THE IMPACT OF EXCHANGE RATE CHANGES AND VOLATILITY ON TRADE IN SUB-SAHARAN AFRICA

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DEDICATION

I dedicate this thesis to my Father Mr. Gilbert Tekouenko and my mother Mrs. Francoise Tekouenko.

ABSTRACT

At a macroeconomic level, deficits as well as surpluses in trade are occasionally attributed to deliberate high or low level of exchange rates. Hence, understanding the influence of exchange rate movements as well as its volatility on trade is therefore of great cognizance to both researchers and policymakers, specifically in this present time of global imbalances. However, previous studies examining these relationships have not been convincing enough regarding the precise impact of exchange rate changes as well as volatility on trade with specific concentration on Sub-Saharan Africa (SSA). Against this backdrop, the main objective of this study is to provide an empirical examination of the impact of exchange rate changes and its volatility from the perspective of imports, exports and trade balance in SSA. The study takes cognizance of the importance and presence of trade blocs in the region. Countries belonging to these trade blocs benefit from certain advantages in terms of their trading activities. In lieu of this, one of the objectives of this study is to provide a comparative analysis of the effects of exchange rate changes and volatility on trade distinguishing four major trading blocs in SSA. These trade blocs include the EAC, CEMAC, ECOWAS and SADC.

The two macroeconomic concepts of exchange rate changes and volatility are two distinct concepts which have been empirically misused in the literature. This study therefore provides a thorough econometric analysis distinguishing exchange rate changes and exchange rate volatility impact on trade. This study particularly based itself from empirical literature and theoretical frameworks underpinning exchange rate changes and trade on one hand, and exchange rate volatility and trade on the other hand. In lieu of this, to model exchange rate changes and trade, several variables were chosen to estimate imports, exports and trade balance equations. These variables include domestic income proxy by national GDP, foreign income proxy by USGDP and G7 production index, exchange rate, inflation and money supply. Additionally, to model exchange rate volatility and trade, various measures of volatility were used namely, the standard deviation, GARCH and HP-Filter approaches.

The method of analysis used in this study is the panel data analysis which has the advantage of combining both time series and cross-section data. This study uses annual data for 39 countries over the period 1995 to 2012, thus consisting of 702 observations. Eviews 8 was used to analyse the data.

Regarding the impact of exchange rate changes and volatility on trade for the entire SSA (Sub-Saharan Africa), the pooled, fixed and random effects model are estimated and based on statistical tests, the most suitable model is chosen. The results of the analysis justified that domestic income, money supply and inflation positively and significantly affect imports in SSA. Though not expected from economic theory, the results indicate that there is a significant positive relationship between exchange rate changes and imports. However, this finding could be attributed to the fact that the vast majority of countries in SSA are still underdeveloped, and therefore tends to depend heavily dependent on imports. As a result, even in an event of a depreciation in their exchange rate, imports are still bound to increase – given the necessity of the produces.

In addition, the results maintain that foreign income proxy by USGDP significantly contribute to increase in exports in SSA. However, the production index of advanced economies which also stands as a proxy for foreign income significantly contributes to a

decrease in exports in SSA. Other variables such as inflation, exchange rate and money supply were also seen to negatively contribute to exports in SSA but were insignificant. The results of the analysis also sustained the theoretical foundation that exchange rate depreciation has a great role to play in increasing trade balance in SSA. The results of the impact of exchange rate volatility on trade in SSA indicate that while some measures indicate a positive relationship with trade, other measures indicate a negative relationship while others are insignificant.

Regarding the comparative analysis, the panel cointegration analysis was used, grounded on the fact the results of the unit root test were in favour that the variables are non-stationary. About the impact of exchange rate changes and trade, the results sustained for all trade blocs' domestic income positively contribute to an increase in imports. In addition, it was shown that exchange rate changes do not have a significant impact on imports in ECOWAS. In EAC and SADC, the results justify that exchange rate depreciation has a significant positive impact on imports. The exports model shows that except for CEMAC, exchange rate depreciation has no significant effect on exports. On the other hand, EAC, CEMAC and SADC trade blocs were found to display significant coefficients. While the coefficient for the EAC and SADC display a positive relationship, the coefficient for CEMAC instead displayed a negative relationship. The positive nexus between exchange rate depreciation and imports in EAC and SADC was again ascribed to the high dependence of these countries on imports, as they tend to be very essential for their survival. As a result, even in an event of a depreciation of their exchange rates, imports are still bound increase. In turn, the results of the exports model revealed that except for the ECOWAS trade bloc, there is a statistical significant negative relationship between exchange rate changes and exports. As well as being contrary to economic theory, the study highlighted that these findings may be explained by the fact that the countries' export base are likely to be undiversified and may suffer from poor quality produces. Hence, even in an incident of a depreciation in their exchange rate, if the countries' exports are not solicited by foreign demand, exports are likely to decline.

Based on the results of the analysis, the study recommends that policy makers should give attention to strategies that will keep the exchange rate competitive as this will aid in maintaining a positive trade balance. Also, it is recommended that authorities of SSA countries maintain a stable exchange rate environment as it was shown that exchange rate volatility dampen trade. Furthermore, it will important for policy makers to draw up strategies and programmes that will make the economies less reliant on imports. This is of utmost importance because majority of SSA countries are heavily dependent on imports, which leaves them at the mercy on volatile commodity prices. Hence, a depreciation of their exchange rates may have little or no effects in improving their respective balance of payments account, given the ever-increasing level of imports. In turn, following the mixed results encountered for each measure of volatility used, it is suggested that researchers should consider each volatility measure in their respective model estimation. This is particularly important as each measure is really shown to differ; hence, it is important to consider each of them to avoid unreliable results.

Keywords: Exchange rate changes, exchange rate volatility, fixed effects model, exports, imports, panel cointegration, pooled model, random effects model, trade balance.

DECLARATION

I, **Christelle Meniago**, hereby declare that apart from the aid acknowledged, the original work contained in this thesis for the degree PhD in Economics at North-West University (Mafikeng Campus) is my own. It has not been submitted before for any degree or its equivalence at this or any other university. I also declare that all secondary information used has been duly recognized in this thesis.

Signature.. Date.....................................

Christelle Meniago

The above declaration is confirmed by:

Signature.. Date.....................................

Supervisor

CERTIFICATE OF ACCEPTANCE FOR EXAMINATION

This thesis entitled "**THE IMPACT OF EXCHANGE RATE CHANGES AND VOLATILITY ON TRADE IN SUB-SAHARAN AFRICA**", submitted by **Christelle Meniago**, student number **23063106** of the Department of Economics in the Faculty of Commerce and Administration is hereby recommended for acceptance for examination.

Signature...Date...................................

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LIST OF ACRONYMS

ADF	Augmented Dickey Fuller
ARCH	Autoregressive Conditional Heteroskedasticity
ARDL	Autoregressive-Distributed Lag
BCEAO	Banque Centrale des Etats de l'Afrique de l'Ouest
BEAC	Banque des Etats de l'Afrique Centrale
BP-LM	Breusch-Pagan Lagrange Multiplier
BOT	Balance of Trade
CAEMC	Central African Economic and Monetary Community
CEMAC	Communauté Economique et Monétaire de l'Afrique Centrale
CFA	Communauté Financière Africaine
DF	Dickey-Fuller
DOLS	Dynamic Ordinary Least Squares
EAC	East African Community
ECOWAS	Economic Community of West African States
EGARCH	Exponential Generalized Autoregressive Conditional Heteroskedasticity
FMOLS	Fully-Modified Ordinary Least Squares
GARCH	Generalized Autoregressive Conditional Heteroskedasticity
$GARCHVol_{it}$	Generalized Autoregressive Conditional Heteroskedasticity measure at country i in period t
GDP	Gross Domestic Product
G7	Group of seven largest industrialized nations (Italy, France, Germany, USA, Japan, Canada, UK)
HP-Filter	Hodrick-Prescott-Filter
$HPVOL_{it}$	Hodrick-Prescott-Filter volatility measure in country i at period t
IBRD	International Bank for Reconstruction and Development.
IMF	International Monetary Fund
INF_{it}	Inflation rate in country i at period t
IPS	Im, Pesaran and Shin
$LGDP_{it}$	Logs of national GDP in country i at period t
$LG7I_{it}$	Logs of G7 industrial production index in country i at period t

LLC	Levin, Lin and Chu
LM	Langrage Multiplier
LM_{it}	Logs of demand for imports in country i at period t
$LM2_{it}$	Logs of money supply in country i at period t
$LNER_{it}$	Logs of nominal exchange rates in country i at period t
LTB_{it}	Logs of trade Balance in country i at period t
$LUSGDP_{it}$	Logs of US GDP in country i at period t
LX_{it}	Logs of demand for exports in country i at period t
M-L	Marshall-Lerner
OECD	Organization for Economic Corporation and Development
OLS	Ordinary Least Squares
PP	Phillips-Perron
SADC	Southern African Development Community
$SDVol_{it}$	Standard Deviation Volatility measure in country i at period t
SSA	Sub-Saharan Africa
UDEAC	Union Douanière des Etats de l'Afrique Centrale
UMOA	Union Monétaire Ouest Africaine
USA	United States of America
VOL_{it}	Volatility in country i at period t
WAEMU	West African Economic and Monetary Union

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GLOSSARY OF TERMS

Bretton Woods system is a landmark system for monetary and exchange rate administration established in 1944. The Bretton Woods treaty was developed at the United Nations Monetary and Financial Conference held in Bretton Woods, New Hampshire, from July 1 to July 22, 1944.

Cointegration is an econometric technique for testing the relationship between non-stationary time series variables. If two or more series are themselves non-stationary, but a linear combination of them is stationary, then the series are said to be cointegrated.

Fixed exchange rate which is also called pegged exchange rate is a type of exchange rate regime where a currency's value is fixed against the value of another currency or to a basket of other currencies.

Floating exchange rate is a type of exchange rate regime where its currency is set by the foreign exchange market through the demand and supply of that currency relative to other currencies.

Gold standard is a monetary system in which a country's government allows its currency unit to be freely converted into fixed amounts of gold and vice versa. Alternatively, it is a system by which the value of a currency was defined in terms of gold, for which the currency could be exchanged. The gold standard was generally abandoned in the Depression of the 1930s.

J-curve effect is a situation whereby the trade balance of a country initially worsens following a depreciation or devaluation.

Marshall-Lerner condition refers to a condition where a depreciation/devaluation of a country's currency will bring an improvement in trade balance if the absolute value of import and export demand elasticity is greater than one.

Pooled effects model is a type of panel data analysis assuming that the cross-sections are homogeneous. In other words, when using pooled effects regression, it is assumed that there are no unique attributes in the cross-section and no distinct effects across time.

Fixed effects model which is also known known as Least Squares Dummy Variable model, it is a type of panel data analysis that assumes that there are attributes in the cross-sections that are not the results of random variations that do not vary across time.

Random effects model is a type of panel data analysis that assumes there are unique, time constant attributes of the cross-sections that are the results of random variation.

CHAPTER 1

ORIENTATION OF STUDY

1.1 Introduction

In view of the fact that different countries use different currencies, there appears to be an apparent need for the exchange of domestic currency into foreign currencies and vice versa. International transactions can only take place between countries of different currencies if only their respective currencies can be converted. On account of that, the foreign exchange market authorizes the conversion of currencies in an efficient way and can be thought of as the market in which rates of exchange are determined (Harwick et *al.*, 1999).

In designing a state's economic policy, exchange rate usually plays a core role. One of the most imperative resolutions that government authorities have to make is to determine what kind of exchange rate system to adopt. Exchange rate constitutes one of the greatest essential macroeconomic policy variables which govern the trade condition, foreign direct investment, inflation and the growth of an economy. Yol and Baharumshah (2005) argue that the coordination and implementation of exchange rate policies requires an accurate and proper understanding of the trade balance response to changes in exchange rate. Following this, it is therefore no astonishment that exchange rate policy is being used to access the country's competitive position in the world trade.

Unquestionably, trade plays a very important role in an economy as it contributes to the economic growth of a country and increases inducements for developments. It is therefore of no argument to say that an economy cannot exhibit high growth rate without good trading activities. In lieu of this, it is observed that trade among less developed countries is becoming as significant as trade amongst developed economies. It is also observed that the ever increasing interdependence of developing economies through trade have been more apparent. Economic affluence has consequently benefited a lot of importance when economies with diverse currencies participate in trading activities. Given its importance, the exchange rate does not only ease different economies to transact with each other, but it also acts as a strong assurance and competitive index in an economy's political and economic policy. The price at which goods are being traded between countries is thus very important. Nevertheless, it is important to understand that the big problem that businesses which are involved in international transactions face is the unexpected changes in price, which is mainly caused by the changes in exchange rates as well as their volatility. Therefore, it is important to understand how these changes in exchange rate affect trade and also to investigate the danger associated with these distant dealings as well as how to manage them.

Generally, an economy's degree of competitiveness at the international standard is most often determined by its real exchange rate. Therefore, as exchange rate constitutes an essential element to determine an economy's rate of competitiveness, the study can then consequently associate its importance to a country's foreign trade development. Accordingly, exchange rate policy has gained a lot of attention both amongst academics, economists and macroeconomic policy makers. Considerably, over recent years, more attention has been driven on the exchange rate instabilities worldwide. In view of the attention given to this topic, it is thus of vital importance to analyse its effects on other macroeconomic variables such as growth and investment, among others. Nevertheless, the attention in this research is more concentrated on analysing both the impact of exchange rate changes and volatility on the trade of Sub-Saharan countries.

It is imperative to accentuate that dissimilarity is made between the changes in exchange rate on one hand, and the volatility of exchange rate on the other hand. According to Ozturk (2006), exchange rate volatility is defined as the risk associated with unexpected movements in the exchange rate. In other words, exchange rate volatility can be defined as the deviation from the "normal state", of which the deviation implies unpredictability, uncertainty or risk. That is why exchange rate volatility is commonly referred in the literature as uncertainty or risk. That being said, the more the value of exchange rate is uncertain over time, the more volatile it is considered to be, and this constitutes one of the core issues in this study. Volatility of exchange rates constitutes one of the main structures of an exchange rate regime; therefore, it is important to consider its relationship with trade. However, when exchange rate is being referred to as changing, it implies that it is subject to fluctuations over time which is determined by demand and supply. In other words, it either appreciates or depreciates. It is thus of essence to highlight that exchange rate that is changing is not necessarily volatile; hence, exchange rate that changes may not necessarily be volatile and vice versa.

Most often, the common belief held amongst economists is that exchange rate volatility generates uncertainty and leads to a higher level of riskiness and depress trade thereof. The standard theoretical argument that exchange rate volatility may hinder the flow of international trade focuses on the notion that exchange rate volatility represents uncertainty, and will impose costs on risk adverse commodity traders (Zhao, 2010). This assertion is also established by Todani and Munyama (2005) who confirmed that greater exchange rate volatility generates uncertainty thereby increasing the level of riskiness of trading activity. Nevertheless, the authors further supported that following the ever increasing debate on exchange rate volatility, South Africa followed by many other African countries have not escaped as these countries have witnessed consistent depreciation of their exchange rates at lower levels. On the other hand, regarding the relationship between exchange rate changes and trade, the common belief is that a real depreciation of the currency will improve the trade balance if the sum of the price elasticity of the demand for imports and exports is greater than unity. This is referred to as the Marshall-Lerner condition.

The Marshall-Lerner condition and the J-Curve theory best elucidate the relationship between these two economic variables (exchange rate changes and trade). This study hence acknowledges the work of Yuen-Ling et *al.* (2008) who affirmed that the depreciation of the currency will certainly have great impact on trade balance but the impact may vary, probably due to different levels of economic development. Notwithstanding, Huchet-Bourdon and Korinek (2011) accentuated that the depreciation of a country's currency makes its exports cheaper and its imports more costly. However, the authors stressed that in the reality of a globalized economy, industries are very integrated and exported products contain a large proportion of imported components. In this regard, globalization has led to a new pattern of world trade and has been seen to have a direct impact on international competitiveness, trade and financial flows. Mauro et *al.* (2008) argued that globalization has brought about changes in the dynamic interactions of economic variables, including possibly the way changes in the exchange rate affect the economy.

Traditionally, the history of exchange rate fluctuations and volatility can be traced as far back to the breakdown of the Bretton Woods system of fixed exchange rates in the 1970s. The Bretton Woods system of exchange rates was launched in 1944. During that year, the United States accounted as one the most powerful country in regard to world's trading capacity. For this reason, leaders entered into a common agreement of fixing world currencies to the US currency (US dollar). Under the regime of the Bretton Woods system, other than the US, countries were expected to maintain a fixed exchange rate in regard to their respective currency and the US dollar. If it however happened that a country's currency exceeded the US dollar, central bank authorities would have to sell their currency in exchange for the dollar, which will in turn depreciates the value of its currency and vice versa. Everything appeared to have operated quite well until the year 1966. Post to the mentioned year, several crises began to arise, all of which contributed to the collapse of the system. The devaluation of several currencies was experienced post to that year and following that, the Bretton Woods system of fixed exchange rates carried on until 1971. In 1973, the leading nation (United States) and other countries worldwide agreed upon allowing their currency to operate in a flexible system. It is worth noting that prior to the Bretton Woods breakdown, the general argument was that transferring from a fixed to a flexible exchange rate system will cause exchange rate to be very stable. In the years ahead, it was however revealed that the volatility of exchange rates has instead increased which caused international business transactions to be more changing and uncertain than they were before.

The breakdown of the Bretton Woods system has really brought about wide fluctuations and volatility in exchange rates. Ever since, many countries suffered austere financial and currency crises followed by devastating consequences on their economies. Following this aforementioned incident, liberal economists seemed to have welcomed the regime of floating exchange rate system while on the other hand it was not hugged by other groups of economists as they held the certainty that the switch from a fixed to a floating exchange rate system will deteriorate trade. The post Bretton-Woods era has thus brought forth quarrels following the traditional conception that the adjustment from a fixed to a flexible exchange rate system regime would make exchange rates more unwavering. Hence, since the advent of the flexible exchange rate system, it is evident that exchange rate volatility has increased, which is different from what was anticipated. The higher volatility of exchange rate experienced in several economies advocated that the atmosphere for international transactions is now riskier in the present compared in the past when exchange rate were fixed (era prior to the breakdown of the Bretton-Woods system). As a result, many countries, especially those countries open to international trade, have felt the negative impact of this floating exchange rate regime on their respective economies. Since then, with regard to exchange rate policies, the views of different economists have changed. Following the replacement of the fixed exchange rate system by the flexible exchange rate system in most countries, arguments have arisen as to examining the effects of exchange rate volatility on the trade volumes of a country. Subsequently, the effects of the exchange rate's fluctuations have also aroused interest amongst researchers to cogitate its possible consequences on imports, exports and trade balance (difference between a country's exports and imports). Nevertheless, despite the many opinions in support of flexible exchange rate regimes, apprehensions are always being raised among researchers concerning the effects that exchange rate changes and volatility can have on trade. Still, arguments are still on the plate and researchers substantiate that exchange rate changes and volatility have respectively either a negative, positive effect or even no effect on trade.

It is worth noting that the majority of countries in Sub-Saharan Africa have adopted the floating exchange rate system following the Bretton Woods era, and as such, many experienced high fluctuations and volatility in their exchange rates. Olayungbo et *al.* (2011) maintained that foreign exchange rates for Sub-Saharan African countries have been highly volatile following the introduction of the structural adjustment reforms since early 1980s. Bahmani-Oskooee and Hegerty (2009) asserted that companies/businesses affected by exchange rate volatility could probably see their profits harmfully touched due to increased costs in hedging against this risk. As cited in Musila and Al-Zyoud (2012), Sub-Saharan African 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). The authors further asserted that the exchange rate volatility was extremely high in SSA in the year 1990 because of devaluations.

In summary, the post Bretton Woods era has shown evidence of high exchange rate fluctuations and volatility which contributed to the sharp decline in world trade. Several researchers worldwide have tried to address this issue without success and limited studies were able to identify a clear relationship between exchange rate risk as well as changes and the volume of trade flows. It is therefore of great significance to investigate these relationships. Results from empirical studies regarding the impact of exchange rate changes as well as volatility on trade are diverging and there is currently no clear trend that emerges from previous studies. The lack of clarity on this topic therefore brings forth the importance of investigating further on the relationship between exchange rate changes and volatility on trade. This thesis therefore emanates from the theoretical and empirical disagreement still present in this area of study. It is therefore around this problem that treats the phenomenon of the reliance of exchange rate volatility plus changes and its impact on trade that this present study is developed. As a result, the main objective of this thesis is to present the theoretical and empirical relationship between exchange rates changes and volatility and international trade. This study also attempts to empirically detect the causal relationship between these macroeconomic variables. Given the existence of minimal studies on Sub-Saharan Africa, the researcher felt the importance and timing of undertaking this research.

1.2 Problem Statement

The managing of the exchange rate plays a serious issue especially in developing countries. In an exposed economy (an economy that is open to trade), the level of exchange rate is very important as it will eventually affect its economic growth, businesses, investments and policy issues. Exchange rate is a prominent determinant of world trade; therefore, it is receiving much attention in the context of global imbalances (Umaru et *al.*, 2013). Since 1974, many home currencies have depreciated against the dollar. The advent of the floating exchange rate regime produced substantial instability and ambiguity in exchange rates. Under that system regime, countries were under the obligation of effecting a monetary policy which will keep their exchange rate currency value fixed. Nevertheless, this situation immediately altered after countries adopted the floating exchange rate regime. Following the breakdown of the 1973 Bretton Woods system regime of fixed exchange rate, it has been observed that many countries around the world adopted a floating exchange rate regime thereby bringing into attention the impact of exchange rate volatility and changes on trade. With the floating regime of exchange rate, this allows the governments no part in determining the level of exchange rate, but instead they are governed by the demand and supply factors.

Trade in developing economies constitutes one of the main drivers of economic growth in these economies. This study takes cognition of the fact that developing economies rapidly increased their economic growth due to their independence on trading activities with other countries. Douillet and Pauw (2012) sustained that trade integration is a powerful driver of economic growth in developing countries, particularly if it creates export opportunities. The authors further acknowledged that Africa has by far the lowest level of intercontinental trade in the world. This study observes that the functioning of floating exchange rate systems in most Sub-Saharan African countries and the growing economic growth are partly due to their interdependence on trading activities. Exchange rates in Africa have been very volatile since the adoption of the floating exchange rate system (Omojimite & Akpokodje, 2010). The authors noted that exchange rate volatility ranged between 0.04% and 150% in 1973 and

2006 respectively, and an average of 95% in 1973-2006. It is therefore of crucial importance to empirical test if the relationship between exchange rate changes and volatility on trade hold for the case of Sub-Saharan Africa. Omojimite and Akpokodje (2010) further maintained that African intercontinental trade grew more rapidly (25%) than African exports to the rest of the world (16%), thanks in part to renewed political commitment from African governments and development agencies to accelerate regional integration from historically low levels. The authors additionally affirmed that Africa's share in world trade has been decreasing, falling from an annual average of 4.5% in the period 1970-1979 to 1.8% in 2000-2006. Notwithstanding, Douillet (2012) noted that the ratio of trade to GDP in SSA rose from 50% in 1960 to 60% in 2010 and from 25% to 55% worldwide.

The problem of determining the exact relationship between exchange rate changes and volatility on trade thus remains very important as it constitutes a major factor regarding the implementation of policy decisions relating to exchange rate and trade policies. This thesis attempts to analyse this problem in the context of Sub-Saharan countries as these countries tend to mainly depend on trade. Foreign trade in these countries has increased and become mainly significant.

Although some developing nations have sustained some form of pegging arrangement for their currencies, they cannot avoid the fluctuations in their effective exchange rates, as long as major currencies float against each other. The discussion with regards to the impact of exchange rate changes/volatility and trade in developing countries is still gaining attention in the literature as it is evident that their individual markets are categorized by high degree of exchange rate volatility with regard to advanced economies. High volatility in exchange rates will have harmful repercussions especially for traders (as it will affect their profits) and policy choices in these developing economies. Hence, the absence of transparency on this issue will generate uncertainty in policy strategies.

Subsequent to the above discussion, the analysis relating to the impact of exchange rate changes and volatility on trade has been a theme of debate in both developed and developing economies; consequently, this topic has been subject to large theoretical and empirical literature. Available studies that treat this topic suggest that exchange changes and volatility impacts on trade performance somewhat, as it plays a major role on investment decisions. That said, this topic has attracted a lot of attention on the literature. However, many studies were seen to focus more on developed countries, while there are comparatively few studies that focused on developing countries, and more specifically on SSA countries. Among the different authors that gave attention to this topic, there is still no consensus in the literature with regard to the exact effects of exchange rate volatility on trade. While others argue that the effects of exchange rate volatility will produce a negative effect on trade (Hooper & Kohlagen, 1978; Adubi & Okumadewa, 1999; Musila & Al-Zyoud, 2012), others argue that the effects will be positive (De Grauwe, 1988), while other studies prove the non-existence of a significant effect (Brada & Mendez, 1988). The lack of consistency in the empirical literature proves that there the question of the relationship between exchange rate volatility and trade is still of debate. Hence, there is a need for further research to be conducted. In this regard, this thesis will therefore be a gap-filler in respect of limited studies dedicated to African countries. More specifically, this study gives attention to SSA countries, but however uses a different methodological approach of the panel data analysis, as opposed to the gravity model utilized by Musila and Al-Zyoud (2012).

Countries belonging a particular trade bloc benefit from certain advantages as opposed to countries that do not belong to any trade bloc. Among other significant trade blocs in SSA, this study notes the EAC, the CEMAC, the ECOWAS and SADC, of which their existence have eased trade among member countries. While it will be interesting and highly significant to understand the response of trade to exchange rate changes and volatility respectively among different trade blocs in SSA, this type of comparative analysis however lacks in the literature. Nevertheless, this study recognizes the work by Sekkat and Varoudakis (1998, 2000) who empirically explored the effects of exchange rate policy on manufactured export performances on a panel of major Sub-Saharan African countries over the period 1970-1992. The authors used a number of eleven countries (1998) and sixteen countries (2000) respectively in total and the empirical analysis made an attempt to distinguish between non-CFA countries (flexible exchange rates) and CFA countries (fixed exchange rates). On the other hand, Sekkat and Varoudakis (2002) attempted to empirically examine the effects of trade and exchange rate policies on manufactured exports in North Africa. Notwithstanding, Ogun (1998) also attempted to evaluate and measure the impact of exchange rate movements on the growth of non-oil exports in Nigeria over the period 1960 to 1990. The author performed his analysis using the real exchange rate misalignment and the real exchange rate volatility to find their respective impacts on exports. This study draws attention to the fact that though these studies have contributed to the literature on developing countries, it however revealed some gaps. Despite that Sekkat and Varoudakis (1998, 2000) focused on

Sub-Saharan African countries, the study reveals that only a limited number of cross-sections were used (a total of eleven and sixteen countries respectively). In addition, while distinguishing between CFA and non-CFA countries, limitations were found with regards to the fact that the study solely gave attention to the export performance whereas neglecting the import and the trade balance performances of the respective countries under investigation. Still, Sekkat and Varoudakis (2002) also divulge some gaps. The respective studies have concentrated only on a section of Africa (North Africa) and on the export performance of the respective countries, disregarding the imports as well as the trade balance despite its vital importance. A similar gap was observed in Ogun (1998) who also concentrated on investigating the impact of exchange rate misalignment and volatility on the export performance of Nigeria. It is important to note that engaging in both import and export activities are both essential for the growth of an economy. If special attention is solely given to policies aimed at increasing exports while neglecting policies that can reduce imports, the economy is likely to record wide trade deficits. Hence, one of the major problems found in the literature is the attitude towards neglecting imports which is a major macroeconomic variable in an economy. As a result, this thesis attempts to fill these aforementioned gaps. The first contribution in filling the aforementioned gaps is to employ more Sub-Saharan African countries (a total of 39 will be used) which make the empirical analysis more robust compared to previous studies. Moreover, compared to Sekkat and Varoudakis (1998, 2000) who made a comparison between CFA and non-CFA countries, this study broadens its assessment by distinguishing between several trade blocs regions of Sub-Saharan Africa. The study fills the gap by comparing the impact of exchange rate changes and volatility on trade in EAC (East African Community), CEMAC (Economic and Monetary Community of Central Africa), ECOWAS (Economic Community of West African States) and SADC (Southern African Development Community) trade blocs, thus making the study very robust and highly significant. As Sekkat and Varoudakis (2002) orientated their respective studies merely on a section of Africa, this study fills this limitation by analysing the whole set of Sub-Saharan African countries. Doing the comparison analysis with the trade blocs enables the study to also distinguish the sections of Africa, specifically; EAC, CEMAC, ECOWAS and SADC trade blocs which mostly comprise of East, Central, West and Southern African countries respectively. In addition, Sekkat and Varoudakis (1998; 2000; 2002) and Ogun (1998) orientated their analysis on the export performance of the respective countries under investigation and in this regard, only the export equations were estimated. Given that majority of studies found in the literature focus only on countries' export performances, while neglecting the direction of imports, and the overall trade balance this study attempts to address this limitation. More specifically, this study investigates in great detail how SSA's respective trade components are respectively affected by exchange rate changes and volatility. That said, this study does not only estimate the export equation but the effects on imports and trade balance is also taken into account which is a great contribution to the literature.

It is also important to note that despite these few studies conducted in developing economies and particularly in Africa, it has come to realization that a majority of the studies have focused in a single country framework and very few attempted to conduct this analysis in a multiple country framework which is regarded as a limitation. This study therefore closes this vacuum by empirically and quantitatively investigating the effects of exchange rate volatility and changes on trade in a multiple country framework (a panel of Sub-Saharan African countries). This will be a great contribution to a methodological based body of knowledge.

As earlier stated, exchange rate changes and volatility are two distinct concepts. Exchange rate that changes is not necessarily and vice versa. Accordingly, this study also draws attention that some studies mixed the concept of exchange rate changes and exchange rate volatility in their individual studies. The mixed up was observed where studies whose main goal was to investigate the impact of exchange rate changes on trade instead employed literature reviews as well as theoretical perspectives associated towards exchange rate volatility. This therefore brings confusion and disorganization in the literature. On this note, this study cites the work done by Umoru and Oseme (2013), whose study mixed the two concepts. With reference to this present flaw in the literature, this study therefore critically endeavours to distinguish the two concepts of exchange rate changes and exchange rate volatility regarding their respective impacts on trade. As formerly noted, tough they seem similar; these two macroeconomic concepts are actually different both in their theoretical perspectives and on their respective effects on trade; and it is therefore vital that they should be differentiated in the analyses.

The managing of a suitable exchange rate regime is considered as an essential, but not a satisfactory condition for the accomplishment of macroeconomic goals. The steadiness and appropriate arrangement of the exchange rates are definitely critical for growth in the tradable sector and the entire economy as a whole. Increased exchange rate volatility will therefore have adverse effects on trade in an economy. For this reason, regardless of the prominence of exchange rate in effecting macroeconomic strategies, the empirical examination of the impact of exchange rate changes and volatility on trade in Sub-Saharan African countries is limited. It is therefore counter to this context that this study saw the great importance of filling the gaps present in the literature by investigating the impact of exchange rate changes and volatility on trade in Sub-Saharan Africa.

1.3 Research Questions

Against the context elucidated beyond, this thesis pursues to address the following main research questions:

1.3.1 What is the impact of exchange rate changes on trade in Sub-Saharan Africa?

1.3.2 What is the impact of exchange rate volatility on trade in Sub-Saharan Africa?

In addressing these main research questions, the sub-research questions are as follows:

1.3.3 What is the relationship between exchange rate changes and volatility with respect to imports, exports and trade balance respectively?

1.3.4 Is there a difference between the diverse trade blocs of Sub-Saharan Africa regarding the effects of exchange rate changes and volatility on trade?

1.3.5 Is there a significant difference in utilizing the various measures of volatility, notably the standard deviation, GARCH and HP-Filter in separate models? How robust are they?

1.3.6 What recommendations can be outlined to policy makers based on the results of this study?

1.4 Objectives of the Study

A considerate number of studies have attempted to empirically investigate the impact of exchange rate changes and volatility on trade. Similarly, contributions have been made to define the direction of the impact of the two aforementioned variables. Nevertheless, no clear conclusions have been made. Therefore, the major objectives of this thesis are listed below.

1.4.1 To scrutinize and quantify the effects of exchange rate changes on trade in Sub-Saharan Africa

1.4.2 To scrutinize and quantify the effects of exchange rate volatility on trade in Sub-Sahara Africa

In an attempt to address the main objectives, this study also focuses in answering the following specific/sub objectives:

1.4.1 To estimate an econometric model for trade (Imports, Exports and trade balance) for the period 1995-2012.

1.4.2 To provide a comparative analysis of the impact of exchange rate changes as well as volatility on trade amongst the different trade blocs of Sub-Saharan Africa.

1.4.3 To construct and evaluate different measures of volatility and to examine the robustness of the different measures used in the estimation of the models

1.4.4 To provide suggestions to policy makers based on the results of this study.

1.5 Hypotheses

The different sets of hypotheses considered in this study are presented as follows:

H_0[1]: Exchange rate changes will have a negative effect on trade in Sub-Saharan African countries, as well as distinct trade blocs.

H_1[2]: Exchange rate changes will have a positive effect on trade in Sub-Saharan African countries, as well as distinct trade blocs.

H_0: There exists a positive impact between exchange rate volatility and trade in Sub-Saharan Africa, as well as distinct trade blocs.

H_1: There exists a negative impact between exchange rate volatility and trade in Sub-Saharan Africa as well as distinct trade blocs

H_0: There is no distinction on the impact of exchange rate volatility on trade using different measures of volatility in the estimation of the models.

H_1: There is a distinction on the impact of exchange rate volatility on trade using different measures of volatility in the estimation of the models.

