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THE EFFECT OF VOLATILITY ON TRADE IN THE EAST AFRICAN COMMUNITY COUNTRIES (1995 – 2015)

HARRIET CHEPKOSGEI SUGUT[1], DR.SYMON KIPROP[2], DR.AQUILLARS MUTUKU KALIO[3],
[1]DEPARTMENT OF ECONOMICS, EGERTON UNIVERSITY, EGERTON, KENYA.
[2]LECTURERS, DEPARTMENT OF ECONOMICS, EGERTON UNIVERSITY, EGERTON, KENYA.

ABSTRACT

There has been a wide debate on the effect of exchange rate uncertainty on trade but the existing empirical literature does not suggest an unequivocally clear understanding or show consistency on the impact of changes in exchange rates on trade. Furthermore, majority of the previous studies used standard deviation which is the traditional measure of exchange rate volatility and has the limitation of assuming the empirical distribution of real effective exchange rate to be normal. In addition, it ignores the distinction between predictable and unpredictable elements in the exchange rate process. It is against this backdrop that this study aimed to analyze the effect of exchange rate uncertainty on the EAC countries trade for the period 1995-2015 using GARCH measure of exchange rate variability which measures exchange rate variability by positioning a structural relationship between volatility and its determinants. The specific objective of this study is to investigate the effect of exchange rate volatility on the EAC countries trade. This study used secondary data sourced from World Data Indicator, International Monetary Fund and Kenya National Bureau of Statistics. The study used historical design because it took into account the trend of the data and the prediction of the future was also made possible. The study employed the profit maximization model to develop the theoretical framework. The study tested for stationarity of data using the Im-Pesaran-Shin test for panel unit root test. Cross sectional dependence was tested using the Breusch Pagan Langrange multiplier test. The maximum likelihood random effect estimation was employed in the study which tested explicitly for non-normality of the exchange rate changes. The study found a significant negative relationship between exchange rate uncertainty and trade. The policy makers in EAC therefore should put in place policies on financial hedging which reduces the firms' vulnerability to the risks arising from volatile currency movements. This will hence increase trade in the EAC countries resulting to a faster economic growth in the region.

1. INTRODUCTION

The uncertainties in the exchange rate trigger trade deficits and surpluses which increase transaction costs and reduce the gains of international trade. This is transmitted into the economy by means of trade imbalances thus affecting international trade which is an integral part of the modern world. This could consequently affect the economic growth of the EAC countries which is an attempt of achieving vision 2050 of being a middle income economy. The effect of exchange rate level on trade has been highly debated but the existing literature does not suggest a clear understanding of the trade impacts of changes in exchange rate. For instance some studies found a negative relationship between exchange rate uncertainty and trade, others did not find any significant relationship and others found a positive relationship. Besides, much of the evidence considers currencies of large economies while few studies have been conducted in the less developed countries hence, this study will consider the five EAC countries. Trade is considered the major sources of employment because of its earnings on the exported and imported products. Any shock to the trade sector affects both employment and foreign exchange earnings.

The role of trade particularly exports has been highly acknowledged (Pigka-Balanika, 2005). Ideally, export activities stimulate growth in a number of ways including production and demand linkages and increased productivity through specialization (Basu *et al*., 2000; Fosu,1990; and Giles and Williams, 2000). According to Davoodi (2012), for the East African Community (EAC) to have an economic growth beyond 5%, it needs to enhance the contribution of exports which is an engine of growth. According to WDI data, the net exports are a drag on growth, having reduced the overall growth of EAC countries by 4.5% in 2015. This is reflected in the large and widening trade deficit (this is shown in Figure 4-8 in the appendices). This will hence delay the growth momentum of the EAC to become upper middle income economies by 2050 which is their ambition (Kiggundu, 2016). If EAC was to match imports with exports, while maintaining its current levels of consumption and investments, its overall growth would have been at 8%.The EAC has maintained large trade deficits as its total imports are more than twice its total exports in value terms during 2000-2014 period (refer to Figure 4-8 in the appendices). This large gap between exports and imports has been contributed largely by the variations of the real effective exchange rate which causes uncertainties in the export sector (Clark, 1973).

