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Does Exchange Rate Volatility Deter Trade in Sub-Saharan Africa?

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ABSTRACT

This study investigates the effects of exchange rate volatility on trade in 39 selected Sub-Saharan Africa (SSA) countries for the period 1995-2012. Export and import models were estimated using panel data econometric technique. Three measures of volatility are used. These are standard deviation, generalized autoregressive conditional heteroskedasticity and Hodrick-Prescott (HP)-Filter. The results suggest that the effect of exchange rate volatility on trade is dependent of the type of volatility measure used. This reflects the importance of not solely relying on a unique measure of volatility. The results revealed that exchange rate volatility (measured with standard deviation and HP filter) depresses exports, suggesting that SSA exporters are susceptible to reduce their export activities when exchange rates become volatile. However, the fact that the degree of the impact of exchange rate volatility on trade is relatively weak, suggest that should SSA's policy makers decide to pursue a policy intended to reduce exchange rate volatility in order to boost trade, it might be of little or no value. The results also indicate that exchange rate volatility is associated with a reduction in imports.

Keywords: Exchange Rate Volatility, Panel Data, Sub-Saharan Africa
JEL Classifications: F10, F14, O10

1. INTRODUCTION

Trade is an important indisputable vehicle to a country's economic growth. It plays a significant role in countries' development. Developing economies, most notably Sub-Saharan Africa (SSA), rapidly increased their economic growth in recent years due to their openness to trade. Douillet and Pauw (2012) stated that trade integration is a powerful driver of economic growth in developing countries, particularly if it creates export opportunities. On the back of this, one can without doubt substantiate the assertion that an economy cannot exhibit high growth rates without good trading activities. However, the demise of the Bretton Woods system of fixed exchange rates in 1973, which brought forth volatile exchange rates, has led to a now riskier atmosphere for international transactions. As a result, many countries post the Bretton-Woods era, principally those open to international trade, have suffered austere financial and currency crises followed by devastating consequences on their economies. Against this background, the ever-increasing volatility of exchange rates and its effects on trade have been a crucial concern to economists, academics and policy makers. Hence, the debate on the exchange rate volatility-trade nexus has received a lot of attention in the literature in recent decades. However, there is yet no consensus that has emerged from these studies.

Exchange rate volatility, which is generally defined as the risk associated with unpredicted movements in exchange rates, has a direct effect on a country's economic policy. This was confirmed by Asteriou et al. (2016), who avowed that central banks of countries that adopted an inflation targeting regime need to revise their expected inflation targets because of volatile exchange rates. The majority of countries in SSA have adopted the floating exchange rate system following the collapse of the Bretton Woods system, and most of them experienced fluctuating and volatile exchange rates. This was confirmed by Olayungbo et al. (2011), who argued that foreign exchange rates of SSA countries have been highly volatile after the introduction of the structural adjustment reforms since the early 1980s. According to Musila and Al-Zyoud (2012), SSA countries recorded the highest average level of volatility in their exchange rates between 1970 and 2002 than any other region in the world (Clark et al., 2004).

Investigation of the impact of exchange rate volatility on trade has received considerable attention in literature. The majority of these studies were on developed and industrialized economies. Cognizant of the growing role of trade in most developing and emerging economies, many studies attempted to fill this gap by examining the aforementioned relationship in developing countries, and more specifically in Africa. However, studies on the effect of exchange rate volatility on trade in SSA are limited. Hence, the aim of this study is to investigate the responsiveness of trade to exchange rate volatility. This current study is more interested in analyzing the trade-exchange rate volatility nexus in SSA. That is because exchange rates have been extremely volatile in SSA since the adoption of a floating exchange rate regime. This was expected to have undesirable impact on trade and growth.

Conventional wisdom suggests that higher volatility in exchange rates depresses trade. Despite that, there is no consensus in the empirical literature on the effect of exchange rate volatility on trade. While some of the earlier studies such as Clark (1973) and Hooper and Kohlhagen (1978) established a negative relationship between exchange rate volatility and trade, latter studies by Mackenzie and Brooks (1997) and Kasman and Kasman (2005) found a positive relationship. Other studies such as Aristotelous (2001) failed to establish any significant relationship.