[1] H_0 indicates the null hypothesis

[2] H_1 indicates the alternative hypothesis

1.6 Significance and Contribution of the Study

Several studies have been conducted on this topic with a special emphasis on developed economies and just few have been directed to transition economies (developing economies). The study acknowledges the few studies that focused on developing economies and especially in Africa, but they are still very few compared to studies on developed economies. Therefore, this study will attempt to provide a contribution by adding to the literature and filling the research vacuum on the relationship between exchange rate changes and volatility and trade in less developed economies with a special emphasis on Sub-Saharan African countries.

Analysing the impact of exchange rate changes and volatility on trade has heen revealed to be a subject of a single-country framework analysis. Very few studies have attempted to do an analysis of the connection between these macroeconomic concepts utilizing a panel analysis involving a large number of countries. In lieu of this, the group of countries under examination also serve as a contribution because to the best of our knowledge, this study will stands among the very few related studies to do such a large data set analysis in Africa.

The cointegration analysis and the vector error correction model have been seen as the mostly used methods to conduct this type of investigation in individual countries. This study therefore tends to contribute to the literature by providing an analysis mostly based on a panel data approach.

Considering the existence of diverse trade blocs in Sub-Saharan Africa, this study contributes to the literature by providing a comparative analysis of the impact of exchange rate changes and volatility among the respective trade blocs Sub-Saharan Africa that will be considered in this study. It should be noted that this study will be the first of its kind to consider such a comparison.

Lastly, this study stands out of other studies by investigating in great detail the effects of exchange rate changes and volatility on trade on exports, imports and lastly on trade balance. The results of this thesis will serve as a source for understanding the effects of exchange rate changes and volatility on Sub-Saharan trade. More essentially, through the findings, policy makers shall be able to determine whether a strategy of deteriorating their home currencies will benefit trade or whether other strategies need to be used.

1.7 Limitations/Delimitations

Presently, limitations in this study include the availability of data for the 48 countries inclusive in SSA. In this regard, only the readily available data was used in this study and this is considered as a delimitation.

This study also experienced some limitations regarding the acquisition of quarterly data for the countries under consideration. For this reason, this study utilized annual data (1995-2012) and this is regarded as a delimitation.

Real effective exchange rate data was not available for all countries under investigation, as such the nominal exchange rate is used in addition to inflation as a separate variable and this is regarded as a delimitation.

1.8 Structure of the Thesis

This thesis will consist of the following chapters:

Chapter 1: Orientation of the study

Chapter 2: Literature Review

Chapter 3: Model, Data and Methodology

Chapter 4: Empirical Results and Interpretation

Chapter 5: Conclusions, Policy Implications and Recommendations

As stated above, Chapter 1 comprises of the preliminary chapter. This chapter offers a detail account of the introduction, problem statement, research questions, aims and objectives, hypothesis combined with the significance and limitations/delimitations of the study. Chapter 2 is the literature review and it provides both theoretical and empirical literature with regard to this study. It also comprises an acute assessment of all former studies and how it narrates to this study. In chapter 3, a thorough description of the estimation methods applied in this study is provided. In this chapter, a model will be specified in accordance with the theoretical framework and some relevant empirical studies. Moreover, the source and definition of the variables used are detailed explained. The results of the different tests conducted in the previous chapter are provided in Chapter 4 combined with their interpretation whereas Chapter 5 gives a conclusion of the study, the policy implications and the recommendations.

CHAPTER 2

LITERATURE REVIEW

2.1 Theoretical Background on Exchange Rate Changes and Trade

For a numbers of years now, problems associated to exchange rate changes have been of interest to empirical and theoretical analyses globally. Since the adoption of the floating exchange rate regime, exchange rate particularly plays a central role as countries use different currencies to trade with each other. A firm or an individual who wishes to purchase commodities in another country has to take into account the rate of exchange of that country.

To examine the relationship between exchange rate changes and trade, it is important to initiate with a detailed study of the elasticity view of the balance of payments. Presently, in the literature dedicated to international economics, there exist three core theories that well describe the liaison between exchange rate changes and trade namely; the Elasticity approach, the Absorption approach and the Monetary approach. Though the three theories are all aimed at explaining the connection between exchange rate changes and trade, they actually differ. When referring to the elasticity approach, this approach gives attention more to the current account of the balance of payments. In simpler terms, this approach focuses more on the trade balance. Via this approach, the trade balance is evaluated via the variations in exports and imports which emanated as a product of the changes in exchange rates. The absorption approach on the other side differs greatly from the former approach in the sense that it does not only give attention to the current account side of the balance of payment, but it also takes into consideration the capital account side of it. In this approach, the method of examination differs where the analysis is prolonged by taking account income outcomes that may arose due to variation in prices. As for the monetary approach, it is identical to the elasticity approach as it only focuses on the current account. Through its examination, this approach considers the analysis of the trade balance in terms of the disequilibrium of the demand and supply of money.

Despite the great significance and distinct inputs played by the three approaches in examining the relationship between exchange rate changes and trade, the elasticity approach basically stands as the most used theory in this context. The three approaches will be investigated in great detail in the following paragraphs.

2.1.1 The Elasticity Approach

As cited in Igue and Ogunleye (2014), the elasticity approach was developed by Bickerdike (1920), Robinson (1947) and Metzler (1948). This approach originates from the well-known Marshall-Lerner condition which stipulates that the depreciation of a country's currency will lead to an improvement of the trade balance if the sum of the elasticity of both the demand of exports and imports exceed unity.

This approach originated in the 1950s when exchange rates were still fixed. According to this approach, the discrepancy in foreign and domestic prices accounts for the main source of the instability in the balance of payments. In other words, one can undoubtedly sustain that this approach gives primary concern to the issue of price changes as it acts as a determining factor to a country's exchange rate and balance of payments. The elasticity approach deals with the question of how does imports and exports react when a nation's currency depreciates. This approach thus reflects the sensitivity of imports and exports and to variation in the value of a nation's currency.

Under the elasticity approach, it is of great importance to highlight that there are two essential theories that form the foundation of the examination of the impact of currency depreciation on a country's trade balance. These theories constitute the Marshall-Lerner condition and the J-Curve which will be explained in great detail below.

2.1.1.1 Marshall Lerner Condition

In gauging the efficacy of policies that are designed at improving a country's balance of trade through the devaluation of a currency, it is imperative to comprehend how the changes in exchange rates and prices affect the international trade pattern of a country. The Marshall-Lerner (henceforth M-L) condition sustains that the depreciation (devaluation in case of a fixed exchange rate regime) of a nation's currency will have a significant positive influence on the trade balance. Specifically, a devaluation of a currency will cause domestic merchandises to be cheaper and foreign merchandises to be more costly in the international market. In other words, when a country experiences depreciation in its currency, the volume of exports will rise and the volume of imports will decline. Pandey (2013) accentuates that it is both the elasticity of imports and exports with regard to the changes in exchange rates that determine the overall impact of the depreciation on the trade balance. The position of a country's trade balance account is designated in relation of the amount paid for imports and the amount received for exports. Thus, the effects of the devaluation of a country's currency do not merely depend on the variation in quantities of exports and imports but on their relative prices as well.

In the area of international economics, the condition under which depreciation in exchange rate will result in either an improvement or worsening of trade is referred to as the M-L condition. The M-L condition states that a devaluation of a nation's currency will improve its trade balance. However, it is accentuated that this condition can only be met if the demand for imports and the demand for exports exceed unity. The next section will elaborate in great detail how the Marshall-Lerner condition is derived mathematically.

This study adopts the mathematical derivation of the impact of exchange rate change on trade based on the study conducted by Hermawan (2011).

The author defined the trade balance as the difference between the values of total exports less the value of total imports which mathematically represented as follows:

$$BOT = P_d Q_x - eP_f Q_m \quad \textbf{(2.1)}$$

where

BOT represents the balance of trade

P_d is the domestic price (price in the home-based country)

Q_x represents the total value of exports

e represents the rate of exchange (rate or price at which a country's currency is exchange for another)

P_f represents the foreign price (price in the partner/foreign country)

Q_m is the total value of imports

Several assumptions have been made in deriving the model. The author assumed a constant price both on the produce of imports and the produce of exports. Moreover, it is assumed that both the domestic and the foreign price levels are identical. Precisely, it is meant that $P_d = P_f$. Also, to simplify and for a better understanding, both are assumed to be equal to unity

(1). Following these assumptions, the total value of exports $P_d Q_x$ will be equal to unity ($P_d = 1$) as well the total value of imports $P_f Q_m$ ($P_f = 1$) will equal to unity.

Therefore, the balance of trade model is simplified as follows:

$$BOT = (1)Q_x - e(1)Q_m \quad \textbf{(2.2)}$$

$$BOT = Q_x - eQ_m \quad \textbf{(2.3)}$$

After substitution, equation (2.3) represents the simplified trade balance model.

Equation (2.3) is differentiated to the first order with respect to the exchange rate (e) and the following equation is obtained:

$$\frac{\partial BOT}{\partial e} = \frac{\partial Q_x}{\partial e} - e\ \frac{\partial Q_m}{\partial e} - Q_m \quad \textbf{(2.4)}$$

Afterwards, equation (2.4) is divided by the value of exports Q_x. The following equation is arrived at:

$$\frac{\partial BOT}{\partial e} * \frac{1}{Q_x} = \frac{\partial Q_x}{\partial e} * \frac{1}{Q_x} - e\ \frac{\partial Q_m}{\partial e} * \frac{1}{Q_x} - Q_m * \frac{1}{Q_x} \quad \textbf{(2.5)}$$

After re-arranging, the following equation is attained:

$$\frac{\partial BOT}{\partial e Q_x} = \frac{\partial Q_x}{\partial e Q_x} - \frac{e \partial Q_m}{\partial e Q_x} - \frac{Q_m}{Q_x} \quad \textbf{(2.6)}$$

At this stage, it is assumed that the economy is at equilibrium. In simpler terms, it is considered that the total value of exports and total value of imports are identical. In mathematical terms, this implies that:

$$BOT = Q_x = eQ_m \quad \textbf{(2.7)}$$

Following a substitution of the total value of exports Q_x by Q_{the} in the last section of equation (2.5) which is $\frac{e\partial Q_m}{\partial e Q_x} - \frac{Q_m}{Q_x}$, the following equation is attained:

$$\frac{\partial BOT}{\partial e Q_x} = \frac{\partial Q_x}{\partial e Q_x} - \frac{e \partial Q_m}{\partial e Q_m e} - \frac{Q_m}{Q_m e} \quad \textbf{(2.8)}$$

After cancellation of the common terms, the simplified equation is represented as follows:

$$\frac{\partial BOT}{\partial e Q_x} = \frac{\partial Q_x}{\partial e Q_x} - \frac{\partial Q_m}{\partial e Q_m} - \frac{1}{e} \quad \textbf{(2.9)}$$

Subsequently, equation (2.9) is multiplied by the exchange rate *e* and the resulting equation is obtained:

$$\frac{\partial BOT}{\partial eQ_x} * e = \frac{\partial Q_x}{\partial eQ_x} * e - \frac{\partial Q_m}{\partial eQ_m} * e - \frac{1}{e} * e \quad \textbf{(2.10)}$$

After cancellation of the common terms, the next equation is achieved:

$$\frac{\partial BOT}{\partial eQ_x} * e = \frac{\partial Q_x}{\partial eQ_x} * e - \frac{\partial Q_m}{\partial eQ_m} * e - 1 \quad \textbf{(2.11)}$$

Equation (2.11) can be represented as follows:

$$\frac{\partial BOT}{\partial eQ_x} * e = \eta xe - \eta me - 1 \quad \textbf{(2.12)}$$

where ηxe and ηme represent correspondingly the demand elasticity of exports and imports in regard to the exchange rate.

As stated by the M-L condition, the trade balance can only improve in the long-run if only the condition of the sum of the elasticity of the demand for imports and exports shall surpass unity or positive. This therefore means that the left side of equation (2.12) must be exceeding unity. This condition can be expressed as follows:

$$\eta xe - \eta me - 1 > 0 \quad \textbf{(2.13)}$$

This in turn implies that

$$\eta xe - \eta me > 1 \quad \textbf{(2.14)}$$

Equation 2.14 can be re-written as:

$$\eta xe + |\eta me| > 1 \quad \textbf{(2.15)}$$

The condition of the M-L states that several effects may occur following the values of the sum of the demand elasticity of exports and exports. Carbaugh (2006) achieved the following conclusions:

1. Firstly, in case where the sum of the demand elasticity of imports and exports equal to unity, this will cause the balance of trade to remain unaffected following changes in exchange rate values. This will therefore suggest that in this case, the depreciation of a currency is not genuine and there are therefore no significant consequences on the balance of trade.

2. Secondly, if it happens that the sum of the price elasticity of both exports and imports is less than unity, the trade account will tend to be unstable and causing disequilibrium to widen. In summary, the depreciation of the currency will be ineffective in improving the trade balance or in other terms, it will worsen trade balance.

3. Lastly, as the sum of elasticity exceeds unity, the trade account will remain stable and this will cause the disequilibrium to narrow. This will mean that the depreciation of the currency will improve the trade balance.

Despite the M-L condition that a real depreciation of a country currency causes the trade balance to improve in the long-run, this situation can change in the short-run. In the short-run, it is assumed that a real devaluation/depreciation of a nation's currency might instead cause the balance of trade to deteriorate and this situation is referred as the J-curve.

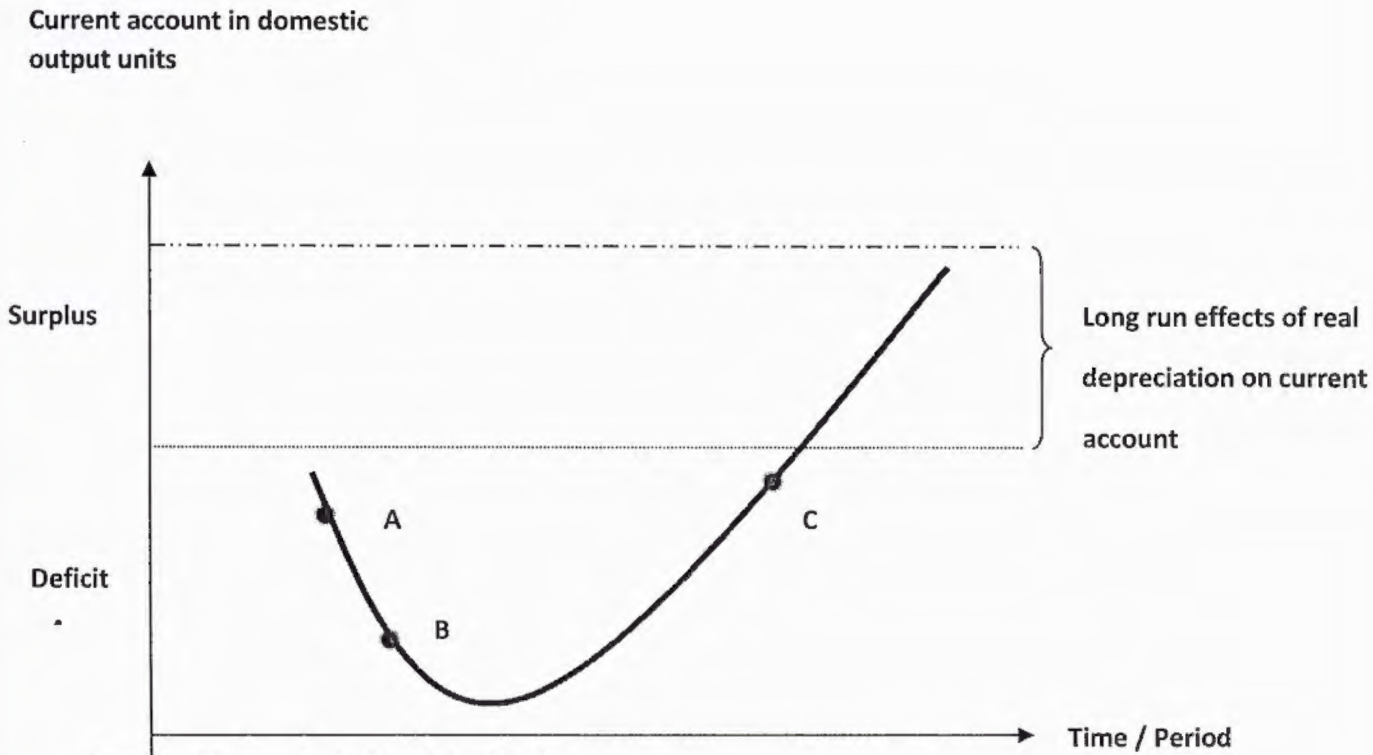
2.1.1.2 The J-Curve

Contrary to the M-L condition, it is however often observed that a real devaluation of a currency will cause the current account to deteriorate but may still recover in the months later. In a situation where the current account degrades after the depreciation of a currency, this situation is referred as the J-Curve effect. The phenomenon of the J-curve advocates the existence of a lag period before both the total volume of exports and imports could retort to some changes which may arise from movements in exchange rates.

Relating to this theory, economists established the hypothesis that in the short-run, following a devaluation/depreciation of a nation's currency, the balance of trade will decay but as time goes by, the elasticity will improve thereby causing the balance of trade to also improve. This situation usually leads to a shape which bears a resemblance to the letter "J", henceforth the name "J-Curve pattern".

The figure below describes a situation of a J-curve:

Figure 1.1: J-Curve effect



Source: Krugman & Obstfeld, 2009.

From figure 1.1 above, the Y-axis represents the current account which is measured is terms of the domestic currency. As stated by the theory, following the devaluation of a currency, the current account will deteriorate thereby leading to a movement from point A to point B. The following paragraph illustrates in detail how the J-curve occurs.

The study considers a random economy which experiences a trade deficit in its current account. To eradicate this deficit, authorities/central banks will come to a decision of devaluating the currency. In doing that, imported goods will tend to be expensive while on the other hand; the exported goods will become cheaper. This situation will therefore cause the balance of trade to weaken thus causing the movement from point A to point B. This situation is also confirmed by Krugman and Obstfeld (2009) who emphasized that this situation occurs mainly because most imports and exports orders are placed months in advance.

Nevertheless, after some months have elapsed, the situation may be different. After some time, traders may resolve now to begin adjusting to the new prices of both exports and imports that arose due to the devaluation of the currency. As the traders begin to be comfortable with the new prices, this will lead to a rescue in the foreign demand for products that are produced domestically. As foreign demand is recovered, the curve in fig 1.1 starts to move upwards until it reaches point C. Point C reveals a scenario where the trade account is improve. In other terms, this just means that from the starting point and at the given balance of trade, the depreciation of the currency will first cause the trade balance to decrease in the short run because a subsequent improvement is attained in the long run. This also implies that even in a situation where the M-L condition is encountered, the current account balance may tend to worsen in the short run before an improvement occurs in longer terms.

2.1.2 The Absorption Approach

The absorption approach was established by the economist Sidney Alexander in the 1950s where he describes that variations in domestic income are very significant in understanding balance of trade. Rehman and Rashid (2006) define this approach as payments imbalances that are categorised by ex-ante discrepancies between cumulative income receipts and cumulative domestic expenditures. The authors further accentuated that the absorption approach gives considerate attention to the product market while less attention is given on the exchange rate market and the monetary/money market is entirely disregarded. Also, Melvin and Norrbin (2013) explained the absorption approach to the total trade balance as a theory that underlines how local expenditure on national goods varies with respect to domestic output. Melvin and Norrbin (2013) additionally accentuated that the total balance of trade is regarded as the difference between what the economy produces and what the economy absorbs/consumes for local purposes.

It is important to highlight that this approach is established from the Keynesian school of thought while holding the vision as earlier stated that the balance of payments is directly associated to some proportion in real national income. Consequently, to elucidate the balance of payments under the absorption approach, this study based itself on the Keynesian model to categorise the constituents of income and expenditure in an economy. This study follows the model proposed by Melvin and Norrbin (2013) mathematically stated as follows:

$$Y = C + I + G + (X - M) \tag{2.16}$$

where

Y = Total output or total income

C = Consumption by households

I = Total Investments

G = Total expenditure by the government

X = Total spending on exports

M = Total spending on imports

(X-M) = Trade Balance

The authors assumed that this approach associates the term C+I+G from the previous equation into one single term expressed as "A" which symbolizes the absorption. D'souza (2009) defines absorption as a country's total spending on final goods and services. For this reason, the total income is rewritten as follows:

$$Y = A + (X - M) \tag{2.17}$$

The above equation can still be written as

$$Y - A = (X - M) \tag{2.18}$$

$$A = Y - (X - M) \tag{2.19}$$

$$(X - M) = Y - A \tag{2.20}$$

The previous equation (2.20) reflects that total domestic output/income less the absorption is identical to the total balance of trade. The above equations signify that the amount by which total income/spending exceeds absorption/total spending is defined by total export over total imports which will means a surplus trade balance. Following the equations, Melvin and Norrbin (2013) recognized that this approach or polices that can be of usage at correcting the occurrence of trade discrepancies can be split down into two different categories. The two categories are as follows; firstly whether the economy is at its full employment level of whether the economy has unemployed resources.

1. In a situation where the economy is at its full employment, total income Y cannot rise or be expanded. In this case, resources are being fully utilized and the depreciation of a country's currency can only be efficient if absorption drops down. Consequently, the exports value will exceed the imports value. In this case, the country will be in the responsibility of exporting the rest of its output and therefore experiencing a balance of trade/current account surplus. This conclusion is also supported by Wang (2005) and Kennedy (2013) who state that if a country's expenditures is less than its production (Y>A), the economy will export goods to many countries thereby causing a situation of current account surplus.

2. On the other hand, in a situation where an economy is faced with unemployed resources, total income is not at its maximum value and therefore its value could increase. If absorption A exceeds domestic income/output Y, this will means the value of exports is less the value of imports causing therefore the component Y-A to be negative. For this reason, the country will experience a balance of trade/current account deficit.

Following the above explanations, it is imperative to now illustrate how the absorption approach operates. As said, its main aim is to investigate the effects of exchange rate changes on trade balance via the absorption channel. Wang (2005) illustrates the following effects. A depreciation of the exchange rate will affect the trade balance in the following ways. Primarily, depreciation will cause a change in total output Y, which will consecutively bring some variation in absorption (A). Subsequent to this, a variation in the balance of trade will constitute variations in both total income and absorption. Furthermore, the depreciation in exchange rate may alter absorption for any particular level of real income.

This study also notes how the elasticity approach differs with the absorption approach. Whereas the elasticity approach centred its outcomes on the effects of exchange rate variations on distinct microeconomic performance (Marshallian demand and supply analysis), the absorption approach on the other hand concentrates its analysis predominantly on economic aggregates, typical of Keynesian study. In conclusion, the fundamental theme of this approach is the notion that any development in the balance of trade necessitates a proliferation of total income over total domestic spending.

2.1.3 The Monetary Approach

The years 1950s and 1970s saw the advancement of innovative methodologies targeted to enhance the understanding of the structures of economic proceedings that could possibly lead to countries balance of payments deficits and measures that could prevent or correct such problems. According to Murshed (1997), the roots of the monetary approach grew out of dissatisfaction during the early 1970s, with the Keynesian income-expenditure flow models of the balance of payment and exchange rate determination. Frenkel and Golstein (1991) also asserted that the view that the balance of payments is essentially a monetary phenomenon gained a widespread popularity during the 1960s and the 1970s. Distinct from the elasticity and the absorption approach, the monetary approach integrates both the current account (trade in goods and services) and trade in financial assets. The core notion of the monetary approach is the assertion that the balance of payments is in essence a monetary occurrence. In other words, under this approach, the performance of the balance of payments should be analysed from the approach of the demand and supply of money. It can therefore be easily asserted that money acts as a disorder and an alteration to the balance of payments.

According to Sharan (2008), under this approach, the process of adjustments in both money demand and supply greatly varies and depends on the type of exchange rate system the country has chosen. The exchange rate systems are the fixed and the flexible rate regimes accordingly. Below follows an explanation of how the monetary approach functions under these two distinct regimes.

Before a detailed explanation is given, it is noted that under this approach, the balance of payments is affected by inconsistencies between the amount of money individuals' aspire to hold in hand and the amount supplied by the central bank. Scheuch, Brunner and Neumann (n.d) designated that under the fixed exchange rate regime, the nation's central bank can choose the composition but not the quantity of nominal assets off the banking system since the nominal money supply is demand determined. Also confirmed by Kreinin (2006), under the monetary approach in fixed exchange rate regime, the country's central bank has no control over its domestic money supply. As earlier stated, money demand and supply constitute the two core fundamentals under this approach. It is therefore of great significance to elucidate their derivation. This study adopts the demand and supply of money equations established by Kreinin (2006). The author mathematically defines the demand for money as follows:

$$M^d = kPy \qquad \textbf{(2.21)}$$

where

M^d is the demand for money

k is the desired ratio of nominal money balances to nominal national income

P is the national price level

y is the total real output

From the above equation, Py represents the national income also viewed as the gross domestic product (GDP). It is evident from the equation that the demand for money is a positive function of real income and the national price level. It is also assumed that k, P and y do not adjust significantly over time.

On the other side, the supply of money is stated as follows:

$$M^s = m[D + R] \quad \textbf{(2.22)}$$

where

M^s is the total money supply

m is a constant multiple of the monetary base / money multiplier which for the sake of simplicity is viewed as a constant

D is the domestic credit created by the monetary authorities

R is an international reserve component of the country's monetary base

The two equations of the demand and supply of money establish the focus of the monetary approach. In a situation of equilibrium on the money market, the demand for money is same as the supply for money. This means that

$$M^d = M^s \quad \textbf{(2.23)}$$

Following this, it is asserted that the demand for money can be satisfied from either domestic or international sources. Under the fixed exchange rate system, if the amount of money people desired to hold (money demand) is greater than the money supply, the excess demand would be satisfied by an increase in R (international reserve component). In other words, the excess demand would be met through the influx of currency from abroad. This situation will produce a surplus in the balance of payments. On the other hand, if the money supply is greater than money demand, the excess supply will be eradicated via the outflow of cash to other countries. Sharan (2008) sustained that the inflow and outflow of money influence the balance of payments. In summary, a surplus in the balance of payments will occur when the demand for money will exceed the supply for money. This situation is self-correcting and will last until the money stock rises to the level that the demand for money balances. A situation of balance of payment deficit occurs when the supply for money exceeds the demand for money. This situation is temporary and self-correcting because the demand and supply refers to money balances as a stock.

Thus, the direct effect of a devaluation of a country's currency will be a rise in the national currency prices of imports and exports and because of international product substitution, the prices of non-traded goods will also rise to a lesser degree. The increase in prices will therefore cause the demand for money to increase also. Consequently, the devaluation of a country's currency will reduce real domestic money balances and will therefore force national of the country to restore them through the global credit or commodity markets. In other terms, the effects of the devaluation will be strictly transitory. Looking at the long run, devaluation has no effect on real economic variables; it merely raises the price level. In opposition, the rise in domestic money supply while the demand for money remained unchanged will instead produce a deficit in the balance of payments. A currency appreciation would produce a transitory deficit in balance of payments if it lowered prices.

In a floating exchange rate system, the demand for money is attuned to the supply for money through some deviations in exchange rate. Holding other variables constant, the extra money supply will lead to an upsurge in the domestic price levels in a way that the national currency will depreciates. In general, under the flexible exchange rate regime, the monetary approach shows that alterations in the balance of payment are partially due to changes in both demand and supply of money. At this point, the prominence is essentially on the financial description contrary to the current account that constitutes the balance of payments.

2.2 Theoretical Background on Exchange Rate Volatility and Trade

The adoption of the floating exchange rate regime in the late 1970s has brought about significant instability in exchange rates. The relationship between exchange rate volatility and the volume of international trade is fundamentally based on the behavior of importers and exporters in service in a global economy characterized by major fluctuations in exchange rates.

The theoretical literature is usually unanimous on the argument that given the aversion of economic agents in regard to risk, the volatility of exchange rates causes a reduction in trade. The connection between exchange rate volatility and international trade is fundamentally based on the performance of traders (both importers and exporters) functioning in a worldwide economy characterized by substantial instabilities of exchange rates. In lieu of this unstable world, enterprises/companies/organizations which are involved in trading activities potentially incur exchange rate risk which will in turn affect their performances. These aforementioned companies can therefore decide on to adjust by reducing their participation in world markets.

While examining the literature on the relationship between exchange rate volatility and international trade, it is obvious that a lot of attention was directed on the empirical side and less on the theoretical side. Several theoretical models were used by different studies as a base for theoretical background and these theories will be examined in great detail in this chapter.

2.2.1 Hooper and Kohlhagen (1978)

One of the initial studies written on the impact of exchange rate, volatility and trade is the study conducted by Hooper and Kohlhagen (1978). The authors established one of the most used theoretical models in this area where they analyzed the impact of exchange rate risk on trade. Based on the literature, this model has the merit of having established a fundamental research base for subsequent work. This theoretical model is a model of import and export supply sides which integrates foreign exchange risk and its main was to analyze the impact of exchange risk on the price and quantities of traded goods on the world market. The authors emphasized that the main purpose of incorporating both import and export functions is to enable them to consider the attitude of the traders in regard the risk. In developing the model, the authors presumed that exchange rates account for the only sources of volatility.

The model is presumed to function in a two-period framework characterized by an unstable environment and transactions which are solely completed in the importers or exporters respective national currencies. The model essentially assumes that at the initial period (the first period), businesses accrue orders from the customers and place these orders to the respective suppliers/sellers for the imported goods. During the next period (second period), the goods are being received and suppliers are being paid while on the other hand, deliveries are made to the customers and payments are recorded. It is worth noting that these transactions are risky in many ways but this model actually assumes that the only source of uncertainty here is the future value of exchange rate while all other variables are kept constant. The model also assumes that the behavior of agents is characterized by a certain degree of risk aversion. This assumption is therefore what constitutes the essential foundation for the negative relationship between exchange rate risk and international trade.

2.2.1.1 Import Demand Function

In this model, it is assumed that the trade in (importing) firm produces final goods and the inputs utilized is an imported commodity. It is also assumed that the importer can hedge foreign exchange risk by purchasing foreign exchange forward and hedge commodity price and freight rate price by going long in futures markets (Zhang and Reed, 2006).

This model assumes that each importer faces a demand for its produces.

$$Q = aP + bPD + cY + dCU \quad ; \quad a, d < 0 \; and \; b, c > 0 \tag{2.24}$$

where

P represents the price of the produces

PD represents the price of other goods available in the economy

Y represents the household income

CU represents an index of rationing

This equation actually implies that the importer/importing firm is faced with a domestic demand for its output (Q) which is a function of its own price (P), prices of other goods available (PD), household/domestic income (PD) and an index of rationing (CU). Following this demand function, the importer now has to choose the level of production which maximizes his utility. The model assumes that agents are risk-averse and the profit maximizing equation will therefore be written as:

$$MAX\ EU = E(\pi) - \gamma[V(\pi)]^{1/2} \tag{2.25}$$

where

E represents the expected value operator

U represents the total utility

V represents the variance of the profit operator

γ represents the relative measure of the risk preference ($\gamma > 0$ implies risk aversion, $\gamma < 0$ implies risk taker and $\gamma = 0$ implies risk neutral.

In addition, as assumed by the model that that the firm receives orders for outputs and places the orders for its inputs in the first period while it pays and receives payments for its outputs in the second period, the importing firm has to define a level profits which is the difference between the total sales value and the cost of all factors of production. The profits of the firm can therefore be written as:

$$\pi = QP(Q) - UCQ - HP^{*}iQ \tag{2.26}$$

where

UC is the total unit cost of production

P^* represents the price of imported goods expressed in foreign currency

i represents the fixed ratio of imports to total production

$q = iQ$ represents the amount of imported inputs necessary to produce quantity Q and

H stands for the foreign exchange rate variable

The model also assumes that the imported commodity is debited in foreign currency and the importing firm has entrée to both foreign exchange and commodity future contracts. In other words, P^*Q is the total cost of imported inputs uttered in the currency of the exporter. Thus, to convert this into local currency, the cost of foreign exchange for the importer is multiplied by a weight (H). It will now depend on the currency in which the contract imports reads and the proportion of the deal which constitutes the subject of coverage of the foreign exchange market.

$$H = \beta[\alpha F + (1 - \alpha)R1] + (1 - \beta)F \qquad \textbf{(2.27)}$$

where

F is the forward exchange rate of the importer's currency per unit of the exporter's currency

$R1$ is the spot rate at the future payment date

$\alpha \; and \; \beta$ represent the parameters of the model and they are significant because they determine the extent to which the profits of the importing firm are exposed to exchange rate risk

B is defined as the proportion if imports denominated in the currency of the exporter

(1-β) represents the proportion of imports denominated in the currency of the importing firm

α represents the fraction of purchase inputs that the importing firm covers on the futures markets.

Hooper and Kohlhagen (1978) explained that on the date the contract is completed, a percentage of β of the imports is denominated in the exporter's currency whereas some fraction (1- β) is denominated in the importer's currency.

From the above equation, the following interpretations are arrived at:

1. The total cost of imports is identified with certitude in either one of the following cases. α=1 will reflect the state where all imports which are conveyed in the exporter's currency are hedged on the future markets. On the other hand, β=0 implies that the importing firm negotiated the deal for the acquisition of inputs in its own currency.

2. Regarding the deal of the importer, uncertainty comes in when the share of the contract (covered by the importer) is stated in the exporter's currency (β>0, $\beta \leq 1$) and for other reasons, its currency requirements are not met in the futures market.

3. The study also notes that the model undertakes the risky part of the contract (in addition to other payments delays) so that changes in exchange rates future spot (R1) will cause fluctuations in profits.