The tendency of real effective exchange rates to fluctuate and its unpredictability has been pointed out for limiting gains from international trade and lowering welfare (Straub and Tchakarov, 2004). The exchange rate volatility is a measure that intends to capture the uncertainty faced by exporters, due to unpredictable fluctuations in exchange rates.

The real effective exchange rate is the rate at which goods and services produced in one country can be exchanged for those produced in another country or group of countries abroad. Increased Real Effective Exchange Rate (REER) volatility would for instance, increase the uncertainty of profits on contracts dominated in a foreign currency and would therefore reduce economic growth to levels lower than would otherwise exist if uncertainty were removed (Côte, 1994).

Exchange rate is one of the key barometers of economic performance indicating growth (output), demand conditions, and the levels and trends in monetary and fiscal policy stance. Exchange rate policy emerged as one of the controversial policy instruments in developing countries in the 1980's with vehement opposition to devaluation for fear of its inflationary impact among other effects.

The exchange rate across the East African Community (EAC) countries has been fluctuating widely in relation to the dollar($), especially after the collapse of the Bretton Woods in1973 system of fixed exchange rates, since then there has been an extensive debate about the impact of exchange rate variability on the international trade. The widely held belief is that greater exchange rate variability generates uncertainty thereby increasing the level of riskiness of trading activity and this will eventually depress trade. A vast majority of economic literature however contains highly ambiguous and inconsistent theoretical and empirical results on this issue (Todani and Munyama, 2005).

Furthermore, the exchange rate for of the EAC countries has been highly volatile following the introduction of the structural adjustment reforms since early 1980s (since the introduction of floating exchange rate).The question debated by most economists is what has been the effect of this exchange rate uncertainty on the growth of trade.

One strand of theoretical model in literature demonstrates that increased risk associated with exchange rate uncertainity is likely to provoke risk-averse agents to direct their resources to riskless economic activities since such variability generates uncertainty which increases the level of riskiness of trading activities and this will depress trade. According to these economists, this occurs because markets may be imperfect especially in the LDCs and also because hedging may not only be imperfect but also very costly as a basis for averting exchange rate risk. Hence in line with risk aversion hypothesis, exports may be negatively correlated with exchange rate volatility (Doroodian, 1999).

On the contrary, other theoretical models in literature show that higher risk associated with fluctuations in exchange rates present greater opportunity for profits and thus should also increase trade. According to Aziakpono *et al.(*2005), this occurs because if exporters are sufficiently risk-averse, a rise in exchange rate variability leads to an increase in expected marginal utility of exports revenue which acts as an incentive to exporters to increase their exports in order to maximize their revenues. This ambiguity in the theoretical literature causes similar ambiguity and inconsistencies in the empirical investigation of the effect of exchange rate uncertainty on trade.

2. LITERATURE REVIEW

Ozturk and Kalyoncu (2009) used the moving standard deviation approach as a proxy for exchange rate variability in a study to investigate the effect of exchange rate volatility on the trade flows of six countries: Poland, Pakistan, South Korea, Hungary, Turkey and South Africa over the quarterly period of 1985-2005. The study employed Engle Granger residual based cointegration technique and Error correction models to obtain the estimates of the cointegrating relations and the short run dynamics. The study also applied the Augumented Dickey Fuller (ADF) test for stationarity. The authors found a long run relationship between real export, relative prices, real foreign demand, real exchange rates and exchange rate volatility. In addition the study found that increase in exchange rate volatility approximates exchange rate uncertainty and this exerts a significant negative effect on trade for Poland, Pakistan, South Korea and South Africa and a positive effect for Hungary and Turkey in the long run. However, Ozturk and Kalyoncu (2009), used quarterly data which according to Melitz (1988), is insignificant as it uses overlapping observations and therefore cannot measure annual volatility properly. This study used annual data which avoids overlapping observations and is more accurate than monthly data observations.