On the back of the above information, this suggests that the volatility-trade nexus remains an empirical question, and therefore require further investigation. The literature divulges that while many of the studies concentrated mostly on developed economies, studies in SSA countries are still very few, likely because of insufficient data. Studies that attempted to concentrate on SSA are Olayungbo et al. (2011) and Musila and Al-Zyoud (2012). The contribution of this study to the literature is threefold. Firstly, unlike previous studies that used past data, this paper uses more recent data (1995-2012) in the empirical investigation which will provide a latest understanding the trade-exchange rate volatility nexus. Secondly, this study uses a new measure of volatility, the Hodrick-Prescott (HP) filter as against previous studies that merely used the standard deviation and the generalized autoregressive conditional heteroskedasticity (GARCH) to proxy volatility. To the best of our knowledge, this study stands as the first of its kind to use the HP-filter technique to compute volatility, while examining the effects of exchange rate volatility on trade in SSA. Finally, against previous studies that solely concentrated on export performance, this study estimates both imports and exports, given the predominant role of the former on productivity growth.

That being said, the objective of this study is to contribute to the overarching debate of the relationship between exchange rate volatility on trade. This study will therefore contribute to the existing literature by examining the aforesaid relationship in the context of SSA.

The study is organized as follows. Section 2 presents the theoretical background and empirical literature related to exchange rate volatility and trade. Section 3 presents the model specification, data and methodology used. While section 4 discusses the results, section 5 presents the conclusion.

2. THEORETICAL BACKGROUND AND EMPIRICAL LITERATURE

2.1. Theoretical Background

The adoption of the floating exchange rate regime in the late 1970s has brought about significant instability in exchange rates. Amongst others, this paper is mainly based on the theoretical framework established by Clark (1973) and Hooper and Kohlhagen (1978). The model by Clark (1973) accounts for one of the earliest models in examining the impact of exchange rate volatility and trade. Clark's model is based on a number of assumptions. Firstly, the study assumes that the firm, functioning under strict competitive terms with no market power, produces a unique product. Furthermore, the firm is not involved in the imports of goods which could be used in the production process. In addition to the above-mentioned, in the process of production, it is presumed that no risk is involved. As the competitive firm engages in export activities, it is considered that goods are sold in the foreign market at a "constant" foreign price and in return, the competitive firm receives its profits/revenues in foreign currency of which afterwards, it exchanges its incomes at the current exchange rate in the forward exchange market. Worthy is to accentuate that the exchange rate is neither constant nor stable, suggesting that it is being volatile. It also assumed that because of associated costs involved in the production process, the competitive firm cannot alter its inputs to take advantage of movements in exchange rates. As such, the erraticism in the firm's profits will exclusively ascend from the exchange rate. This means that greater exchange rate volatility will lead to a reduction in output and subsequently exports. The conclusion of a negative relationship between exchange rate volatility and trade was also reached by Hooper and Kohlhagen (1978) which was an expansion of the study conducted by Clark (1973).

2.2. Empirical Literature

The adjustment from a fixed to a flexible exchange rate system has created instabilities in exchange rates which have led researchers to investigate the extent to which trade flows are affected by volatile exchange rates. Several empirical studies have investigated the impact of exchange rate volatility on trade both theoretically and empirically. Despite the immense research on the topic, there is still no general unanimity that has been reached. The literature reveals diversified outcomes making this topic an empirical question which still requires further investigation. While some studies revealed the existence of a negative relationship, others established a positive nexus, while others found no significant relationship at all.

Arize et al. (2000) analyzed the effect of exchange volatility on foreign trade in thirteen less developed countries. The study used the error correction technique to conduct this analysis using quarterly data for the period 1973-1996. The countries under investigation were a mixture of developing countries in both the African and Asian continents. The results of the analysis pointed to a significant negative long-run relationship between exchange rate volatility and exports flows in 13 of the countries under investigation. The study further affirms the existence of a significant short-run relationship of exchange rate volatility on trade. Similarly, Sekkat and Varoudakis (2000) attempted to empirically assess the impact of exchange rate policy on manufactured export performance in a panel of 11 SSA countries using annual data from the period 1970-1992. Specifically, the study examined the impact of real effective exchange rate changes, exchange rate volatility and misalignment on exports. One interesting feature of this study is when the study attempted to gauge this impact at a sectorial level and provide a distinction between CFA countries (countries with a fixed exchange rate regime) and non-CFA countries (those with flexible/floating exchange rates). The results of the analysis suggest that the export performance in SSA is impacted by changes in real effective exchange rate. Notwithstanding, another fascinating feature of the analysis is that there is a significant alteration in the impact of exports between the CFA region and the non-CFA region. In subsequent years, Sekkat and Varoudakis (2002) investigated the impact of trade and exchange rate policy reforms on manufactured exports in North Africa. With evidence of the results, the study suggested that exports are indeed affected by exchange rate policies as it was manifest by the real exchange rate misalignment and volatility.