It is essential to note that all variables excluding R1 are presumed to be well-known with confidence on the contract date. In this regard, the risk to the importing firm is measured by the variance of its profits:

$$V(\pi) = (\theta P^{*} iQ)^{2}(\sigma^{2})_{R1} \quad \textbf{(2.28)}$$

where

$$\theta = \beta(1-\alpha)$$

$(\sigma^{2})_{R1}$ is the variance of R1

The above equation also assumes that COV (R1, P) =0 which implies that changes in the nominal exchange rates are not counterweight by changes in the price of the produces. The study however notes that this assumption tends to overestimate the degree and potential impact of exchange rate fluctuations on the price and volume of trade flows. This should therefore be inferred as a short term measure. Substituting equations (2.24) and (2.27) into (2.26) will yield an expression for π which will in its turn be substituted in equation (2.25) and (2.28). Following this, equation (2.25) will be differentiated with respect to Q. Hence, the following import demand function stated in equation (2.29) is arrived at:

$$Q = \left({}^{i}/_{2}\right)\{(aUC + bPD + cY + dCU) + aiP^{*}\ [E(H) + \gamma\theta\sigma_{R1}]\} \quad \textbf{(2.29)}$$

where

γ represents a very imperative parameter because it stands for the measurement of the degree of risk aversion. If it stands that agents like risks (this suggest that $\gamma < 0$), then the conventional argument of the negative relationship will not hold in this case and there will be positive relationship. If on the other hand, there is a neutral attitude towards risk, no relationship will holds.

a represents the sensitivity of demand for the produces compared to its prices (where a<0). The negative effect of exchange rate risk on imports will tend to be more significant than domestic demand is sensitive to price variations. Ultimately, an importing firm who would be a price taker in its domestic market and will ultimately tend to be very sensitive to any increase in exchange rate volatility.

$\theta = \beta(1-\alpha)$ stands for the exposure to exchange rate volatility. ($0< \theta<1$). An importing firm who trades exclusively in its own currency or who automatically covers itself on the futures market reduce its international transactions of risks associated to exchange rate fluctuations. On the other hand, the firm which makes its deals denominated in the currency of the supplier without covering itself on the futures market is fully exposed to fluctuations in exchange rate.

2.2.1.2 Export Supply Function

This model assumes that the entire production of the exporting firm is sold on the external market. The authors Hooper and Kohlhagen (1978) derived an export supply function where for instance an exporting firm is expected to sell a fraction (β) of its total productivity (output) q* at price p* and some other portion (1- β) at price RP* uttered in the currency of the importer. The firm thereby faces the demand of the entire market which consists of "X" corresponding importers and the market demand function is specified as: q*=nq.

Accordingly, the resulting export supply function is obtained.

$$q^* = {}^{ni}/_{2}\{(aUC + bPD + cY + dCU) + aiP^*[E(H) + \theta\delta(\sigma)_{R1}]\} \quad \textbf{(2.30)}$$

In lieu of this equation, the exporting firm maximizes a utility function similar to that of the importing firm, but the degree of risk aversion θ may possibly be not the same. Nevertheless, as the exporting firm does not use imported inputs, it is exposed to a high degree of exchange rate risk through its transactions. Ultimately, it becomes apparent the negative relationship between exchange rate volatility/risk and exports volume. It is worth noting that this negative relationship between the two macroeconomic variables is quite identical to that of the importer.

$$MAX_{q^*}^{U^*} = E(\pi^*) - \theta^*[V(\pi^*)]^{\frac{1}{2}} \quad \textbf{(2.31)}$$

θ^* is a measure of the degree of risk aversion of the exporter. From the above equation, the exporter is presumed to maximize his utility with a diminishing standard deviation of profits and a growing function of expected profits (π^*).

Regarding the exporter's profit function, it is identical to that of the importing firm apart from the fact that the exporter does not use imported inputs in the production. The profit function is therefore represented as follows:

$$\pi^* = q^*p^*H^* - q^*UC^* \quad \textbf{(2.32)}$$

UC^* is the domestic unit cost of production carried by the exporter, H* is defined as follows:

$$H^* = \beta + (1-\beta)R\left(\alpha^*/_F + 1 - \alpha^*/_{R1}\right) \quad \textbf{(2.33)}$$

H* denotes the amendments to the exporter's receipts denominated in its own currency. In addition to this, the exporting firm is supposed to hedge a portion α* of his foreign exchange exposure by selling forward exchange at the rate F.

Similar to the case of the importer, except for R1, all variables are known with confidence on the contract date and the risk incurred by the exporter is measured by the variance of its profits which is as follows:

$$V(\pi^*) = [P^*q^*(1-\beta)(1-\alpha^*)R]^2 \frac{\sigma_1^2}{R_1} \quad \textbf{(2.34)}$$

$\frac{\sigma_1^2}{R_1}$ stands for the variance of the exchange rate $\frac{1}{R_1}$

With different substitution into several equations and subsequent differentiation, the following export function is obtained:

$$q^* = \left[\frac{1}{\partial p^*/_{\partial q^*}}\right]\left[\frac{UC^*}{EH^* - \theta^*\delta^*(\sigma)_{1/_{R1}}} - P^*\right] \quad \textbf{(2.35)}$$

Lastly, after applicable operations of substitutions and differentiation, the theoretical model yielded the following equilibrium price and quantities:

$$P^* = \frac{UC^*}{2(EH^* - \theta^*\delta^*\frac{\sigma_1}{R1})} - \frac{aUC + bPD + cY + dCU}{2ai(EH + \theta\delta\ \sigma_{R1}} \quad \textbf{(2.36)}$$

$$q^* = \frac{ni}{4}(aUC + bPD + cY + dCU) + \frac{nai^2}{4}\frac{UC^*(EH+\theta\delta\sigma_{R1})}{(EH^*+\theta^*\delta^*\sigma_{R1})} \quad \textbf{(2.37)}$$

The above equations reveal that the equilibrium price and quantity are affected by the level of exchange rate risk encountered by the traders (importers and exporters).

Nonetheless, to empirically test the anticipated results based on the estimated model, the authors decided to use a linear approximation for each of the above equations and the following linear approximations were derived.

$$P^* = c_0 + c_1UC^* + c_2UC + c_3PD + c_4Y + c_5CU + c_6EH^* + c_7EH + c_8\delta^*\sigma 1/_{R1} + c_9\delta\sigma 1/_{R1} \quad \textbf{(2.38)}$$

$$q^* = d_0 + d_1UC^* + d_2UC + d_3PD + d_4Y + d_5CU + d_6EH^* + d_7EH + d_8\delta^*\sigma 1/_{R1} + d_9\delta\sigma 1/_{R1} \quad \textbf{(2.39)}$$

Based on this theoretical model, the coefficients c_1, c_3, c_4, c_8, d_3, d_4 and d_6 is supposed to be positive, whereas c_0 and d_0 have to be positive or negative while the remaining coefficients have to be all negative.

In brief, the model of Hooper and Kohlhagen (1978) predicts that an increase in exchange rate volatility will certainly reduce the volume of trade without having a sure effect on the price balance of trade. Actually, this effect depends on the relative degree of risk aversion of both the exporter and the importer.

In testing their own derived model, the authors utilized various measures of exchange volatility. Using data from 1965 to 1975, the authors empirically tested this relationship for both US and German trade flows alongside other trading partners taking into consideration how both importers and exporters retort towards risk. However, it is worth highlighting that the results obtained after estimation of these two equations revealed the existence of a negative relationship between exchange rate risk and price when the risk is sustained by the importing firm only. However, a positive effect was seen when exchange rate risk and price when the risk is sustained by the exporting firm.

Nevertheless, regardless of the theoretical expectations and the empirical results obtained in regards to prices, the authors seem not to have found a significant relationship between exchange rate volatility and international trade flows. The authors remarkably explained that the unexpected results obtained from their empirical analysis are due to the inelasticity of both the import and export supply functions in the short term. Accordingly, based on the authors, as the importing firm demand for tradable goods is elastic, the greater will be the impact the impact of exchange rate risk on trade.

To conclude, the model of Hooper and Kohlhagen (1978) maintains that an increase in exchange rate risk will decrease the volume of trade in respective of whether it is the importers or the exporters who bear the risk. The results of the analysis also revealed that the price of traded goods can change in either direction depending on who faces the risk.

Basically, the negative relationship between the volatility of exchange rate and the volume of trade flows is mainly based on this model of Hooper and Kohlhagen (1978) via the main assumption that the behavior of the trading agents is characterized by a certain degree of risk aversion. Furthermore, it is presumed that financial markets are imperfect so that firms are not able to fully protect themselves against unexpected changes in exchange rate. But despite the fact this model serves as a baseline theory to study the impact of exchange rate volatility on trade, it remains unsatisfactory and at times contradictory with respect to empirical results.

Until the year 1986, the majority of empirical studies have based their studies on the theoretical model proposed by Hooper and Kohlhagen (1978) to test the hypothesis of the negative effects of exchange rate volatility on trade. Taking into account the inability of this study (Hooper & Kohlhagen, 1978) to render a concrete answer to the main problem, other studies have attempted to present new hypotheses with respect to determining the exact connection between exchange rate volatility and international trade. In this regard, this study also reviews other related theoretical approaches.

2.2.2 De Grauwe (1988)

De Grauwe (1988) presents an alternative hypothesis different from the theory of Hooper and Kohlhagen (1978) which instead falls within the political economy of exchange rate variability. De Grauwe (1988) criticized the utility function proposed by Hooper and Kohlhagen (1978) and based on the work of Newbery and Stiglitz (1981) on the modern theory of production and consumption in a risky environment, the author shows that the impact of exchange rate volatility depends on the degree of risk aversion.

According to this author, an increase in exchange rate risk will result to both a substitution and an income effect. The author specifically shows that a high degree of risk aversion can push exchange rate volatility to have an expansionary effect on trade. De Grauwe (1988) derived a model and captures the essential ambiguity of the debate by modeling a competitive producer whereby he must decide between selling on the local or on the foreign market. By assigning a given amount of resources of the two activities (selling either on the domestic and foreign market), the author assumes that the barely source of uncertainty (risk) is the price gained in local currency for the output he sells in the foreign market. In doing that, the source of uncertainty is solely owed to the instability of exchange rates. Based on the two activities in the domestic and foreign markets, the total net profits of the competitive producer can be defined as follows:

$$\bar{\pi} = \left(\bar{p}_f q_f - w x_f\right) + \left(p_d q_d - w x_d\right) \quad \textbf{(2.40)}$$

$\bar{p}_f$ is defined as the price at which the output is traded on the foreign market (which is measured in local currency)

$\bar{p}_f$ is defined as the product of the value of exchange rate (e) and the price at which the output traded in the foreign currency is sold in the foreign country (P^*). It is mathematically represented as: $\bar{p}_f = e\, p^*$

p_d represents the price at which the output is sold in the domestic market

q_f and q_d respectively stands for the output produced for the foreign and domestic markets

x_f and x_d respectively stands for the resources utilized in the production of output in the foreign and domestic markets.

w is defined as the unit wage rate and is presumed to be identical in the two sectors.

The author further defined output as follows:

$$q_f = q\left(x_f\right) \quad \textbf{(2.41)}$$

$$q_d = q\left(x_d\right) \quad \textbf{(2.42)}$$

Substituting output in the total net profits equation and the price at which output is traded at the foreign market yields to the following profits equation:

$$\bar{\pi} = p^* \bar{e} q\left(x_f\right) + p_d q\left(x - x_f\right) - wx \quad \textbf{(2.43)}$$

As the author presumed wx to be a constant variable and resolve that, it should be released from the analysis, the total revenue $\bar{Y}$ is hence well-defined as:

$$\bar{Y} = p^*\bar{e}q(x_f) + p_d q(x - x_f) \quad \textbf{(2.44)}$$

The choice dilemma of the individual producer will therefore rests on deciding an x_f that will exploit the anticipated value of his total revenue $\bar{Y}$. That will be denoted as: $MAX\ EU\ (\bar{Y})$. From the above, Utility (U) is defined as a function of income $\bar{Y}$.

After substitution of the above maximization function into the total revenue function $\bar{Y}$, a new maximization function is obtained and is defined as:

$$MAX\ EU[p^*\bar{e}q(x_f)] + p_d q(x - x_f) \quad \textbf{(2.45)}$$

The author simplified the analysis and decided to separate the utility function in two distinct terms. Following that, the author also supposed that the marginal utility of the export revenue is not dependent to fluctuations in domestic revenue. The new utility function is therefore as follows:

$$MAX\ \left\{EU_f[p^*\bar{e}q(x_f)] + U_d\left(p_d q(x - x_f)\right)\right\} \quad \textbf{(2.46)}$$

After several manipulations, the optimal condition is denoted as:

$$\frac{d^2 U_f' \bar{e}}{de^2} = -\frac{1}{e}\left[R(1 - R) + R'\bar{Y}_f\right] \quad \textbf{(2.47)}$$

where $R = {U_f'' Y_f}/{U_f'}$ stands for the coefficient of risk aversion and $\bar{Y}_f = P^*\bar{e}q$ represents the export revenue.

From the above equation, it is assumed that if it stands to be positive or negative, the function $U_f'\bar{e}$ will be convex and concave in nature respectively. Considering that the degree of risk aversion (R) is commonly constant in the literature, the authors also assumed this coefficient to be constant in this case. In lieu of this, as R is constant, it will result that the convexity of the function $U_f'\bar{e}$ will only hold if R is greater than one (R>1) and on the other hand, concavity will hold if R is less than one (R<1).

The following deduction and economic intuition will therefore follow:

1. If the producers are sufficiently risk-averse, where the degree of risk aversion is greater than unity, then an increase in exchange rate uncertainty will elevate the marginal utility of the export revenue. This will result in an increase in the producer 'export activities.

2. If on the other hand, in a situation where the degree of risk-aversion is less than unity (a situation where the producers are not risk-averse), an increase in exchange rate uncertainty will reduce the marginal utility of export revenues. This will result in a decrease in export activities.

3. The very risk-averse persons tend to be concerned about the potential outcome. For this reason, when uncertainty (risk) escalates, they will export more to dodge the probability of deterioration in their returns.

4. The less risk-averse individuals are less worried with extreme effects. This category of persons is of the simple view that given an increase in uncertainty (risk), the profits on export activities will be less attractive and henceforth, they will resolve to export less.

De Grauwe (1988) highlights that the above conclusions and economic intuitions can be more comprehended if it is taken into cognition that a rise in exchange rate risk has both an income and a substitution effect. The author defines the occurrence of the substitution effect as a situation when an increase in exchange rate uncertainty is observed to shrink the attractiveness of uncertain activities and hence leads individuals to reduce their activities. On the other hand, an income effect takes place where; when exchange rate uncertainty increases, the expected total utility of export revenue drops. To conclude, De Grauwe (1988) points out that if the income effect dominates the substitution effect, higher exchange rate uncertainty (risk) will result to greater export activity.

The conclusion derived from the model of the De Grauwe (1988) is as follows.

Dropping the assumption of the coefficient of risk aversion being constant (R=0), hence Increased exchange rate risk will lead to:

1. Increasing exports if $R(1-R) + R'\bar{Y}_f < 0$

2. Less exports if $R(1-R) + R'\bar{Y}_f > 0$

After deriving the theoretical model, the author attempted an empirical assessment using bilateral trade flows among ten major industrial countries namely; Belgium, Canada, France, the Federal Republic of Germany, Italy, Japan, the Netherlands, Switzerland, the United Kingdom, and the United States. Using two sets of data from the period 1960 to 1969 and 1973 to 1984, the results approve that the long run variability in exchange rate significantly contribute to the slowdown in international trade. De Grauwe (1988) further accentuated that nearly 20 percent of the decline in international trade can be attributed to the substantial increase in exchange rate inconsistency. However, despite its great significance, the increase in real exchange rate variability does not stand to be the most essential factor that contributes to the increase in real exchange rates.

2.2.3 Clark (1973)

The model of Clark (1973) accounts also for one of the main core models developed in the area of exchange rate risk and international trade. The author established a model where he will be able to thoroughly investigate how a nation's exports level is shaken (affected) by exchange rate risk. In deriving the model, the author undertakes and considers a series of assumptions which are enumerated as follows:

- ❖ The firm in consideration is assumed to produce and be involved in the export trading activities of a unique identical product (denominated as *x*). Moreover, the firm is assume to function under strictly perfect competitive terms whereby he has no market power as per his resolution on the price level of the exported product to the international market as well as the exchange rate level.
- ❖ In addition, it is assumed that as the firm possesses no market power, it does not involve in the imports of goods which could be used in producing goods and therefore all which is produced is bound to be traded to the foreign market.
- ❖ 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 (*p*) and in return the competitive firm receives his profits/revenues in foreign cash of which afterwards he exchanges his incomes at the current exchange rate in the forward exchange market. It is important to accentuate that the exchange rate is neither constant nor stable, thus it varies at an irregular manner. It can therefore be referred as being volatile.
- ❖ Maturity is assumed to take place (90 days of maturity) on the forward exchange market. It is also presumed that the forward exchange rate is a random variable denoted by *f* which carries an expected value of E(*f*) and has a constant variance denoted by σ_f^2.

Considering the assumption that the competitive firm planning prospect is supposed to be longer than the maturity period, it is also taken into consideration that exchange rate values fluctuate and cannot be predicted in the future. Following this assumption, there will consequently be a continuous movement of export trading activities which will accordingly effect to an endless flow of income denominated in foreign currency. Moreover, it is assumed on the other hand that there is a flexible and a random flow in national (domestic) cash for the reason that this domestic cash of export deals is only known 90 days (maturity period) before the importer considers any payment. Subsequent to the above presumptions, Clark (1973) derived the following profit maximizing equation of the competitive firm as follows. He assumes the profits maximizing function (π) which is denominated in national currency in any of the maturity period is as follows:

$$\pi = fpx - C(x) \quad \textbf{(2.48)}$$

where $C(x)$ stands for the total cost function. It follows the assumption that the level of profits is free from casual instabilities only in the in the beginning but not in the succeeding 90 days period. Hence, after manipulation and the assumption that the equilibrium level of production is subject on the firm objective function, the new utility profit function is as follows:

$$U(\pi) = a\pi + b\pi^2 \text{ Where a >0, b}\geq 0. \quad \textbf{(2.49)}$$

The author also defines the expected utility profits as follows.

$$E[U(\pi)] = \int_{-\infty}^{\infty} U(\pi)\, g(f) df \quad \textbf{(2.50)}$$

As the author previously explained, the incredibility about imminent exchange rates thereby translates the instability about the upcoming revenues in national currency. Clark (1973) therefore established that if the competitive firm maximizes its profits and has a degree of risk aversion exceeding zero, the unique condition under which the firm can continue to produce goods for export trading activities is only when the firms' profits will exceed his total cost.

In conclusion, the theoretical model derived by Clark (1973) sustains that movement in exchange rates will probably lead to instabilities in the future prices which exporters will ought to pay or either receive.

2.2.4 Cushman (1983)

In the year 1983, Cushman provided an extension and a modification of the theoretical model derived by Hooper and Kohlagen (1978). Specifically, the author attempted to evaluate the consequences of exchange rate risk on the volume as well as the prices of trade. In so doing, the author utilizes the Hooper and Kohlagen (1978) model as a basis for the empirical work.

As mentioned in Cushman (1983), after several assumptions and mathematical derivations, Hooper and Kohlagen (1978) arrived at the simplified import demand and export supply functions:

$$Q = f(Y, CU, UC, UC^*, PD, EH, EH^*, \sigma_{R1}) \quad \textbf{(2.51)}$$

$$P_n^* = f(Y, CU, UC, UC^*, PD, EH, EH^*, \sigma_{R1}) \quad \textbf{(2.52)}$$

where

Q represents the volume of total exports

P_n^* is the nominal export price which is denominated in the exporter's currency

Y is the income in the importing country

CU represents importer's non-price rationing

UC, UC^* represents respectively the importer's and the exporter's unit cost

PD is the importer's domestic price level

EH, EH^* respectively represents the expected cost of foreign exchange for the importer and exporter

σ_{R1} is the standard deviation of the future spot rate.

Cushman (1983) therefore modifies the above model. The author presumed different assumptions compared to that of Hooper and Kohlagen (1978). Contrary to the previous model, Cushman (1983) instead assumes that the utility of the firm is not reliant on nominal earnings but rather on real profits. Moreover, unlike the model proposed by Clark (1973) about the planning horizon (the maturity period), Cushman postulates that the trading firm here under consideration has an extended planning horizon. The author explained that the reason for this lengthier horizon is because the trading is attracted not only to profits acquired at the present but also to future profits and contracts. The author made further assumptions that all the earnings and the prices within a nation are projected to grow at a mutual rate of inflation. Following this hypothesis, there is hence no alleged risk resulting from ambiguous movements in price levels within a nation. Additionally, it is also assumed that trading firms are of the common conviction that the prices of total exports will raise at the rate of inflation in the country that the currency is denominated.

While deriving the utility function, the assumption that the trading firm future profit function (in nominal terms) is adjusted (deflated) by the imminent national price level is made. In regards to the adjustment of variables to the price level, this will consequently cause all variables to be measured in real terms except for the exchange rate which follows a different calculation. The adoption of real variables in the model of Cushman (1983) is the main significant difference compared to the Hooper and Kohlagen (1983) model that focused more on the utilization of nominal variables. As exchange rate is not adjusted to inflation directly, it is calculated as the multiplication of the price of foreign currency and the ratio of foreign currency to domestic currency. The author therefore derives and explained the expected results of the adjustment of the foreign currency in expressed in denominated values. Based from the model of Hooper and Kohlagen (1978), the following were arrived at. The author assumed that let:

X stands for the imminent price of the importing firm's currency expressed in terms of the exporting firm's currency

$P_n and P_n^*$ represent the future price of exports (nominal values) in the importing and exporting firm currency, accordingly

$P_d and P_d^*$ is the future price levels of the importer and exporter respectively

q and q^* is the quantity of total exports, the prices of which are to be denominated in the importer's and exporter's respectively.

Following this, the importer's foreign currency cost expressed in real terms is as follows:

$$\frac{P_n^* q^*}{X.PD} = \frac{P^* q^*}{R} \quad \textbf{(2.53)}$$

On the other hand, the exporter's foreign currency cost denominated in real terms is represented as follows:

$$\frac{X.P_n q}{PD^*} = R.P.q \quad \textbf{(2.54)}$$

where

P is the total export price (expressed in real terms) denominated in the importer's domestic currency. $P = {}^{P_n}/_{PD}$.

P^* is the total export price (expressed in real terms) denominated in the exporter's currency.

$P^* = {P_n^*}/{PD^*}$

R is the real exchange rate. $R = {X.PD^*}/{PD}$

Considering that all variables have undergone the inflation process, Cushman suggests that the trading firm only faces risk in regards to unlikely movements in the real exchange rate. With this assumption made, the trading firm is expected to take its future real values as identical to the current real values. Consequently, the author breaks down the expected real exchange rate R stands for the exporting firm and ${1}/{R}$ for the importing firm as thus:

$$R = R_0.\theta \qquad \textbf{(2.55)}$$

where

R_0 is the existing recognized level of exchange rate value

θ is the uncertain growth rate of the existing value of exchange rate (R)

Cushman (1983) highlights the fact that the value θ is the unique undefined value in the analysis as it is equivalent to the indeterminate growth of the rate of exchange times the undefined rate of inflation.

The author defined the following conclusions:

1. If the value of θ equals to unity, then it is said that the PPP (purchasing-power-parity) is sustained.

2. If the value of θ is less than unity, it is said that than the exporting firm becomes less competitive and will therefore get its real profits to deteriorate.

3. If the value of θ is greater than unity, it is said that the exporting firm becomes more competitive and therefore get its real profits to appreciate.

On the base of Hooper and Kohlagen (1978) utility function, Cushman expressed the exporter anticipated variable as $E\theta$ whereas the importer anticipated variable is stated as $E\left[\frac{1}{\theta}\right] \cong \frac{1}{E\theta}$.

Moreover, the risk variable of the exporting firm is stated as $\sigma\theta$ whereas that risk variable of the importing firm is stated as $\sigma\left[\frac{1}{\theta}\right] \cong \sigma\theta$

Following this, it is assumed that if the variables R or $E\theta$ rise, trading in the future will appear to be more profitable to both the importing and exporting firms whereas the variable $\sigma\theta$ represents point to imminent riskiness.

After several manipulations, Cushman arrived at deriving both import demand and export supply functions which differ from that of Hooper and Kohlagen in that both functions fluctuate via movements in R and $E\theta$. The reduced form export quantity and export price equations are expressed respectively as follows:

$$Q = a_0 + a_1Y + a_2CU + a_3UC + a_4UC^* + a_5R + a_6M + a_7S + a_8D \quad \textbf{(2.56)}$$

From this export quantity equation, the coefficients a_1, a_5 and a_8 are expected to bear positive signs whereas the coefficients a_2, a_3, a_4, a_6 and a_7 are expected to be negative while a_0 is uncertain.

$$PX = b_0 + b_1Y + b_2CU + b_3UC + b_4UC^* + b_5R + b_6M + b_7S \quad \textbf{(2.57)}$$

From the above export price equation, b_1 and b_4 are expected to be negative while b_0, b_5, b_6, and b_7 are uncertain.

The above reduced models differ from that of Hooper and Kohlagen (1978) in that the variables Y, CU, UC, UC^* are all stated in real terms as well as other variables that have dropped and got replaced in the model.

After deriving the model, the author proceeded with the empirical examination. Cushman attempted to analyze the impact of real exchange rate risk on international trade in the US and fourteen trading partners over the period 1965 to 1977. The empirical results reveal that the long run expectation of an increase in real exchange rate will lead to a deterioration of the quantity of trade. In other words, the author confirms the existence of a negative relationship between exchange rate risk and international trade.

2.3 Exchange Rate Systems

2.3.1 Fixed Exchange rates

Arnold (2015) defined a fixed exchange rate system as a situation whereby a country's currency is set at a permanent rate relative to all other currencies and central bank authorities interfere in the foreign exchange market to sustain the fixed rate. When a country operates under a fixed exchange rate regime, its exchange rate is fixed and therefore it is not permitted to freely fluctuate on the market or to react to changes in demand and supply. On the foreign exchange market, central bank authorities act by selling and buying currencies and have the task of preserving the fixed exchange rate. Here is an example of how countries operate under the fixed exchange rate regime. The study assumes that there are two countries of Sub-Saharan Africa, Nigeria and South Africa who come to an agreement on having a fixed exchange rate of their currencies. In this system, the two countries do not allow the currencies to either appreciate or depreciate to each other but instead fixed a relative rate. For example the two countries may decide to agree upon 1Naira = 0.14Rand. This implies that a fixed exchange rate was agreed to be 0.14ZAR = 1Naira. The system of the gold standard is seen as the fitting example whereby countries were operating under a fixed exchange rate. This statement was confirmed by Baumol and Blinder (2011) who stated that the only time exchange rates were truly fixed was under the system of the gold standard. Kreinin (2006) on the other hand maintained that exchange rates were fixed was under the gold standard (1870-1914) and the Bretton Woods system (1870-1914). The following section explains the gold standard system.

2.3.1.1 The Gold Standard

Between the year 1870 and 1914, economies operated under the gold standard system. Under this standard/system, currencies from all countries were expressed in relation to gold. Government authorities therefore sustained a stable exchange rate between their currencies and gold. In other terms, under the gold standard, gold was openly used as money/means of exchange. Gold was being used in transactions where all values were stated in terms of the amount of gold needed in the purchase. The main purpose for the use of gold was that during that system, gold was a very scarce commodity with its supply being very limited. Because of the nature of its scarcity, gold was seen as a very safe asset by several shareholders as it was apparent that it cannot be damaged easily. Baumol and Blinder (2011) advocated that in a situation where a random country is undergoing a balance of payment deficit, the only way to eradicate it was to sell gold. The authors sustain that the motive why countries had to trade gold was for the reason that the local supply of currency was centered on gold. Regarding this, the study considers a situation where there exist only two countries in the whole world that operate under the gold standard. Considering two Sub-Saharan countries again, South Africa and Kenya. It is anticipated that South Africa and Kenya engage in trading activities where South Africa is an importer and is undergoing a trade balance deficit, while Kenya is an exporter and is instead facing a balance of trade surplus. As gold stands as the major means of payment here, in regards to the trade balance positions of the respective countries, this will entail that there will an outflow of gold from South Africa into Kenya as a method of payment. As South Africa will have less gold in its economy, this will induce a reduction in the money supply as under this system gold is identical to money. As the country was experiencing some deficit, the situation will result in a reduction in the price levels thereby causing a deflation/devaluation. Kreinin (2006) explained that by deflating the economy during periods of deficit, both the price and income mechanisms will exert a powerful balancing pressure. Consequently, this will discouraged imports and encourage imports. With the same reasoning, Kenya will be experiencing an influx of gold from South Africa. As more gold will he entering the economy, this will cause an increase in money supply which will in turn cause the price level to increase. The increase in price will cause Kenya's exports to become more expensive and imports becoming cheaper instead.

Several school of thoughts pointed several difficulties with regards to the gold standard. Firstly, it is said that under the fixed exchange rate system, as central banks acts on the foreign exchange market by buying and selling currencies to keep exchange rate fixed, monetary policy therefore becomes unsuccessful in influencing productivity and employment. Among others, Baumol and Blinder (2011) highlighted that the gold standard posed one severe difficulty which was that the world's trade was solely dependent upon gold discoveries. Despite the fact that the gold standard operated well, it however began to experience some difficulties and started being inefficient following World War I. The gold standard terminated in World War I.

2.3.1.2 The Bretton Woods System

The collapse of the gold standard and jointly damaging economic policies persuaded authorities that a fresh set of compliant economic and trade measures was essential to maintain world economic cooperation and success. Therefore, towards the end of the Second World War, a new international order was planned by the allied powers. Negotiations regarding the initiation of a new international monetary system were largely focused between Britain and the US. To this regard, in 1944, a final agreement on the new system was reached at Bretton Woods, New Hampshire, during a conference of Allied Nations. The subsequent global treaty is hence called the Bretton Woods system.

The Bretton Woods system was a system whereby countries were given the task of maintaining a fixed exchange rate regime with the United States. This system regime originated in the year 1944 with a total of 44 nations who came together in Bretton Woods, in the United States and initiated an international control of global monetary relations between nations. Kreinin (2006) defined the Bretton Woods as a post-World War II conference in Bretton Woods that established the system of fixed exchange rates, based on the dollar as the anchor and reserve currency. Planners of the Bretton Woods system main concern were to deal with the question of how to reconcile internal and external balance and how to limit international policy conflict. Hall et *al.* (2010) pointed that the Bretton Woods system had numerous objectives to attain. Amongst them, the authors cited that their form's main aim was to attempt to avoid the exchange-rate instability of the floating –rate regime of the 1920s. Also, it was highlighted that the Bretton Woods system was undertaken to provide some autonomy for national authorities to pursue domestic policies targeted at achieving full employment.

During the Bretton Woods system, gold did no longer pay an important role as under the gold standard. Instead, it was replaced by the "US dollar" and it was regarded as the core of the system where all currencies were pegged to the dollar at a fixed exchange rate. With the US dollar playing the core of the system, each nation's central bank was given the task of fixing the value of its currency relative to the dollar by either purchasing or vending of internal properties in exchange for the dollar. In sequence, the dollar was fixed to gold at a rate of $35 an ounce. In simpler terms, under the gold Bretton Woods system, the price of the US dollar was secure in terms of the gold (not to other currencies) while that of other currencies were fixed in regards to the US dollar. This system differs from that of the gold standard in the view that the Bretton Woods system was irregular, whereby only the US might adopt its specific monetary policy.

Following the adoption of the Bretton Woods system and to achieve its main goals for which it was created for, two novel international economic organizations/institutions originated namely the IMF (International Monetary Fund) and the IBRD (International Bank for Reconstruction and Development). The IBRD also known as the World Bank was established to provide loans, to finance reconstruction and development. On the other hand, the IMF was designed to promote international monetary cooperation and an orderly exchange rate system and to provide short term financial assistance to meet temporary balance of payment needs. Originally, the main conception under this system was ideally the arrangement of a compliant stable/fixed exchange rate system which will evade the inducement of countries suppliant to each other. Under this system, if a country was in difficulty (undergoing a deficit), instead of going through the route of devaluation of its currency, he was to seek financial assistance from the International Monetary Fund.

In a general view, the Bretton Woods system was successful. The system actually boosted and re-established international trade even though it also demonstrated some imperfections as in any fixed exchange rate regime. Baumol and Blinder (2011) justified that the Bretton Woods system, one which was assumed to fully operate under fixed exchange rates was not really a fixed exchange rate regime but instead one in which exchange rates were fixed till additional notice. The authors explained that under that regime, when a country was undergoing a deficit in its balance of payments, that country will devalue his currency relative to the dollar. In view of these imperfections revealed in the system, the system collapse in the early 1970s. Nevertheless, despite its failures, it recorded many advantages. Firstly, the Bretton Woods system brought in some confidence in trading activities as those involve in import and export would know with certainty at what price their currencies will be exchange for. Moreover, with the fixed exchange rate regime, depreciation of currencies was prohibited as all nations' currencies were fixed to one single currency.

With the collapse of the Bretton Woods System, the majority of countries worldwide adopted the floating/flexible exchange rate regime.

2.3.2 Flexible/Floating Exchange Rate

After the collapse of the Bretton Woods system, the international currency system has been a mixture of fixed and floating exchange rates (Kreinin, 2006). A Floating exchange rate is just the opposite of the fixed exchange whereby in this case, government and central bank authorities have immediate control over their supply of money and freely allow their exchange rates to adjust to demand supply forces. In this system, exchange rates are determined by the market forces of demand and supply. Therefore, government authorities do not interfere in the foreign exchange market so as to set the exchange rate. Johnson (1969) defined flexible exchange rates as rates that are determined daily by the market forces of demand and supply without restrictions imposed by governments. Broda and Romalis (2011) highlighted that a traditional criticism to flexible exchange rate regimes is that flexible exchange rates increase the level of exchange rate instability and reduces incentives for trade. Some authors even argue that under a flexible exchange rate system, exchange rates turn to be highly uncertain/volatile and very difficult to foretell.