Bahmani-Oskooee *et al*. (2014) did a study on the effects of exchange rate volatility on 148 Korean export industries and 144 Korean import industries using bilateral data of the span period 1971-2011 and estimated Korea's trade with the rest of the world. The variables used in the study was industrial production index used as proxy for foreign income, real effective exchange rate as a measure of relative price and the exchange rate variability. After applying the Autoregressive-Distributed Lag (ARDL) model they found that in the long run, 20 export industries respond negatively to exchange rate risk, while 12 industries respond positively. For imports however, the study found that eight have negative coefficients and fourteen have positive ones. The majority of the industries are unaffected. Bahmani-Oskooee *et al.* (2014), employed standard deviation method as a proxy to measure exchange rate volatility, however standard deviation method has the limitation of assuming that the exchange rate experiences a normal distribution. This is not always the case. It also ignores the distinction between predictable and unpredictable elements of the exchange rate process. Thus, utilizing standard deviation approach could lead to volatility being overstated. This study therefore employed the GARCH measure of exchange rate volatility which is superior to the standard deviation approach.

Vergil (2002) investigated the effect of exchange rate volatility on the export flows in Turkey to its' three major trading partners: United States, Germany and France for the period 1990 to 2000. The study used real exchange rate, real foreign economic activity and exchange rate volatility as the variables where the standard deviation method was used to measure exchange rate volatility. The order of integration was determined using Augumented Dickey Fuller (ADF) test, while Johansen (1995) Cointegration test and error-correction models were used to obtain the estimates of the Cointegration relations and the short-run dynamics respectively. The author found out that volatility causes exports to underperform because, in addition to creating uncertainty and effective planning, it discourages local suppliers from expanding into foreign markets for fear of being exposed to profit variability which may result from unstable exchange rates. The study added that in a free market the exporters have the freedom to exit the market when they perceive the environment to be too risky and to re- enter when stability returns. Just like Bahmani-Oskooee *et al.* (2014), Vergil (2002), employed standard deviation method as a proxy to measure exchange rate volatility. Standard deviation method has the limitation of assuming that the exchange rate experiences a normal distribution. This is not always the case. This study hence, employed the GARCH measure of exchange rate volatility.

Zhao (2010) applied Johansen (1999) cointegration test and Vector Error Correction Model in the investigation of the impact of real exchange rate volatility on the real bilateral export flows of New Zealand using quarterly data. The model estimated New Zealand and its trading partners: Australia, Japan, United States and the United Kingdom over 1991Q1 to 2007Q1 sample period. The study employed the Augmented Dickey Fuller test and Philips- Peron test for stationarity. It used moving average standard deviation of the percentage change in the real exchange rate as a proxy of exchange rate volatility. The variables included real foreign income, real exchange rate and volatility. The study found out that the long run relationship between New Zealand's real exports and its bilateral real exchange rate volatility is insignificantly positive. The study however, used quarterly data which uses overlapping observations and therefore cannot measure annual volatility properly. This study used annual data which avoids overlapping observations and hence is more accurate than monthly data observations.

Asafu-Adjaye (1999) investigated the effects of increase in real exchange rate variability on the slowdown of export growths in Fiji for the period 1981:01 to 1997:06. The study used the sample standard deviation of the growth rate of the real exchange rate as a proxy for exchange rate volatility. Using error-correction and the Johansen and Juselius (1990) cointegration modeling techniques, the study found that real exchange rate variability has both short and long run adverse effects on exports growth. The study also found that real exchange rate, relative prices and foreign real income has a great impact of export growth. Asafu-Adjaye (1999) used standard deviation as a proxy for exchange rate volatility which has the limitation of ignoring the distinction between predictable and unpredictable elements of the exchange rate process. This study hence used GARCH model which takes into account both the predictable and the unpredictable elements of exchange rate volatility.

Chowdhury (1993) used the moving sample standard deviation of the growth rate of real exchange rate as a measure of exchange rate variability in the study, relative price and real foreign income variables in a bid to study whether exchange rate variability depresses trade. The study examined the impact of exchange rate volatility on the trade flows of the G-7 countries; Canada, France, Germany, Italy, Japan, United Kingdom and United States from the year 1973:I to 1990:IV. Using the multivariate error correction model, the study found out that exchange rate has a significant negative effect on export volume in all the G-7 countries. Chowdhury (1993) employed standard deviation method as a proxy to measure exchange rate volatility. Standard deviation method has the limitation of ignoring the distinction between predictable and unpredictable elements of the exchange rate process. Thus, utilizing standard deviation approach could lead to volatility being overstated. This study employed the GARCH measure of exchange rate volatility which is superior to the standard deviation approach.

