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Exchange Rate Volatility and Trade Balance in Sub-Saharan African Countries: A Causal Relationship

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Abstract

This study examined the causal nexus between exchange rate volatility and trade balance in 13 sub-Saharan African countries from 2000-2015. Exchange rate volatility was generated using Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model. Pairwise Granger causality was used to determine the direction of causality among the variables. The result shows that there is unidirectional causality between exchange rate volatility and trade balance. Furthermore, the result shows that there is bidirectional causality between real exchange rate and exchange rate volatility; and trade balance and economic growth. The study concluded that exchange rate volatility is important in determining trade balance in sub-Saharan African countries.

Keywords

Exchange Rate Volatility, Real Exchange Rate, Trade Balance, Granger Causality, GARCH

1. Introduction

Exchange rate volatility has been defined as the risk associated with the unexpected movements in exchange rate [1]. In an open economy, foreign exchange rate policies are among the most important macro-economic indicators, because of the fact that they affect the business world's investment decision [2]. In developing countries, especially sub-Saharan African countries' exchange rate volatility has been attributed to changes in macro-economic variables such as unemployment rate, inflation rate, price, interest rate, balance of payment etc, which became more volatile in the 1980s and early 1990s due to the Structural Adjustment Program (SAP) of International Monetary Fund (IMF) embarked upon by many of these countries [3].

In modern times, real world scenarios have also been changing just like the number and extent of the studies in this area. Some of the changes (inflation rate, interest rate, balance of payment, etc) have worsened the exchange rate fluctuation whereas some of them have improved it. Specifically, one of the policies of structural adjustment program (SAP) of International Monetary Fund; that is international trade liberalization, also in connection with the huge increase in cross-border financial transactions has actually increased exchange rate volatility [4]. For example, the currency crisis of late 1980s and early 1990s in the developing countries is a solid foundation for increasing exchange rate volatility. However, several other changes have occurred over the previous years that have also served to reduce fluctuations in exchange rates. For instance, proliferation of multinational companies (MNCs), the currency stabilization effort of the apex banks of different countries and monetary authorities, the rapid spreading of credit and hedging instruments in financial markets and protection of agro-based industries may have reduced the exchange rate volatility to a great extent. Theory explains that exchange rate volatility creates uncertainty with regard to the prices exporters would have to pay and receive in the future [5].

In recent times, the trends in the world economy as the movement of goods and services, labour, technology and capital throughout the world regardless of the geographical boundaries affect the economies of countries. Trade transactions involving more than one country or region

normally require the conversion of a currency to another currency. Whether or not the demands for traded goods are sensitive to exchange rates fluctuation has long been recognized as a central issue in international transmission and adjustment. Empirical studies related to exchange rate volatility and trade still remains matter of interest to economists, especially in developing countries like sub Saharan African countries, despite a relatively enormous body of literature in this area. This is largely so because the concept of exchange rate in whatever conceptualization, is not only an important relative price, which connects domestic and world markets for goods and assets, but it also signals the competitiveness of a country's exchange power vis-à-vis the rest of the world in market [6]. Understanding the direction of causality between trade and exchange rate volatility is crucial to the implementation of successful trade policy.

2. Review of Literature

Most of the research works related to the direction of causality between exchange rate volatility and trade focused mainly on the advance countries and some Asian countries with less emphasis on sub-Saharan African countries. Few available studies in sub-Saharan African countries still generate controversies on the direction of causality. Bulks of studies in the literature have focused on the relationships between exchange rate volatility and trade. However, in this paper, some important research works undertaken in recent years which are closely connected with this study are reviewed.

