betas (SE)	Betas (SE)	Betas (SE)	Betas (SE)
Independent variables						
$Log(GDP_i/GDP_j)$	1.549 (1.178)	0.062 (0.499)	1.803** (0.783)	-0.547 (0.906)	-4.694* (2.103)	0.631 (1.395)
$Log(PCI_i/PCI_j)$	-1.600 (0.513)	0.3610596 (0.603)	-1.828 (1.022)	1.488 (1.196)	6.900* (2.914)	-0.081 (1.824)
$LogD_{i,j}$	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted
$LogMU_{i,j}$	-0.019 (0.345)	-0.521* (0.218)	-0.405** (0.175)	0.144 (0.453)	0.742 (0.827)	-0.149 (0.415)
_Const.	-59.330 (55.311)	8.865 (24.279)	-71.393** (35.545)	29.689 (40.880)	217.995* (92.573)	-22.681 (61.715)
Model statistics						
F	17.01	37.72	55.39	33.25	3.800	26.65
Prob > F	0.001	0.000	0.000	0.000	0.040	0.000
R-squared	0.865	0.942	0.957	0.893	0.487	0.879
Adj. R-squared	0.814	0.917	0.942	0.866	0.359	0.846

Numbers in parentheses are the standard errors of the estimates; Asterisks * and ** indicate significant at the 5% and 10% levels respectively. PCI is the Per Capita Income, that is, the product of the real GDP for country *i* and country *j* divided by the product of the respective populations at a given period. Omitted: Because of collinearity

Source: Author (2018)

Overall, findings indicated that the models were significant in predicting over 85% of the variation except the model for Tanzania, Uganda and Burundi which was explaining 48.7% of variation in the combined trade.

The model for Tanzania, Kenya and Rwanda indicated that R-squared value of 0.942 indicating that the model accounted for 94.2% of the variation in the combined trade among the three countries and the model is significant in explaining the change in the combined trade. The model produced a β_4 estimate of -0.521 which was negative and statistically significant at 5% level of significance. This indicated that a MU elasticity was -0.521, meaning that MU would reduce trade for Tanzania, Kenya and Rwanda by 41% $[(1 - e^{-0.521}) \times 100 = 41]$ as compared to none union members. In other words, Tanzania, Kenya and Rwanda countries trade 59% less than when they have their separate currencies.

The model for Tanzania, Kenya and Burundi depicted R-squared value of 0.957 indicating that the model accounted for 95.7% of the variation in the combined trade among the three countries and the model is

significant in explaining the change in the combined trade. The model delivered a β_0 intercept estimate of -71.393 which was negative and statistically significant at 10% level of significance. This was an indication that other variables not captured in this study had elasticity of -71.393, which could reduce trade for Tanzania, Uganda and Burundi countries. This insinuated that other variables not captured in this study had elasticity of -71.393, which could reduce trade for Tanzania, Kenya and Burundi countries. This indicated that the variables in the study accounted for most of the determinants of Tanzania's trade with Kenya and Burundi countries by 100% $[(1 - e^{-71.393}) \times 100 = 100]$. Therefore, from the regression equation, it was revealed that holding GDP, per capita income, distance and monetary union to a constant zero; the intercept coefficient was negative meaning the study accounted for most of the determinants of Tanzania's trade with Kenya and Burundi countries.

The model produced a β_4 estimate of -0.405 which was negative and statistically significant at 10% level of significance. This indicated that a *MU* elasticity was -0.405 , meaning that *MU* would reduce trade for Tanzania, Kenya and Burundi by 33% $[(1 - e^{-0.405}) \times 100 = 33]$ as compared to none union members. In other words, Tanzania, Kenya and Burundi countries trade 67% less than when they have their separate currencies.

The results also showed that the model produced a β_1 estimate of 1.803 which was positive and statistically significant at 10% level of significance. This indicated that elasticity for GDP was 1.803 , implying that GDP would increase trade for Tanzania, Kenya and Burundi by 505%, that is, $(e^{1.803} - 1 = 6.05 - 1 = 5.05)$ as compared to none union members.