Hondoyiannis *et al*. (2005) studied exchange rate volatility issue for 12 industrial economies examining a model that indicates real export earnings of oil-producing economies as a determinant of industrial- country export volumes. Five estimation techniques were used, including the generalized method of moments (GMM) and random coefficient (RC) estimation. The study employed panel data approach covering the period from 1977 to 2003 using three measures of volatility; standard deviation, ARCH and GARCH models. The author found no instance in which volatility has a negative and significant impact on trade. Hondoyiannis *et al*. (2005) employed GMM estimation method which can generate non normal distributions and give misleading inferences when there is weak identification of the instrumental variables. This study used a better estimation method which estimated the parameters of the conditional mean and conditional variance real exchange rate equations simultaneously with the trade volume equations by using maximum likelihood estimation which ensures consistency and efficiency.

Cheong (2004) investigated the effect of exchange rate volatility on the UK's import trade. GARCH (1,1) model was used in measuring exchange rate volatility. The study used monthly data from 1974-2000 and employed UK's relative price, UK's income and exchange rate volatility as the variable. The author used the OLS estimations and found negative impact of exchange rate volatility on Britain's imports. Using the OLS estimates, Cheong 2004 did not employ the outlier detection algorithm to remove outliers from his study therefore the results could have been biased. This study employed maximum likekelihood estimation which is a superior method to OLS.

3. METHODOLOGY

The study employed historical research design as it seeks to determine the effect of exchange rate uncertainty on trade for the EAC countries. This research design was used because it is able capture the trend of the fluctuations in exchange rate over the period 1995– 2015. The study used secondary data and unbalanced panel data analysis.

The study analyzed the effect of exchange rate uncertainty on the EAC countries trade. The EAC countries include; Rwanda, Burundi, Tanzania, Kenya and Uganda. This study left out Sudan which is a new member of the EAC and therefore is new to its policies and objectives.
Descriptive analysis was employed on the study to show the relevance of the information by showing the summary of the variables through giving the mean, variance and standard deviation of the variables. Tables were then used to present results of the analysis. Statistical analysis of data using STATA software was employed.

Unit root test was conducted, it aims at establishing stationarity of time series data. Since panel data is simply a collection of time series data for a given number of cross-sectional units collected over a number of years, then there is need to test for unit roots. Im *et al.*,(2003) developed a unit root test for panel data which is commonly abbreviated as IPS. IPS tests the null hypothesis of presence of unit root against an alternative hypothesis of absence of unit roots. Johansen Maximum Likelihood (ML) procedure was used to determine whether a stable long-run relationship exists between the variables.

Meeting the Objective
The study followed Bollerslev (1986) and Engel (1982) and used the Autoregressive Conditional Heteroskedasticity (ARCH) and the generalized conditional heteroskedasticity GARCH models to determine the exchange rate volatility. Suppose an assumption is made that exchange rate volatility is generated by first order autoregressive process that is specified as follows;

$$P_t = \gamma_0 + \gamma_1 P_{t-1} + \varepsilon_t \qquad (1)$$

Where; P is the natural logarithm of the real effective exchange rate, $\gamma_0$and γ_1 are the parameters to be estimated, and ε_t is an error term that is distributed normally with mean 0 and variance σ_t^2. The variance of the error term depends upon t, and the objective of the model is to characterize the way in which this variance changes over time. The ARCH model assumes that this dependence can be captured by any autoregressive process of the form;

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \varepsilon_{t-2}^2 + \ldots + \alpha_m \varepsilon_{t-m}^2 \qquad (2)$$

Where; σ_t^2 is the conditional variance of the real exchange rate, ε_{t-i}^2 for $i = 1,2\ldots m$, are the parameters to be estimated. The restrictions $\alpha_1 \geq 0$, ensures that the predicted variance is always non-negative. ε_{t-i}^2 which represents the ARCH term, is a measure of information about volatility in the previous period. This specification illustrates clearly how current levels of volatility will be influenced by the past, and how periods of high or low real exchange rate fluctuation will tend to persist.