Reference [7] examined the impact of term of trade and real exchange rate volatility on investment and growth in Sub-Saharan African countries. The study makes use of panel data consisting of fourteen Sub-Saharan African countries between the periods of 1980-1995. The study revealed that growth is negatively affected by terms of trade instability, and investment by real exchange rate instability. In addition, both growth and investment increases when the terms of trade improve and real exchange rate overvaluation is eliminated. Reference [8] assessed the effectiveness of exchange rate for twenty-one sub-Saharan African economies from 1973-2010. Four methodologies were used to estimate the equilibrium level; the macro-economic balance, equilibrium real exchange rate, external sustainability and purchasing power parity approaches. The result revealed that sub-Saharan African economies have different dynamics than advance and other lower and middle income countries. Reference [9] examined the effect of exchange rate volatility and trade in forty selected sub-Saharan African countries for the period 1986-2005. The study employs gravity model with pooled ordinary least square allowing for fixed effect and panel generalized method of moment technique. Using the two approaches, the study revealed that exchange rate volatility has positive effect on aggregate trade. Furthermore, the result showed that there is not much difference between the impact of exchange rate volatility on primary and manufactured trade as well as between ECOWAS and non ECOWAS countries. Reference [10] examined the causal relationship between exchange rate volatility (ERV), trade flows and economic growth of the sub-Saharan African countries with exclusive reference to Nigeria, which was considered as small open economy. The empirical study is based on a time series data over the period of 1970-2009. The results indicated significant effects of exchange rate volatility on trade flows and economic growth of Nigeria. Reference [11] examined the causality between effective exchange rate and balance of trade in China with Granger-causality test using monthly data from January 1994 to August 2009. The test suggested that in the short run, balance of trade causes a change in effective exchange rate but not vice versa. Similarly, [12] investigated the effect of real exchange rate on the balance of trade of Cote d'Ivoire using multivariate co-integration tests and vector error correction models with time series data covering the periods of 1975-2007. The results confirmed the existence of long-run relationships among trade balance, real exchange rate, foreign and domestic incomes for Cote d'Ivoire. Estimated results also demonstrated that real exchange rate has a significant positive influence on Cote d'Ivoire's trade balance in both short and long run under fixed real exchange rate management policies for the considering period. Also, Granger causality test revealed that the real exchange rate does Granger causes the trade balance. Furthermore, [13] examined the impact of currency volatility on the export demand within the SAARC region, covering Bangladesh, India, Pakistan and Sri Lanka from 1990:1-2010:12. Using GARCH to model exchange rate volatility and applying the bound testing approach on the standard trade model framework, the result showed that there exists evidence of significance long-run steady state equilibrium where foreign income, real exchange rate and exchange rate volatility does affects export decisions of producers in the region of SAARC. Thus, real exchange rate volatility was found to have a significant and negative impact on the export demand of most of the SAARC countries. Reference [14] examined the causality between exchange rate, trade, inflation, FDI and GDP through a series of models. Annual time series data for the years 1980-2009 was used. The authors' findings revealed that there is no long-run equilibrium relationship between exchange rate and inflation, but there exists long-run equilibrium relationship between exchange rate and trade. Also, long-run equilibrium relationship between exchange rate and FDI and causality runs in both directions, i.e. exchange rate to FDI and FDI to exchange rate. Finally, there is long-run equilibrium relationship between exchange rate and GDP but causality does not run in either direction. Related to [14], [15] and [16] also found that there is no mono-causal explanation for the export performance of East Asia and the favorable exchange rate is only one factor. Reference [17] examined intra-Asia exchange rate volatility and Intra- Asia trade by looking at the type of goods from1980-2009. The study focused on Association of South East Asian Nation (ASEAN) with Hong Kong, China, Japan, Republic of Korea and Taipei, the evidence showed that as intra-regional exchange rate volatility increases intra-regional export in these goods fall. In addition, for South Asia, exchange rate volatility appears to have a positive impact on export. Furthermore, [18] examined