Olayungbo et al. (2011) investigated the impact of exchange rate volatility on trade in 40 selected SSA countries for the period 1986-2005 using the pooled ordinary least squares (OLS) and the generalized methods of moments econometric technique. The results of the analysis suggested that exchange rate volatility tends to enhance trade in SSA, suggesting that traders perceive an increase in volatility as an opportunity for profit making. Nevertheless, the authors advised that the interpretation of the results should be done with caution, as the history of exchange rate volatility is still relatively young in developing economies compared to developed countries. Musila and Al-Zyoud (2012) explored the impact of exchange rate volatility on international trade flows in a sample of 42 SSA countries using annual data from the period 1998-2007. With the aid of a gravity model, the study found the existence of a significant negative relationship between exchange rate volatility and trade (both imports and exports).

Serenis and Tsounis (2014) investigated the effects of exchange rate volatility on exports for a set of three African countries (Malawi, Morocco and South Africa) for the period 1973Q1 to 1990Q1. For all three countries under investigation, the results justified the existence of a significant negative relationship between exchange rate volatility and exports. Notwithstanding, Khosa et al. (2015) examined the determinants of exports in a selected number of emerging market economies with specific focus on the effects of exchange rate volatility on the performance of exports. The authors utilized the panel data econometric technique, with volatility measured using two popular approaches (the standard deviation and the GARCH). Though the core models were unable to find evidence of either a positive or negative relationship between exchange rate volatility and trade, all models however showed that regardless of the measure of volatility used, exchange rate volatility had a negative effect on exports. This brought to the conclusion that emerging market exporters are risk-averse, prompted to reduce their trading activities when exchange rates are volatile.

A number of studies in a single country framework have also emerged in recent years. In this context, we note the study by Ekanayake et al. (2012) who investigated the impact of exchange rate volatility on South Africa's trade flows over the period 1980-2009. The authors applied the bounds testing methodology and the error correction method to conduct the analysis. The results of the analysis confirmed the positive dependence of imports on the level of economic dependence and foreign exchange reserves but a negative relationship was revealed between exchange rate volatility and imports. In addition, Nyahokwe and Ncwadi (2013) examined the impact of effect of exchange rate volatility on South African exports for the period 2000-2009 using a vector error correction model. The authors found that South African exports are sensitive to exchange rate volatility. An interesting feature of this study was the affirmation that the impact of exchange rate volatility depends on the measure of volatility used in the study.

This study also acknowledges the work of Adeoye and Atanda (2012) who investigated the consistency, persistency and the degree of volatility of exchange rate of the Nigerian currency (Naira) relative to the dollar. The study used monthly time series data from 1986 to 2008. The authors used the ARCH and the GARCH as measures of volatility. On the same note, Dickson and Andrew (2013) analyzed the effect of exchange rate volatility on trade imports in Nigeria. With the aid of a standard error correction technique, the results revealed that exchange rate volatility was positively related to import/export but insignificant/significant in explaining variation in import/export respectively. Just to name a few, other studies which concentrated on the Nigerian economy include Yinusa and Akinlo (2008), Akpokodje and Omojimite (2009), Imoughele and Ismaila (2015).

Following the extensive literature review on this topic, it is evident that while some few have attempted to give some attention in Africa, specific studies in SSA appear to be limited in number. Contrary to the studies that concentrated on the experience of SSA, this paper uses more recent data (1995-2012) in the empirical investigation which will provide a more recent understanding the trade-exchange rate volatility. In addition, this study uses a new measure of volatility, the HP filter as against previous studies that merely used traditional measures of volatility (standard deviation and GARCH). This therefore adds novelty to the body of knowledge. The emphasis in the literature on the responsiveness of exports to exchange rate volatility has steered to a nearly complete desertion of the role of imports. Given its predominant role on productivity growth, this study estimates both imports and exports equations against previous studies that solely concentrated on export performance.