Following the discussion on the two systems of fixed and flexible exchange rates, Griffiths and Wall (2011) described the main advantages and disadvantages of the two regimes and is described as follows:

Table 2.1: Advantages and disadvantages of fixed and floating exchange rates

FIXED EXCHANGE RATES	FLOATING EXCHANGE RATES
ADVANTAGES	ADVANTAGES

1. Exchange rate stability provides a realistic basis for expectations	**1.** Automatic eradication of imbalances
2. Stability of exchange rates encourages increased trade	**2.** Reduced need for reserves – in theory, no need at all
3. Reduced danger for international currency speculation	**3.** Relative freedom for internal economic policy
4. Imposes increased discipline on internal economic policy	**4.** Exchange rate changes to relatively smooth steps
5. Domestic price stability not endangered through import prices	**5.** May reduce speculation (rates freely up and down)
DISADVANTAGES	**DISADVANTAGES**
1. Requires large reserves	**1.** Increased uncertainty for traders
2. Internal economic policy largely dictated by external factors	**2.** Domestic prices stability may be endangered by rising import prices
3. No automatic adjustment-danger of large changes in rates	**3.** May increase speculation through coordinated buying or selling

Source: Griffiths and Wall (2011)

2.4 Exchange Rate Regimes in Sub-Saharan Africa

The choice of exchange rate regimes in Africa is mainly characterized by the choices they made at their respective time of independence. Regarding this, it is thus of essence to say that countries in Sub-Saharan Africa are mainly distinguished based on the exchange rate regime adopted. Following this, it has been observed that a variety of exchange rate regimes amongst SSA countries especially during the 1980s.

Observations have shown that compared to developed countries, the economic performance of the majority of Sub-Saharan African countries has been very mediocre. After the demise of the Bretton Woods system, it was greatly observed that many countries worldwide were affected by this change of regime. Maehle et *al.* (2013) justified that several countries in Sub-Saharan Africa have liberalized their economies, specifically in regards to their trade and foreign exchange rate regimes between the year 1980s and early 1990s. The authors also justified that before liberalization, the exchange rate regimes of the respective economies were categorized by administrative controls over foreign exchange allocation and widespread controlling of foreign exchange.

An immense range of exchange rate regimes is present today in SSA. Until the year 1970s, it is noted that the exchange rate policy had played an insignificant part in the balance of payments regulations in SSA countries. In this regard, majority of SSA countries therefore employed the fixed exchange rate regimes. Up to the year 1980, most of the countries in SSA have adopted the fixed exchange rate regime.

In examining the exchange rate regimes in SSA, the study notes country zones that adopted the floating exchange rate regimes and the other group of countries that maintain the fixed exchange rate system. In this regard, this study principally denotes the two groups of countries: Franc zone and the non-Franc zone countries. The Franc zone countries are frequently identified as the CFA (Communauté Financière Africaine) countries whereby the individual countries sustained a fixed exchange rate between their respective currencies and the European currency (Euro), supported by the French authorities. The majority of countries in the franc zone are countries which have heen formerly colonized by the French people. The CFA zone also entails of two distinct monetary unions of which each union has its own respective currency. The monetary unions are the UMOA (Union Monétaire Ouest Africaine) which is in the West of the CFA zone and the UDEAC (Union Douanière des Etats de l'Afrique Centrale) which is in the central of the CFA zone. The UMOA translated in English terms is the West African Economic and Monetary Union (WAEMU) while the UDEAC translated in English is the Central African Economic and Monetary Community (CAEMC). It is also noted that each of these monetary unions got his central bank that supply its own currency with a stable equivalence to the euro. Both currency issued by the respective central banks are generally referred as the CFA franc. Both currencies are distinct but not freely interchangeable, except via the euro convertibility that is guaranteed by the French treasury, which holds 65% of the pooled reserves of each area (Gudmundsson, 2006). Specifically, the BCEAO (Banque Centrale des Etats de l'Afrique de l'Ouest) is the central bank of UMOA of which it issues a single currency-the CFA franc for its respective countries. The countries that comprise the WAEMU monetary union are Benin, Burkina Faso, Ivory Coast, Mali, Niger, Senegal and Togo. After years have elapsed, these countries came to a common arrangement of expanding their economic link by adding an economic dimension to it. In lieu of this, BEAC (Banque des Etats de l'Afrique Centrale) also issues a sole currency to its respective countries which are Cameroon, Central African Republic, Chad, Congo, Gabon and Equatorial Guinea. The abovementioned countries have come to a mutual agreement between themselves and the French authorities whereby a fixed parity should be maintained between their currency and the French franc.

It should however be noted that the fixed parity maintained between the CFA countries and the French Franc lasted only between the year 1948 to 1994; whereby after this year, the CFA currency was devalued against the French Franc. In this regard, the Franc zone countries received some aid from the French government, and in spite of this, it was still necessary for some restrictive and protectionist measures to be adopted to boost back the Franc zone countries. It should be noted that initially, the common belief held was that being a member of the CFA zone would work in the favour of these member countries whereby they will experience an increase in their economic growth, and there will be a reduction in the necessity for economic adjustment. Specifically, the common agreement was that having a country's currency fixed to the euro would offer a positive stable atmosphere for both domestic and foreign investors of which this will contribute to the growth of the economy. However, all these speculations were not attained. Njinkeu and Bamou (2000) sustained that all countries in the CFA zone have experienced damaging external shocks since the 1970s. These external shocks have been mainly characterised by high interest rates, negative term of trade and negative effects of international crisis. The authors sustained the argument that CFA countries experienced these external shocks mainly because their respective economies are characterised by a poor domestic policy atmosphere alongside with a weak industrial base of which all these led to a worsening in the balance of payments, decrease in economic growth, high unemployment and loss of competitiveness in the global market. The poor performance of the CFA countries relative to the non-CFA zone countries brought into attention the benefits of being a member of the CFA zone. All these aforementioned negative shocks experienced by the CFA zone countries have contributed to the devaluation of the CFA franc in January 1994 by 50%. With the devaluation of the CFA franc, 1 French franc equals to 100 CFA Franc which corresponds to 1Euro equals to 655.957 CFA franc. It should be noted that the Euro was replaced to the French franc at the beginning of 1999. Mhemba (2011) sustained that since the 1994 devaluation of CFA Franc, growth has experienced some considerable variations within the CFA countries but the overall growth in GDP have decreased from 5% in 2008 to 1.6% in 2009.

The second group of countries which constitute the non-CFA countries adopted a floating exchange rate regime of which they experienced considerable fluctuations in their exchange rates. Sekkat and Varoudakis (1998) maintained the assertion that the switch to the floating exchange rate regimes facilitated the majority of non-CFA countries to achieve extensive exchange rate depreciation.

2.5 Review of the Empirical Literature

The main goal of this study is to investigate the impact of exchange rate changes and volatility on trade in Sub-Saharan Africa. In the previous paragraphs, the study discussed the main theoretical framework underpinning the effects of exchange rate changes as well as volatility on international trade. In this section, the main task is to review the existing literature pursuing to address the impact of the impact of exchange rate changes and volatility on international trade. This review of the empirical literature hence summarizes the relevant literature in regards to the impact of exchange rate changes and volatility not only in Sub-Saharan Africa but in other relevant countries as well.

2.5.1 Previous Studies of Exchange Rate Changes on Trade

Kodongo and Ojah (2013) investigated the relationship between real exchange rates and net cross-border trade and capital flows for Africa using annual observations for the period 1993 to 2009. The selected African countries under investigation in this study were Botswana, Cote d'Ivoire, Egypt, Kenya, Mauritius, Morocco, Nigeria, South Africa and Tunisia. In this study, the authors computed two separate equations (the real exchange rate and the trade flow equations). Real exchange rate, net trade flows (net foreign direct investment flows and net portfolio flows separately) were used as variables in this study. Using the Panel cointegration technique, the results confirmed the traditional trade balance theory which states that a real devaluation/depreciation of the currency will lead to an improvement in trade balance. In the same line, this study also takes cognition of the work done by Hsing (2008) who studied the J-Curve between the United States and seven South American trade partners. The countries under investigation were Argentina, Brazil, Chile, Colombia, Ecuador, Peru, and Uruguay. The author employed the vector error correction model technique to find the existence of a long run and short run relationship among the variables under study. In addition, the generalized impulse response function was also used to capture the response of trade balance to a shock in exchange rate depreciation. It is worth recognizing that the analysis was done for each of the eight countries separately. The results of the analysis confirmed the presence of a J-curve for Ecuador, Chili and Uruguay and there was no evidence of a J-Curve for Brazil, Argentina, Columbia and Peru. Following the results, the study concluded that the common argument that real exchange rate depreciation improves trade balance does not hold for all of the countries. Bahmani-Oskooee and Kantipong (2001) also investigated the existence of a J-Curve between Thailand and her five most trading partners which are Japan, Germany, Singapore, United States and United Kingdom. Over the quarterly period 1973 to 1977, the authors used the cointegration econometric technique to find existence of a J-Curve in these countries. Even this case, the analysis is performed for each country separately. The analysis revealed that a J-Curve pattern exist in the US and Japan.

Consistently like the previous studies aforementioned, this study will examine the effects of exchange rate changes in a set of countries in SSA. It should be noted that different from the previous studies mentioned, the analysis will not only focused on trade balance but all components of trade which are imports, exports and trade balance will be distinctly estimated. Despite the fact that this study also uses multiple countries, our methodological approach is different from the method of Hsing (2002) who conducted his analysis for each single country. This thesis follows the approach of Kodongo and Ojah (2013) that employed the panel data analysis. Despite its weaknesses, the analysis of panel data has several advantages over time series analysis in the sense that we can group all countries together and estimate only one single equation and avoid the cumbersomeness of estimating an equation for each and every country. Singh (2002) used a reduced-form trade balance model to analyse the effects of exchange rate and domestic and foreign incomes on the trade balance in India from the period 1960-1995. The study modelled trade balance as a function of real domestic income, foreign real income and three measures of exchange rates. Domestic income was proxied by real GDP while foreign income was proxied as an index of real world GDP. The results confirmed the significant role played by real exchange rate and real GDP in affecting trade balance meanwhile the world income plays a less significant role. The study further acknowledged the fact that the impact of exchange rate on trade differs depending on the type of exchange rate being utilized (nominal or real exchange rates).

Notwithstanding, the study also notes the work of Wang et *al.* (2012) who examined the J-Curve hypothesis and the long-run trade balance effect of real exchange rate between China and its eighteen major trading partners using a panel dataset over the period 2005–2009.

Using the panel cointegration test, the authors modelled trade balance (defined as the ratio of real exports to imports) as a function of real income of trading partners, Chinese real income and real bilateral exchange rate. The results affirm that a real appreciation of the Chinese Yuan has a decreasing long run effect in 5 of the 18 trading partners. With mixed and confusing results found in this study, it was therefore concluded that the real appreciation the Chinese currency has no general significant long-run impact on China's trade balance.
Narayan and Narayan (2004) also employed a reduced form trade model to explore the reality of a J-curve occurrence in Fiji. The ARDL (Autoregressive-Distributed Lag) technique was used to test if a long run relationship is present among the variables. The tests confirm that a real depreciation of the exchange rate will improve the trade balance while in the short-run it will be aggravated (existence of a J-curve effect).

Petrović and Gligorić (2010) conducted a study to determine whether in the case of Serbia, a depreciation of the exchange rate will improve the trade balance or whether an appreciation will deteriorate the trade. Using monthly data from January 2002 to September 2007, the authors used the Johansen technique and the ARDL approach to test the hypothesis that exchange depreciation will increase trade or vice versa. Following the analysis, the results confirm that a long run cointegration analysis is present in Serbia. The authors went in to further confirm that the Marshall-Lerner condition is found to be true in Serbia as the results maintain that a one percent increase in exchange rate depreciation will lead to a 0.92 to 0.95 percent improvement in trade balance. The existence of a J-curve was also seen to exist in Serbia as an increase in exchange depreciation was revealed to worsen trade in the short-run. Nonetheless, Hameed and Kanwal (2009) endeavoured to study if the J-curve phenomenon was found to be existent in Pakistan and ten of his major trading partners specifically UK, US, Germany, France, Singapore, Netherlands, Korea, Japan , Italy and Canada. Quarterly data from 1972 to 2003 was used in the vector error correction model. The study confirmed that the Marshall-Lerner condition stating that a devaluation of a country's currency increase its trade balance holds but the study however fails to identify a J-curve effect. A study conducted by Akonji et *al.* (2013) also supports the J-curve occurrence in the Nigerian economy. Through annual data from 1980 to 2010, the authors used the cointegration technique and the results approve a J-curve to exist but failed to sustain the existence of a long run relationship.

Following the literature on other countries, it is important to mention studies that were done specifically in Sub-Saharan Africa. In regards to this, the study takes cognition of Rawlins and Praveen (1993) who attempted to examine the connection between currency depreciation and trade balance in selected Sub-Saharan African countries. By the use of a standard econometric model, the authors used 19 Sub-Saharan countries and the results of the analysis confirm that exchange rate changes does indeed improve the countries' trade balance in the period of devaluation. The results were however confirmed in 17 out of the 19 countries under investigation. Rawlins (2011) investigated the relationship between currency depreciation and trade balance in Sub-Saharan Africa. The authors employed a bilateral approach where he uses a panel of 21 Sub-Saharan countries with four industrialized countries namely US, Britain, Japan and France. Using the panel cointegration analysis over the period range of 1995 to 2005, the author came to the conclusion that currency devaluation would be an effective policy tool in reversing the precarious balance of payment situation facing most of these countries. Likewise, this thesis aims at discovering the relationship between exchange rate changes and trade in Sub-Saharan Africa. This study also employs the panel data approach for its main applicability of dealing with large data sets. However, this study does not employ the bilateral approach as it was utilized by Rawlins (2011) as it is not our main to consider the relationship of exchange rate changes and trade with respect to other major trading partners. Also, compared to Rawlins and Praveen (1993), this study incorporates more Sub-Saharan African countries to aim at more significant results.

Notwithstanding, this study acknowledges the study conducted by Yol and Baharumshah (2007) which examined the impact of exchange rate changes on the bilateral trade of ten Sub-Saharan African countries with respect to the US. The authors employed the panel cointegration analysis and the Fully-Modified Ordinary Least Squares (FMOLS) over the period 1977 to 2002 with the exception of Nigeria and Uganda which involves fewer observations. It is important to emphasize that the authors estimated on one hand individual equations for each of the countries and on the other hand a unique equation for all the countries using the panel approach. The results of the analysis show that real exchange rate depreciation improves trade balance in six countries over the ten under investigation. The results also revealed that Tanzania on its side instead show a negative impact while Ghana, Morocco and Senegal was found with no significant effect.

It is apparent that since the incident of the Bretton Woods, this topic has benefited a considerate level of attention. Despite the vast literature, the exact direction of the effects of exchange rate changes is not known, be it in the long-run or in the short. Though the theory revealed the direction and the degree of influence of exchange rate changes on trade, it is worth emphasizing that empirical studies tend to differ a lot in their respective analysis. More specifically, while some studies found that the Marshall-Lerner theory holds in their case, other studies fail to establish this affirmation. As a result, that shows there is no clear direction in the literature regarding the direction of exchange rate changes and trade. The literature has shown studies to be conducted mainly where a single country is involved and the popular technique of cointegration analysis continually being used in this type of study. However, it is also taken into cognizance other studies which were conducted and incorporated several countries in their analysis (two to ten countries), but still used the cointegration analysis or other time series techniques specifically for the main reason that these studies adopted a bilateral approach. As a result of this, the analysis was done on each and every country under consideration and was accordingly separately interpreted. This thesis differs from other studies in this area in several ways. This thesis takes into account the whole region of Sub-Saharan African countries. However, due to the lack of available data for some countries, these respective countries were omitted from the analysis and hence this study is limited to 39 countries. If the analysis has to be done for each and every country, it will be very cumbersome and will involve a lot of confusion following the many equations that will need to be investigated. In lieu of this, this thesis employs the technique of panel data which has the capability of combining the data of all the countries into and estimating only one equation for the whole Sub-Saharan region.

2.5.2 Previous Studies on Exchange Rate Volatility on Trade

Following the breakdown of the Bretton-Woods system, the switch from a fixed to a flexible exchange rate system has created instabilities in exchange rates which have led to the investigation of the extent to which trade flows are affected by the volatility in exchange rates.

Many less-developed countries, specifically Sub-Saharan African countries have been undergoing trade discrepancies for decades. The universal perception is that exchange rate volatility and trade flows follow a negative trend. A vast amount of literature exists on the relationship between exchange rate volatility and trade. Several studies have conducted studies modelling the relationship between these two variables (exchange volatility and trade) using different types of econometric techniques. Despite much debate around this area of study, there is still no consensus that has been reached with regard to the impact of exchange rate volatility on trade. In addition, while this study recognises the vast amount of literature dedicated to this area of study, it is worth acknowledging that the majority has been directed to developed economies as compared to developing countries.

Several empirical studies have investigated the impact of exchange rate volatility on trade both theoretically and empirically. Despite the vast research on the topic, still no general unanimity seemed to have been reached. The literature reveals diversified outcomes making this topic an empirical query which still needs to be researched. While some studies revealed exchange rate volatility to be positive on trade, other studies revealed exchange rate volatility to be negative with trade on the other extreme while other studies revealed exchange rate volatility and trade to be insignificant.

Erdal *et al.* (2012) conducted a study to investigate the effects of exchange rate volatility on trade in Turkish with a special emphasis on the agricultural trade sector. Specifically, the authors modelled the relationship between exports/imports and real exchange rate volatility using the Johansen cointegration approach from 1995 to 2007. The granger causality test was also employed to determine the direction of the causality between the variables under study. The results of the analysis described that there exists a long term relationship between imports and real exchange rate volatility. The study further came to the conclusion that increase in exchange rate volatility will stimulate exports and decrease imports in the Turkey economy. Notwithstanding, the study also concedes the work of Arize et *al.* (2008) who empirically investigated the impact of real exchange volatility on exports in a sample of 8 Latin American countries over the period 1973-2004. Cointegration and error-correction techniques were utilized in this study to investigate the long-run and short-run relationship between the variables respectively. The variables used in this study were exports, world demand condition, relative prices and exchange rate risk. Following the unavailability of the data on these variables, proxies were used. The study notes that variables such as world demand condition was proxied by "real world income" while exchange rate volatility was proxied and computed following the Engle model (presently known as the ARCH model). The results of the analysis reveal the existence of a statistically negative relationship between exports and exchange rate volatility both in the long and short run for the 8 Latin American countries under study. Consistent with these studies, this thesis also investigates the connection between exchange rate volatility and trade in the case of Sub-Saharan Africa. Relatively, variables such as exports, imports, and measures of exchange rate risk are employed in this study to measure the effect of these variables on trade.

The study also acknowledges the work of Nazlioglu (2013) who conducted a study to investigate the impact of exchange volatility on Turkey's exports from top 20 export industries to 20 major trading partners. The author used a panel cointegration analysis for the period 1980-2009. The author used export volumes, real income (GDP was used a proxy), bilateral real exchange rate and volatility. The analysis concluded that the impact of exchange rate volatility on Turkish exports differs across industries. Similarly, because of the large set of countries involved, this study employs utilizes the same methodology of the panel data analysis to determine a long run trade balance equation for Sub-Saharan African countries.

Like many other studies, Bahmani-Oskooee et *al.* (2012) assert that despite the numerous empirical studies on exchange rate volatility and trade, a universal agreement of whether this uncertainty reduces trade flows have not been reached. This study employs the ARDL cointegration technique of Pesaran et *al.* (2001) using annual data from 1965-2006 to examine US exports to Korea for 96 individual industries. The study concluded that exchange volatility has significant short-run effects on most industries' exports and imports.

In addition, Nishimura and Hirayama (2013) conducted a study to investigate whether exchange rate volatility deters Japan-China trade. Two measures of exchange rate volatility was used in this study explicitly the simple standard deviation method and the EGARCH (Exponential Generalized Autoregressive Conditional Heteroskedasticity) method. The authors used the ARDL model and assessed the effects of macroeconomic variables on China's and Japan's exports both in the long-run and the short-run. The results of the analysis revealed that Japan to China's exports are not significantly affected by the volatility while on the other hand, China to Japan's exports was seen to be affected by the volatility.

Koray and Lastrapes (1989) utilized the vector autoregressive method to investigate the impact of real exchange rate volatility on US imports. A measure of volatility was accounted for in this study and following the analysis, the results revealed the existence of a weak relationship between exchange rate volatility and trade.

Aside the immense literature on this topic, it is important to note that these studies most often differ vis-a-vis the data (variables) being used. It has been observed in the literature that in modelling the relationship between exchange rate and trade balance, different exchange rate variables are being used. The study identifies the use of a simple real exchange rate (which is the nominal exchange rate deflated by its relative price) and the exchange volatility measure. Chit et *al.* (2010) conducted a research on the effects of exchange rate volatility on exports among emerging East Asian economies. The study modelled the volume of real exports on a number of explanatory variables of which the exchange volatility was accounted for. Mckenzie (1998) estimated the effects of exchange rate volatility on trade flows in Australia. The author asserted that based on the traditional trade theory, trade is a function of domestic income, foreign real income, real exchange rate and volatility. However, it is important to emphasize that not all studies incorporate "volatility" as one of the explanatory variables probably due to the fact it is difficult to measure/estimate it. A number of studies have however used proxies to account for volatility. Chit et *al.* (2010) sustained that there is indeed no universal unanimity in regard to the most suitable proxy to characterize volatility. Measuring volatility has developed over time to reveal new progresses in econometric methods although a clearly dominant method has not yet been reached. Mckenzie (1998) points the fact that it is important to capture volatility as it is uncertainty in the exchange rate which constitutes the volatility and the changes in exchange rate fail to fully capture the "uncertainty" element embodied in the changes in exchange rates.

However, this study notes that three common proxies are generally being used to account for exchange rate volatility. The first proxy mostly found in the literature to capture volatility is the moving average standard deviation of the real exchange rate. The study takes cognition of the work of Bahmani-Oskooee and Kovyryalova (2008), Héricourt and Poncet (2013), Nicita (2013) who used the standard deviation measure as a proxy to account for exchange rate volatility. One of the most common proxies found in the literature to measure exchange rate volatility is the GARCH (Generalized Autoregressive Conditional Heteroskedasticity) method. The GARCH approach in measuring volatility has gained a lot of popularity in recent years and stands now as one of the most common technique for measuring volatility. Following the trend in the literature, this study also employs these two common measures of volatility namely the standard deviation and the GARCH volatility measures. In addition, for more robustness, this study employs another method of measuring exchange rate volatility namely the Hodrick-Prescott-Filter (henceforth HP-Filter) approach. The HP-Filter method used in capturing exchange rate volatility has been very popular in the literature and thus, this study brings novelty by measuring volatility by the HP-Filter method. It should be noted that this study uses these different measures of volatility simultaneously to make the study robust as the literature is very silent regarding the most appropriate exchange rate volatility measure.

Following the literature survey, it is rational to affirm that a huge amount of attention has been given to the investigation of the impact of exchange rate volatility on trade in developed economies meanwhile the concern has been neglected in developing economies. Because of the more attention diverted to developed economies compared to developing economies and specifically African economies, there is no conclusive consensus as to how African trade flows react to exchange rate volatilities. The lesser consideration of this topic in Africa has brought ambiguity regarding the response of trade due to exchange rate volatilities. The study however mentions some studies who attempted to research this relationship in Africa. Sekkat and Varoudakis (2000) attempted to empirically assess the impact of exchange rate policy on manufactured export performance in a panel of 11 Sub-Saharan African countries using annual data from the period 1970-1992. Specifically, this paper attempts to provide evidence of the impact of real effective exchange rate changes, the impact of volatility and the impact of misalignment on exports. Sekkat and Varoudakis (2000) study is more interesting when it challenges to gauge this impact at a sectorial level and provide a distinction between CFA countries (countries which have 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 Sub-Saharan Africa is impacted by changes in real effective exchange rate and exchange rate misalignment. Notwithstanding, another interest 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. Notwithstanding, in later 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 evident by the real exchange rate misalignment and volatility.

Musila and Al-Zyoud (2012) explored the impact of exchange rate volatility on international trade flows in a sample of 42 Sub-Saharan African countries using annual data from the period 1998-2007. Using the gravity model, the authors found the existence of a significant negative relationship between exchange rate volatility and trade (both imports and exports). Ghura and Greenes (1993) also conducted an analysis to determine the relationship between real exchange rate and macroeconomic performance in Sub-Sahara Africa. Using data for 33 Sub-Saharan African countries, the authors confirmed the existence of a negative relationship between real exchange misalignment and economic performance. Furthermore, Arize et *al.* (2000) analysed the effect of exchange volatility on foreign with evidence from thirteen less developed countries. The authors used the error correction technique to conduct this analysis over the quarterly period 1973-1966. It is important to note in this study that the countries under investigation were a mixture of developing countries in both the African and Asian continents. In addition to that, despite the large number of countries under investigation, the econometric analysis conducted was done for each and every country separately. The results of the analysis suggested that a negative and significant long-run relationship between exchange rate volatility and exports flows in the 13 countries under investigation. The authors further affirm that there was a significant short-run effect of exchange rate volatility on trade.

This study also takes into account studies that were conducted in Africa in a single country framework. It is acknowledged that this topic has gained a lot of importance particularly in Nigeria. Regarding this, this study acknowledges the work of Adeoye and Atanda (2012) who studied the consistency, the persistency and the degree of volatility of exchange rate of the Nigerian currency vis-a-vis the dollar. The authors used monthly time series data from 1986 to 2008. The ARCH (Autoregressive Conditional Heteroskedasticity) and the GARCH models were used as the measures of volatility. On the same note, Dickson and Andrew (2013) analysed the effect of exchange rate volatility on trade imports in Nigeria. The authors utilized the standard error correction technique and the results revealed that exchange rate risk 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 & Omojimite (2009), Imoughele and Ismaila (2015).

Notwithstanding, Ekanayake, Thaver and Plante (2012) investigated 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. The study also revealed a mixed up effect of exchange rate volatility on imports in the long and short run. 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 movements in exchange rate. 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.

Following the extensive literature review on this topic, it is evident that while some few attempted to give some attention in Africa, specific studies in Sub-Saharan Africa appears to be limited in number. Musila and Al-Zyoud (2012) stands among one of the unique studies to consider the whole SSA, this study therefore adds to the literature of SSA by investigating how trade retorts to volatilities in exchange rate in Sub-Saharan Africa. The literature has also revealed that many studies have been conducted in a single country analysis and very few have attempted to conduct such studies in a multiple country analysis (panel data). This study will also contribute in investigating such a relationship in a panel data framework which will take into account a large set of Sub-Saharan African countries. However, it is of great importance to highlight that similar to the work of Seddak and Varoudakis (2000), this study will attempt to provide a comparative analysis. Explicitly, this study will conduct a separate analysis of the impact of exchange rate changes and volatility distinguishing between the distinct trade blocs present in SSA. The trade blocs taken into consideration in this study are the EAC, CEMAC, ECOWAS and SADC trade blocs.

CHAPTER 3

MODEL SPECIFICATION, METHODOLOGY AND DATA

3.1 Introduction

In the previous chapter, the theoretical framework and empirical literature underpinning the impact of exchange rate changes and volatility on international trade was provided. The present chapter however gives a presentation and the specification of the different econometric models to be estimated in this thesis. In addition to the models, this chapter also gives a description and a justification of the different data used. Precisely, the estimation technique combined with the different tests that will be used is introduced. The estimation techniques used in this study is the panel data analysis which is a combination of both times and cross-sectional analysis. The main reason why the panel data analysis is used in this study is because of its main advantage of combining time series and cross-section data. It also overcomes the problems of limited observations of data. Moreover, it counters for bias which can arise as a result of omitted variables.

3.2 Model Specification

In this section, a detailed description of the variables employed to build the empirical model is provided. The variables utilized in this model are guided by the theoretical and empirical literature described in the previous chapter. Specifically, based on the evidence set in the previous chapters, this section provides the model that will be estimated. The estimated model assisted in answering the main research questions of this research which is "what is the impact of exchange rate changes and volatility on international trade in Sub-Saharan African countries".

Before the estimated model is discussed, it is important to highpoint that the majority of studies that attempted to model the relationship between exchange rate changes as well as volatility and trade adopted the elasticity approach. To recall, modeling trade using the elasticity approach is estimating trade as a function of exchange rate and income (both domestic and foreign). However, this thesis notes the study conducted by Duasa (2007) who adopted a slightly different approach compared to other studies. Unlike other related studies, Duasa (2007) estimated the trade model with the inclusion of money supply as an independent variable in the model. The main essence of this variable was to account for both the monetary and absorption approaches to the balance of payments which other studies failed to do. In other words, the traditional model of trade was expanded. With the application of the ARDL cointegration approach, Duasa (2007) found the existence of a positive insignificant relationship between trade balance and exchange rate. Moreover, the author also found the existence of a negative relationship between trade and the money supply. The interesting part of the study is that the outcome was consistent with the monetary and absorption approach to the balance of payments. As mentioned in the previous chapters, international trade consists of components such as imports, exports and trade balance. While many studies concentrated only on exports, or imports or trade balance individually, this thesis estimates the three equations individually which contributes in making this study more robust in regards to previous studies.

As trade constitutes a major component that contributes to the economic well-being of a country, this study analyses and investigates the effects and the direction of the impact of exchange rate changes and volatility on trade in Suh-Saharan African countries. Based on theory and literature, a number of variables were considered in this study. Following the extensive review of the theoretical and empirical literature in the previous chapter, the relationship between exchange rate changes and volatility on trade is respectively presented in the following sections.

3.2.1 Model Specification for Exchange Rate Changes and Trade

Based on the theoretical framework, the standard import equation with regards to exchange rate changes is specified as follows:

$$M_{it} = f\ (Y_{it}^{d}\ , RP_{it}) \quad \textbf{(3.1)}$$

The standard export equation is therefore of the form:

$$X_{it} = f(Y_{it}^{f}\ , RP_{it}) \quad \textbf{(3.2)}$$

The trade balance equation is of the form:

$$TB_{it} = f\ (Y_{it}^{d}\ , Y_{it}^{f}, RP_{it}) \quad \textbf{(3.3)}$$

where

M_{it} = Total value of imports in country i at period t

X_{it} = Total value of exports in country i at period t

TB_{it}= Trade balance which is usually calculated as the difference between exports and imports (X_{it} - M_{it})

Y_{it}^{d}= Domestic income which is often measured by the domestic GDP

Y_{it}^{f}= Foreign income is often measured by foreign GDP and G7 industrial production index. Real GDP of the major trading partner is most often used as a proxy to account for foreign income. Nevertheless, some studies are found to have used US GDP as a proxy of foreign income as USA accounts for the most significant trading partners in many countries and particularly Sub-Saharan Africa in our case. In this study, GDP of the major importing country is also used as a proxy (USA is mostly used; Shawa and Shen, 2013). In addition, the G7 industrial production index is also used as a proxy for foreign income. In conclusion, the two variables namely the US GDP and the G7 industrial production index will account for foreign income.

RP_{it}= Relative prices which is proxied as the log of real exchange rates.

It is also noted that the majority of studies have used this basic trade relationship in investigating the impact of exchange rate changes on trade. Some studies however incorporated other variables which may affect a country's trade balance alongside the variables suggested by the theory. As previously stated Duasa (2007) incorporated money supply (proxied as M3) in the estimation of his trade equation. Shawa and Shen (2013) used a large set of variables in the estimation of trade balance determinants in Tanzania. Not exclusively, the study notes variables such as foreign direct investment, government expenditures, household consumption expenditures and inflation. Despite the fact that many studies depict the use of the standard variables in the estimation of their model, the study divulges that there are indeed other variables which affect the imports, exports and trade balances of a country.

This study contributes to the research on this topic by incorporating variables other the regular variables in the different models. In spite of the standard variables which are domestic income, foreign income, and relative prices; this study added another variable in the model to cater for the monetary approach to balance of payments. Money supply (of which M2 shall be used as a proxy) will be incorporated in the model.

The models of exchange changes (imports, exports and trade balance) utilized in this study will therefore be of the form:

$$M_{it} = f\ (Y_{it}^{d}, RP_{it}, M2_{it}) \quad \textbf{(3.4)}$$

$$X_{it} = f(Y_{it}^{f}, RP_{it}, M2_{it}) \quad \textbf{(3.5)}$$

$$TB_{it} = f\ (Y_{it}^{d}, Y_{it}^{f}, RP_{it}, M2_{it}) \quad \textbf{(3.6)}$$

where

M_{it} = Total value of imports in country i at period t

X_{it} = Total value of exports in country i at period t

TB_{it}= Trade balance which is Exports - Imports

Y_{it}^{d}= Domestic income (GDP will be used as a proxy for this variable)

Y_{it}^{f}= Foreign income (GDP of trading partners-USA and G7 industrial production index will be used in this case).

RP_{it}= Relative prices in country i at period t expressed as the logs of real exchange rates

$M2_{it}$ = Money supply in country i at period t

Based on the previous equations, after incorporating the respective proxies, the individual regression equations of imports, exports and trade balance will therefore be of the following form:

$$\boldsymbol{LM_{it} = \beta_0 + \beta_1 LGDP_{it} + \beta_2 LRER_{it} + \beta_3 LM2_{it} + \epsilon_{it}} \quad (3.7)$$

$$\boldsymbol{LX_{it} = \beta_0 + \beta_1 LUSGDP_{it} + \beta_2 LG7I_{it} + \beta_3 LRER_{it} + \beta_4 LM2_{it} + \epsilon_{it}} \quad (3.8)$$

$$\boldsymbol{LTB_{it} = \beta_0 + \beta_1 LGDP_{it} + \beta_2 LUSGDP_{it}, \beta_3 LG7I_{it} + \beta_4 LRER_{it} + \beta_5 LM2_{it} + \epsilon_{it}} \quad \textbf{(3.9)}$$

where

LM_{it} = Logs of total value of imports in country i at period t

LX_{it} = Logs of total value of exports in country i at period t

LTB_{it}= Logs of trade balance in country i at period t

$LGDP_{it}$= Logs of domestic GDP in country i at period t

$LUSGDP_{it}$= Logs of foreign (US) GDP in country i at period t

$LRER_{it}$= Logs of real exchange rates in country i at period t

$LG7I_{it}$= Logs of G7 industrial production index in country i at period t

$LM2_{it}$= Logs of money supply in country i at period t

The variables in the regression here are denoted in terms of their natural logarithms so that the coefficients can be easily interpreted in terms of their elasticity.