The findings have revealed that the model is significant in explaining the change in the combined trade between the three countries of Tanzania, Uganda and Burundi, $F(3, 12) = 3.80$, $p < 0.05$, 0.1. The model explained 48.7% (R-squared = 0.4870) of the variation in the combined trade among the three countries. The model delivered a β_0 intercept estimate of 217.995 yielding $e^{217.995} = 1.08 \times 10^{94}$ which was positive and statistically significantly at 5% level. This implied that GDP, per capita income, distance and monetary union to a constant zero; the positive intercept coefficient indicated that there were other variables not captured in the study that influenced Tanzania's trade with Uganda and Burundi countries.

The results indicated that a β_1 estimate of -4.694 yielding 0.0094 which was positive and statistically significant at 5% level of significance. This implied that Tanzania's output when trading with Uganda and Burundi would increase trade by over 4.7% as much with each other, holding GDP, distance and monetary union constant.

The results indicated that a β_2 estimate of 6.9 being positive 947 which was a positive and significant at 5% level of significance. This implied that Tanzania's per capita income when trading with Uganda and Burundi would increase trade by 947 times as much with each other, holding GDP, distance and monetary union constant. Trade analysis with referenced to Kenya and Uganda is presented in table 3.18.

Table 3.18: Trade Analysis with Referenced to Kenya and Uganda

DepVar	Ken_Uga_Rwa	Ken_Uga_Bur	Ken_Rwa_Bur	Uga_Rwa_Bur
	lgKenUgaRwa_Tra Betas (SE)	lgKenUgaBur_Tra Betas (SE)	lgKenRwaBur_Tra Betas (SE)	lgUgaRwaBur_Tra Betas (SE)
Independent variables				
$\text{Log}(GDP_i)(GDP_{jk})$	2.388** (1.234)	1.829* (0.491)	3.465* (0.925)	0.191 (1.595)
$\text{Log}(PCI_i)(PCI_{jk})$	-2.591 (1.536)	-2.084* (0.649)	-4.000* (1.190)	0.599 (2.117)
$\text{Log}D_{i(jk)}$	Omitted	Omitted	Omitted	Omitted
$\text{Log}MU_{i(jk)}$	Omitted	-0.554* (0.166)	-0.284 (0.302)	0.389 (0.547)
_Const.	-97.029 (57.074)	-67.794* (22.019)	-142.969* (41.075)	-4.518 (69.569)
Model statistics				
F	18.53	44.02	18.58	26.05
Prob > F	0.001	0.000	0.001	0.000
R-squared	0.823	0.943	0.875	0.877
Adj. R-squared	0.778	0.922	0.828	0.843
A superscript of a star * and ** indicate 5% and 10% level of significance respectively. <i>PCI</i> is the Per Capita Income, that is, the product of the real GDP for country <i>i</i> and country <i>j</i> divided by the product of the respective populations at a given period. <i>Omitted</i> : Because of collinearity.				

Source: Author, 2018

The overall mode for Kenya, Uganda and Rwanda was significant in explaining the change in the combined trade, $F(2, 8) = 18.53$, $p < 0.01$ with the model accounting for over 82.3% of the variation in the combined trade. The results indicated that a β_1 estimate of 2.388 yielding $e^{2.388} \approx 10.72$ which was positive and statistically significant at 10% level of significance. This implied that Kenya's output when trading with Uganda and Rwanda would increase trade by over ten times as much with each other, holding per capita income, distance and monetary union constant.

The results also indicated that the model delivered a β_0 intercept estimate of -67.794 yielding $e^{-67.794} = 5.7 \times 10^{-30} \approx 0.000$ which was approximately zero and significant at 5% level of significance. This indicated that the variables influencing Kenya's trade with Uganda and Burundi were considered in this study, holding GDP, per capita income, distance and monetary union to a constant zero.

The results indicated that a β_1 estimate of 1.829 yielding 6.151 which was positive and statistically significant at 5% level of significance. This implied that Kenya's output when trading with Uganda and Burundi would increase trade by over six times as much with each other, holding per capita income, distance and monetary union constant.

The results indicated that a β_2 estimate of negative 2.084 being positive $e^{-2.084} \approx 0.126$ which was positive and significant at 5% level of significance. This implied that Kenya's per capita income when trading with Uganda and Burundi would increase trade by 0.126 times as much with each other, holding GDP, distance and monetary union constant.