3. MODEL SPECIFICATION, DATA AND METHODOLOGY

3.1. Model Specification

Following a review on empirical literature on the relationship between exchange rate volatility and trade, the modified Omojimite and Akpokodje (2010) and Choudhry and Hassan (2015) empirical models is specified as follows:

$$LM_{it} = \beta_0+\beta_1 LGDP_{it}+\beta_2 NER_{it}+\beta_3 M2_{it}+\beta_4 VOL_{it}+\beta_5 DUM_{it}+\epsilon_{it} \quad (1)$$

$$LX_{it} = \beta_0+\beta_1 LG7I_t+\beta_2 NER_{it}+\beta_3 M2_{it}+\beta_4 VOL_{it}+\beta_5 DUM_{it}+\epsilon_{it} \quad (2)$$

Where LM is the natural log of total value of imports, LX is the natural log of total value of exports, LGDP is the natural log of gross domestic product, LG7I is the natural log of the production index of advanced economies (a proxy for the income of trading partners), NER is the nominal exchange rate, M2 is money supply, Vol is the measure of volatility and DUM is the dummy to account for the effect of the 2008-2009 global financial crisis. The subscripts i and t account for countries and time respectively. In this study, exchange rate is defined as the local currency unit per US dollar (LCU/USD). Consequently, an increase in exchange rate will allude to a depreciation/devaluation of the currency and a decrease to an appreciation. One of the limitations of this study is the unavailability of real effective values for exchange rates for all countries under investigation. Thus, in an attempt to address this weakness, this paper used the nominal exchange to compute volatility. Our approach is similar to the work of Ogundipe et al. (2013) who also used nominal exchange in their analysis. As cited by Ogundipe et al. (2013) economic agents in developing countries are more concerned about changes in nominal exchange rate than real exchange rate (Agbola, 2004).

Exchange rate volatility is a measure to account for the instabilities in exchange rate. When one attempts to investigate the effects of exchange rate volatility on international trade, the major question one needs to ask is: What is the best proxy to use to quantify the uncertainty that traders face as a result of exchange rate fluctuations? In this regard, one of the major concerns pertaining to this area of study therefore relies upon the measure of volatility. Generally, exchange rate volatility is not a variable that can be measured and as such no perfect measure of volatility exists. The suitable measure of exchange rate volatility has been long pondered in the literature but no unique consensus has yet been reached. For this reason, different measures of volatility have been employed in the literature namely the standard deviation method, the ARCH, the GARCH method, etc. Against this background, this study will follow the same path as the literature and will use the standard deviation of the log of exchange rate (nominal exchange rate in our case) and the GARCH (GARCH (1, 1)) approaches as measures of volatility. In addition to the aforementioned exchange rate volatility measures, this study uses a novel method to measure volatility, the HP filter technique.

The HP filter was first introduced by American economists Hodrick and Prescott in the context of business cycle estimation in the year 1980 but which was later published in the year 1997. Usually referred to as the HP filter, it is a mathematical tool that is commonly used in the area of macroeconomics specifically in business cycle theories with its main aim to remove the cyclical component of a time series from raw data. Explicitly, the main purpose of this tool is to decompose economic data into a trend and a cyclical component. In easier terms, the HP filter smooths the original time series to estimate the trend component. As such, the cyclical component is the difference between original series and its trend; and the result will constitute the volatility estimate. Most economists usually consider the HP filter as a regular and effective procedure to distinct the long run path of an economic series from short run fluctuations. Despite the fact this is a commonly used measure; the literature acknowledges that it presents some drawbacks. However, Ravn and Uhlig (2002) acknowledged that the HP filter has withstood the test of time and the fire of discussion remarkably well.

3.2. A Priori Expectations

Equation 1 demonstrates that imports depend on gross domestic product, exchange rate, money supply and volatility. In line with theoretical arguments, the expected sign for LGDP is positive. Similarly, the coefficient of LM2 is expected to be positive, reflecting the monetarist approach of the balance of payments which advocates that an increase in money supply will give rise to imports. On the other hand, the coefficient of NER is projected to be negative, following the assertion that exchange rate depreciation will lead to a rise in import prices, resulting to a decrease in the volume of imports. The expected sign on volatility is ambiguous, suggesting that it can either be positive or negative despite the fact a priori expectations suggest that exchange rate volatility dampens trade.