the effect of exchange rate volatility on trade balance by focusing directly on the Nigerian economy. Monthly data from 2000:1 to 2015:12 was used. Applying Generalized Autoregressive Conditional Heteroscedacity (GARCH 1, 1) to model the volatility in exchange rate; and the result revealed the presence of exchange rate volatility. In addition, autoregressive distributed lag was used to estimate the model, the results showed that the model corrects its short run dis-equilibrium by 52% monthly; real exchange rate and exchange rate volatility has negative effect on trade balance both in short run and long run. In addition, [25] investigated the effect of foreign exchange rate and real exchange rate on foreign trade in Liberia from 1980-2015 using Autoregressive Distributed Lag (ARDL). The result confirmed nominal exchange rate was inversely related to import while real exchange rate was positively related to import. Furthermore, the authors found that significant negative effect of nominal exchange rate on trade balance while real exchange rate has a positive and significantly related to trade balance. Reference [26] investigated the effect of exchange rate volatility on Jordanian international trade form 1997-2013 using quarterly data. Using GARCH to model exchange rate volatility, the results revealed negative effects of real exchange rate volatility on imports and exports of Jordanian economy and a positive effect on real GDP. Focusing on sub Saharan African countries, [27] explored international trade-exchange rate interaction among countries in sub Saharan African countries using partial equilibrium analysis. The results from the study showed that export and import are inelastic to changes in exchange rate. Reference [28] estimated the effect of real effective exchange rate volatility on the balance of trade of Iran during the year 1993 to 2011. The results showed that the real effective exchange rate has no significant effect on the trade balance.

From all of the above it is evident that there is few empirical studies relating to direction of causality and also focusing on a sample of sub-Saharan African countries; hence, this study. The purpose of this paper is to provide some additional evidence with regard to the direction of causality between volatility of exchange rate and trade balance by utilizing a set of sub-Saharan African countries for which there is a small amount of empirical work.

3. Methodology

The trade balance is expected to depend on the real exchange rate and a measure of domestic and foreign income respectively, i.e. on the main determinants of import and export. This research will utilize a reduced form equation similar to that of [19] who found out that foreign income is not statistically significant, hence the variable is drop. The study ends up with the following model to be estimated:

$$TB_{it} = f(GDP_{it}, REER_{it}, EXV_{it}) \tag{1}$$

Where TB is trade balance, GDP is gross domestic product as a measure of domestic income, REER is real exchange rate and EXV is exchange rate volatility. i represent countries and t represent time.

This research adopts the statistical framework of Panel Vector Autoregressive (PVAR) methodology to determine the direction of causality between Exchange rate volatility and trade balance. Mathematically, the PVAR system representation can be written as follows:

$$X_{it} = \alpha_1 + \sum_{j=1}^{p} \beta_{1j} X_{i,t-j} + \sum_{j=1}^{p} \chi_{1j} Y_{i,t-j} + \varepsilon_{1t} \tag{2}$$

$$Y_{it} = \alpha_2 + \sum_{j=1}^{p} \beta_{2j} X_{i,t-j} + \sum_{j=1}^{p} \chi_{2j} Y_{i,t-j} + \varepsilon_{2t} \tag{3}$$

Where the ε's are the stochastic error term while X and Y are the variables and p maximum lag length. All the variables in this study: REER, ERV, GDP and TB are treated endogenously in the model as shown below:

$$X_{it} = (TB_{it}, REER, ERV_{it}, GDP_{it}) \tag{4}$$

The data comprises of 13 countries in sub-Saharan Africa from 2005 to 2015. The data were collected from World Bank Development Indicators (WDI) of the Word Bank. The countries selected are Central Africa Republic, Cameroon, Cote d'Ivoire, Gambia, Gabon, Ghana, Equatorial Guinea, Malawi, Nigeria, South Africa, Togo, Uganda and Zambia

Trade balance is the difference between export and import and gross domestic product are in millions dollars. Exchange rate volatility is generated from real exchange rate using Generalised Autoregressive Conditional Heteroscedacity (GARCH, 1 1). As the name suggests, GARCH approach of determining exchange rate volatility is based upon conditioning the variance by allowing changing over time based on past errors, also ability to capture both volatility clustering and unconditional return distribution with heavy tails. While conventional time series and econometric models operate under an assumption of constant variance, this type of model is useful in modeling variability in the exchange rate and inflation [20]. Furthermore, because the Autoregressive Conditional Heteroskedasticity (ARCH) proposed by [21] encountered the problem of negative variance parameter estimates in empirical applications, extension of the ARCH model including a more flexible lag structure was immediately sought [22].