Bollerslev (1986), extended the ARCH model to produce the Generalized Auto-Regressive Conditional Heteroskedastic (GARCH) model, in which the variance is given by;

$\sigma_t^2 = \alpha_0 + \beta_1\sigma_{t-1}^2 + \beta_2\sigma_{t-2}^2 + \ldots\beta_k\sigma_{t-k}^2 + \alpha_1\sigma_{t-1}^2 + \alpha_2\sigma_{t-2}^2 + \ldots \alpha_m\sigma_{t-m}^2$ (3)

Where; σ_{t-j}^2 for j = 1,2…k, is the GARCH term representing last periods forecast variance. The simplest specification in this model and the one most widely used is referred to as GARCH(1,1) model and is given by;

$$\sigma_t^2 = \alpha_0 + \beta_1\sigma_{t-1}^2 + \alpha_1\varepsilon_{t-1}^2 \quad (4)$$

This study therefore employed equation 12 as the GARCH process. The results of equation 3 is interpreted as exporters/importers prediction of the current periods' real exchange rate variance. This variance is measured as a weighted average of the long term average (the constant term) and the GARCH and ARCH terms. Thus, the predicted values of σ_t^2 from equation 4 provide us with a measure of real exchange rate volatility. The generalized autoregressive conditional heteroskedasticity model allows the entry of not only the conditional variance but also allows entry of lagged conditional variances, furthermore, according to Wald's decomposition argument, GARCH is a parsimonious model.

The objective was met through maximum likelihood estimation of parameters. The likelihood function is maximized with respect to the parameters and by finding the mode of the distribution. While the estimated conditional mean and variance of real exchange rate could be substituted into the trade equation in a two step estimation procedure, as several previous studies have done, this could lead to a generated regressors problem of biased estimates of the parameters' standard errors and potentially inconsistent parameter estimates(McKenzie, 1999). The study hence eliminated this problem by estimating the parameters of the conditional mean and conditional variance real exchange rate equations simultaneously with the trade volume equations by using maximum likelihood estimation which ensures both consistency and efficiency.

3.2 Exchange Rate Volatility

Exchange rate is defined as the price of one currency in terms of another currency. In a floating exchange rate regime, the transaction costs are higher compared to a pegged or fixed exchange rate (Jones and Kenen, 1990). Volatility is defined as unobservable or latent variable, deterministic or stochastic. However, there have been studies carried out to make exchange rate volatility an observable variable with varied results (Bauwens and Sucarrats, 2005). Real effective exchange rate (REER) volatility refers to short term fluctuations of the REER about their longer term trends (Frenkel and Goldstein, 1989).

Most studies have used the measure of variance to capture volatility. The volatility variable in this case is constructed as the standard deviation of the exchange rate variable or as a moving standard deviation (Cho *et al.*, 2002). A moving standard deviation exchange risk proxy focuses on short term volatility rather than long term swings in exchange rates. Peree and Steinherr (1989) pointed out that exporters can easily and costlessly insure against short term risk through forward market transactions. De Grauwe and Bellefroid (1986) and De Grauwe (1988) argue that short run variability is irrelevant to trade. On the contrary it is difficult and expensive to hedge against long-term risk. De Vita and Abbott (2004) find stronger impacts of exchange rate volatility on exports using a long term volatility based on the past five years.

The GARCH model as a measure of exchange rate volatility developed by (Bollerslev and Tim, 1986) are designed to model and forecast conditional variances. This procedure models the variance of each period's disturbance term as a function of the errors in the previous period. The variance of the dependent variable is modeled as a function of past values of the dependent variable and exogenous variable. In so doing, it allows volatility clustering, so that large variances in the past generate large variances in the future. The study hence used the GARCH measure of volatility. The GARCH measure for exchange volatility is given by:

$$\delta_t^2 = \alpha_1 + \alpha_2\varepsilon_{t-1}^2 + \beta_1\delta_{t-1}^2 \quad (5)$$

The study expected to a find a positive or a negative relationship depending on the risk averseness of the exporters.

4. ESTIMATION AND DISCUSSION OF RESULTS

The study employed the descriptive statistics and correlation of the variables which were presented to provide the general characteristics of the variables in terms of mean, range, standard deviation and the correlation. Unit root test was initially conducted to check on the stationarity and the co-integration of the variables. GARCH model was used to estimate the variability of real effective exchange rate and maximum likelihood estimation (MLE) was conducted to examine how the independent variables affect trade in East Africa Community (EAC) countries.