Equation 2 posits that exports depend on the production index of advanced economies (LG7I) exchange rate, money supply and volatility. A priori expectations suggest that the coefficient of LG7I will bear a positive sign following the argument that as income of trading partners increase, domestic exports will receive a boost. Similarly, we expect the coefficient of NER to bear a positive sign centered on the justification that as exchange rate increases, exports will be made cheaper, thereby boosting the demand of trading partners. The coefficient of LM2 is expected to bear a negative sign, reflecting the theoretical argument that as money supply increase, this is likely to give rise to inflation, causing exports to be relatively expensive. As a result, the volume of exports is bound to decrease. Similar to the import equation, the expected sign on volatility is ambiguous.

3.3. Data Sources and Definition

For our empirical examination, we employ annual times series data for the period 1995-2012 for 39 selected SSA countries (due to the lack of available data for all countries). The 39 SSA countries are listed as follows: Angola, Burundi, Benin, Burkina Faso, Botswana, Central African Republic, Cote d'Ivoire, Cameroon, Republic of Congo (Brazzaville), Democratic Republic of the Congo (Kinshasa), Comoros, Cape Verde, Ethiopia, Equatorial Guinea, Gabon, Ghana, Guinea, Gambia, Kenya, Lesotho, Madagascar, Mali, Mozambique, Mauritius, Malawi, Namibia, Niger, Nigeria, Sudan, Senegal, Sierra Leone, Swaziland, Seychelles, Chad, Togo, Tanzania, Uganda, South Africa, Zambia.

The data sources for our respective variables as well as their unit of measurement are varied and are summarized in Table 1.

3.4. Estimation Methodology

This study examines the relationship between exchange rate volatility and trade in 39 SSA countries. To achieve, this paper uses the panel data analysis because of its advantage of being able

Table 1: Data sources

Variables	Unit of measurement	Source
Exports of goods and services	Current US Dollars	World Bank
Imports of goods and services	Current US Dollars	World Bank
Nominal exchange rate	LCU/USD	World Bank
G7 industrial production index	Index (2010=100)	OECD
Money supply (M2)	As a percentage of GDP	World Bank
GDP	Current US Dollars (Billions)	IMF (World Economic Outlook)
Volatility	Standard deviation approach, HP Filter and GARCH approach	Author's calculation

GDP: Gross domestic product

to combine both time series and cross section data. As a preamble to our model estimation, the standard deviation, GARCH and HP-Filter approaches are adopted to generate the exchange rate volatility series. A brief step of our methodological framework is presented as follows.

3.4.1. Unit root test

After obtaining the volatility series, the next step of our analysis is to test for stationarity in the variables. Estimating a model on variables that contain unit roots (non-stationary) is likely to result to biased estimates. Consequently, it is vital when analyzing economic data to conduct initial tests of non-stationarity before continuing to the thorough estimation of the model. Based on the literature, there are five varieties of panel unit root tests, namely, Levin et al. (2002), Breitung (2001), Im et al. (2003), Fisher-type tests using ADF and PP tests (Maddala and Wu, 1999; Choi, 2001; Hadri, 2000). Despite their importance, for the purpose of this study, only three of these tests (popular in the literature) will be employed namely; the Levin, Lin and Chu (LLC) test, the Im, Pesaran and Shin (IPS) and the Fisher Augmented Dickey Fuller (ADF) and Fisher Phillips Perron (PP) tests.

3.4.2. Panel models

Having determined the order of integration, we can now proceed in estimating the models. The estimation of the models will however depends on the other of integration of the variables. If the variables are stationary (I (0)), we will proceed in estimating the pooled, fixed and random effects models. Estimating a pooled OLS implies merging both time series and cross-sectional data into one single equation and estimate an OLS regression model. The pooled OLS model rests on the hypothesis that the coefficients of the independent variables are unique across all cross sections. In other words, the pooled effects model ignores the effects of country specific effects. Estimating the pooled effects model in this study will possibly lead to biased estimates especially considering that the majority of countries in SSA have unique characteristics. Whereas the fixed effects regression model is essentially based on the hypothesis that each cross section has its own distinctive intercept, the random effects model on the other hand is based on the assertion that for each intercept is a random draw and therefore independent of the error term for any particular observation. However, if the variables are non-stationary (I (1)), the cointegration tests by Pedroni and Kao will be the most appropriate.

3.4.3. Choosing the suitable model

Since our regression equations contain country-specific effects, it is imperative to decide whether they follow a fixed or a random pattern. Against this background, we will use various types of statistical tests. These tests are the F-test (testing between the fixed and pooled OLS) and the Hausman test (testing between the fixed and random effects model). With regard to the latter test, if the null hypothesis of no correlation between the regressors and the fixed effects is rejected, then the fixed effects model is the most suitable model for this study as opposed to the random effects model.