4. Empirical Result

Exchange rate volatility (VOL) was generated from GARCH (1, 1). The result in Appendices 1 shows that the values of the standard error of the mean and variance equation are greater than half of their coefficient, showing that the coefficients are statistically significant. Also making used of the probability level, the coefficients are significant ($p < 0.05$). However, statistics such as R^2 might be meaning less in GARCH model [23]. Furthermore, the addition of the coefficients of variance equation is less than one ($0.98 < 1$).

This result ensures that the conditional variance is strictly positive, thus satisfying the necessary conditions of exchange rate volatility being persistent.

Since non-stationary panel data pose some challenges in regression analysis, it is, thus, important to check the time series properties of panel data before analyzing the direction of causality that exist among the variables. It has been well established in the literature that regression result produces spurious estimate while using data that is not stationary (have unit root). To avoid spurious regression result, panel unit root test were performed on all the variables used in this study. Levin, Lin and Chu (LLC), Im, Persaran and Shin (IPS), Augmented Dickey Fuller (ADF) and Phillip Peron (PP) panel unit test were used to test the level of stationarity of the variables as presented in Table 1. The result shows that all the variables are stationary at first difference except real exchange rate and exchange rate volatility that is stationary at level using LLC and PP test statistics.

Table 1. *Panel Unit Root Test.*

Variable	Levin, Lin and Chu	Im, Persaran and Shin	ADF	PP
TB	0.1869 (0.5742)	1.6406 (0.9496)	15.8318 (0.9402)	17.2861 (0.9002)
ΔTB	-6.3359 (0.0000)*	-5.5108 (0.0000)*	80.4235 (0.0000)*	187.968 (0.0000)*
REER	-1.7929 (0.0365)*	-0.8620 (0.1943)	35.6221 (0.0988)	42.9400 (0.0196)*
ΔREER	-	-3.7554 (0.0001)*	56.4487 (0.0005)*	-
GDP	2.8256 (0.9976)	5.0565 (1.0000)	7.8477 (0.9998)	5.0145 (1.0000)
ΔGDP	-8.0577 (0.0000)*	-5.9181 (0.0000)*	83.2810 (0.0000)*	152.989 (0.0000)*
VOL	-4.2040 (0.0000)*	1.5681 (0.9416)	18.1097 (0.8717)	55.9080 (0.0006)*
ΔVOL	-	-4.9096 (0.0000)*	70.3168 (0.0000)*	-

Source : Author's Computation, 2016 using E-view 9

Note: (a) "()" are probability values. (b) "*" denotes level of significant at 5%. (c) "Δ" denotes first difference. (d) TB is trade balance, REER is real exchange rate, GDP is gross domestic product and VOL is exchange rate volatility.

Table 2 presents the Pairwise Granger Causality test for all the four variables in our model using 10 as the lag length. The results show that (1) the effects of exchange rate volatility on trade balance is not statistically significant while the effect of trade balance on exchange rate volatility is significant. (2) The effects of real exchange rate on trade balance is not significant while the effect of trade balance on real exchange rate is significant. (3) The effects of GDP on trade balance and trade balance on GDP are statistically significant. (4) The effects of real exchange rate on exchange rate volatility and exchange rate volatility on real exchange rate are statistically significant. (5) The effects of GDP on exchange rate volatility is significant, while the effect of exchange rate volatility on GDP is not significant. (6) The effect of GDP on real exchange rate is significant, while the effect of real exchange rate on GDP is not significant. Thus, our empirical findings can be summarily explained as follows:

I. There is bidirectional causality between trade balance and economic growth in sub Saharan African countries. This shows that as trade balance plays a significant role in determining economic growth in the region. This result is in line with the findings of [24] and theoretical postulations.