It is of great importance to highlight that in this thesis, there is lack inconsistent data on real exchange rates (also real effective exchange rates) for the countries under consideration. The study acknowledges the fact that real exchange rate is the best proxy to use to account for the relative prices, but the lack of available data leads to the modification of the respective models specification. Specifically, in lieu of having real exchange rate in the models, nominal exchange rates and inflation rates are both incorporated in the models to correct the flaw. In addition to the fact that this thesis would instead use nominal exchange rates instead of real, it is also evident that the estimated volatility measures were derived using nominal terms. The thesis recognizes that indeed the use of real exchange rates would be best, but unfortunately the lack of inconsistent data does not permit to do so. Clark et *al.* (2004) stated that as nominal and real exchange rates have a tendency of closely moving together, the decision to use either one of them is not likely to affect the estimated results. Nevertheless, the authors affirmed that the use of real exchange rates as compared to nominal exchange rates is more desirable on theoretical grounds.

In regards to this, the respective models to be estimated in this thesis are as follows:

$$\boldsymbol{LM_{it} = \beta_0 + \beta_1 LGDP_{it} + \beta_2 LNER_{it} + \beta_3 INF_{it} + \beta_4 LM2_{it} + \epsilon_{it}} \quad \textbf{(3.10)}$$

$$\boldsymbol{LX_{it} = \beta_0 + \beta_1 LUSGDP_{it} + \beta_2 LG7I_{it} + \beta_3 LNER_{it} + \beta_4 INF_{it} + \beta_5 LM2_{it} + \epsilon_{it}} \quad \textbf{(3.11)}$$

$$\boldsymbol{LTB_{it} = \beta_0 + \beta_1 LGDP_{it} + \beta_2 LUSGDP_{it} + \beta_3 LG7I_{it} + \beta_4 NER_{it} + \beta_5 INF_{it} + \beta_6 LM2_{it} + \epsilon_{it}} \quad \textbf{(3.12)}$$

The variables in the regression (inflation rate) here are denoted in terms of their natural logarithms so that the coefficients can be easily interpreted in terms of their elasticity.

3.2.2 Model Specification for Exchange Rate Volatility and Trade

The empirical model of exchange rate volatility follows the same reasoning like that of exchange rate changes. In lieu of this, the models for exchange rate volatility and trade (imports, exports and trade balance) utilized in this study are given in the following paragraphs. It is worth emphasizing that these models differ from the previous models (exchange rate changes on trade) in that a measure of exchange rate volatility is now accounted for. So the main focus here shall be to determine the effects of exchange rate volatility on exports, imports and trade balance respectively.

$$M_{it} = f\ (Y_{it}^{d}\ , RP_{it}, M2_{it}, Vol_{it}) \quad \textbf{(3.13)}$$

$$X_{it} = f(Y_{it}^{f}\ , RP_{it}, M2_{it}, Vol_{it}) \quad \textbf{(3.14)}$$

$$TB_{it} = f\ (Y_{it}^{d}\ , Y_{it}^{f}, RP_{it}, M2_{it}\ , Vol_{it}) \quad \textbf{(3.15)}$$

where

TB_{it}= Trade balance which is Exports - Imports

Y_{it}^{d}= Domestic income (GDP will be used as a proxy for this variable)

Y_{it}^{f}= Foreign income (GDP of trading partners-USA and G7 industrial production index will be used in this case).

RP_{it}= Relative prices which is expressed as the log of real exchange rates

$M2_{it}$ = Money supply

VOL_{it} = Volatility in exchange rate

Because of data unavailability on real exchange rates, the study adopts the same reasoning like that of exchange rate changes. The standard models are modified and in this case the respective models to be estimated for the model of exchange rate volatility are as follows:

$$\boldsymbol{LM_{it} = \beta_0 + \beta_1 LGDP_{it} + \beta_2 LNER_{it} + \beta_3 LM2_{it} + \beta_4 VOL_{it} + \epsilon_{it}} \quad (3.16)$$

$$\boldsymbol{LX_{it} = \beta_0 + \beta_1 LUSGDP_{it} + \beta_2 LG7I_{it} + \beta_3 LNER_{it} + \beta_4 LM2_{it} + \beta_5 VOL_{it} + \epsilon_{it}} \quad (3.17)$$

$$LTB_{it} = \beta_0 + \beta_1 LGDP_{it} + \beta_2 LUSGDP_{it}, \ \beta_3 LG7I_{it} + \beta_4 LNER_{it} + \beta_5 LM2_{it} + \beta_6 VOL_{it} + \epsilon_{it} \quad (3.18)$$

where

LM_{it} = Logs of total value of imports in country i at period t

LX_{it} = Logs of total value of exports in country i at period t

LTB_{it}= Logs of trade balance in country i at period t

$LGDP_{it}$= Logs of national GDP in country i at period t

$LUSGDP_{it}$= Logs of US GDP in country i at period t

$LG7I_{it}$= Logs of G7 industrial production index in country i at period t

$LNER_{it}$= Logs of nominal exchange rates in country i at period t

INF_{it}= Inflation rate in country i at period t

$LM2_{it}$= Logs of money supply in country i at period t

VOL_{it}=Volatility in country i at period t

The variables in the regression (except for volatility and inflation rate) here are denoted in terms of their natural logarithms so that the coefficients can be easily interpreted in terms of their elasticity.

This study takes cognition of the fact that the estimation of the model of exchange rate volatility on trade may suffer some correlation problems. Explicitly, based on the fact that the three measures of volatility are derived from the nominal exchange rate, there is a possibility that the two variables are correlated. In order to tackle this flaw, this study will estimate a second set of equations for imports, exports and trade balance ignoring LNER as a variable. The essence of doing this is to avoid the correlation problem and also to compare if there will be differences on the impact of exchange rate volatility based on the two estimated models (model incorporating nominal exchange rate and volatility measures (Model 1) and the other model incorporating only the volatility measure (Model 2)). This study recognizes that in the estimation of the model of exchange rate volatility on trade, studies varies per incorporating exchange rate and volatility measures or volatility measures only. This study acknowledges studies such as Sauer and Bohara (2001) as well as Khosa et *al.* (2015) who modelled exchange rate volatility on trade while incorporating exchange rate and the volatility measure in the equation. On the other hand, this study also takes cognition of studies such as Arize et *al.* (2000) and Doganlar (2002), who while modelling the impact of exchange rate volatility on trade, only the measure of volatility was used in the equation, ignoring the exchange rate variable. With these different model specifications present in the literature in regard to the impact of exchange rate volatility on trade, this study therefore estimates both. In lieu of this, the following set of equations that will represent model specification 2 will also be estimated to account for the impact of exchange rate volatility and trade.

$$LM_{it} = \beta_0 + \beta_1 LGDP_{it} + \beta_2 LM2_{it} + \beta_3 VOL_{it} + \epsilon_{it} \tag{3.19}$$

$$LX_{it} = \beta_0 + \beta_1 LUSGDP_{it} + \beta_2 LG7I_{it} + \beta_3 LM2_{it} + \beta_4 VOL_{it} + \epsilon_{it} \tag{3.20}$$

$$LTB_{it} = \beta_0 + \beta_1 LGDP_{it} + \beta_2 LUSGDP_{it}, \beta_3 LG7I_{it} + \beta_4 LM2_{it} + \beta_5 VOL_{it} + \epsilon_{it} \tag{3.21}$$

3.3 Data Description

In this section, the description of variables that were used in the empirical model is provided. From the previous discussions, it is apparent that the main variables that cause trade to be altered are exchange rates, domestic income and foreign income. Based on these variables, this thesis also incorporated these variables in the model and expands the trade model by incorporating money supply to account for the monetary approach. In the paragraphs that follow, a detailed description of the choice of every variable used in estimating our different models (import, export and trade balance models).

1. Imports

For the import equation, total value of imports will be used as the independent variable.

2. Exports

For the export equation, total value of exports will be used as the independent variable.

3. Trade balance

For the trade balance equation, trade balance is constructed and used as the independent variable. Trade balance is constructed by taking the difference between the value of exports and imports.

$$TB_{it} = EXP_{it} - IMP_{it}$$

where TB_{it} is the trade balance of country i at year t, EXP_{it} is the total volume of exports of country i at year t, IMP_{it} is the total volume of imports of country i at year t.

4. Domestic income

The economic theory recommends that real domestic income plays a major role in international trade and stands as an important determinant for a country's imports and trade balance. Domestic income plays a critical role in both the import and the trade balance equation as it is apparent that a nation needs to receive income to be capable to engage in import trading activities (that is importing goods from abroad). Specifically, it is observed that the more domestic income a country produces, the more its import will be as well as its trade balance. Nevertheless, as domestic income is not easily measured, domestic (national) GDP is used as the proxy to account for this variable. Theoretically, this coefficient is therefore expected to bear a positive sign for both the import and trade balance equation. Nevertheless, Trinh (2012) pointed that an increase in domestic output (GDP) would certainly raise imports but could also have a negative effect on exports thereby causing the trade balance to either improves or worsen. This inconclusive effect of domestic income on trade balance is also confirmed by Yuen-Lin *et al.* (2008) who stated that the size of the effect could as well be either positive or negative. In this case, the effect the effects on trade balance could either be positive or negative.

5. Foreign income

Like domestic income, this variable as well is not easily measured. The proxies used to account for foreign income are mainly motivated by the tradition in the literature. The tradition in the literature is to use the GDP of the major trading partners and the industrial production index of advanced economies as proxies. Motivated by the tradition, this study also employs these respective proxies to account for foreign income. As supported by the literature, it is noted that this study employs the USGDP (USA representing one of the major trading partners of SSA) and the industrial production index of the G7 countries (Italy, USA, France, Japan, Germany, Canada, UK) as they represent the nations that majority of SSA countries trade with.

The theoretical framework proposes that as foreign income (income of the respective trading partners) increases, the result will be a greater volume of exports and trade balance respectively. The expected coefficient for this variable is positive for the imports as well as the trade balance equation.

6. Relative Price Level

The relative price level acts as an indicator of international competitiveness. It is evident that trade between the two countries depends on the exchange rate/relative prices of the trading partners. Traditionally, this variable is measured as the logarithm of real exchange rates. As earlier explained, the nominal data was used instead of real due to its unavailability. The theory suggests that there is an inverse relationship between exchange rate and imports. In this thesis, it is therefore acknowledge that as the value of the currency of the respective countries depreciates, imports will be more expensive. On the export side, the theory suggests that the effect of exchange rate increase on exports will be positive. Thus, the study concludes that a depreciation of the domestic currency will cause exports to increase. A positive relationship is therefore expected. Theoretically, a depreciation in exchange rate will cause trade balance to increase. Hence, a positive relationship is expected.

7. Inflation

Inflation is used in the model specification to account for the fact that real exchange rate could not use used. Inflation do not only creates harms in an economy but also negatively affects its trade situation. It is noted that high rates of inflation in the national markets would cause domestic goods to be unattractive to the non-nationals thereby causing a reduction in the demand for exports. In the same reasoning, because of increased domestic prices, nationals will prefer to buy foreign products thereby causing an increase in imports. In other words, inflation is expected to negatively affect exports and trade balance and positively affect imports.

8. Money supply

Following the monetarist approach of the balance of payments, the increase in money supply is expected to give rise to imports and decrease exports. This situation causes the trade balance to deteriorate. As a result, the expected sign for this coefficient is negative for the export equation, positive for the import equation and negative for the trade balance equation.

9. Exchange rate volatility

As the literature portrays, the expected sign for this coefficient is uncertain. In lieu of this, this coefficient can either be positive or negative. The literature portrays that the size of the relationship will be dependent on whether the exporters are risk averse. If they are less risk averse, a negative relationship will be met and a positive relationship if the exporters were less risk averse. The measurement of this variable is complex and will be explained in great detailed as follows.

3.3.1 Measuring Exchange rate Volatility

Volatility usually provides enough information on the sensibility of the market. Most often, high volatility reflects a context of instability and uncertainty that cause investors to develop a sense of mistrust of the stock market. On the other hand, when the volatility is low, this reflects that the market is stable. When the market is stable, this increase the confidence of exporters and importers to engage more in trading activities. When exchange rate volatility is high, this will cause the risk associated to be also high.

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 in regard to this topic therefore relies upon the measurement of exchange rate 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 been reached. For this reason, concerns regarding the measure of exchange rate volatility consist whether the exchange rate should be nominal or real, bilateral or multilateral, short-term or long term horizons, etc. Different measures of exchange rate volatility have been employed in the literature namely the method of the standard deviation, the ARCH, the GARCH method, etc.

This study uses three measures of exchange rate volatility namely the standard deviation, the GARCH estimation technique and the Hodrick-Prescott filter technique. These three aforementioned methods are simultaneously employed in this thesis to test its validity and how they differ in estimating the various models.

3.3.1.1 Standard Deviation Approach to Exchange Rate Volatility

The first approach to measure exchange rate volatility is the standard deviation approach. This method accounts for the most extensively used approach in the empirical literature. This approach is the calculated standard deviation of the moving average of the logarithm of real; exchange rate. Mathematically, the standard deviation method is denoted as follows:

$$V_t = \left[\frac{1}{m}\sum_{k=1}^{m}(InR_{t+i-1} - InR_{t+i-2})^2\right]^{1/2} \quad (3.22)$$

where R_t is the real exchange rate at time t, m is the moving average. Likewise other studies in the literature, because of yearly data, this thesis uses 2 as the order of moving average. This will therefore be referred as the short term exchange rate volatility. Despite the fact it would be best to use real exchange rates, nominal exchange rates is employed.

Following an extensive review of the literature, the main criticism of this method is the failure to capture the possible impacts of high and low peak values of the exchange rate. Another criticism in regard to this method is that it mistakenly takes on the assumption that the observed distribution of exchange rate is normal (Takaendesa et *al.*, 2006). In addition to that, this method disregards the dissimilarity concerning expected and irregular features in exchange rate processes. Following these drawbacks, using the standard deviation method as a measure of exchange rate volatility will certainly lead to exchange rate volatility being exaggerated.

To counter for the criticisms on the method of standard deviation in measuring exchange rate volatility, alternative approaches were proposed such the ARCH and GARCH method. Nonetheless, this study uses only the GARCH method for its extensive use and recommendation in the literature.

3.3.1.2 Generalized Autoregressive Conditional Heteroskedasticity (GARCH) Approach to Exchange Rate Volatility

The alternative method used in measuring exchange rate volatility is the Generalized Autoregressive Conditional Heteroskedasticity (henceforth GARCH) method. For a starting point, the GARCH econometric procedure is based on the Auto-Regressive Conditional Heteroskedasticity (henceforth ARCH) process. Bollerslev (1986) sustained that the (ARCH) was developed by Engle (1982) to permit the conditional discrepancy to differ over time as a function of past errors thereby leaving the unconditional variance stable. In this study, it is assume that exchange rate volatility is prompted by a first order autoregressive (AR) process denoted as follows:

$$P_t = \lambda_0 + \lambda_1 P_{t-1} + \varepsilon_t \quad (3.23)$$

where P represents the natural log of real exchange rate.

$\lambda_0$and $\lambda_1$are estimated parameters

$\varepsilon_t$is the error term which follows a normal distribution around a zero mean with a variance ${\sigma^2}_t$.

The main objective of the ARCH model is to characterize the way in which the variance changes over time (as the variance is dependent upon time t). This model also presumes that the dependence of the variance upon time can be easily apprehended by an Auto-Regressive model of the form:

$$ {\sigma^2}_t = \alpha_0 + \alpha_1 {\varepsilon^2}_{t-1} + \alpha_2 {\varepsilon^2}_{t-2} + \cdots + \alpha_m {\varepsilon^2}_{t-m} \quad \textbf{(3.24)} $$

where ${\sigma^2}_t$ is the conditional variance of the real exchange rate.

This model, it can clearly portray that existing levels of volatility are subjective to past values and how episodes of high and low exchange rate uncertainty will be likely to persevere.

The ARCH model was further prolonged to develop the GARCH model. The variance of the GARCH model is given by:

$$ {\sigma^2}_t = \alpha_0 + \beta_1 {\sigma^2}_{t-1} + \beta_2 {\sigma^2}_{t-2} + \cdots + \beta_k {\sigma^2}_{t-k} + \alpha_1 {\sigma^2}_{t-1} + \alpha_2 {\sigma^2}_{t-2} + \cdots + \alpha_m {\sigma^2}_{t-m} $$

(3.25)

${\sigma^2}_{t-j}$for j=1,2,3..k represents the GARCH term indicating the last period forecast variance.

The simplest specification and the most widely used GARCH process is the GARCH (1, 1) represented as follows:

$$ {\sigma^2}_t = \alpha_0 + \beta_1 {\sigma^2}_{t-1} + \alpha_1 {\varepsilon^2}_{t-1} \quad \textbf{(3.26)} $$

From the above equation, the predicted values of ${\sigma^2}_t$ will provide us with a measure of the exchange rate volatility. Choudhry (2005) noted that while the GARCH (1, 1) model assumes that the conditional variance of the time series is dependent upon the square residuals of the process, it also has the advantage of including heteroscedasticity into the conditional variance. Maestas and Gleditsch (1998) also sustained that economists have effectively used GARCH models to estimate the levels of volatility, or uncertainty surrounding the expected values of variables such as inflation, exchange rates or stock prices. Regarding this, this approach stands as one of the popular method in measuring exchange rate volatility.

3.3.1.3 The Hodrick-Prescott filter

The Hodrick-Prescott 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 proper terms, the HP filter smooths the original time series to estimate the trend component. In this regard, 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.

3.4 Sources of Data

In this section, the sources of the data used as well as the year span are presented. In this regard, the complete list of data used as well as their respective sources is described in the Table 3.1 beneath.

Table 3.1: Data description and sources

VARIABLES	UNIT OF MEASUREMENT	SOURCE
1. Exports of goods and services	Current US Dollars	World Bank
2. Imports of goods and services	Current US Dollars	World Bank
3. Trade balance	Current US Dollars	Author's Calculation (Exports – Imports)
4. US GDP	Current US Dollars (Billions)	IMF (World Economic Outlook)
5. G7 industrial production index	Index (2010=100)	OECD
6. Money supply (M2)	As a percentage of GDP	World Bank
7. GDP	Current US Dollars (Billions)	IMF (World Economic Outlook)
8. Exchange rate	Local currency unit per US Dollar	World Bank
9. Inflation rate	Average percentage change	IMF (World Economic Outlook)
10. Volatility	Standard deviation approach, HP Filter and GARCH approach	Author's calculation

It should be noted that some countries experienced missing data and for that purpose, data extrapolation[3] was computed to fill in the missing values. The above data are all measured annually from the year 1995 to 2012. Initially, the study was aimed to cover the entire Sub-Saharan region but unfortunately, due to unavailability of data, some countries were ignored. In lieu of this, the thesis consists of 39 countries which are listed as follows:

Angola, Burundi, Benin, Burkina Faso, Botswana, Central African Republic, Cote d'Ivoire, Cameroon, Congo Republic, Congo Democratic, 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.

In addition, considering that a portion of this thesis deals with comparing the impact of exchange rate changes and volatility on trade within the distinct trade blocs of Sub-Saharan

[3] Extrapolation is a process whereby a missing value is estimated based on extending a known sequence of values or facts. In this study, extrapolation was done in excel.

Africa, Table 3.2 below shows the respective trade blocs of SSA that will be considered in this study.

Table 3.2: Different trade blocs of Sub-Saharan Africa

Regions	Countries
EAC[4]	*Burundi, Kenya, Uganda, Tanzania*
CEMAC[5]	*Chad, Cameroon, Republic of Congo, Central African Republic, Equatorial Guinea, Gabon*
ECOWAS[6]	*Benin, Burkina Faso, Ivory Coast, Cape Verde, Gambia, Ghana, Guinea, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo*
SADC[7]	*Angola, Botswana, Democratic Republic of Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia,*

Source: Official websites of EAC, CEMAC, ECOWAS, and SADC

3.5 Modelling Strategy

Despite the fact that several estimation techniques exist in the world of econometrics, the application of panel data estimation technique has gained a lot of popularity in recent years. For this reason, because of the large data sets involved, this thesis conducts the panel data analysis to investigate the impact of exchange rate changes and volatility on international trade in Sub-Saharan Africa. Basically, the main essence of applying this technique is because this study does not deal only with a single country but comprises a set of multiple countries. With multiple countries framework, the literature has revealed that the panel data analysis appears to be the most efficient and appropriate method. It is important to note that time series could have been used in this study but it reveals several disadvantages particularly in the context of this study. Time series analysis is appropriate when dealing with a single country time sheet but unfortunately this cannot be apply to our study as this study involves more than one country. In addition, it will be cumbersome to estimate a model for each and every country of Sub-Saharan African and as such panel data analysis appears to be the most appropriate and effective method to be used in this study.

Before proceeding in a detail explanation of the steps of a panel estimation technique, it is imperative to describe the advantages and disadvantages of this technique.

[4] EAC members were taken from http://www.eac.int/

[5] CEMAC members were taken from http://www.cemac.int/

[6] ECOWAS members were taken from http://www.ecowas.int/

[7] SADC members were taken from http://www.sadc.int/

3.5.1 Advantages and Limitations of panel Data Estimation Technique

According to Torres-Reyna (2007), panel data which is also known as longitudinal or cross sectional time series data is a data set in which the entities are observed over time. The author specified that the entities could be countries, states, companies, individuals, etc. In other words, a panel data is one that follows a given sample of individuals over time and thus provides multiple observations on each individual in the sample. Panel data analysis is now being used in many countries both in the developed and the developing countries. Panel data sets for economic research possess several major advantages over conventional cross sectional or time series data sets and the four core areas of the benefits of this technique as maintained by Hsiao (2003, 2006) are listed below:

- Increased degree of freedoms of reduction of multicollinearity problems among the variables.
- Identification of economic problems and discrimination between economic hypotheses
- Removal and lessening of biased results
- Provision of micro foundation for aggregate data analysis.

For a deeper understanding of this technique, a detailed explanation of the aforementioned core benefits is provided as follows:

- Panel data analysis has the great advantage of having a rich sample (i.e. large number of data points). Researchers dealing with time series often face the challenges of having small sample size and this limitation often causes shortages in the degree of freedom and multicollinearity among the variables. This problem faced by time series often cause their model estimation to be very tricky as the small size sample is not often enough to meet the information requirements of the specified model. As per this difficulty encountered in both time series and cross sectional data analysis, the panel data due to its large sample size propose more degree of freedom and lesser chances that variables be multicollinear.
- Hsiao (2003) maintained that in many fields, i.e. the field of social sciences, economic sciences, there is a high probability that there exist competing theories. The author notes that time series data are not particularly useful for discriminating between hypotheses that depend on micro economic attributes. It is noted that time series data sets fails to offer significant information on the effects of certain category of factors

(e.g. socio-demographic factors). On the other side, while cross sectional data is useful in providing information on the variation on demographic variables, unfortunately it cannot be used to model dynamics or causal ordering. Due to the progressive observations on a number of individuals that panel data offers, it permits the researcher to differentiate between interindividual and extraindividual differences.

- In the world of statistics and econometrics, a big problem that a researcher can face is that of a model specification problem. When a researcher specifies a model, he has to be very careful as to what variables to include in the model as well as the relationship between the explanatory variables and the dependent variable. Most often, significant variables are omitted in the model. In this regard, in a situation where the impact of the omitted variables is closely correlated with the independent variables present in the model, the estimated model will lead to biased estimates. Majority of researchers have come to the conclusion that the major reason that one does or does not find a particular desirable effect is because of the omission of certain variables. Panel data has the advantage of controlling the impact of omitted variables in a model specification. Hsiao (2006) sustained that panel data contain information on both the intertemporal dynamics and the individuality of the entities may allow one to control the effects of missing or unobserved variables.
- Hsiao (2003, 2006) advocates that aggregate data analysis often invokes the "representative agent" assumption. The author however pointed that if micro units are heterogeneous, the time series properties of aggregated data could be different from that of disaggregated data and policy evaluations on disaggregated data will certainly lead to biased results. The author further confirmed that the prediction of aggregate outcomes using aggregate data can be less accurate than the prediction based on micro-equations.
- Considering the fact that panel data usually have large sample size which implies large sets of observations, the estimates based on panel data are often more accurate than that of time series or cross sectional.
- Another benefit related to panel data is that it allows the researcher to answer important economic research questions that cross sectional and time series could not afford to do. Precisely, certain economic questions require sequential observations for a number of individuals. In answering certain types of question, panel data approach is usually seen as the best fit to address some significant tricky economic questions. In

other words, panel data allow the researcher to construct complicated models that times series and cross sectional fails to do.

- Time series and cross sectional data analyses are often known for their difficulty in the error measurements which usually leads to the unidentification of the model. Nonetheless, panel data, because of the large observations, allows the researcher to estimate an otherwise unidentified model (Hsiao, 2006).

From the brief review of the benefits of using panel data, it can be observed that panel data can enrich empirical analysis in ways that may be possible if one uses a combination of both cross section and time series data. However, it is acknowledged that despite the fact that panel data possess several benefits, there are also some issues involved in the utilizing panel data.

3.5.2 Limitations of Panel data

- One of the problems involved in utilizing panel data is the heterogeneity bias issue. Baltagi (2008) confirmed that the main problem involved with panel data method is the collection of data. Most at times, there are problems involved in the data collection ad management as well as the design. The author added that the problem associated with the collection of data is due to the fact that respondents are cooperative in disclosing information.
- Another issue arising in panel data usage is the distortions of measurement errors. It is emphasized that measurement errors may arise as a result of faulty responses caused by either unclear questions or distortion of responses.
- Selectivity problems may occur in using panel data methods. This may also be attributed to the non-cooperation and non-response of participants.

Having provided with brief advantages and limitations of panel data, the study now proceeds to a detail explanation of the panel data estimation technique.

3.5.3 Panel Data Technique

Panel also called longitudinal or cross sectional time series data is a combination of both time series and cross sectional data in a very specific way. Specifically, panel data involves observations on the same variables from the same cross sectional sample from two or more different time periods.

A panel data regression analysis greatly differs from a regular time series or cross section regression in that it has a double subscript on its variables. A panel data regression is denoted as follows:

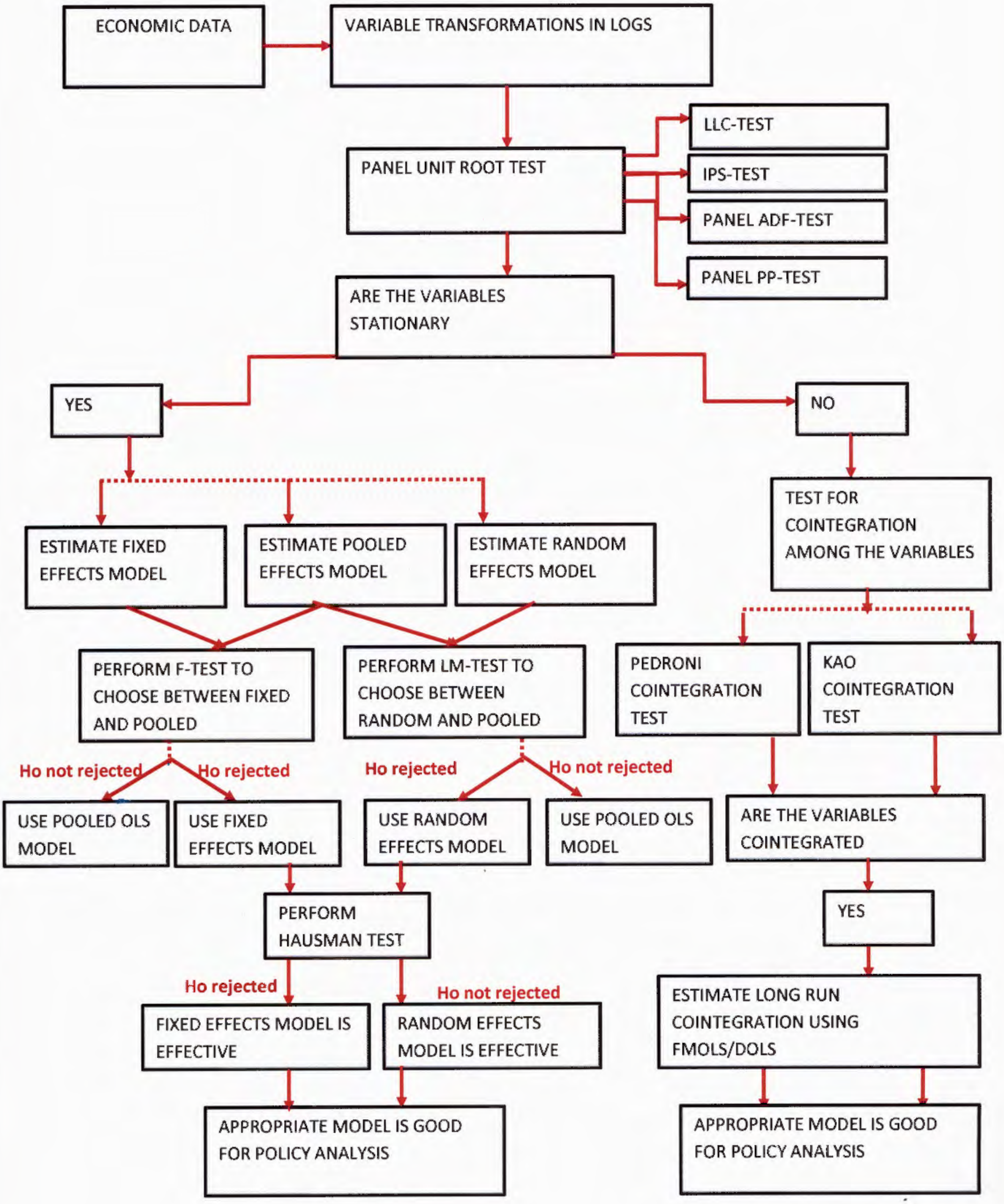
$$Y_{it} = \alpha_0 + \alpha_1 X_{it} + U_{it} \text{where i=1,....,N ; t=1,........,T} \quad \textbf{(3.27)}$$

i here can denote households, firms, countries etc.. and t denotes the time . Under the panel data analysis, the i represents the cross sectional dimension whereas the t represents the time series dimension.

The time series constituents of panel data may be liable to spurious regression and hence it is advisable to test for the presence of unit roots in the data to check the order of integration of the variables. This is a very important step in the estimation of a panel data regression as this test will determine which technique of regression to use. Therefore, panel unit roots are used in this study to test for the order of integration of variables. If variables are found to be stationary, the procedure will either to use the pooled, fixed effects or random effects regression. On the other hand, if variables are found to be non-stationary, the panel cointegration analysis will be used to test the existence of cointegrating vectors or in other words the existence of a long run relationship among the variables.

Before proceeding to the explanation of the detailed modelling strategy used in this study, the steps are first presented in Figure 3.1. Figure 3.1 main goal is to provide a guide to the econometric procedure that this study adopts.

Figure 3.1: Econometric procedure for panel data analysis employed in this study



3.5.4 Unit Roots

Majority of studies have shown that most macroeconomic variables are non-stationary. Performing a regression on variables that are non-stationary will provide inefficient and biased results. As a result, it is vital when analysing economic data to conduct initial tests of non-stationarity before continuing to the thorough estimation of the model.

Tasseven and Teker (2009) noted that one of the primary reasons behind the application of unit root to a panel of cross section units was to gain statistical power and to improve on the poor power of their univariate counterparts. Usually, it has been observed that while utilizing panel data sets, one may come across the problem of heterogeneity among the variables. In this study, the data set consists of different countries which are unique and distinct in terms of their characteristics thereby implying that the variables will not possess the same properties. In lieu of this, it is therefore of great importance to test for unit roots in the variables before estimation of the model so as to avoid spurious regression.

Generally, the power of unit roots tests under time series data is very low probably because of the small set of sample involved. In this regard, instead of time series unit roots test (ADF, PP and KPSS); panel unit roots are used because it has possessed more power. Monte Carlo simulations have revealed that compared to individual time series, panel unit roots have gained advantage in terms of its power because it contains more information. In essence, considering the fact that the power of unit roots tests under panel data depends on the number of observations and their variation, they are more useful than time series unit roots. Panel unit roots also has an advantage over time series unit roots in that it does follow an asymptotic standard normal distribution of which the latter fails to do.

The simplest approach to begin testing for unit root begins with an AR (1) process for panel data:

$$Y_{it} = \rho_i y_{it-1} + X_{it}\delta_i + \varepsilon_{it} \qquad \textbf{(3.28)}$$

where i=1,2,3,,,,N which represents cross sections

t=1,1,3,,,,T which represents time.

X_{it}represents the exogenous variables in the model

$\rho_i$represents the autoregressive coefficients

ε_{it} represents the errors.

From this equation, a decision is reached to see whether the variables have a unit root or not. If$|\rho_i| < 1$, then Y_{it} is said to be weakly stationary. Conversely, if$|\rho_i| = 1$, then it is concluded that Y_{it} has a unit root.

Several types of unit root test exist. Based on the literature, there are five varieties of panel unit root tests namely; Levin, Lin and Chu (2002), Breitung (2000), Im, Pesaran and Shin(2003), Fisher-type tests using ADF and PP tests (Maddala and Wu (1999) and Choi (2001)), and 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 LLC (Levin, Lin and Chu) test, the IPS (Im, Pesaran and Shin) and the Fisher test. A detail explanation of these tests combined with their assumptions and hypotheses are presented below.

3.5.4.1 The Levin, Lin and Chu test (LLC)

Levin, Lin and Chu (2002) are considered as the first authors to propose the test of panel unit root. Their approach in testing for unit roots is directly inspired by the time series unit root test proposed by Dickey and Fuller (1979). The main assumption of the LLC test is that there exists a common unit root process such that it is identical across the cross-sections. The null hypothesis of this test is that each individual time series contains a unit root against the alternative that each time series is stationary. The LLC test considers the following ADF (Augmented Dickey Fuller) specification:

$$\Delta Y_{it} = \alpha y_{it-1} \sum_{j=1}^{\rho_i} \beta_{ij} \Delta Y_{it-j} + X_{it}'\delta + \varepsilon_{it} \qquad \textbf{(3.29)}$$

where i and t stands for the cross-section (country) and time respectively.