4. EMPIRICAL RESULTS

4.1. Panel Unit Root Tests

Table 2 presents the results of the unit root tests conducted by the LLC, IPS, Fisher ADF and PP tests under the assumption of an individual intercept and deterministic trend.

Due to discrepancies in the results of the various unit root tests, this study will use the outcome of the test that shows more consistency. The results of the LLC test, which shows more consistency, reveal that all variables do not contain a unit root, hence stationary at the level (I (0)). In this regard, following that the majority of the results are in favor of variables being I (0), the next step of our analysis will be to estimate the model using the pooled, fixed and random effects approach, and choose the appropriate model for this study using a variety of statistical tests.

After estimating the respective pooled, fixed and random, the next step of the analysis is to choose the most suitable model for this study. In choosing the appropriate model for this study, we use the F-test (testing between the fixed and pooled OLS) and the Hausman test (testing between the fixed and random effects model).

Table 3 presents the results of the statistical tests which assisted in choosing the appropriate models for this study.

Each model inclusive all measures of volatility was simultaneously tested to determine which is the most suitable for this study. The Hausman test (Hausman, 1978) assesses the null hypothesis that the coefficient estimates of the random effects model are identical to the estimates of the fixed effects model. As such, if the probability value of the chi-square statistic is >5%, then it is suitable to use the random effects model as the core model of the study. On the other hand, if the probability value is <5% (significant), the fixed effects model should be used as the most appropriate model for the study. Based on the above explanation, for all measures of volatility, we can conclude that the fixed effects model is the most appropriate model for imports ($P < 5\%$), whereas the random effects model is the most suitable model for exports ($P > 5\%$).

Table 2: Unit root tests

Intercept+trend	Level			First difference		
Type of test	Test statistics	P	Conclusion	Test statistic	P	Conclusion
LX						
LLC Test	−4.86493	0.0000	I(0)*	−17.3248	0.0000	
IPS Test	−0.82778	0.2039		−12.2881	0.0000	I(1)*
Fisher ADF-Test	84.9754	0.2252		274.958	0.0000	I(1)*
Fisher PP-Test	94.7786	0.0713	I(0)***	378.858	0.0000	
LM						
LLC Test	−4.85085	0.0000	I(0)*	−15.9956	0.0000	
IPS Test	−1.72344	0.0424	I(0)**	−12.6649	0.0000	
Fisher ADF-Test	92.4754	0.1257		277.858	0.0000	I(1)*
Fisher PP-Test	81.5504	0.3695		326.108	0.0000	I(1)*
LGDP						
LLC Test	−4.07998	0.0000	I(0)*	−14.0392	0.0000	
IPS Test	−1.18166	0.1187		−8.01773	0.0000	I(1)*
Fisher ADF-Test	86.5554	0.2375		190.379	0.0000	I(1)*
Fisher PP-Test	40.4317	0.9999		212.028	0.0000	I(1)*
LG7I						
LLC Test	−10.5348	0.0007	I(0)*	−14.5669	0.0000	
IPS Test	−2.19596	0.0140	I(0)**	−7.46977	0.0000	
Fisher ADF-Test	89.2463	0.1806		182.582	0.0000	I(1)*
Fisher PP-Test	63.4101	0.8841		518.126	0.0000	I(1)*
NER						
LLC Test	−4.75254	0.0000	I(0)*	−7.29164	0.0000	
IPS Test	−2.85357	0.0022	I(0)*	−2.68131	0.0037	
Fisher ADF-Test	108.551	0.0127	I(0)**	110.509	0.0091	
Fisher PP-Test	42.8008	0.9996		144.652	0.0000	I(1)*
M2						
LLC Test	−1.95308	0.0254	I(0)**	−8.80968	0.0000	
IPS Test	0.51650	0.6972		−7.18283	0.0000	I(1)*
Fisher ADF-Test	73.0696	0.6367		185.040	0.0000	I(1)*
Fisher PP-Test	97.7704	0.0645	I(0)***	390.262	0.0000	
Vol-SD						
LLC Test	−5.67323	0.0000	I(0)*	−20.7162	0.0000	
IPS Test	−5.62530	0.0000	I(0)*	−17.3218	0.0000	
Fisher ADF-Test	154.012	0.0000	I(0)*	371.551	0.0000	
Fisher PP-Test	172.591	0.0000	I(0)*	467.938	0.0000	
Vol-GARCH						
LLC Test	−1.21081	0.0130	I(0)**	−23.7402	0.0000	
IPS Test	−2.18274	0.0145	I(0)**	−20.4649	0.0000	
Fisher ADF-Test	104.497	0.0243	I(0)**	375.217	0.0000	
Fisher PP-Test	124.551	0.0006	I(0)*	435.073	0.0000	
Vol-HPfilter						
LLC Test	2.98077	0.0986	I(0)***	−5.05595	0.0000	
IPS Test	−4.04691	0.0000	I(0)*	−6.94744	0.0000	
Fisher ADF-Test	126.434	0.0004	I(0)*	177.235	0.0000	
Fisher PP-Test	46.5177	0.9982		167.244	0.0000	I(1)*