Descriptive Statistics

Table 1 presents the results that show real effective exchange rate (REER) and exchange rate volatility (VOL) to have a larger variation in comparison to the other variables. Exchange rate volatility has a mean value of 3.57 and a standard deviation of 1.75. This implies that exchange rate volatility (VOL) has a relatively high degree of variation. The high variations in real effective exchange rate and volatility may be caused by the adoption of the floating exchange rate system by the East African Community countries as from the year 1995. The adoption of floating exchange rate in the East African Community (EAC) countries marked the climax of efforts to make the real effective exchange rate more aligned to the market determined equilibrium real effective exchange rate and thereby eliminating real effective exchange rate stability. This variation may also be caused by the EAC trade movements, capital movements, stock exchange operations, speculative transactions, banking operations, monetary policy and political conditions of the EAC. The value of the skewness shows that real effective exchange rate and exchange rate volatility is highly skewed to the left. The value of the kurtosis and skewness show a non-normal distribution of exchange rate volatility suggesting that the exchange rate and volatility distribution is Platykurtic (negative kurtosis). This means that very little data is at the peak, most of it is in the tails which is fat and flat. This hence suggests that exchange rate volatility displays a high standard deviation.

Table 1: Descriptive Statistics

		LnOPEN	LnGDP	LnVOL
N	Valid	95	76	90
Mean	Statistic	2.69	5.82	3.57
Standard Deviation	Statistic	1.45	0.58	1.75
Variance	Statistic	2.10	0.35	3.06
Skewness	Statistic	-0.61	0.16	-1.22
Kurtosis	Statistic	2.31	2.31	-4.98
Minimum	Statistic	1.57	4.68	1.26
Maximum	Statistic	3.49	7.13	4.47

Where; LnOPEN = natural logarithm of openness.
LnGDP = natural logarithm of gross domestic product
LnVOL = natural logarithm of volatility.

Openness has a mean value of 2.69 and standard deviation value of 1.45 This suggests that exchange rate variations has got significant effect on trade in the EAC. With the exception of gross domestic product, all variables are negatively skewed.

Correlation Results

Table 2 presents the correlation coefficients for the relationship between trade and the two variables volatility and Gross Domestic Product. The study focuses on the correlation between volatility and all the other variables. Correlation coefficient value ranges between -1 and 1. A value of 0 indicates absence of correlation while the extreme values of -1 and 1 indicate a perfect inverse correlation and a perfect positive correlation respectively.

Table 2: Correlation Coefficient Results of the Relationship between Trade and the Independent Variables.

	LnVOL	**LnGDP**	**LnOPEN**
LnVOL	1.0000		
LnGDP	0.7162**	1.0000	
LnOPEN	-0.7650**	0.7693**	1.0000

** Means that the Correlation is significant at 1% level (2-tailed test).

The results suggests that exchange rate volatility (VOL) is positively and significantly correlated with all the variables except openness. Correlation between exchange rate volatility (VOL) and openness (OPEN) on one hand and exchange rate volatility (VOL) and gross domestic product (GDP) on the other hand are much stronger -0.7650 and 0.7162 respectively. This suggests that depreciation of EAC domestic currency to the foreign currency would result to cheap exports and expensive imports, hence a rise in the domestic aggregate demand by the domestic country. Openness is positively correlated with gross domestic product and terms of trade but negatively correlated with real effective exchange rate and exchange rate volatility. These correlations are expected because as countries experience favorable terms of trade, so does trade (proxied by openness) of that country increase. When a country exports goods, it sells them to a foreign market in other countries. The exports bring money into the particular country and this result to increase in the exporting nations GDP (This explains the positive correlation of 0.7693 between LnGDP and LnOPEN). The negative correlations of -0.7650 and -0.7723 between exchange rate volatility (VOL) and openness (OPEN) implies that exchange rate variations has a negative effect on the EAC trade.

Panel Unit Root Test

Non-stationarity of time series data is one of the major econometric problems that lead to spurious regression results, inconsistent estimates and meaningless inferences. To address this problem, the study conducted panel unit root test. This study employed Im-Pesaran-Shin (IPS) Unit root test Im *et al.*,(2003), since it gives better results in small samples than the Levin–Lin-Chu unit root test and is appropriate for unbalanced panel data. IPS tests the null hypothesis of presence of unit root against an alternative hypothesis of absence of unit roots.