Y_{it} is the time series variable for all countries that is being tested for stationarity.

Δ is the first difference operator

ε_{it} stands for the error term

The LLC test assumes that $\alpha = \rho - 1$

One of the advantages of the LLC test is the fact that it allows the presence of deterministic components and lag lengths in the regression. Below are the three scenarios in which the LLC test is performed:

Model I: Without an intercept (constant)

In this case, the panel unit root test is based on the following regression equation:

$$\Delta Y_{i,t} = \rho y_{i,t-1} + \varepsilon_{i,t} \quad \textbf{(3.30)}$$

In this model, the equation does not include any deterministic trend (no constant/intercept). Based on this model, the LLC test offers the following hypotheses as follows:

$$H_0: \rho = 0$$

$$H_1: \rho < 0$$

where H_0 is the null hypothesis that the series has a unit root and H_1 is the alternative hypothesis that the series does not have a unit root.

Model II: With a constant/intercept

Under this case, the panel unit root is based on the following regression equation:

$$\Delta Y_{i,t} = \alpha_i + \rho y_{i,t-1} + \varepsilon_{i,t} \quad \textbf{(3.31)}$$

The above equation includes a constant/intercept to capture for a deterministic component in the equation.

Like in the first model, the LLC test offers the following hypotheses as follows:

$H_0: \rho = 0; \alpha_i = 0, \forall_i = 1,,,, N$

$H_1: \rho < 0; \alpha_i \in R, \forall_i = 1,,,, N$

where H_0 is the null hypothesis that the series has a unit root and H_1 is the alternative hypothesis that the series does not have a unit root.

Model III: With a constant/intercept and trend

Under this case, the unit root test is based on the following regression form:

$$\Delta Y_{i,t} = \alpha_i + \beta_i t + \rho y_{i,t-1} + \varepsilon_{i,t} \quad \textbf{(3.32)}$$

The above equation contains both a constant/intercept and a deterministic trend. The hypotheses to be tested are identical to the previous models.

$H_0: \rho = 0; \beta_i = 0, \forall_i = 1,,,, N$

$H_1: \rho < 0; \beta_i \in R, \forall_i = 1,,,, N$

Where H_0 is the null hypothesis that the series has a unit root and H_1 is the alternative hypothesis that the series does not have a unit root.

Decision rule

Under the null hypothesis for the three cases, a modified t-statistic for the resulting $\hat{\alpha}$ is normally distributed and is given as follows:

$$t^* = \frac{t_\alpha - (NT)S_N\hat{\sigma}^2 Se(\sigma)\hat{\mu}MT^*}{\sigma MT^*} \quad \textbf{(3.33)}$$

where t_α is the standard t stat for $\hat{\alpha}$=0

$\hat{\sigma}^2$represents the estimated variance of the error term.

$Se(\sigma)$ is the standard error

For all three cases, the decision rule is as follows:

- If the probability value is significant less than the significance level, then the null hypothesis will be rejected while the alternative hypothesis will be accepted. This will therefore imply that the series does not have a unit root, hence stationary at its level (I (0)).
- If the probability value is greater than the significance level, then the null hypothesis will be accepted while the alternative hypothesis shall be rejected. This will imply that the series does contain a unit root; hence it will need to be differenced.

Despite the fact that the LLC is very popular in the literature in the computation of unit root test, it presents some weaknesses.

- The major weakness faced by the LLC test is that it relies on the assumption that all series have a common autocorrelation coefficient. In other terms, the LLC test assumes independence across units. For this reason, once this assumption is violated, the LLC fails to be applicable. The test therefore becomes inappropriate when autocorrelation is present between the cross sections.
- Based on the condition that the parameters are similar across all units, the alternative hypothesis stands strong in any empirical case while the null applies only to some situations.

3.5.4.2 The Im, Pesaran and Shin (2003) test (IPS)

The Im, Pesaran and Shin (henceforth IPS) is a test that was proposed by the three authors to correct the limitations of the LLC test in regard to the homogenous nature of the autoregressive root under the alternative. Practically, it is unlikely to have a situation where in case of rejection of the unit root hypothesis, the hypothesis of a common root for all series is accepted.

The IPS test is actually an extension of the LLC test in that it allows for heterogeneity under the alternative hypothesis. In this regard, contrary to the LLC test assumption, the IPS test offer a panel unit root test under the assumption that some series (not exclusively all) contain a unit root. Im-Pesaran-Shin (2003) test for variables non-stationarity is based on the assumption of no cross-sectional dependence.

The IPS test considers the following ADF specification:

$$\Delta Y_{i,t} = \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{\rho_i} \theta_{ij}\, \Delta y_{i,t-j} + \varepsilon_{i,t} \quad \textbf{(3.34)}$$

where t=1,2,3,,,T

Im, Pesaran and Shin consider a model with individual effects and without deterministic trend (equivalent to model 2 in Levin, Lin and Chu). In the absence of residual autocorrelation, this model is:

$$\Delta Y_{i,t} = \alpha_i + \rho_i y_{i,t-1} + \varepsilon_{it} \quad \textbf{(3.35)}$$

where t=1,2,3,,,T

Under this model, the hypotheses to be tested are as follows:

$H_0: \rho_i = 0; , \forall_i = 1,,,, N$

$H_1: \rho_i < 0; \forall_i = 1,,,, N \quad ; \rho_i = 0; \forall_i = N+1, N+2,,,,, N$

Where H_0 is the null hypothesis that the series has a unit root and H_1 is the alternative hypothesis that the series does not have a unit root.

Decision rule

The IPS t-statistics is the average of the individual ADF statistic which is given as follows:

$$\bar{t} = \frac{1}{N}\sum_{i=1}^{N} t_{\rho_i} \quad \textbf{(3.36)}$$

From the above equation, t_{ρ_i} represents the average of the individual t-statistics for the testing the null hypothesis $H_0 = \rho_i = 1$

The decision is given as follows:

- If the probability value is less than the significance level, then the null hypothesis is rejected while the alternative hypothesis is accepted. This will imply that the series does not have a unit root, hence stationary at its level (I (0)).
- If the probability value is greater than the significance level, then the null hypothesis is accepted while the alternative hypothesis is rejected. This imply that the series does contain a unit root; hence it will need to be differenced.

HOW DO THE LLC AND IPS TEST DIFFER?

- The main significant difference that exists between the two tests is that one test (LLC) assumes a common unit root across the cross section while the other test (IPS) test assumes individual unit root across the series.
- Moreover, the other difference that exists between the two tests is the fact that the LLC test is based upon the assumption that under the alternative hypothesis, all series are stationary. On the other hand, it is assumed that under the alternative hypothesis, the IPS requires only some (not all) series to be stationary.
- The two tests however suffer the same limitation under the assumption that the error terms across the cross sections are independent.

3.5.4.3 Fisher ADF and PP Panel Unit Root tests

The Fisher ADF (Augmented Dickey Fuller) and Fisher PP (Phillips-Perron) panel unit root tests were proposed by Maddala and Wu (1999). These tests are essentially based on the same assumption as that of the IPS panel unit root test. But in addition to the IPS test, the Fisher ADF and Fisher PP tests combines the probability value of the test statistic of unit root in each cross section.

In essence, the tests assume individual unit root processes across cross sections in the panel. The tests assume the null hypothesis that the series is non stationary at its level versus the alternative hypothesis that the series is stationary. The decision rule remains the same as the other two previous tests (LLC and IPS). Therefore, the null hypothesis that the series has a unit root is rejected when the probability value is less than the chosen significance value. On the other hand, the null hypothesis will be accepted if the probability value is greater than the significance level. The Fisher test statistic proposed by Maddala and Wu (1999); Choi (2001) is given as follows:

$$P = -2\sum_{i=1}^{N} In\, p_i \quad \textbf{(3.37)}$$

The above test statistic associates the p-value from unit root tests from each cross section i to test for unit root in panel data. The Fisher test is assumed to be chi-square ($_\chi{}^2$) distributed with 2N degrees of freedom as $T_i \rightarrow \infty$ for all N. Based on the Fisher test statistics, when p_i is nearly 0, the null hypothesis will not be accepted; the same as when p_i is nearly 1, the null hypothesis is not rejected.

The literature acknowledged that one the main advantages of the Fisher tests is its applicability of dealing successfully with unbalanced data sets. Choi (2001) pointed out some advantages of the Fisher test which are defined as follows:

- In the Fisher type test, the cross section series can either be finite or infinite
- Individual groups can have diverse types of non-stochastic as well as stochastic constituents
- The time series dimension, T can be diverse for each i (unbalanced panel series),
- The alternative hypothesis would allow some groups to have unit roots while others may not.

Despite these advantages, the author pointed that the main inconveniency in this test is the computation of the P-value using Monte Carlo simulations.

The next step of the analysis will be determined by the results of the panel unit root tests. If the variables are found to be stationary at their level (i.e. I(0)), the next procedure will he the estimation of the regression model (through the pooled OLS, fixed and random effects regression model). On the other hand, if the variables are found to be instead non-stationary at their first difference (i.e. I(0)), the next procedure will be to test for cointegration among the variables. A detailed description of these procedures is explained below.

3.5.5 Pooled OLS Regression

Estimating a regression based on the method of the pooled OLS (Ordinary Least Squares) is combining both time series and cross-sectional data into one single equation and run an OLS regression model. A simple OLS model is described as follows:

$$Y_{it} = \gamma + \beta X_{it} + \varepsilon_{it} \quad \textbf{(3.38)}$$

where i stands for the countries

t is the time

Y_{it} is the dependent variable

X_{it} is the set of independent variables

ε_{it} is the error term.

To achieve efficient results after estimation of the pooled model, the following assumptions must be satisfied:

- Zero mean
- The residuals must be normally distributed
- The error terms must not be correlated with the independent variables
- The variance must be constant
- The explanatory variables must be strictly exogenous (that is the variables do not depend on the current, past as well as future values of the error term).

While estimating the pooled OLS regression model, the nature of the data (i.e. the time series and cross sectional data are ignored). In so doing, the pooled model stands therefore as the stress-free approach that could be used to estimate the relationship between a set of variables. This method is seen as the easiest method because it rests on the hypothesis that the coefficients of the explanatory variables are identical across all entities (i). The fact that all coefficients are assumed to be the same across all countries constitutes the main benefit of this regression model. Regardless of this benefit, this approach has some shortcomings. The pooled OLS model presents a high risk of autocorrelation. This problem will arise because of the assumption that intercept must be identical for all countries. Nevertheless, in real life, this situation is unlikely to happen because it is evident that countries usually possess their own distinct features. Secondly, the pooled model also shoulders that the slope coefficients of the explanatory variables are identical across countries. This assumption is also unrealistic as this cannot happen in real life situation as the countries are different in their characteristics.

In essence, it is broadly portrayed that the major drawback of the pooled OLS regression is the fact as it assumes all countries to be identical; the important characteristic of heterogeneity (uniqueness and individuality of the cross-section) is ignored in this model. Considering the aforementioned drawbacks faced by the pooled OLS method, it can be clearly affirm that this model will render a high risk of producing inappropriate and inefficient results.

To therefore achieve desirable and efficient estimates, it is thus of great significance that the individuality and uniqueness (heterogeneity) feature of the cross section be accounted for. For this reason, to correct these flaws faced the pooled OLS model, Gujarati (2003) states the intercept should be introduced in the model so that each country's unique characteristics can be accounted for.

3.5.6 Fixed Effects Model

According to Stock and Watson (2012), fixed effects regression is a method that permit the control of omitted variables in panel data when these omitted variables vary across states (countries) but do not change over time. The authors further acknowledge that fixed effects regression can be used when there are two or more time observations for each entity.

Generally, the fixed effects regression model is one that has "n" diverse intercepts, one for each entity. The intercepts may also be easily characterized by a set of binary variables which plays the role of absorbing the impacts of all possible omitted variables that differ from one entity to the next. Following this, it can be further generalized that the fixed effects regression model rests an applicable specification of the fixed regression model particularly if the focus is based on the set of N countries. The fixed effects model is thereby a regression in which the intercept terms vary over the individual units. The above affirmation stands as one of the great benefits of using a fixed effects regression model because it allows the model to be flexible. Under this model, the intercepts are allowed to change but restrictions is put on the slope parameters (it must be constant through all countries). This therefore implies that only the intercept is allowed to change with the intercept varying only across countries but not over time.

To summarize, the main aim of the fixed effects regression model is to discover the connection that may exist between the dependent and independent variables within an entity (countries, companies, etc...). However, unlike the case of the pooled effects model, each entity has its own unique features that may or not affect the predictor variables.

The fixed effects regression model can be written as follows:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Z_{it} + \varepsilon_{it} \quad \textbf{(3.39)}$$

where Z_{it} accounts for an unobservable variable that fluctuates from one country to another but is time invariant.

Estimating the coefficients β_i will imply that Z_i has to be hold constant as it does not change over time. Following that Z_i varies from one state to another but is constant over time implies that the above equation can be interpreted as having n intercepts for each country. It therefore follows the assumption that $\alpha_i = \beta_0 + \beta_2 z_i$; the fixed effects regression can therefore be written as follows:

$$Y_{it} = \beta_1 X_{it} + \alpha_i + \varepsilon_{it} \tag{3.40}$$

where $\alpha_1, \alpha_2,,,, \alpha_n$ are all treated as unknown intercepts that are to be estimated for each country. i on the intercept shows that the intercept of the entities may be different due to individual distinct features of the countries. These features could be economic and political issues present in the countries that may surely contribute to the performance of economic variables.

$Y_{it}$is the dependent variable, i=entity; t is time

$X_{it}$is the independent variable

$\varepsilon_{it}$is the error term

The fixed effects regression can also be estimated using binary variables. It is therefore assume that D_1 is a binary variable that equals to 1 when i=1 and equals to 0 otherwise; so on and so forth for all D_i; i=1,2,3,,,N. The fixed effects regression model for binary variables can therefore be written as follows:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \gamma_2 D_{2i} + \gamma_3 D_{3i} +,,,,,, + \gamma_N D_{Ni} + \varepsilon_{it} \tag{3.41}$$

where $\beta_0, \beta_1, \gamma_1,,,,, \gamma_N$ are coefficients that must be estimated.

For the fixed effects regression model to produce efficient and robust estimates, it must satisfy the following classical assumptions:

1. The errors terms must have a conditional mean zero. This assumption can be mathematically denoted as $E(\varepsilon_{it} \backslash X_{i1}, X_{i2},,,,, X_{iT}, \alpha_i) = 0$. This assumption is a very important assumption if the fixed effects model must yield robust estimates. This assumption will therefore be violated if the error term ε_{it} is correlated with the value of the explanatory variables (past, present and future values).

2. Secondly, the variables for one entity must be distributed identically to, but independently to of the variables for another entity. This implies that $(X_{i1}, X_{i2},,,, X_{iT}, U_{i1}, U_{i2},,, U_{iT}), i = 1,,, n$
3. The error terms must be normally distributed
4. There should no evidence of multicollinearity

Following this information on the fixed effects regression model, it can therefore be said that one of the great benefits of using this model is that controls for unobserved heterogeneity to control for country and time specific effects. Furthermore, this model is advantageous in that it avoids the bias of results that may arise due to omitted variables that do not vary over time.

Despite the advantages of the fixed effects regression, this model however presents few drawbacks:

- In estimating the fixed effects model, the degree of freedom tend to be very low because one degree of freedom is loss per cross sectional observation because of the time depreciating.
- Any explanatory variable that do not vary across time in each nnit will be perfectly collinear with the fixed effects, for this reason, it cannot be included in the model.

Studenmund (2011) acknowledged that the drawbacks of the fixed effects regression model are very minor with regard to their advantages. Hence, the fixed effects are recommended to be used by researchers in estimating panel data.

3.5.7 Random Effects Model

An alternate approach to the fixed effects model is the random effects model. The two regression models differ in the sense that while the fixed effects regression model is essentially based on the hypothesis that each cross section has its own unique intercept, the random effects model on the other hand is based on the statement that for each cross sectional unit, is drawn from a distribution that is centered around the mean intercept. From the above information, this therefore means that each intercept is a random draw from an intercept distribution and is therefore independent of the error term for any particular observation.

The random effects regression model therefore rests as a proper specification when the number of countries under investigation is random selected from the population. This will imply that the differences in the countries here are treated as being random rather than fixed as in the case of the fixed effects model. In the random model therefore, the disparity across the entities (countries) is presumed to be random and uncorrelated with the independent variables.

The random effects model can be written as follows:

$$Y_{it} = \alpha_i + \beta_1 X_{it} + \alpha_i + \varepsilon_{it} \quad \textbf{(3.42)}$$

Because the random effects model assumes no individual distinct effects, but instead considers the individual effect to be a random variable, α_i in this case is no longer treated as a constant. The intercept is reformulated as:

$$\alpha_i = \alpha + U_{it} \quad \textbf{(3.43)}$$

After substitution, we arrived at the following:

$$Y_{it} = \beta X_{it} + \alpha + U_{it} + \varepsilon_{it} \quad \textbf{(3.44)}$$

$Y_{it}$is the dependent variable, i=entity; t is time

$X_{it}$is the independent variable

$U_{it}$is the error term between the entity

$\varepsilon_{it}$is the error term within the entity

With the random effects model, it is presumed that there is no presence of autocorrelation between the entity's error term and the independent variables. This hypothesis is to allow for the time invariant variables to play a role as explanatory variables. Moreover, in estimating the random effects model, those distinet characteristics that play a role in influencing the variables must be specify. But it has been commonly observed that these characteristics are not often measurable and therefore lead to the problem of omission of variables which in turn will cause bias of estimates.

One of the main advantages of the random effects model compared to the fixed effects model is that the random effects model will have more degree of freedom. Another advantage of this model is the possibility of inclusion of time invariant variables of which the fixed effects fails to do (time invariant variables are captured by the intercept under the fixed effects).

3.5.7.1Testing the different Panel Regression Models

Among the pooled OLS, fixed or random effects, choosing the most suitable model for the study is dependent of the type of data being use. As it was previously explained, if the sample of data (countries) under consideration is the main focus of the study, then, the fixed effects regression is the suitable model to estimate. On the other hand, if the countries/data were randomly selected and the results have to be generalized to the entire population, then, the random effects regression is more applicable.

In this regard, a variety of tests exits to select the most suitable model.

3.5.7.1.1 Testing Fixed vs. Pooled OLS regression: The F-test

The decision to use either the fixed or the Pooled OLS regression can be attained by performing a statistical test called the F-test. The main aim of the F-test is to verify that the individual country specific coefficients/effects are identical under the null hypothesis and against the alternative hypothesis that these effects differ between the countries. Explicitly, the null hypothesis is that all the fixed effects are zero. The respective hypotheses are presented as follows:

$$H_0: \beta_1 = \beta_2 = - - - - \beta_N = c \qquad (3.45)$$

$$H_1: \beta_i \neq \beta_j \qquad (3.46)$$

Where N is the number of countries under investigation

The F-stats is presented as follows:

$$F = \frac{(RSS-URSS)/(N-1)}{URSS/(NT-N-K)} \sim F_{N-1,N(T-1)-K} \qquad (3.47)$$

where RSS is the residual sum of squares derived from the pooled effects model,

URSS is the unrestricted residual sum of squares derived from the fixed effects model

N is the number of cross-section observations

T is the time frame

K is the number of parameters

If the null hypothesis is rejected, then the fixed effects regression model will be the appropriate method to use. Otherwise, if the null hypothesis is accepted i.e failure to reject the null, then the pooled OLS model will be the most suitable.

3.5.7.1.2 Testing Random Vs Pooled OLS regression: The Breusch-Pagan Lagrange Multiplier test (BP-LM)

The Breusch-Pagan LM test is used to determine if the random or the pooled OLS regression model should be used. The null hypothesis of the BP-LM test states that the variance of the unobserved heterogeneity is zero against the alternative that the variance of the unobserved heterogeneity is different from zero. The hypotheses are mathematically represented as follows:

$$H_0 = \sigma_\alpha^2 = 0 \quad \textbf{(3.48)}$$

$$H_1 = \sigma_\alpha^2 \neq 0 \quad \textbf{(3.49)}$$

The BP LM statistic is mathematically represented as follows:

$$\lambda_{LM} = \frac{nT}{2(T-1)} \frac{\sum_{i=1}^{T}\left(\sum_{i=1}^{T}\epsilon_{it}\right)^2}{\sum_{i=1}^{n}\sum_{t=1}^{T}\epsilon_{it}^2} - 1 \sim x_1^2 \quad \textbf{(3.50)}$$

Given these hypotheses, failure to reject the null hypothesis will imply that the pooled OLS regression stands as a better estimate. On the contrary, if the null hypothesis is rejected, this will denote the presence of random effects in the sample of countries under investigation. In lieu of this, performing the pooled OLS regression will lead to inconsistent and biased estimates and the researcher will need then to concentrate on either using the fixed or the random effects model.

3.5.7.1.3 Choosing Between Fixed and Random Effects: The HAUSMAN TEST (1978)

In a situation where the null hypothesis is rejected in the BP-LM test, deciding whether to apply the fixed or the random effects model will necessitate the use of the Hausman test.

Most often, in real world situations, countries are different with regard to their characteristics and features. Within this argument, researchers often tend to prefer the fixed effects regression as it takes into account the differences in entities. However, despite the fact countries may be different; the fixed effects may not always be the most appropriate model to use. For this reason, the Hausman test is usually employed to determine the most suitable model.

This therefore implies that deciding to choose between a fixed and a random effect regression model is not done out of a common sense, but researchers must rely on the Hausman test which was developed in 1978. Clark and Linzer (2015) affirmed that the Hausman test was designed to detect violation of the random effects modelling assumption that the explanatory variables are orthogonal to the unit effects. The Hausman test (1978) is based on the variances between the fixed and random effects estimates.

Generally, the Hausman test tests the specification of individual effects in panel data. Specifically, it is used to discriminate between the fixed and the random effects. The Hausman test tests the following hypothesis:

H0: The coefficient estimates of the random effects model are identical to the estimates of the fixed effects model

H1: The coefficient estimates of the random effects model are not identical to the estimates of the fixed effects model

The Hausman test statistics is written as follows:

$$H = (\hat{\beta}_{RE} - \hat{\beta}_{FE})'\left[Var(\hat{\beta}_{RE}) - Var(\hat{\beta}_{FE})\right]^{-1}(\hat{\beta}_{RE} - \hat{\beta}_{FE}) - x^2(\#\hat{\beta}_{FE}) \quad \textbf{(3.51)}$$

The above test can only hold if $\#\hat{\beta}_{FE} = \#\hat{\beta}_{RE}$

Following these hypotheses proposed by the Hausman test, the decision rules are stated as follows:

- If the probability value is significant, that is less than the significance level (P<5%), then the appropriate model to use is the fixed effects regression model (In other words, the null hypothesis is rejected).
- If the probability value is insignificant, that is greater than the significance level (P>5%), then the suitable model to use in this case is the random effects model (In other words, the null hypothesis is accepted).

The following procedures will be done if it is found out that variables display stationarity behaviours at their levels. This implies that the computation of the pooled, fixed and random effects regression models will only hold if the variables are I (0), that is stationary at their level. However, if the variables are found to be stationary after first difference, estimation regressions using the pooled, fixed and random model will lead to biased estimates. Therefore, if variables are found to be stationary after first difference, this implies that variables may exhibit a long run relationship and this has to be tested via the panel cointegration test.

3.5.8 Panel Cointegration Tests

The argument of fake regression and the need to carry out stationarity has been previously discussed. If the stationarity test discussed above shows that the variables display some form of unit root (hence non-stationary), then the first difference need to be carried out to correct for non-stationarity. Let's consider a scenario of a bivariate analysis with dependent variable Y and independent variable X. It is so said that if X and Y are alleged to be integrated of order one, this implies that the variables X and Y become stationarity only after the first difference.

Ever since the pioneering work of Levin and Lin (1992), literature on the econometrics of non-stationary panel data and in particular cointegrated have been given a lot of attention. The concept of cointegration has gained a lot of popularity in recent years and is being used in several economic research works to overcome the problem of spurious regression. Cointegration was first officially introduced by Engle-Granger (1987) and the authors acknowledged that it is a useful method to examine if I (1) variables (non-stationary variables) are cointegrated. Principally, the main idea behind cointegration is that it offers budding evidence about the long run relationship between the variables.

The first step in testing whether the variables are cointegrated is to determine the order of integration. Upon identifying that the variables are non-stationary, the next step is to determine if the variables are cointegrated. Two types of cointegration tests exist in the literature namely the Pedroni panel cointegration test and the Kao panel cointegration test.

Both tests are similar to the residual tests proposed by Engle and Granger (1987). In essence, both tests are residual based and mostly appropriate in bivariate regression.

3.5.8.1 Pedroni Cointegration Test

Pedroni (1995, 1997) proposed various tests to understand the null hypothesis of absence of intra-individual cointegration for both homogenous and heterogeneous panels. In the year 1999 and 2004, Pedroni proposed an extension in case the cointegration relationship includes more than two variables. Similar to the IPS test of panel unit root, the Pedroni test takes into account the heterogeneity by using parameters that may differ between individuals. The inclusion of such heterogeneity is a definite advantage since in practice it is rare that the cointegrating vectors are identical from one individual to another panel. The implementation of the Pedroni test requires first the estimation of a long run relationship.

$$Y_{it} = \alpha_1 + \delta_1 t + \beta_{1i}x_{1,it} + \beta_{2i}x_{2,it} + \dots + \beta_{Mi}x_{M,it} + \varepsilon_{it} \quad (3.52)$$

where i=1,…,N; t=1,….,T; m=1,….,M

Pedroni (1999) recommends a set of seven tests which consist of four panel statistics and three group statistics. Each of the tests follows a normal distribution. Of the seven tests proposed by Pedroni, four are based on the dimension Within (Intra) and three dimension between (inter).

The distinction between the two categories of Pedroni tests rests on the level of specification of the alternative hypothesis.

- For the test based on the intra dimension, the alternative hypothesis is given as follows: $\rho\rho ii =< \forall 1$
- For the category of test based on the inter dimension, the alternative hypothesis is given as follows:$\rho_i i < \forall 1$

In these seven tests, the statistics are constructed on the basis of residuals of the cointegrating vectors and a number of parameters. Pedroni assumes a null hypothesis that there is no cointegration against the alternative hypothesis that there is no cointegration. If the computed test statistics exceed in absolute value the critical value, then the null hypothesis of no cointegration will be rejected. If the null hypothesis of no cointegration is rejected, it implies that there is a long run equilibrium relationship between the variables under investigation. If the presence of cointegration is found among the variables, the next step will be the estimation of a panel error correction model to capture the short run dynamics, the speed of adjustment to equilibrium.

3.5.8.2 Kao Cointegration Test

In the year 1999, Kao developed a test which is based on the ordinary Engle-Granger test. Specifically, just as the Engle-Granger test, this test is based on the residual based procedure where the Dickey-Fuller (DF) and the augmented Dickey-Fuller (ADF) tests are applied on the residuals. Specifically, the Kao (1999) cointegration test presents two types of cointegration tests in panel data namely the Dickey-Fuller and the Augmented Dickey Fuller tests.

The Kao cointegration test proposes the null hypothesis that there is no cointegration among the variables (that is the residuals are non-stationary) whereas the alternative hypothesis considers that there is presence of cointegration among the variables (in other terms the residuals are stationary). In mathematically notation, the hypotheses are represented as follows:

$$H_0\text{: } abscence\ of\ cointegration$$

$$H_1\text{: } presence\ of\ cointegration$$

The Kao cointegration test differs from the Pedroni cointegration test in that the former test considers the precise case where the cointegrating vectors are presumed to be identical through the individuals. In simpler terms, the Kao cointegrating test does not take into consideration the assumption of heterogeneity under the alternative hypothesis and are also valid for a bivariate system (this implies that only one regressor is present in the cointegrating relationship).

The Kao cointegration test proposed by kao (1999) tests the following ADF regression equation as follows:

$$\hat{\varepsilon}_{it} = \rho\hat{\varepsilon}_{it-1} + \sum_{j=1}^{\rho} \varphi_j\, \Delta\hat{\varepsilon}_{it-j} + u_{ij} \qquad \textbf{(3.53)}$$

The Dickey Fuller test can be calculated from the estimated residuals as follows:

$$\hat{u}_{it} = \gamma\hat{u}_{it-1} + \upsilon_{it} \qquad \textbf{(3.54)}$$

where $\hat{u}_{it}$ represents the computed residuals from the estimated equation.

Like Pedroni test, if the computed test statistics exceed in absolute value the critical value, then the null hypothesis of no cointegration will be rejected. If the null hypothesis of no cointegration is rejected, it implies that there is a long run equilibrium relationship between the variables under investigation. As the presence of cointegration is found among the variables, the next step will be the estimation of a panel cointegrating relationship.

3.5.8.3 Estimation of the Panel Cointegrating Relationship

After evidence of cointegration among the variables, the next is to estimate a long-run cointegrating relationship. The literature depicts that there exist two elementary econometric approaches for the estimation of a single cointegrating vector in panel namely the Fully Modified Ordinary Least Squares (FMOLS) and the Dynamic Ordinary Least Squares (DOLS). Nevertheless, the literature also sustains the fact that it is better to estimate the cointegrating relationship using the DOLS as it presents several advantages compared to the FMOLS. This statement was confirmed by Lee and Tang (2003), Chien, Lee and Cai (2014) who acknowledged that generally, DOLS estimator is better than the FMOLS estimator. As cited in Lee and Tang (2003), Kao and Chiang (2000) stated that the DOLS outperforms the FMOLS in two main features:

- Firstly, the DOLS reduces bias better than the FMOLS while being computationally simpler at the same time
- The t-statistics from DOLS approximates the standard normal density much better than the t-stats from OLS or FMOLS.

In lieu of this, as a better estimator compared to the FMOLS, this study uses the DOLS in estimating the single cointegrating equation.

To conclude, this chapter has described all the steps that were utilized when investigating the impact of exchange rate changes and volatility on international trade in SSA. In the sequel, the results of the analysis will be presented in the following chapters.

CHAPTER 4

EMPIRICAL RESULTS – EXCHANGE RATE CHANGES AND VOLATILITY ON TRADE IN SSA

4.1 Introduction

The preceding chapters have underlined the exchange rate system in Sub-Saharan Africa and also discussed the theories linking exchange rate changes as well as volatility on trade. The review of the literature relating to exchange rate changes as well as volatility on international trade reveals no standard consensus as to the direction of the relationship between the respective variables. Explicitly, the literature exposes diverse opinions regarding the relationship. In fact, many studies have endeavored to understand and empirically test the effects of exchange rate changes as well as volatility on trade. Despite this, the empirical relationship between these variables still remains unclear. Regarding this, the literature divulges that whereas some studies have found the existence of a negative relationship between exchange rate changes as well volatility on trade, some studies have instead found the existence of a positive relationship between the respective variables. Nonetheless, the literature also acknowledges the existence of some studies that do not support the evidence of a significant relationship between exchange rate changes/volatility and trade. Based on these diverse empirical outcomes found in the literature, it is therefore of no argument to say that no proper conclusion have yet been found regarding the impact of exchange rate changes/volatility on trade. The previous chapters have well explained that ever since the breakdown of the Bretton Woods system of fixed exchange rate, many economists and researchers worldwide paid interest in this area of study. However, the survey of the literature reveals that more attention has been directed to advanced economies while neglecting developing economies precisely Sub-Saharan African economies.

Hence, the main aim of this chapter is to empirically examine and provide new evidence on the effects of exchange rate changes and volatility on trade in Sub-Saharan Africa. This chapter therefore presents the empirical outcomes of this study, which investigates a sample of 39 countries in Sub-Saharan Africa. More specifically, three distinct equations namely the import, the export and the trade balance equations are employed to investigate their respective responses to exchange rate changes and volatility. With regards to this, panel data was acknowledged as the most suitahle method of analysis for this study for its main advantage of being able to estimate cross-section and time series data together. Consequently, the pooled, the random and fixed effects models will be utilize to model our respective equations.

The study recalls that even though the two concepts of exchange rate changes and volatility seem to be similar, they are totally two different macroeconomic concepts. Hence, a separate empirical analysis will be done distinguishing between these two concepts. This is done so as to properly distinguish between the two concepts of exchange rate changes and exchange rate volatility.

In essence, based on the econometric steps discussed in chapter 3, this chapter provides an analysis. In the course of proceeding to the analysis, it is highlighted that all variables are transformed into natural logarithms except for inflation rate and volatility measures to avoid some misspecification problems and for the purpose that estimated coefficients can be easily interpreted as elasticities. The variables used in this study are as follows: LM_{it} (natural log of imports), LX_{it} (natural log of exports), LTB_{it} (natural log of trade balance), $LGDP_{it}$(natural log of GDP (domestic)) $LUSGDP_{it}$ (natural log of US GDP), $LG7I_{it}$ (natural log of G7 industrial production index), $LNER_{it}$ (natural log of nominal exchange rate), $LM2_{it}$ (natural log of M2 (money supply)), INF_{it} (inflation rate), $SDVol_{it}$ (Standard deviation volatility measure), $GARCHVol_{it}$ (GARCH volatility measure) and $HPVol_{it}$ (HP-Filter volatility measure).

To achieve the aims of this chapter, the first step of the analysis is to test the order of integration of each variable under study by the use of respective panel stationarity tests. Based on the results of the aforementioned test in regards to the order of integration of the variables, one shall then decide whether to proceed with the estimation of the panel models or the panel cointegration test.