The model produced a β_4 estimate of -0.4000 which was negative and statistically significant at 5% level of significance. This indicated that a *MU* elasticity was -0.4000, meaning that *MU* would reduce trade for Kenya with Uganda and Burundi by 98% $[(1 - e^{-0.4000}) \times 100 = 98]$ as compared to none union members. In other words, Tanzania, Kenya and Burundi countries trade 2% less than when they have their separate currencies.

The overall mode fit for Kenya, Rwanda and Burundi was significant in explaining the change in the combined trade, $F(3, 8) = 18.58$, $p < 0.05$ with the model accounting for 87.45% of the variation in the combined trade between the countries. The findings showed that the model delivered a β_0 estimate intercept of negative 142.969 resulting in a positive $e^{-142.969} = 2.129 \times 10^{-62} \approx 0.000$ but tending towards zero and statistically significant at 5% level of significance. This depicted that holding GDP, per capita income, distance and monetary union to a constant zero; the intercept coefficient was zero meaning the study accounted for most of the determinants of Kenya's trade with Rwanda and Burundi countries.

The results indicated that a β_1 estimate of 3.465 yielding 31.24 which was positive and statistically significant at 5% level of significance. This implied that Kenya's output when trading with Rwanda and Burundi countries would increase trade by over thirty-one times as much with each other, holding per capita income, distance and monetary union constant.

The results indicated that a β_2 estimate of -2.084 being positive $e^{-2.084} \approx 0.126$ which was positive and significant at 5% level of significance. This implied that Kenya's per capita income when trading with Rwanda and Burundi would increase trade by 0.126 times as much with each other, holding GDP, distance and monetary union constant.

IV. Conclusion and Policy Implication

The impact of a currency union on bilateral trade flows was observed upon pairing the five EAC countries and applying Gravity Model. The pairing brought forth three categories whereby sixteen pairings were obtained. Out of the sixteen pairings, the result showed that five pairings of countries could form a monetary union: (1) Tanzania, Kenya Uganda and Rwanda; (2) Kenya, Uganda, Burundi and Rwanda (3) Tanzania, Kenya and Rwanda; (4) Tanzania, Kenya and Burundi and (5) Kenya, Uganda and Burundi. The results indicated that formation of a monetary union by these four paired countries were negative and statistically significant at either 5% or 10% level of significance.

The results indicated that per capita income for the pairing of the following countries was negative and significant: all the five EAC countries; Tanzania, Kenya, Uganda and Rwanda; Tanzania, Kenya, Burundi and Rwanda; Kenya, Uganda, Burundi and Rwanda; Tanzania, Kenya and Uganda and Tanzania, Kenya and Burundi. This implied that the variables in the study accounted for most of the determinants of trade within the countries.

The combined GDP for Tanzania, Kenya Uganda and Rwanda had a positive and significant effect on the combined trade among the four countries while the combined GDP for Kenya, Uganda, Burundi and Rwanda both at 5% level of significance. The pairing of Tanzania, Kenya and Burundi showed that the combined GDP had a positive and significant effect on the combined trade at 10% level of significance while the combined GDP for Kenya, Uganda and Burundi had a positive and significant impact on combined trade at 5% level of significance.

With regard to per capita income, the formation of a monetary union by Tanzania, Uganda and Burundi could result in a positive and significant impact. This implied that the welfare for these three EAC countries could improve upon using a single currency. Likewise, the formation of a monetary union by Kenya, Uganda and Burundi resulted in an increased per capita income indicating reduction of the welfare of the citizens of the three EAC countries. Also, the same conclusion was arrived at with the prospective formation of a monetary union by Kenya, Rwanda and Burundi. While the combined economy would result in increased GDP, the formation of a monetary union indicated that this would have a negative effect on trade for the individual country.