The results of the Im-Pesaran-Shin (IPS) test reported in Table 3 shows that the null hypothesis of presence of a unit root is rejected at 5% significance level for LnVOL and LnOPEN variables and the alternative hypothesis of absence of a unit root is accepted for these variables. LnGDP variable was found to have unit root hence were differenced to make them stationary. The results confirm that some variables are stationary at level and are integrated of order zero I(0) while other variables are integrated of order one I(1). Co-integration test was not conducted because the variables are not integrated of the same order.

Table 3: Results of Im-Pesaran-Shin (IPS) Panel Unit Root Test

Variable		IPS (Level)		IPS (First Difference)		Order of Integration
		Statistic	P-Value	Statistic	P-Value	
LnOPEN	z-t-tilde-bar	-2.9328	0.0017	-	-	I(0)
LnGDP	z-t-tilde-bar	-1.1667	0.5662	-3.5123	0.002	I(1)
LnVOL	z-t-tilde-bar	-1.2839	0.0996	-	-	I(0)

Hausman Test

Hausman (1978) proposed a test used to decide whether to use Random effect (RE) or Fixed effects (FE) model. The null hypothesis of the test is that the preferred model is the RE against the alternative FE. According to the model, if the country specific effects are correlated with the regressors, then the RE estimator is inefficient and inconsistent while the FE is consistent. Therefore to test the efficiency of the RE estimates, Hausman and Taylor (1981) suggested a comparison of the RE and FE estimates. This study conducted Hausman test and the results are presented in Table 4.

Table 4 : Hausman Test Results

Variables (V)	(b) Fixed	(B) Random	(b-B) Difference	Std.Error
LnGDP	-0.4423916	-0.4387479	-0.0036437	0.0059337
LnVOL	0.4873496	0.0862762	0.4010734	0.12565544
χ^2 (6) = 0.23			Prob> χ^2 = 0.1653	

From the Hausman test results, the p-value is 0.1653 which is greater than 0.05. The study therefore accepts the null hypothesis. This means that the country specific effects are uncorrelated with the regressors and hence this study used the random effect (RE) model.

Maximum Likelihood Estimation

The maximum likelihood random effect estimation results are presented in Table 5 and have been tested for the following econometric problems: cross-sectional dependence, heteroscedasticity and autocorrelation.

Table 5: Maximum Likelihood Random Effect Estimation of the Effect of Exchange Rate Variability on EAC

Variable	Coefficient	Std .Error	Z Statistic	P Value
LnGDP	0.1886407	0.0759576	2.48	0.013
LnVOL	-0.034547	0.0021937	-15.75	0.000
Constant	-1.408266	0.5889873	-2.39	0.017
Adjusted R^2 =0.7342				
Breusch Pagan LM test of Cross sectional dependence			**Chi^2 (53)** = 10.432 **p-value=** 0.6218	
Modified Wald test for groupwise heteroscedasticity			**Chi^2 (53)** = 6.12 **p-value=** 0.4813	
Wooldridge Test for Autocorrelation			**p-value=** 0.0631	

Effect of Volatility on EAC Openness

From Table 5, the long run exchange rate volatility has a statistically significant negative effect on trade. If exchange rate volatility were to rise by one percent, trade would fall by 0.03%. This effect is consistent to the estimates found by previous studies like Eichengreen (2008) which established that maintaining appropriate and stable exchange rate volatility enables countries to explore their growth and development capacities. Excess exchange rate volatility reduces the level of trade and economic growth by creating business uncertainty, deteriorates competitiveness, lower productivity and profits as well as increasing domestic prices.

Ethier (1973) also established that the exchange rate uncertainty will have a harmful inhibiting effect on world trade. Existence of forward exchange market will therefore help limit the risks of trading firms. Other studies that found similar results include Rose (2000) and Tenreyro (2003).

Econometric Tests

The study carried out several econometric tests, cross sectional dependence test, heteroskedasticity test and serial correlation test, none of the econometric problems was found existent. Hence, the study results don't suffer spurious regressions.

5. SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

Summary

This study aimed at examining the effect of exchange rate uncertainty on East African Community (EAC) trade using panel data over the period 1995-2015. To achieve this objective, the study used openness of the economy as a measure EAC trade. Openness was obtained by adding the intra-EAC exports and imports an expressing them as percentage of GDP. Other variables used in the study include real effective exchange rate, terms of trade, gross domestic product and exchange rate volatility.

Unit root testing was performed using the Im-Pesaran-Shin (IPS) panel unit root test. The variables were found to be stationary, except for real effective exchange rate and gross domestic product which were then differenced to make them stationary. First differencing for real effective exchange rate and gross domestic

product made them stationary. Hence the two variables were integrated of order one I(1). Cointegration test was not conducted because all the variables were not integrated of the same order.

The Hausman test was conducted so as to select the preferred model between the fixed effect and random effect model. The results showed that the country specific effects were uncorrelated with the regressors and hence the maximum likelihood RE model was selected for the study.

Maximum likelihood random effect estimation revealed that since the adoption of a flexible exchange rate system in EAC from 1995, uncertainty in investment increased and hence study found a negative significant effect between exchange rate volatility and openness. There was no cross sectional dependence and serial correlation in the data. The model used the right number of instruments and it was not over identified as reported by the Sargan test for over identification.

Conclusion

The econometric results of this study show that EAC trade is significantly influenced by exchange rate uncertainty. Excess exchange rate variability has adverse effects on EAC's openness (proxy for trade). Since exchange rate uncertainty adversely affects trade negatively, the intended effect of the current trade liberalization policy being implemented in EAC countries may be dammed thereby precipitating a balance of payment crisis. The results suggest financial hedging which reduces the firms' vulnerability to the risks arising from volatile currency movements. The study highlights the need for policy measure to maintain stability in the currency in addition to keeping it competitive. Floating currency enables exchange rate risk to be minimized by hedging on the futures market, this option is not possible under the fixed exchange rate regime.

Given that gross domestic product has a significant positive effect on openness, it is necessary for EAC to absorb any volatility created by fluctuating resource revenues/gdp. Example, taking into account possible economic crises and price booms/crashes, it would be better for EAC to act as a lender than a borrower, in order to have some safety cushion (Ploeg 2009).

Policy Recommendations

Having conducted the study and established that exchange rate uncertainty negatively affects openness in the EAC, maintenance of exchange rate stability becomes necessary. For this reason, policies that enhance exchange rate stability need to be formulated by the policy makers and be implemented in order for the region to realize improvement in trade and hence economic growth. For instance, to reduce the risks from exchange rate volatility, the trading firms can use the forward exchange rate, which is quoted and traded today but delivered and paid on a specific future date. Depending on traders risk aversion on exchange rate fluctuations, also increases the costs to protect against those risks.

To maintain real effective exchange rate stability, the EAC central bank should sterilize the excess capital inflows through open market operation. In order to sterilize the persistent capital inflows, the EAC central banks can take other policy measures like encouraging private investment and foreigners to borrow from local markets. Along with policy measures for reducing appreciation of EAC real effective exchange rate, policies to boost exports in EAC is important. Policies such as investment on human capital, widening the scope of technological innovation, reducing infrastructure inadequacies, promoting export diversification and more value addition to the EAC exports.

Suggestions for Further Research

This study investigated the effect of exchange rate uncertainty on trade using averaged annual data but exchange rate variation is usually recorded on a daily basis and monthly basis too. Therefore there is need to study exchange rate uncertainty using quarterly, monthly or daily data to capture the very fine details of exchange rate variations.

Moreover, the study investigated the effect of exchange rate uncertainty on trade of the EAC countries, without recognizing the different sectors of the economy that are involved directly with the exchange rate variability. Future studies could be conducted on the various sectors of the economy that the EAC countries have for instance, agriculture, manufacturing and service sectors. This would give sector specific policies on the different economic sectors depending on how the sectors respond to exchange rate variations.

Lastly, this study determined the effect of exchange rate uncertainty on the general trade of the EAC countries. Future studies could look into the effect of exchange rate uncertainty on bilateral trade which would be able to give the partner-specific trade policies and also give the international linkages of the particular countries.

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