The outline of this chapter is therefore as follows: Section 4.2 presents the results of the stationarity tests of the variables. Section 4.3 presents the empirical findings of the impact of exchange changes and trade in the entire Sub-Saharan Africa. Section 4.4 presents the empirical findings on the comparative analysis of exchange rate changes and volatility distinguishing between the distinct trade blocs of Sub-Saharan Africa. Section 4.5 presents the conclusion

4.2 Panel Unit Root Test

Usually, panel data series are likely to display some features of heterogeneity. In this study, the countries under investigation are distinct in terms of their characteristics and features, which therefore imply that the variables in the series may not have similar characteristics. This argument entails that the series may not be stationary and performing regressions on non-stationary data will lead to inconsistent and biased results. Hence, in order to avoid inaccurate results, it is therefore of great importance to check the order of integration of the variables before the estimation of the models. To achieve this, this study uses various stationarity tests namely, the Levin, Lin & Chu (LLC), the Im, Pesaran and Shin (IPS) and the Fisher ADF and PP panel unit root tests. Table 4.1 to 4.12 show the panel unit root test conducted for each variable.

Table 4.1: Panel Unit root test for LM_{it}

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	3.46153	0.9997			-17.9467	0.0000	I(1)*
	IPS	9.27902	1.0000			-15.5082	0.0000	I(1)*
	ADF - Fisher	17.1609	1.0000			357.813	0.0000	I(1)*
	PP - Fisher	21.2204	1.0000			415.603	0.0000	I(1)*
Intercept + Trend	LLC	-4.85085	0.0000	I(0)*		-15.9956	0.0000	
	IPS	-1.72344	0.0424	I(0)**[8]		-12.6649	0.0000	
	ADF - Fisher	92.4754	0.1257			277.858	0.0000	I(1)*
	PP - Fisher	81.5504	0.3695			326.108	0.0000	I(1)*

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

Table 4.2: Panel Unit root test for LX_{it}

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	2.23816	0.9874			-19.1344	0.0000	I(1)*
	IPS	7.71021	1.0000			-15.4146	0.0000	I(1)*
	ADF - Fisher	27.7399	1.0000			352.398	0.0000	I(1)*
	PP - Fisher	47.0906	0.9963			429.212	0.0000	I(1)*
Intercept + Trend	LLC	-4.86493	0.0000	I(0)*		-17.3248	0.0000	
	IPS	-0.82778	0.2039			-12.2881	0.0000	I(1)*
	ADF - Fisher	84.9754	0.2252			274.958	0.0000	I(1)*
	PP - Fisher	94.7786	0.0713	I(0)***		378.858	0.0000	

Table 4.3: Panel Unit root test for LTB_{it}

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	-24.4309	0.0000	I(0)*		-21.0423	0.0000	
	IPS	-7.44559	0.0000	I(0)*		-20.4422	0.0000	
	ADF - Fisher	131.543	0.0001	I(0)*		473.365	0.0000	
	PP - Fisher	124.078	0.0007	I(0)*		1982.47	0.0000	
Intercept + Trend	LLC	-7.94848	0.0000	I(0)*		-20.6575	0.0000	
	IPS	-7.11319	0.0000	I(0)*		-17.7084	0.0000	
	ADF - Fisher	186.393	0.0000	I(0)*		364.146	0.0000	
	PP - Fisher	207.530	0.0000	I(0)*		500.507	0.0000	

Table 4.4: Panel Unit root test for $LGDP_{it}$

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	3.59201	0.9998			-14.1311	0.0000	I(1)*
	IPS	9.49056	1.0000			-10.4343	0.0000	I(1)*
	ADF - Fisher	9.77611	1.0000			247.417	0.0000	I(1)*
	PP - Fisher	19.7574	1.0000			248.527	0.0000	I(1)*
Intercept + Trend	LLC	-4.07998	0.0000	I(0)*		-14.0392	0.0000	
	IPS	-1.18166	0.1187			-8.01773	0.0000	I(1)*
	ADF - Fisher	86.5554	0.2375			190.379	0.0000	I(1)*
	PP - Fisher	40.4317	0.9999			212.028	0.0000	I(1)*

Table 4.5: Panel Unit root test for $LUSGDP_{it}$

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	-15.6950	0.0000	I(0)*		-6.13590	0.0000	
	IPS	-6.04572	0.0000	I(0)*		-4.26644	0.0000	
	ADF - Fisher	148.965	0.0000	I(0)*		116.631	0.0030	
	PP - Fisher	148.965	0.0000	I(0)*		123.219	0.0008	
Intercept + Trend	LLC	-3.18950	0.0007	I(0)*		-3.85605	0.0001	
	IPS	1.93283	0.9734			-2.12112	0.0170	I(1)*
	ADF - Fisher	36.8077	1.0000			86.1085	0.2480	I(1)*
	PP - Fisher	5.47840	1.0000			88.4218	0.1969	I(1)*

Table 4.6: Panel Unit root test for $LG7I_{it}$

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	-10.1000	0.0000	I(0)*		-23.7917	0.0000	
	IPS	-6.44858	0.0000	I(0)*		-16.6032	0.0000	
	ADF - Fisher	156.749	0.0000	I(0)*		378.535	0.0000	
	PP - Fisher	186.132	0.0000	I(0)*		407.017	0.0000	
Intercept + Trend	LLC	-9.45533	0.0000	I(0)*		-21.6433	0.0000	
	IPS	-1.25358	0.1050			-13.1385	0.0000	I(1)*
	ADF - Fisher	73.7026	0.6167			282.983	0.0000	I(1)*
	PP - Fisher	63.4101	0.8841			518.126	0.0000	I(1)*

Table 4.7: Panel Unit root test for $LNER_{it}$

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	-8.28514	0.0000	I(0)*		-10.3413	0.0000	
	IPS	-3.59541	0.0002	I(0)*		-7.46262	0.0000	
	ADF - Fisher	130.524	0.0002	I(0)*		189.871	0.0000	
	PP - Fisher	382.572	0.0000	I(0)*		207.747	0.0000	
Intercept + Trend	LLC	-7.92670	0.0000	I(0)*		-9.61285	0.0000	
	IPS	-2.47747	0.0066	I(0)*		-4.52161	0.0000	
	ADF - Fisher	106.369	0.0181	I(0)**		137.105	0.0000	
	PP - Fisher	62.9860	0.8916			151.894	0.0000	I(1)*

Table 4.8: Panel Unit root test for INF_{it}

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-11.0750	0.0000	I(0)*	-8.06511	0.0000	
	IPS	-15.7730	0.0000	I(0)*	-20.8181	0.0000	
	ADF - Fisher	504.692	0.0000	I(0)*	493.028	0.0000	
	PP - Fisher	881.643	0.0000	I(0)*	2183.48	0.0000	
Intercept + Trend	LLC	-8.43151	0.0000	I(0)*	-14.0275	0.0000	
	IPS	-12.1154	0.0000	I(0)*	-20.1352	0.0000	
	ADF - Fisher	270.775	0.0000	I(0)*	419.050	0.0000	
	PP - Fisher	429.398	0.0000	I(0)*	656.836	0.0000	

Table 4.9: Panel Unit root test for $LM2_{it}$

.		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	0.44697	0.6726		-18.2443	0.0000	I(1)*
	IPS	2.81225	0.9975		-17.4716	0.0000	I(1)*
	ADF - Fisher	50.4666	0.9934		404.184	0.0000	I(1)*
	PP - Fisher	51.1659	0.9919		672.846	0.0000	I(1)*
Intercept + Trend	LLC	-1.46162	0.0719	I(0)***	-17.5029	0.0000	
	IPS	-2.84897	0.0022	I(0)*	-14.3453	0.0000	
	ADF - Fisher	134.075	0.0001	I(0)*	313.633	0.0000	
	PP - Fisher	136.080	0.0001	I(0)*	444.109	0.0000	

Table 4.10: Panel Unit root test for $SDVol_{it}$

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	-11.5078	0.0000	I(0)*		-24.6802	0.0000	
	IPS	-11.8575	0.0000	I(0)*		-21.2954	0.0000	
	ADF - Fisher	282.032	0.0000	I(0)*		491.751	0.0000	
	PP - Fisher	334.687	0.0000	I(0)*		700.229	0.0000	
Intercept + Trend	LLC	-5.67323	0.0000	I(0)*		-20.7162	0.0000	
	IPS	-5.62530	0.0000	I(0)*		-17.3218	0.0000	
	ADF - Fisher	154.012	0.0000	I(0)*		371.551	0.0000	
	PP - Fisher	172.591	0.0000	I(0)*		467.938	0.0000	

Table 4.11: Panel Unit root test for $GARCHVol_{it}$

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	3.67271	0.9999			-25.2172	0.0000	I(1)*
	IPS	3.95364	1.0000			-22.9147	0.0000	I(1)*
	ADF - Fisher	45.9917	0.9985			775.156	0.0000	I(1)*
	PP - Fisher	43.8916	0.9994			803.483	0.0000	I(1)*
Intercept + Trend	LLC	-1.21081	0.1130			-23.7402	0.0000	I(1)*
	IPS	-2.18274	0.0145	I(0)**		-20.4649	0.0000	
	ADF - Fisher	104.497	0.0243	I(0)**		375.217	0.0000	
	PP - Fisher	124.551	0.0006	I(0)*		435.073	0.0000	

Table 4.12: Panel Unit root test for $HPVol_{it}$

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	-7.08599	0.0000	I(0)*		-4.77112	0.0000	
	IPS	-7.40393	0.0000	I(0)*		-12.0063	0.0000	
	ADF - Fisher	185.631	0.0000	I(0)*		281.012	0.0000	
	PP - Fisher	102.686	0.0320	I(0)**		262.114	0.0000	
Intercept + Trend	LLC	2.98077	0.9986			-5.05595	0.0000	I(1)*
	IPS	-4.04691	0.0000	I(0)*		-6.94744	0.0000	
	ADF - Fisher	126.434	0.0004	I(0)*		177.235	0.0000	
	PP - Fisher	46.5177	0.9982			167.244	0.0000	I(1)*

The results of the panel unit root test reveal mixed results. To interpret the results, the study looks at the probability value. If the probability value is less than the significance level (1%, 5%, 10%), the null hypothesis is rejected and vice versa. Variables that show consistent results for all unit root tests and which are stationary at their level-I(0) are LTB, volatility (standard deviation), Inflation, Volatility (HP-Filter) and LNER (except for Fisher-PP for the model of intercept + trend which shows that LM and Volatility (HP-Filter) is I(1)). On the other hand, the remaining variables reveal inconsistent results. The results for LX show that for the model of intercept, all four tests show that the variable is integrated at order 1 but then for the model of intercept and trend, the LLC and IPS tests show that the variable is I(0) at 1% and 10% respectively while on the other hand, the Fisher-ADF and Fisher-PP tests reveal that LX is I(1). From the results, it can also be shown that LGDP and LG7I are integrated of order 1 and 0 correspondingly except for the LLC test under the model of intercept and trend which contradicts by showing that LGDP is I(0). For all tests at the model of intercept, LUSGDP is stationary at level but I(1) for all tests under the model of intercept and trend except for LLC (LUSGDP is I(0)). In addition, the results also reveal that LM2 and Volatility (GARCH) is I(1) for all tests at the model of intercept but I(0) for the model of intercept and trend except for the LLC test. From the above discussion, it is clear that the panel unit root test have produced very mixed results.

For the sake of simplicity and at the discretion of the researcher, for each model, the majority of results are chosen. With a critical look at the panel unit root results, it is observed that under the benchmark of the model of intercept, majority of the results conclude the variables are stationary at their level. In other terms, the variables are integrated of order 0. Likewise under the benchmark of the model of intercept and trend, majority reveals that the variables are I(0). It is important to highlight the fact that the results display some consistency with the LLC test under the model of intercept and trend. Under this model, the LLC test displays that all variables are indeed stationary at their level except for the Volatility (GARCH and HP Filter) which shows that the variable is integrated of order 1. In this regard, Following that the majority of the results are in favor of variables being I(0) and also for the fact that except for GARCH and HP Filter volatility measures, LLC produces consistent results of I(0) variables, this study therefore considers that the variables under study are all I(0). The implication of variables being stationary (I(0)) is that the estimated models will lead to valid results. In econometrics, it is known that performing regression on non-stationary variables will result to spurious regression. However, this problem of spurious regression can be eliminated when the variables are cointegrated. Hence, performing regression with I(0) variables implies that not only the variables are predictable, but they will lead to reliable results estimates. With the conclusion that the variables are I(0), the next step of the analysis will be to estimate the regression equations. The pooled, fixed and random effects regression model will be estimated. The regression equations will be estimated for each of the model of imports, exports and trade balance. Section 4.3 therefore presents the empirical findings of the impact of exchange rate changes and volatility on trade in the entire SSA. It is important to recall at this stage that as the main aim of this thesis is to investigate how trade is affected by exchange rate changes on one hand and exchange rate volatility on the other hand, the results estimations will be divided into two sections to avoid confusion.

In this regard, while section 4.3.1 presents the empirical results of the impact of exchange rate changes on trade (imports, exports and trade balance), section 4.3.2 presents the empirical results of the impact of exchange rate volatility on trade (imports, exports and trade balance).

4.3 Estimation Results: The Impact of Exchange Rate Changes and Volatility on Trade

4.3.1 Estimation Results: The Impact of Exchange rate Changes on Trade

Three distinct types of panel data models were used in this study namely the pooled regression, the fixed effects model regression and the random effects model regression. Each of these models differs in terms of their assumptions and analysis. The pooled regression model assumes that all countries are homogeneous and therefore treats them the same. Explicitly, the model is based on the assumption that there is a constant intercept and slope for each country. Hence, the country specific effects are ignored in the pooled model. In regards to this, combining the 39 cross-sections in this study implies that this study neglects the unique characteristics of each of the cross-sections. It should be noted that the pooled model is not realistic as it is well known that countries and specifically countries in SSA are unique in terms of their characteristics. The fixed effects regression model is different from the pooled model. Under the fixed effects model, countries specific effects are not disregarded and in lieu of this, time invariant differences/characteristics between countries are taken into account. Explicitly, the fixed effects model allows for heterogeneity or individuality across the countries by permitting to have its own intercept. Similar to the fixed effects regression model, the random effects model also acknowledges the presence of unique characteristics in the cross sections. But, the random effects model differs from the fixed effects model in the logic that it assumes that the country specific effects are generated by a specific distribution. After the estimation of these distinct panel models, the appropriate tests will be used to investigate which model is the most suitable for this study.

4.3.1.1 Pooled Effects Regression Model

The results of the estimation of equations 3.10, 3.11 and 3.12 respectively specified in Chapter 3 are presented in this section. The pooled regression for the model of imports, exports and trade balance are presented in Table 4.13.

Table 4.13: Pooled regression model for Imports, Exports and Trade balance

IMPORTS MODEL

Variables	LGDP	LNER	INFL	LM2	C
Coefficients	0.849922	-0.023416	8.56E-06	0.284320	8.338425
Standard Error	(0.012554)	(0.008003)	(4.13E-05)	(0.028275)	(0.048795)
T-statistics	[67.69880]	[-2.926057]	[0.207110]	[10.05567]	[170.8884]
Probability	0.0000	0.0035	0.8360	0.0000	0.0000
R-squared		0.877059			
Adjusted R-squared		0.876353			

EXPORTS MODEL

Variables	LUSGDP	LG7I	LNER	INFL	LM2	C
Coefficients	3.089542	-1.962000	-0.182721	0.000110	-0.150540	1.095092
Standard Error	0.347898	1.249234	0.024688	0.000127	0.090659	1.786997
T-statistics	8.880599	-1.570563	-7.401299	0.863821	-1.660503	0.612811
Probability	0.0000	0.1167	0.0000	0.3880	0.0973	0.5402
R-squared	0.192915	0.192915				
Adjusted R-squared	0.187117	0.187117				

TRADE BALANCE MODEL

Variables	LGDP	LUSGDP	LG7I	LNER	INFL	LM2	C
Coefficients	12.08441	-37.09507	75.10847	0.996057	0.008207	-4.157259	-15.91755
Standard Error	1.007253	8.898368	30.35049	0.616536	0.003084	2.215565	43.54094
T-statistics	11.99739	-4.168750	2.474704	1.615569	2.661060	-1.876388	-0.365577
Probability	0.0000	0.0000	0.0136	0.1066	0.0080	0.0610	0.7148
R-squared	0.196966						
Adjusted R-squared	0.190033						

For each of the model of imports, exports and trade balance, the pooled regression model was estimated. The pooled regression model provides an estimation of a linear connection between the dependent and the independent variables. In this study, import performance is explained by domestic GDP (LGDP), nominal exchange rate (LNER), inflation (INFL) and money supply (LM2). As the theory suggests, all the variables in the import model bear the expected signs. Explicitly, in accordance with economic theory, the results also portray the evidence of a positive statistical significant relationship between domestic GDP as well as money supply with imports. Inflation also reveals a positive relationship with imports but however the coefficient appears to be insignificant. Conversely, for the model of exports, export performance in this study is explained by foreign income proxied by LUSGDP and LG7I, nominal exchange rate, inflation and money supply. For this model, not all coefficients have the expected signs as suggested by the theory. Only LUSGDP and LM2 bear the expected signs, however only LUSGDP appears to be statistically significant. Likewise in the trade balance equation, not all coefficients have the expected signs. Except for LUSGDP and INFL, all the other variables bear the correct sign proposed by the theory.

As it was discussed in the previous chapter, the pooled regression model assumes that all countries are alike, and in this regard ignored the distinctiveness and individual characteristics of the cross-sections. This implies that in this pooled regression model, all observations were pooled in the OLS regression meaning that it is assume that the coefficients as well as the intercepts are similar for all countries. However, in real world situations, different scenarios are observed. In our case, it is obvious that countries in Sub-Saharan Africa are all distinct. Thus, relying on the pooled OLS estimation may lead to biased results. To overcome the problem of biased results, the fixed and the random regression models will be estimated.

4.3.1.2 Fixed Effects Regression Model

The fixed effects model differs from the pooled regression model in that it allows for the intercepts of the cross-section (countries) to differ as a result of countries distinct effects. When talking about country distinct characteristics, the study refers here to their political situations, and policies, among others. Compared to the pooled regression model, this model may not lead to unbiased results as it controls for unobserved heterogeneity to control for country and time specific effects. For each of the models of imports, exports and trade balance, the estimates of the fixed effects regression model are shown below in table 4.14.

Table 4.14: Fixed effects regression model for Imports, Exports and Trade balance

IMPORTS MODEL[9]

Variables	LGDP	LNER	INFL	LM2	C
Coefficients	0.890938	0.157061	0.000124	0.295657	7.927649
Standard Error	0.017017	0.014281	2.62E-05	0.031365	0.043082
T-statistics	52.35570	10.99796	4.739029	9.426398	184.0143
Probability	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.970900				
Adjusted R-squared	0.969045				

EXPORTS MODEL[10]

Variables	LUSGDP	LG7I	LNER	INFL	LM2	C
Coefficients	2.829244	-2.165261	-0.020600	-6.85E-05	-0.095419	2.163029
Standard Error	0.110759	0.361195	0.026178	4.54E-05	0.058456	0.514139
T-statistics	25.54414	-5.994716	-0.786903	-1.510542	-1.632306	4.207091
Probability	0.0000	0.0000	0.4316	0.1314	0.1031	0.0000
R-squared	0.939007					
Adjusted R-squared	0.935021					

TRADE BALANCE MODEL[11]

Variables	LGDP	LUSGDP	LG7I	LNER	INFL	LM2	C
Coefficients	26.48108	-70.43322	99.31394	3.894296	0.008469	-9.065444	61.66749
Standard Error	2.790738	-7.316733	4.740011	2.612983	3.335263	-2.813528	30.95454
T-statistics	9.488918	-7.316733	4.740011	2.612983	3.335263	-2.813528	1.992195
Probability	0.0000	0.0000	0.0000	0.0092	0.0009	0.0050	0.0468
R-squared	0.690432						
Adjusted R-squared	0.669700						

[9] The cross-section fixed effects for Imports are presented in Appendix A
[10] The cross-section fixed effects for Exports are presented in Appendix B
[11] The cross-section fixed effects for Trade balance are presented in Appendix C

Compared to the pooled regression models, the fixed effects display greater R-squares. For all the three models of imports, exports and trade balance, not all models have the expected signs. For the model of imports, only the variables LGDP, INFL and LM2 bear the expected positive sign and they are all statistically significant meanwhile LNER is not in accordance with economic theory. The export equation reveals the signs of the estimated coefficients are all consistent with the theory except for LG7I and LNER which shows a negative insignificant relationship with export performance. On the other hand, despite being all significant, the estimates of the trade balance equation produces mixed results. Only LGDP, LG7I, LNER and LM2 are all consistent with economic theory while the others are not.

The following section will proceed with the estimation of the random effects model.

4.3.1.3 Random Effects Regression Model

Compared to the fixed effects regression model, the random effects regression model is used when the cross-sections (countries in this thesis) are randomly selected from the population. Under this model therefore, the distinct characteristics of each individual country are arbitrary and uncorrelated with the independent variables.

The results of the random effects regression model are therefore presented as follows in Table 4.15.

Table 4.15: Random effects regression model for Imports, Exports and Trade balance

IMPORTS MODEL[12]

Variables	LGDP	LNER	INFL	LM2	C
Coefficients	0.892260	0.118577	8.74E-05	0.326823	7.961726
Standard Error	0.015960	0.012599	2.53E-05	0.029587	0.050177
T-statistics	55.90588	9.411447	3.451828	11.04604	158.6730
Probability	0.0000	0.0000	0.0006	0.0000	0.0000
R-squared	0.892260				
Adjusted R-squared	0.858205				

EXPORTS MODEL[13]

Variables	LUSGDP	LG7I	LNER	INFL	LM2	C
Coefficients	2.835573	-2.149150	-0.031749	-7.71E-05	-0.089458	2.119415
Standard Error	0.110511	0.360856	0.025274	4.49E-05	0.057686	0.522530
T-statistics	25.65869	-5.955705	-1.256209	-1.717687	-1.550774	4.056064
Probability	0.0000	0.0000	0.2095	0.0863	0.1214	0.0001
R-squared	0.651174					
Adjusted R-squared	0.648668					

TRADE BALANCE MODEL[14]

Variables	LGDP	LUSGDP	LG7I	LNER	INFL	LM2	C
Coefficients	20.61087	-55.58362	87.08290	2.477845	0.006796	-8.349875	31.92834
Standard Error	2.192671	8.410660	20.42134	1.201729	0.002377	2.964227	29.78695
T-statistics	9.399891	-6.608711	4.264308	2.061901	2.859124	-2.816881	1.071890
Probability	0.0000	0.0000	0.0000	0.0396	0.0044	0.0050	0.2841
R-squared	0.139523						
Adjusted R-squared	0.132094						

[12] The cross-section Random effects for Imports are presented in Appendix D
[13] The cross-section Random effects for Exports are presented in Appendix E
[14] The cross-section Random effects for Trade balance are presented in Appendix F

Likewise the fixed effects regression model, the random effects model display greater R-squares. For all the three models of imports, exports and trade balance, not all models have the expected signs. The coefficients estimates for the model of imports have expected signs according to economic theory except for LNER which display a positive relationship with imports. Similarly, the coefficient estimates for the export model also show signs which are consistent with economic theory except for the LG7I and LNER. The estimates of the trade balance equation produce mixed results. Only LGDP, LG7I, LNER and LM2 are all consistent with economic theory while the others are not.

The three models of pooled, fixed and random were estimated for each of the model of imports, exports and trade balance. In this regard, it is important now to choose which model is the most appropriate for this study. With the aid of statistical tests, we will be able to know which model is the most appropriate. The tests will be done for each of the model of imports, exports and trade balance.

4.3.1.4 Choosing the Suitable Model

4.3.1.4.1 Testing between the Fixed and the Pooled Effects Regression Model (F-test)

Table 4.16 reports the results of the F-statistics test to determine which model between the pooled and the fixed effects regression model is appropriate for this study.

Table 4.16: F-statistics test results

MODEL	F-STATISTICS VALUE	D.F	PROB	DECISION
IMPORTS	55.924448	(38,659)	0.0000	Ho rejected
EXPORTS	211.814501	(38,658)	0.0000	Ho rejected
TRADE BALANCE	27.560258	(38,657)	0.0000	Ho rejected

For all three models, given the significance of F-statistics value as well as its probability values, this implies the presence of heterogeneity in the panels. In other words, the results show that the 39 SSA countries under examination in this study are not identical. In lieu of this, the study must take into consideration the distinct specific effects of each country. The F-statistics results therefore show that the pooled effects model is not appropriate and the fixed model should be estimated.

The next section will now test between the pooled and the random effects regression model.

4.3.1.4.2 Testing between the Random and the Pooled Effects Regression Model (BP LM test)

Table 4.17 reports the results of the BP-LM test statistics test to determine which model between the pooled and the random effects regression model is appropriate for this study. The probability values are reported in parentheses.

Table 4.17: BP-LM test results

MODEL	Cross-section One-sided	Period One-sided	Both	DECISION
IMPORTS	2673.714 (0.0000)	22.05685 (0.0000)	2695.771 (0.0000)	Ho rejected
EXPORTS	4897.771 (0.0000)	5.115206 (0.0237)	4902.886 (0.0000)	Ho rejected
TRADE BALANCE	1941.647 (0.0000)	5.115206 (0.0237)	2695.771 (0.0000)	Ho rejected

The main aim of the BP-LM test is to test whether random effects model is present. So, the null hypothesis is the presence of random effects. If the probability value is significant, then the null hypothesis of no random effects will be rejected and the random effects regression will be more appropriate than the pooled regression model. Based on the results, for all three models of imports, exports and trade balance, the null hypothesis of no random effects is rejected as the respective probability values are significant at 5% significance level. In this regard, the random effects model is preferred compared to the fixed effects model.

Both the F-statistics and the BP-LM tests revealed that the pooled effects regression model is not appropriate and choosing it as the most suitable model will lead to the interpretation of biased estimates. Both tests respectively revealed that the fixed and the random effects are most suitable for this study. However, the Hausman test will aid us to distinguish which model will be more appropriate.

4.3.1.4.3 Testing between the Fixed and the Random Effects Regression Model (HAUSMAN TEST)

The survey of the literature has revealed that most researchers prefer using the fixed effects regression model. But this should not just be done out of a general sense. The Hausman test will aid us to distinguish which model between the fixed and the random regression model is most appropriate for this study. Regarding this, the null hypothesis states that the coefficient estimates of the random effects model are same to the estimates of the fixed effects model and vice versa. Hence, if the Probability value is less than the critical value, the null hypothesis will be rejected and the fixed effects model will be preferred in favour of the random effects model. Table 4.18 presents the results of the Hausman test for all three distinct models.

Table 4.18: Hausman test results

MODEL	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.	DECISION
IMPORTS	38.840868	4	0.000000	Ho rejected
EXPORTS	0.000000	5	1.0000	Ho not rejected
TRADE BALANCE	0.000000	6	1.0000	Ho not rejected

For the model of imports, the probability value is less than the 5% critical value which implies that the null hypothesis is rejected and the fixed effects regression model is the most suitable model. For the exports and trade balance model, the probability value is greater than the critical value, hence the null hypothesis is not rejected. Regarding this, it is therefore concluded that the random effects regression model is the most suitable model for the model of exports and trade balance. The study can therefore provide a thorough interpretation of the results based on the most suitable regression model for each equation. In lieu of this, Table 4.19 reports the suitable models that will considered in this thesis in analysing the effects of exchange rate changes on trade.

Table 4.19: Suitable models for Imports, Exports and Trade balance

IMPORTS MODEL (FIXED EFFECTS)

Variables	LGDP	LNER	INFL	LM2	C
Coefficients	0.890938	0.157061	0.000124	0.295657	7.927649
Standard Error	0.017017	0.014281	2.62E-05	0.031365	0.043082
T-statistics	52.35570	10.99796	4.739029	9.426398	184.0143
Probability	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.970900				
Adjusted R-squared	0.969045				

EXPORTS MODEL (RANDOM EFFECTS)

Variables	LUSGDP	LG7I	LNER	INFL	LM2	C
Coefficients	2.835573	-2.149150	-0.031749	-7.71E-05	-0.089458	2.119415
Standard Error	0.110511	0.360856	0.025274	4.49E-05	0.057686	0.522530
T-statistics	25.65869	-5.955705	-1.256209	-1.717687	-1.550774	4.056064
Probability	0.0000	0.0000	0.2095	0.0863	0.1214	0.0001
R-squared	0.651174					
Adjusted R-squared	0.648668					

TRADE BALANCE MODEL (RANDOM EFFECTS)

Variables	LGDP	LUSGDP	LG7I	LNER	INFL	LM2	C
Coefficients	20.61087	-55.58362	87.08290	2.477845	0.006796	-8.349875	31.92834
Standard Error	2.192671	8.410660	20.42134	1.201729	0.002377	2.964227	29.78695
T-statistics	9.399891	-6.608711	4.264308	2.061901	2.859124	-2.816881	1.071890
Probability	0.0000	0.0000	0.0000	0.0396	0.0044	0.0050	0.2841
R-squared	0.139523						
Adjusted R-squared	0.132094						

4.3.1.5 Detailed Discussion of the Results

The discussion of the results will be done for each of the distinct models of imports, exports and trade balance.

The study starts with the interpretation of results for the model of imports. Based on the diagnostic tests, it was revealed that the fixed effects model was the best fitted model for imports. The overall system indicates a good goodness of fit based on a very high coefficient of determination. Based on the results, the coefficient of determination (R^2) is 0.97 which is very good, thus indicating that 97% of the variation in imports is explained by the respective explanatory variables. In this regard, the remaining 3% are explained by the omitted variables.

The results of the import model reveal that all variables are positive and all significant and all the coefficients hear the expected signs as proposed by the literature and the theoretical perspectives except for exchange rate. The following paragraphs therefore discuss the interpretation of the coefficients.

SSA countries increase in its value of imports can be explained by the increase in its domestic income which is proxied here by its domestic GDP. The estimated coefficient for LGDP is 0.89 which implies that as all other independent variables are kept constant, a percentage increase in LGDP will cause LIMP to increase by 0.89%. The sign of this coefficient is in line with economic theory and it is also statistically significant as confirmed by the significance of the test-statistics. Regarding this, the study concludes that for the 39 countries under observation in this study, there is a positive connection that exists between the value of imports and gross domestic income. This empirical result is also consistent with other similar studies on this topic such as Jiranyakul & Brahmasrene (2002), Fatukasi & Awomuse (2011), as well as Odili (2015) that establish that domestic income (GDP) has a positive role to play in the increase of imports in a country.

The results of the analysis also reveal that imports in SSA countries considered in this study are positively affected by inflation. The outcome shows that for each percentage increase in INFL, LIMP will also increase by 0.0001%. This finding stands consistent with theoretical and empirical literature which state that as inflation increases indicating an increase in domestic prices, the nationals will therefore choose to buy goods from other countries which will increase imports. It is noted that this scenario might only prevail if the domestic produced goods are expensive than foreign produced goods. This scenario was empirically tested in SSA and was found to hold with a statistically significant coefficient. It can therefore be concluded that the higher the level of inflation denoting an increase in the price of goods and services, nationals will incline to buy more foreign products thereby causing imports to escalate. Islam (2013) conducted a study to investigate the impact of inflation on imports. Likewise this study, Islam (2013) found that there exist a positive correlation between domestic inflation and import but the relationship was found to be very insignificant.

The monetary approach to the balance of payments hypothesized that as more money is supplied in the economy, the greater will be the value of imports. Increase in the supply of money translated in the increase in imports indicates that the economy has more money to buy goods from abroad. Consistent with economic theory, the outcome of the analysis suggests that a 1% increase in LM2 will increase LIMP by 0.30%. The coefficient is also observed to be statistically significant which confirms the accuracy of the estimated coefficient. This study therefore concludes that imports in SSA are increase when money supply is also increase.

The empirical results also reveal that as exchange increases, imports will also increase. Based on the definition of exchange rate in this thesis, which is the local currency unit per US dollar, increase in exchange rate here refers to a depreciation of the currency. This therefore implies that, a depreciation of the currency will cause imports to increase which is not consistent with economic theory. The theory suggests that as exchange rate depreciates, exports will increase, imports will decrease therefore causing trade balance to increase. This also means that as exchange rate appreciates, exports will decrease, imports will increase and causing in turn the trade balance to decrease. However, this situation does not seem to hold in this study. But, based on the statistical significance of the coefficient, the study acknowledges that a 1% increase in LNER (which indicates a depreciation of the domestic currency) will increase LIMP by 0.16%. The theory was therefore found not to hold in this study and in light of this, it is concluded that there indeed exist a positive relationship between exchange rate depreciation and imports. The positive connection between exchange rate depreciation and imports can be attributed to the fact that the vast majority of countries in SSA are underdeveloped and therefore tends to be heavily dependent on foreign imports. Being small in size, the local production of majority of SSA countries are generally not sufficient to meet local demand, and therefore have to lean on foreign markets. That said, the fact that SSA imports are mostly essential (food, machineries, hydrocarbon products) will mean that a depreciation of the exchange rate will not always cause a decrease in the imports, unless exports are further boosted. Unless SSA countries can diversify their exports, become self-sufficient in food and other essential products, there is a high probability that imports will still escalate despite an exchange rate depreciation. The ever-increasing level of imports, despite the depreciation of currency, was also established by Kafayat (2014). Kafayat (2014) found that despite the depreciation of Rupee (Pakistan's currency), imports keeps on increasing. Notwithstanding, Pandey (2013) also found that a depreciation of exchange rate will cause an increase in India's imports. The author justifies that this increase in imports may be due to the indirect impact of rising exports incomes overwhelming the effects of rise in import prices, leading to a rise in import volumes. Likewise Kafayat (2014) and Pandey (2013), this study also sustains the argument that the depreciation of the local currencies in SSA have no direct negative impact on imports.

Having examined the import model, the study now proceeds to the exports model. The statistical tests previously conducted revealed that the most appropriate model for export is the random effects regression model. The estimated model shows a fair goodness of fit with a coefficient of determination of 0.65 which means that about 65% of the variation in exports is explained by the explanatory variables while the continuing 35% account for the omitted variables.