*,**,*** Indicates significance level at 1%, 5% and 10% respectively. This reasoning shall goes for all subsequent results

Table 3: Summary of results in choosing the core model

Model	SD			GARCH			HP-Filter		
F-Test	F-stats value	D.F	P	F-stats value	D.F	P	F-stats value	D.F	P
Imports									
Cross-section F	53.095877	(38.658)	0.0000	52.687243	(38.658)	0.0000	51.815017	(38.658)	0.0000
Cross-section Chi-square	984.723619	38	0.0000	980.637698	38	0.0000	971.835939	38	0.0000
Exports									
Cross-section F	213.365247	(38.658)	0.0000	210.061328	(38.658)	0.0000	213.398223	(38.658)	0.0000
Cross-section Chi-square	1817.770868	38	0.0000	1807.643807	38	0.0000	1817.871212	38	0.0000
Hausman test	Chi-square statistic	Chi-square D.F.	P	Chi-square statistic	Chi-square D.F.	P	Chi-square statistic	Chi-square D.F.	P
Imports	24.092611	5	0.0002	29.330580	5	0.0000	24.550326	5	0.0002
Exports	12.754384	5	0.1258	8.786173	5	0.1179	8.935419	5	0.1117

SD: Standard deviation, GARCH: Generalized autoregressive conditional heteroskedasticity, HP: Hodrick-Prescott

Tables 4 and 5 present the estimates of the best fitted models for each of the model of imports and exports.

The results of the analysis clearly indicate that the impact of exchange rate volatility on trade (imports and exports) is sensitive to the type of volatility measure used.

Table 4: Suitable model for imports (fixed effects regression)

Variables	SD Vol	GARCH Vol	HP Vol
LGDP	0.944161	0.958926	0.958362
	[51.55339]	[53.67183]	[52.55528]
	(0.0000)	(0.0000)	(0.0000)
NER	0.000106	0.000154	0.000107
	[9.755443]	[8.949391]	[9.381346]
	(0.0000)	(0.0000)	(0.0000)
M2	3.22E-06	3.65E-06	3.64E-06
	[0.696951]	[0.791116]	[0.782202]
	(0.4861)	(0.4292)	(0.4344)
Volatility	−0.120836	−1.08E-08	1.50E-05
	[−3.334662]	[−3.423096]	[0.295971]
	(0.0009)	(0.0007)	(0.7673)
Dummy	0.051166	0.044331	0.049137
	[2.642984]	[2.289144]	[2.493044]
	(0.0084)	(0.0224)	(0.0129)
C	8.570939	8.534936	8.548261
	[544.2102]	[578.2749]	[595.2955]
	(0.0000)	(0.0000)	(0.0000)
R^2	0.964869	0.964900	0.964280
Adjusted R^2	0.962573	0.962607	0.961946

SD: Standard deviation, GARCH: Generalized autoregressive conditional heteroskedasticity, HP: Hodrick-Prescott. Values in [] represent the respective test-statistics, values in () represent the respective probability values

Table 5: Suitable model for exports (random effects regression)