II. There is uni-directional causality between exchange rate volatility and trade balance; and the direction of causality runs from trade balance causing exchange rate volatility. This is in line with empirical finding conducted by Yaya and Lu (2012). This result shows that exchange rate volatility causes more exports and at the same time discourages more imports into sub-Saharan African countries. This suggests that in the case of real exchange rate depreciation due to movements in any of the exchange rate fundamentals, foreign investors will tend to increase their investment in the economy and therefore improve the trade balance. This further support the theoretical postulation that support floating system of exchange rate.

III. The bidirectional causal flows between real exchange rate and exchange rate volatility indicates the present of exchange rate volatility in the region. This further buttress the result obtained from the GARCH model of the existence of volatility in exchange rate.

Table 2. *Granger Causality Test.*

Null Hypothesis	Obs	F-Statistic	Prob
VOL does not Granger Cause TB	77	0.51204	0.8745
TB does not Granger Cause VOL		4.05831	0.0003***
REER does not Granger Cause TB	78	0.37984	0.9505
TB does not Granger Cause REER		2.04473	0.0450**
GDP does not Granger Cause TB	78	34.8707	0.0000***
TB does not Granger Cause GDP		78.9298	0.0000***
REER does not Granger Cause VOL	77	2.34097	0.0219**
VOL does not Granger Cause REER		1.99340	0.0514*
GDP does not Granger Cause VOL	77	4.49389	0.0001***
VOL does not Granger Cause GDP		0.57965	0.8236
GDP does not Granger Cause REER	78	4.08051	0.0003***
REER does not Granger Cause GDP		1.39038	0.2082

Note that ***1% significant level **5% significant level and *10% significant level

5. Conclusion and Policy Recommendations

This paper explores the direction of causality between exchange rate volatility and trade balance in sub-Saharan African countries. 13 countries in SSA were selected for the study. The result revealed a unidirectional relationship between exchange rate volatility and trade balance with causality running from trade balance to exchange rate volatility. Furthermore, the study concludes that there is bidirectional causality between trade balance and economic growth; and real exchange rate and exchange rate volatility in SSA countries. Given that exchange rate volatility has significant influences on trade balance in a dynamic framework, policy maker could make used of exchange rate policies to influence and enhance trade balance in the region. Also, Exporters in the region should take the advantages of exchange rate volatility since hedging could be costly. Furthermore, policy maker in sub-Saharan African countries should consider both the existence and the degree of exchange rate volatility while implementing trade and exchange rate policies for the growth of exports demand.

Appendices

Table A1. *Estimation Result of ARCH/GARCH model for Real Exchange rate Volatility.*

Dependent Variable: REER				
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)				
Date: 03/15/17 Time: 11:49				
Sample (adjusted): 2 208				
Included observations: 207 after adjustments				
Convergence achieved after 33 iterations				
Coefficient covariance computed using outer product of gradients				
Presample variance: backcast (parameter = 0.7)				
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob**
REER(-1)	0.995940	0.010207	97.57269	0.0000
	Variance Equation			
C	3.864894	0.432532	8.935502	0.0000
RESID(-1)^2	-0.012765	0.001988	-6.421043	0.0000
GARCH(-1)	0.992437	0.003827	259.3373	0.0000
R-squared	0.404063	Mean dependent var		97.41911
Adjusted R-squared	0.404063	S.D. dependent var		15.90144
S.E. of regression	12.27543	Akaike info criterion		7.753532
Sum squared resid	31041.35	Schwarz criterion		7.817932
Log likelihood	-798.4905	Hannan-Quinn criter.		7.779574
Durbin-Watson stat	2.035444			

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