References

- [1]. Alinur, M. (2015). *Analysis of the Euro and the European Monetary System and its Effect on Greece in the Light of the European Financial Crisis*.
- [2]. Asante, S. K. B. (2007). *Building Capacity in African Regional Integration: Acquiring Basic Knowledge of Regionalism*. Ghana Institute of Management and Public Administration (GIMPA).
- [3]. Awa, R. (2015). *An Investigation of the Effect of the European Currency Union (Euro) on Sectoral Trade: An Application of the Gravity Model of Trade*.
- [4]. Bucur, I. A., & Dragomirescu, S. E. (2013). An Analysis of the Fiscal Convergence Criteria in the European Union in Terms of the Sustainability. *Studies and Scientific Researches. Economics Edition*, No 18.
- [5]. Bumtaia, A. J. (2015). *GCC Monetary Union Prospective Effects on Trade and Economic Growth* (Unpublished PhD Thesis). School of Economics, Kingston University,
- [6]. Durlauf, S., Johnson, P., and Temple, J. (2006). *Growth Econometrics*. Amsterdam, North Holland, S. Durlauf, & P. Aghion, (Eds.), *Handbook of Economic Growth*.
- [7]. EAC (2010). *East African Community Development Strategy 2006-2010*. East African Community.
- [8]. EAC (2013). *Protocol on the Establishment of the East African Community Monetary Union*.
- [9]. Eun, C. S., and Resnick, B. G. (2012). *International Financial Management* (6th ed.). New York: McGraw-Hill Irwin.
- [10]. Everitt, B. S. (2002). *The Cambridge Dictionary of Statistics Second Edition* Cambridge University Press.
- [11]. Frankel, J., and Romer, D. (1999). Dose Trade Cause Growth? *American Economic Review*, 89(3), 379-399
- [12]. Frankel, J. A., and Rose, A. (2002). An Estimate of the Effect of Common Currencies on Trade and Income. *Quarterly Journal of Economics*, 117(2), 437-466
- [13]. Geda, A., and Kebret, H. (2008). Regional Economic Integration in Africa: A Review of Problems and Prospects with a Case Study of COMESA. *Journal of African Economies*, 17(3), 357-394.
- [14]. Gros, D., and Thygesen, N. (1998). *European Monetary Integration*. Harlow, Essex, New York: Longman.
- [15]. Hawkins, J., and Masson, P. (2003). Economic aspects of regional currencies. In J. Hawkins, and P. Masson (Eds.), *Regional Currencies and the Use of foreign Currencies* (pp. 4-42). Bazel: Bank of International Settlement.
- [16]. Hsiao, C. (2003). *Analysis of Panel Data* (2nd ed.). Cambridge: University Press.

- [17]. Karakatsanidou, M. T. (2017). *Testing for Inflation Convergence Among European Union Countries: A Panel Approach*.
- [18]. Kenen, P. B. (1969). *The optimum currency area: an eclectic view*. In Mundell, Robert/ Swoboda. *Monetary Problems of the International Economy* (pp. 41-60). Chicago: University of Chicago Press.
- [19]. McKinnon, R. I. (1963). Optimum Currency Areas. *The American Economic Review*, 53(4), 717-725.
- [20]. Mundell, R. A. (1961). A Theory of Optimum Currency Areas. *The American Economic Review*, 51(4), 657-665.
- [21]. Oyeleke, O. J., and Adebisi D. G. (2014). Econometric Analysis of Fiscal Deficit Sustainability of Ghana. *Journal of Economics and Sustainable Development*, 5(28).
- [22]. Riaz, M. (2013). *Theoretical Groundwork for Gravity Model*. Paper presented at the Proceedings of 3rd International Conference on Business Management, School of Business and Economics, University of Management and Technology, Lahore, Pakistan.
- [23]. Rose, A. K. (2000). One Money, One Market: Estimating the Effect of Common Currencies on Trade. *Economic Policy: A European Forum*, 30, 7-33.
- [24]. Salvatici, L. (2013). *The Gravity Model in International Trade: African Growth and Development Policy modeling consortium (AGRODEP)*. (Technical Note TN-04), Dakar, Senegal.
- [25]. Serlenga, L., and Shin, Y. (2007). Gravity Models of EU Trade: Application of the Hausman-Taylor Estimation in Heterogeneous Panels with Time-specific Common Factors. *Applied Econometrics*, 22, 361-381.
- [26]. United Nations Economic Commission for Africa (2010). *Assessing Regional Integration in Africa IV: Enhancing Intra-African Trade*. United Nations Economic Commission for Africa, Addis Ababa, Ethiopia.

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