Variables	SD Vol	GARCH Vol	HP Vol
LG7I	4.529340	4.833209	4.800964
	[11.81239]	[12.53849]	[12.62829]
	(0.0000)	(0.0000)	(0.0000)
NER	4.68E-05	3.30E-05	7.84E-05
	[1.879218]	[0.813690]	[3.008124]
	(0.0606)	(0.4161)	(0.0027)
M2	−1.92E-05	−1.86E-05	−1.86E-05
	[−1.806827]	[−1.723186]	[−1.739421]
	(0.0712)	(0.0853)	(0.0824)
Volatility	−0.364375	4.67E-09	−0.000400
	[−4.405630]	[0.634327]	[−3.478740]
	(0.0000)	(0.5261)	(0.0005)
Dummy	0.135454	0.106774	0.106774
	[2.948873]	[2.312090]	[2.312090]
	(0.0033)	(0.0211)	(0.0211)
C	0.117610	−0.521997	−0.473729
	[0.152625]	[−0.675543]	[−0.620880]
	(0.8787)	(0.4996)	(0.5349)
R^2	0.641419	0.638621	0.638621
Adjusted R^2	0.638843	0.636025	0.636025

SD: Standard deviation, GARCH: Generalized autoregressive conditional heteroskedasticity, HP: Hodrick-Prescott. Values in [] represent the respective test-statistics, values in () represent the respective probability values

The outcome of the analysis indicates mixed results with regard to the impact of exchange rate volatility on imports. While the volatility measured by the standard deviation and GARCH approaches suggests a negative relationship, the HP filter measure on the other hand shows a positive nexus. Yet, only the two former measures are statistically significant, although at a very small degree. More specifically, a percentage rise in exchange rate volatility will dampen imports by 0.12% (according to the model with standard deviation) and 0.00000001% (according to the model with GARCH). This negative volatility effect underpins the rational that a high level of uncertainty denoted by a high level of volatility has an adverse effect on imports.

The coefficients of exchange rate (though not consistent with economic theory) and money supply are very small, suggesting that their effects are not really felt on the performance of imports. On the other hand, for all three models estimated, the coefficient of LGDP is positive and significant, suggesting that an increase in domestic gross domestic product (GDP) increases imports. The coefficient of the dummy variable, which captures the effects of the GFC is positive for all three estimated models.

With regard to the export model, only the volatility measured by the standard deviation and HP Filter methods appears to be statistically significant. As a result, the study concludes that a 1% increase in volatility, measured by standard deviation and HP-filter, induces exports to decrease by approximately 0.36% and 0.004% respectively. This result concurs with theoretical arguments raised by Clark (1973) and Hooper and Kohlhagen (1978), who asserted that a volatile exchange rate has an adverse effect on trade. Though the results of the analysis indicate that exchange rate volatility dampens exports in SSA countries, it is vital to note that that the degree of the impact is relatively small. This therefore suggests that pursuing a policy of reducing exchange rate volatility may only result in marginal improvement in exports. This finding concurs with that of Musila and Al-Zyoud (2012) who also found the impact of exchange rate volatility on exports to be relatively small in SSA economies. Similar with our own study, the authors asserted that pursuing a policy of exchange rate stability may not result in significant improvement in the balance of trade of SSA countries.

The positive relationship found between LG7I and exports in all model estimations indicate that the higher the growth rates of industries in advanced economies, the higher the exports of SSA countries. Similarly to the import model, the coefficients of exchange rate and money supply are very small in size, suggesting their effects are marginal on exports. Unexpectedly, the coefficient of the dummy variable was statistical insignificant in all model estimations.

5. CONCLUSION

The question of whether exchange rate volatility affects international trade has received a lot of attention since the demise of the Bretton Woods system of fixed exchange rate, albeit there is yet no consensus that have emerged from these studies. As such, the debate of the exchange rate volatility-trade nexus is still on the cards and requires further empirical attention. Against this background, the main aim of this study is to provide an empirical investigation of the impact of exchange rate volatility on trade in 39 selected SSA countries. Export and import models were estimated using panel data econometric technique. Three measures of volatility are used. These are standard deviation, GARCH and HP-Filter.

The results suggest that the effect of exchange rate volatility on trade is dependent of the type of volatility measure used. This reflects the importance of not solely relying on a unique measure of volatility. The results revealed that exchange rate volatility (measured with standard deviation and HP filter) depresses exports, suggesting that SSA exporters are susceptible to reduce their export activities when exchange rates become volatile. Accordingly, one can without doubt conclude that SSA traders are risk-averse. However, the fact that the degree of the impact of exchange rate volatility on trade is relatively weak, suggest that should SSA's policy makers decide to pursue a policy intended to reduce exchange rate volatility in order to boost trade, it might be of little or no value. The results also indicate that exchange rate volatility is associated with a reduction in imports.

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