Based on the literature and economic theory, except for the G7 industrial production index, all coefficients bear the anticipated signs. The theory suggests that as the income of trading partners increase, the exports value will also increase. As guided by the literature, the income of trading partners was proxied by two variables in this study namely the US gross domestic product as US represents one of the major trading partners of most of the SSA countries and the industrial production index of advanced economies of which the G7 countries was considered. Therefore, the expectation is that LUSGDP and LG7I will be positively related to LEXP. However, it is noted that the signs of these variables are not all in line with economic theory. As suggested by the theory, LUSGDP is positively related with LEXP. Explicitly, a one percentage increase in LUSGDP will cause LEXP to increase by 2.84%. This coefficient is also significant with a t-statistics value greater than 2. This outcome confirms that as the income of trading partners increase, this will consequently boost exports in the domestic country. Nevertheless, the coefficient of LG7I is not in line with economic theory. The results of the analysis instead reveal that there is a negative correlation between LG7I and

LEXP of which the coefficient is significant. The study therefore concludes that, for the case of SSA, as LG7I increase, exports will instead decrease by 2.15%.
In line with economic theory, the coefficients of LM2 and INFL bear the correct negative signs. The results show that as more money is supplied in the economy, this will imply the economy has more income and this will cause them to increase their imports and in turn discourage exports. The results confirm that a one percentage increase in LM2 will cause LEXP to decrease by 0.09% but this coefficient is statistical insignificant. Inflation also carries the correct negative sign but the coefficient is seen to be statistical insignificant like LM2. Hence, the study concludes that that there was no evidence of a statistical significant relationship between LEXP and LM2/INFL respectively.

As the theory hypothesised, an increase in exchange rate which implies a depreciation of the domestic currency will cause exports to increase. As a result of this, a positive coefficient is expected. In this study, the expected positive relationship was not found. It is seen from the empirical analysis that as exchange rate increases (depreciates) by one percent, exports will instead decrease by 0.03% which is totally contradictory with economic theory. Despite the unexpected sign, it should be noted that this coefficient was not found to be significant. In conclusion, the study postulates that there is no evidence of a significant relationship between exchange rate changes and exports in SSA.

Both the coefficients of the imports and exports model were explained. The study now proceeds to the interpretation of the results of the trade balance model. The coefficient of determination for the trade balance model is low compared to the previous models. The model shows that about 14% of the variation in trade balance is explained by the explanatory variables. One of the central goals of this study was to investigate the effects of exchange rate changes on trade in SSA. The theory by Marshall-Lerner suggests that depreciation in a country's domestic currency will lead to an improvement in the trade balance. The Marshall-Lerner condition seems to hold in this study as there is evidence that as exchange rate depreciates, trade balance also increases. The Marshall-Lerner condition is therefore satisfied in this study. The magnitude of the coefficient shows that a 1% increase in exchange rate will cause trade balance to increase by 2.48%. As this coefficient is significant, it is concluded that a depreciation of local currencies succeeds in decreasing the trade balance in SSA. The evidence of the Marshall-Lerner theory was also confirmed by Eita (2013) who found that depreciation of exchange rates increase trade balance in Namibia.

The theory suggests that the sign for the coefficient of domestic income and foreign income is uncertain. It is expected that the coefficient could either be negative or positive. It is stipulated that an increase in domestic output will lead to a rise in imports but might also lead to a rise in exports and this will lead to either an expansion or a deterioration of trade balance. In this study, it is found that an increase in domestic income leads to an improvement in the trade balance. As LGDP increase by 1%, LTB is seen to also improve by 20.61% and this coefficient is statistically significant. Likewise, foreign income proxied by LUSGDP and LG7I can either be positive or negative as the literature portrays that the signs of the coefficients are uncertain. Both proxies used to account for foreign exchange have contrary signs. LUSGDP is seen to be statistically negatively correlated with trade balance. This means as LUSDGP increases by a percentage, SSA trade balance reduces by 55.58%. Yuen-Lin et *al.* (2008) support that this negative correlation maybe because the growth in foreign real income is due to an rise in the foreign production of import-substitute goods, thus, their imports may decline as income increases. However, the production index of the advanced economies shows an opposite scenario. The results divulge that as LG7I increases, LTB also increases by 87%.

LM2 carries the correct negative sign and is also statistically significant. As LM2 increases by one percent, LTB decreases by 8.35%. This means that as more domestic money supply is supplied to the economy, the purchasing power will also increase, this will encourage the buying of foreign goods (imports) and discourage exports and this will in turn consequently reduce the trade balance.

4.3.2 Estimation Results: The Impact of Exchange rate Volatility on Trade

As one of the main objectives of this study, in this section, this study analyzes the impact of exchange rate volatility on international trade in SSA. Explicitly, this study investigates the extent to which imports, exports and trade balance are affected by exchange rate volatility in SSA. The literature maintains the argument that there exist a negative relationship between exchange rate volatility and trade. In other words, as exchange rate volatility rises, the volume of trade diminishes. However, despite this theoretical foundation on exchange rate volatility and trade, the empirical investigation does not seem to hold any conclusion. Results are mixed in the literature pertaining to the direction of exchange rate volatility and trade. Some studies concluded that there is a negative relationship while others concluded that there is a positive relationship. It is thus of essence in this study to empirically investigate the direction of the impact of exchange rate volatility and trade.

The same procedure will be followed as was the case for the impact of exchange rate changes and international trade in SSA. As it was explained in the previous chapters, volatility is not a variable that is easy to measure. In this regard, this study utilizes three measures of volatility to investigate its impact on imports, exports and trade balance respectively. Three measures of volatility are utilized in this study for the sake of robustness. The main aim of using these diverse volatility measures is to check how they differ and also to investigate whether the result of the analysis is particularly dependent upon the measure of volatility used. The three volatility measures employed in this study are the standard deviation (SDVol), GARCH approach (GARCHVol) and the HP-Filter approach (HPVol). Therefore, for each of the distinct models of imports, exports and trade balance, the three measures of volatility will be employed.

The first step to the estimation of the regression equations is to test the level of stationarity among the variables. However, there is no need to run the stationary test as all tests were run for each variable in the previous section (modelling the impact of exchange rate changes on international trade). Regarding this, at the discretion of the researcher, the majority of the results were chosen and it was therefore observed that except for the GARCH and HP-Filter volatility measures, the LLC was found to produce consistent estimates of I(0) variables. Hence, the study concluded that the variables are I(0), therefore stationary at their levels. Following the conclusion that the variables are stationary, the next procedure is the estimation of the pooled, fixed and random effects regression models and the use of appropriate statistical tests to determine the most suitable regression models for each of the models of imports, exports and trade balance.

4.3.2.1 Pooled Effects Regression Model

The results of three distinct equations are presented in this section. It is important to recall that two set of estimations will be done in this section. It was earlier explained in the previous chapter (chapter 3) that the estimation of the model of exchange rate volatility on trade may suffer some correlation problems. Clearly, grounded on the fact that the three measures of volatility are derived from the nominal exchange rate, there is a high possibility that the two variables are correlated. Hence, to correct this problem, this study therefore estimates another set of equations ignoring the exchange rate as a variable. It was stated that the quintessence of doing this is to compare if there will be dissimilarities on the impact of exchange rate volatility based on the two estimated models (model incorporating nominal exchange rate and volatility measures (Model 1) and the other model incorporating only the volatility measure (Model 2). It is important to emphasize that this will be done for all model estimations henceforth while modelling exchange rate volatility and trade. In lieu of this, Tables 4.20 and 4.21 present the pooled regression model for imports, exports and trade balance for both model specifications (Model 1 and 2 respectively). It is acknowledged that for each model of the distinct models, the three volatility measures will be employed:

	STANDARD DEVIATION VOLATILITY MEASURE					GARCH VOLATILITY MEASURE					HP-FILTER VOLATILITY MEASURE				
	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob
IMPORTS MODEL	LGDP	0.849689	0.012567	67.61081	0.0000	LGDP	0.849938	0.012563	67.65547	0.0000	LGDP	0.850801	0.012571	67.67841	0.0000
	LNER	-0.024763	0.008354	-2.964287	0.0031	LNER	-0.022531	0.008512	-2.646906	0.0083	LNER	-0.023735	0.008004	-2.965376	0.0031
	INFL	3.71E-05	6.53E-05	0.568506	0.5699	INFL	9.48E-06	4.15E-05	0.228641	0.8192	INFL	8.46E-06	4.13E-05	0.204706	0.8379
	LM2	0.278902	0.029869	9.337623	0.0000	LM2	0.284529	0.028301	10.05360	0.0000	LM2	0.283598	0.028271	10.03127	0.0000
	VOL	-0.053970	0.095497	-0.565150	0.5722	VOL	-6.98E-10	2.28E-09	-0.306302	0.7595	VOL	0.000102	8.44E-05	1.211035	0.2263
	C	8.353271	0.055437	150.6794	0.0000	C	8.336990	0.049050	169.9676	0.0000	C	8.339288	0.048783	170.9450	0.0000
	R-squared	0.877115				**R-squared**	0.877075				**R-squared**	0.877317			
	Adjusted R-squared	0.876233				**Adjusted R-squared**	0.876192				**Adjusted R-squared**	0.876436			
EXPORTS MODEL	LUSGDP	3.088879	0.348175	8.871641	0.0000	LUSGDP	3.117426	0.348792	8.937768	0.0000	LUSGDP	3.085933	0.349964	8.817851	0.0000
	LG7I	-1.964404	1.250229	-1.571235	0.1166	LG7I	-2.017212	1.250095	-1.613647	0.1071	LG7I	-1.953730	1.252786	-1.559507	0.1193
	LNER	-0.183719	0.025689	-7.151576	0.0000	LNER	-0.173418	0.026121	-6.639052	0.0000	LNER	-0.182573	0.024748	-7.377180	0.0000
	INFL	0.000132	0.000201	0.657840	0.5109	INFL	0.000120	0.000128	0.942050	0.3465	INFL	0.000110	0.000127	0.863364	0.3882
	LM2	-0.154603	0.095150	-1.624832	0.1047	LM2	-0.150368	0.090647	-1.658828	0.0976	LM2	-0.150085	0.090835	-1.652275	0.0989
	VOL	-0.041537	0.293240	-0.141648	0.8874	VOL	-7.63E-09	7.01E-09	-1.089054	0.2765	VOL	-2.64E-05	0.000260	-0.101284	0.9194
	C	1.113663	1.793056	0.621098	0.5347	C	1.080144	1.786811	0.604510	0.5457	C	1.092346	1.788475	0.610770	0.5416
	R-squared	0.192939				**R-squared**	0.194290				**R-squared**	0.192927			
	Adjusted R-squared	0.185971				**Adjusted R-squared**	0.187334				**Adjusted R-squared**	0.185960			
TRADE BALANCE MODEL	LGDP	12.06363	1.007701	11.97144	0.0000	LGDP	12.01795	1.002981	11.98223	0.0000	LGDP	12.08404	1.008302	11.98454	0.0000
	LUSGDP	-37.13487	8.899976	-4.172469	0.0000	LUSGDP	-35.23184	8.884599	-3.965495	0.0001	LUSGDP	-37.10657	8.939726	-4.150750	0.0001
	LG7I	74.69470	30.35925	2.460361	0.0141	LG7I	71.62209	30.24009	2.368448	0.0181	LG7I	75.13629	30.43236	2.468960	0.0138
	LNER	0.843668	0.640716	1.316758	0.1884	LNER	1.544380	0.646198	2.389950	0.0171	LNER	0.996515	0.617783	1.613050	0.1072
	INFL	0.011491	0.004856	2.366498	0.0182	INFL	0.008826	0.003078	2.866905	0.0043	INFL	0.008207	0.003086	2.659167	0.0080
	LM2	-4.771545	2.324280	-2.052913	0.0405	LM2	-4.167121	2.205513	-1.889412	0.0593	LM2	-4.155787	2.219464	-1.872428	0.0616
	VOL	-6.214956	7.095920	-0.875849	0.3814	VOL	-4.58E-07	1.69E-07	-2.711382	0.0069	VOL	-9.18E-05	0.006305	-0.014560	0.9884
	C	-13.24186	43.65526	-0.303328	0.7617	C	-17.14415	43.34569	-0.395521	0.6926	C	-15.92895	43.57933	-0.365516	0.7148
	R-squared	0.197853				**R-squared**	0.205383				**R-squared**	0.196966			
	Adjusted R-squared	0.189762				**Adjusted R-squared**	0.197369				**Adjusted R-squared**	0.188867			

Table 4.20: Pooled regression model for Imports, Exports and Trade Balance-Model 1

	STANDARD DEVIATION VOLATILITY MEASURE					GARCH VOLATILITY MEASURE					HP-FILTER VOLATILITY MEASURE				
	Variable	**Coefficient**	**S.Error**	**T-stat**	**Prob**	**Variable**	**Coefficient**	**S.Error**	**T-stat**	**Prob**	**Variable**	**Coefficient**	**S.Error**	**T-stat**	**Prob**
IMPORTS MODEL	LGDP	0.855897	0.012461	68.68787	0.0000	LGDP	0.855120	0.012463	68.61484	0.0000	LGDP	0.856837	0.012474	68.68714	0.0000
	INFL	2.39E-05	6.55E-05	0.364667	0.7155	INFL	3.81E-05	4.02E-05	0.946674	0.3441	INFL	3.93E-05	4.02E-05	0.975871	0.3295
	LM2	0.310772	0.028022	11.09043	0.0000	LM2	0.305970	0.027234	11.23495	0.0000	LM2	0.308423	0.027154	11.35830	0.0000
	VOL	0.026817	0.092036	0.291371	0.7709	VOL	-2.74E-09	2.15E-09	-1.274514	0.2029	VOL	9.40E-05	8.49E-05	1.107687	0.3684
	C	8.247565	0.042683	193.2303	0.0000	C	8.259604	0.039554	208.8163	0.0000	C	8.252199	0.039170	210.6771	0.0000
	R-squared	0.875564				**R-squared**	0.875838				**R-squared**	0.875767			
	Adjusted R-squared	0.874850				**Adjusted R-squared**	0.875126				**Adjusted R-squared**	0.875054			
EXPORTS MODEL	LUSGDP	2.737384	0.356889	7.670127	0.0000	LUSGDP	2.844286	0.356915	7.969083	0.0000	LUSGDP	2.684234	0.358724	7.482717	0.0000
	LG7I	-1.722988	1.294012	-1.331508	0.1835	LG7I	-1.937578	1.288141	-1.504167	0.1330	LG7I	-1.695326	1.299469	-1.304629	0.1925
	INFL	3.64E-05	0.000207	0.175390	0.8608	INFL	0.000331	0.000128	2.592057	0.0097	INFL	0.000333	0.000129	2.591190	0.0098
	LM2	0.108973	0.090828	1.199776	0.2306	LM2	0.038954	0.088668	0.439328	0.6606	LM2	0.073883	0.088836	0.831676	0.4059
	VOL	0.533367	0.291989	1.826670	0.0682	VOL	-2.29E-08	6.83E-09	-3.348004	0.0009	VOL	-0.000140	0.000270	-0.517894	0.6047
	C	1.275247	1.856378	0.686955	0.4923	C	1.431905	1.840466	0.778012	0.4368	C	1.528801	1.854829	0.824227	0.4101
	R-squared	0.133547				**R-squared**	0.143192				**R-squared**	0.129728			
	Adjusted R-squared	0.127322				**Adjusted R-squared**	0.137037				**Adjusted R-squared**	0.123476			
TRADE BALANCE MODEL	LGDP	11.74081	0.977940	12.00566	0.0000	LGDP	11.47591	0.980308	11.70643	0.0000	LGDP	11.68634	0.978821	11.93920	0.0000
	LUSGDP	-34.69536	8.709604	-3.983575	0.0001	LUSGDP	-31.36784	8.765820	-3.578426	0.0004	LUSGDP	-33.91816	8.728505	-3.885906	0.0001
	LG7I	72.80896	30.34146	2.399653	0.0167	LG7I	69.52320	30.32963	2.292253	0.0222	LG7I	72.79558	30.43276	2.392014	0.0170
	INFL	0.011943	0.004846	2.464348	0.0140	INFL	0.007069	0.003000	2.356745	0.0187	INFL	0.007075	0.003009	2.351382	0.0190
	LM2	-6.013503	2.125424	-2.829319	0.0048	LM2	-5.931394	2.085335	-2.844336	0.0046	LM2	-5.424764	2.077753	-2.610880	0.0092
	VOL	-8.752266	6.832879	-1.280905	0.2007	VOL	-3.32E-07	1.61E-07	-2.060309	0.0397	VOL	0.000427	0.006304	0.067682	0.9461
	C	-15.51671	43.64409	-0.355528	0.7223	C	-22.80864	43.42731	-0.525214	0.5996	C	-20.14728	43.55090	-0.462615	0.6438
	R-squared	0.195849				**R-squared**	0.198843				**R-squared**	0.193956			
	Adjusted R-squared	0.188906				**Adjusted R-squared**	0.191927				**Adjusted R-squared**	0.186997			

Table 4.21: Pooled regression model for Imports, Exports and Trade Balance-Model 2

Tables 4.20 and 4.21 represent the pooled regression estimates for model specification 1 and 2 for the model of imports, exports and trade balance respectively. The three respective models were estimated with the three distinct measures of volatility as observed in the tables. Only the imports model possesses high R-squared values compared to the exports and trade balance models which show less coefficient of determination. It should be noted that the coefficients of the variables will be explained in detail in the next section as the researcher still needs to determine which model between the pooled/fixed/random will be appropriate for this study. Thus, as one of the main goals of this study is to investigate the impact of exchange rate volatility on trade (imports, exports and trade balance respectively), the study shall only concentrate on this particular variable. It is worth noting that the results of the estimations in both tables tend to be closely identical especially with regard to all variables except for the volatility measures. This therefore explains that there are differences in regards to the estimation of the model (Model 1 and 2). Explicitly, differences are observed mostly in regards to the magnitude and signs of the coefficients. For all model estimations, it is observed that despite the mixed up signs, for volatility measures, there is no significant relationship between exchange rate volatility and imports. For the exports model, the results show that only the GARCH volatility measure is significant in Model 1 while no significant relationship between exchange rate volatility and exports is observed in Model 2. It is interesting to observe that the results are different per model estimation; hence careful attention should be directed when estimating these models. On the other hand, the trade balance model (under the two model specifications) reveals a different scenario. Exchange rate volatility under the trade balance mode has the expected negative expected sign but the three volatility measures differ in terms of their significance. It is observed that only the GARCH measure of volatility is significant while the standard deviation and HP-Filter volatility measures are insignificant.

Considering the assumption that countries under the pooled regression model are homogeneous, which is usually not the case in reality, the subsequent section estimates the model using the fixed effects regression. The fixed effects model is advantageous compared to the pooled model as it permits the intercepts to vary whereby assuming a normal distribution of the residuals.

4.3.2.2 Fixed Effects Regression Model

For each of the measures of volatility, the fixed effects regression model for imports, exports and trade balance is estimated and the results are presented. Table 4.22 indicates the fixed effects regression models for model specification 1 (that is modelling exchange rate volatility and trade with both nominal exchange rate and volatility) while Table 4.23 indicates the fixed effects regression model for model specification 2 (modelling exchange rate volatility and trade with volatility measures only).

	STANDARD DEVIATION VOLATILITY MEASURE					GARCH VOLATILITY MEASURE					HP-FILTER VOLATILITY MEASURE				
	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob
IMPORTS MODEL	LGDP	0.892449	0.017084	52.23996	0.0000	LGDP	0.891560	0.016976	52.51885	0.0000	LGDP	0.892485	0.017342	51.46472	0.0000
	LNER	0.163758	0.015768	10.38514	0.0000	LNER	0.153536	0.014343	10.70438	0.0000	LNER	0.156020	0.014460	10.78997	0.0000
	INFL	0.000102	3.44E-05	2.961654	0.0032	INFL	0.000121	2.62E-05	4.609440	0.0000	INFL	0.000123	2.63E-05	4.702384	0.0000
	LM2	0.297296	0.031407	9.465814	0.0000	LM2	0.282798	0.031880	8.870593	0.0000	LM2	0.295051	0.031410	9.393588	0.0000
	VOL	0.056716	0.056620	1.001686	0.3169	VOL	3.88E-09	1.85E-09	2.095608	0.0365	VOL	2.06E-05	4.38E-05	0.470213	0.6384
	C	7.905936	0.048228	163.9297	0.0000	C	7.948433	0.044101	180.2328	0.0000	C	7.929428	0.043273	183.2427	0.0000
	R-squared	0.970944				R-squared	0.971093				R-squared	0.970910			
	Adjusted R-squared	0.969046				Adjusted R-squared	0.969204				Adjusted R-squared	0.969009			
EXPORTS MODEL	LUSGDP	2.851172	0.109392	26.06388	0.0000	LUSGDP	2.834809	0.110812	25.58216	0.0000	LUSGDP	2.797192	0.111706	25.04067	0.0000
	LG7I	-2.150575	0.356374	-6.034596	0.0000	LG7I	-2.177465	0.361200	-6.028423	0.0000	LG7I	-2.119002	0.361168	-5.867083	0.0000
	LNER	-0.073823	0.028571	-2.583869	0.0100	LNER	-0.017322	0.026306	-0.658496	0.5105	LNER	-0.011711	0.026507	-0.441820	0.6588
	INFL	9.80E-05	5.89E-05	1.665747	0.0962	INFL	-6.50E-05	4.54E-05	-1.431048	0.1529	INFL	-6.14E-05	4.54E-05	-1.352427	0.1767
	LM2	-0.121338	0.057980	-2.092766	0.0368	LM2	-0.084125	0.059164	-1.421900	0.1555	LM2	-0.089252	0.058412	-1.527967	0.1270
	VOL	-0.421649	0.096777	-4.356905	0.0000	VOL	-3.93E-09	3.22E-09	-1.219750	0.2230	VOL	-0.000148	7.53E-05	-1.971675	0.0491
	C	2.223473	0.507444	4.381714	0.000	C	2.146253	0.514132	4.174515	0.0000	C	2.174587	0.513048	4.238565	0.0000
	R-squared	0.940720				R-squared	0.939145				R-squared	0.939366			
	Adjusted R-squared	0.936750				Adjusted R-squared	0.935069				Adjusted R-squared	0.935305			
TRADE BALANCE MODEL	LGDP	26.47277	2.883279	9.181479	0.0000	LGDP	26.66532	2.800860	9.520405	0.0000	LGDP	26.43101	2.811904	9.399684	0.0000
	LUSGDP	-70.40758	9.883703	-7.123604	0.0000	LUSGDP	-71.12877	9.667622	-7.357421	0.0000	LUSGDP	-70.43633	9.633506	-7.311599	0.0000
	LG7I	99.29531	21.02958	4.721697	0.0000	LG7I	100.2183	20.98800	4.775031	0.0000	LG7I	99.38652	20.97321	4.738737	0.0000
	LNER	3.884939	1.695406	2.291451	0.0223	LNER	3.803079	1.495068	2.543751	0.0112	LNER	3.924930	1.504838	2.608207	0.0093
	INFL	0.008493	0.003264	2.601885	0.0095	INFL	0.008378	0.002542	3.295403	0.0010	INFL	0.008490	0.002545	3.336209	0.0009
	LM2	-9.070622	3.255248	-2.786461	0.0055	LM2	-9.447287	3.257700	-2.899987	0.0039	LM2	-9.046384	3.226892	-2.803436	0.0052
	VOL	-0.064309	5.540419	-0.011607	0.9907	VOL	1.42E-07	1.77E-07	0.804700	0.4213	VOL	-0.000636	0.004156	-0.153082	0.8784
	C	61.63807	31.08162	1.983104	0.0478	C	63.13095	31.01621	2.035418	0.0422	C	61.48437	31.00066	1.983325	0.0477
	R-squared	0.690432				R-squared	0.690737				R-squared	0.690443			
	Adjusted R-squared	0.669197				Adjusted R-squared	0.669523				Adjusted R-squared	0.669208			

Table 4.22: Fixed effects regression Model for Imports, Exports and Trade Balance –Model 1[15]

[15] The cross-section fixed effects for imports, exports and trade balance for Model 1 are presented in Appendix G, H, I respectively

	STANDARD DEVIATION VOLATILITY MEASURE					GARCH VOLATILITY MEASURE					HP-FILTER VOLATILITY MEASURE				
	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob
IMPORTS MODEL	LGDP	0.898098	0.018407	48.79036	0.0000	LGDP	0.905785	0.018324	49.43044	0.0000	LGDP	0.911854	0.018698	48.76709	0.0000
	INFL	6.53E-05	3.69E-05	1.770173	0.0772	INFL	-3.32E-05	2.37E-05	-1.400299	0.1619	INFL	-3.17E-05	2.38E-05	-1.331704	0.1834
	LM2	0.363693	0.033149	10.97143	0.0000	LM2	0.358074	0.033668	10.63528	0.0000	LM2	0.376415	0.033054	11.38796	0.0000
	VOL	-0.192605	0.055280	-3.484176	0.0005	VOL	6.20E-09	1.99E-09	3.116334	0.0019	VOL	9.29E-05	4.69E-05	1.980568	0.0481
	C	8.163413	0.044595	183.0585	0.0000	C	8.143546	0.043481	187.2893	0.0000	C	8.119472	0.042848	189.4946	0.0000
	R-squared	0.966182				R-squared	0.966059				R-squared	0.965763			
	Adjusted R-squared	0.964027				Adjusted R-squared	0.963896				Adjusted R-squared	0.963581			
EXPORTS MODEL	LUSGDP	2.798253	0.107920	25.92898	0.0000	LUSGDP	2.821659	0.108951	25.89847	0.0000	LUSGDP	2.787042	0.109252	25.51031	0.0000
	LG7I	-2.214234	0.357052	-6.201437	0.0000	LG7I	-2.195168	0.360043	-6.096964	0.0000	LG7I	-2.128538	0.360302	-5.907651	0.0000
	INFL	0.000113	5.88E-05	1.911910	0.0563	INFL	-4.87E-05	3.81E-05	-1.279304	0.2012	INFL	-5.05E-05	3.80E-05	-1.327308	0.1849
	LM2	-0.131336	0.058099	-2.260546	0.0241	LM2	-0.088211	0.058812	-1.499870	0.1341	LM2	-0.092141	0.058010	-1.588371	0.1127
	VOL	-0.314732	0.087862	-3.582134	0.0004	VOL	-4.14E-09	3.20E-09	-1.294331	0.1960	VOL	-0.000154	7.41E-05	-2.078344	0.0381
	C	2.421107	0.503805	4.805640	0.0000	C	2.205840	0.505889	4.360326	0.0000	C	2.215173	0.504448	4.391281	0.0000
	R-squared	0.940118				R-squared	0.939105				R-squared	0.939348			
	Adjusted R-squared	0.936204				Adjusted R-squared	0.935125				Adjusted R-squared	0.935384			
TRADE BALANCE MODEL	LGDP	24.12108	2.703147	8.923332	0.0000	LGDP	24.73355	2.707142	9.136405	0.0000	LGDP	24.52971	2.727737	8.992695	0.0000
	LUSGDP	-61.61110	9.137159	-6.742916	0.0000	LUSGDP	-63.25983	9.197396	-6.878015	0.0000	LUSGDP	-62.23574	9.146097	-6.804622	0.0000
	LG7I	96.35677	21.05824	4.575728	0.0000	LG7I	98.93913	21.06914	4.695925	0.0000	LG7I	97.69673	21.05557	4.639947	0.0000
	INFL	0.007812	0.003261	2.395529	0.0169	INFL	0.004693	0.002098	2.237013	0.0256	INFL	0.004708	0.002100	2.241330	0.0253
	LM2	-9.026311	3.265704	-2.763971	0.0059	LM2	-8.871931	3.263341	-2.718665	0.0067	LM2	-8.409591	3.231820	-2.602122	0.0095
	VOL	-6.100724	4.889816	-1.247639	0.2126	VOL	1.76E-07	1.77E-07	0.996305	0.3195	VOL	0.000805	0.004137	0.194641	0.8457
	C	41.78966	29.94666	1.395470	0.1633	C	41.99254	30.00643	1.399451	0.1621	C	39.98782	30.01667	1.332187	0.1833
	R-squared	0.687954				R-squared	0.687687				R-squared	0.687233			
	Adjusted R-squared	0.667056				Adjusted R-squared	0.666771				Adjusted R-squared	0.666287			

Table 4.23: Fixed effects regression Model for Imports, Exports and Trade Balance-Model 2[16]

[16] The cross-section fixed effects for imports, exports and trade balance for Model 2 are presented in Appendix J,K,L respectively

Likewise the pooled effects model, the fixed effects model also reveals mixed outcomes relating to the direction of exchange rate volatility on imports, exports and trade balance respectively. For both model 1 and 2, only the trade balance model shows consistent results. Based on the insignificance of the test statistics, the results conclude that there is no evidence of a significant relationship between exchange rate volatility and trade balance. In model 1, the results show that there is a positive relationship between exchange rate volatility and imports (for volatility measure using GARCH). However, in model 2, the results are mixed. All volatility measures are significant except for HP-Filter volatility. While volatility measured by the standard deviation approach shows a negative significant relationship, the volatility measured by GARCH approach display a positive relationship. For the exports models, in model 1, only the standard deviation volatility measure is significant while the remaining volatility measures are insignificant. Model 2 results indicate that there is a significant negative relationship between exchange rate volatility and exports considering volatility measured by standard deviation and HP-Filter respectively. With these mixed results, it is of no argument to say that the result of the analysis is dependent of the volatility measure and model specification.

The fixed effects model has some drawbacks. Davidson and MacKinnon (1993) stated that one of the limitations of the fixed effects is the fact that with the inclusion of many cross-sections, multicollinearity problems may arise which may also raise the standard errors. In lieu of this, the following section estimates the random effects model as it appears to correct some of the limitations encountered by the fixed effects model.

4.3.2.3 Random Effects Regression Model

Table 4.24 and 4.25 shows the estimated random effects model for imports, exports and trade balance for model specification 1 and 2.

	STANDARD DEVIATION VOLATILITY MEASURE					GARCH VOLATILITY MEASURE					HP-FILTER VOLATILITY MEASURE				
	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob
IMPORTS MODEL	LGDP	0.892249	0.016048	55.59815	0.0000	LGDP	0.892628	0.015948	55.96971	0.0000	LGDP	0.894684	0.016234	55.11043	0.0000
	LNER	0.119298	0.013732	8.687705	0.0000	LNER	0.115943	0.012752	9.091866	0.0000	LNER	0.117647	0.012745	9.231075	0.0000
	INFL	8.81E-05	3.43E-05	2.570881	0.0104	INFL	8.47E-05	2.53E-05	3.341906	0.0009	INFL	8.69E-05	2.54E-05	3.428676	0.0006
	LM2	0.326262	0.029768	10.96000	0.0000	LM2	0.316296	0.030043	10.52802	0.0000	LM2	0.325257	0.029663	10.96489	0.0000
	VOL	-0.000179	0.055547	-0.003214	0.9974	VOL	3.34E-09	1.82E-09	1.832696	0.0673	VOL	3.74E-05	4.36E-05	0.858972	0.3907
	C	7.961060	0.054460	146.1820	0.0000	C	7.978184	0.051185	155.8701	0.0000	C	7.963936	0.050460	157.8277	0.0000
	R-squared	0.859101				R-squared	0.859762				R-squared	0.859218			
	Adjusted R-squared	0.858088				Adjusted R-squared	0.858755				Adjusted R-squared	0.858207			
EXPORTS MODEL	LUSGDP	2.856700	0.109150	26.17217	0.0000	LUSGDP	2.841311	0.110576	25.69561	0.0000	LUSGDP	2.804788	0.111446	25.16730	0.0000
	LG7I	-2.140166	0.356048	-6.010899	0.0000	LG7I	-2.162796	0.360883	-5.993071	0.0000	LG7I	-2.104378	0.360862	-5.831525	0.0000
	LNER	-0.082387	0.027487	-2.997329	0.0028	LNER	-0.027891	0.025446	-1.096100	0.2734	LNER	-0.023367	0.025599	-0.912801	0.3617
	INFL	9.60E-05	5.88E-05	1.632579	0.1030	INFL	-7.31E-05	4.50E-05	-1.624516	0.1047	INFL	-7.05E-05	4.49E-05	-1.568515	0.1172
	LM2	-0.118602	0.057319	-2.069167	0.0389	LM2	-0.078336	0.058370	-1.342061	0.1800	LM2	-0.083417	0.057676	-1.446306	0.1485
	VOL	-0.429634	0.096204	-4.465854	0.0000	VOL	-4.05E-09	3.21E-09	-1.264305	0.2065	VOL	-0.000143	7.52E-05	-1.900506	0.0578
	C	2.194393	0.516331	4.249974	0.0000	C	2.104000	0.522771	4.024707	0.0001	C	2.129984	0.521720	4.082622	0.0000
	R-squared	0.661585				R-squared	0.652329				R-squared	0.653379			
	Adjusted R-squared	0.658663				Adjusted R-squared	0.649328				Adjusted R-squared	0.650386			
TRADE BALANCE MODEL	LGDP	20.38761	2.238923	9.105990	0.0000	LGDP	20.65162	2.197488	9.397829	0.0000	LGDP	20.53010	2.201817	9.324162	0.0000
	LUSGDP	-54.82430	8.532500	-6.425350	0.0000	LUSGDP	-55.78090	8.438778	-6.610069	0.0000	LUSGDP	-55.65085	8.419123	-6.610053	0.0000
	LG7I	86.39042	20.47653	4.218997	0.0000	LG7I	87.39195	20.45303	4.272813	0.0000	LG7I	87.34814	20.45365	4.270540	0.0000
	LNER	2.128033	1.317187	1.615589	0.1066	LNER	2.429383	1.213021	2.002754	0.0456	LNER	2.522232	1.210088	2.084337	0.0375
	INFL	0.008325	0.003247	2.563772	0.0106	INFL	0.006746	0.002384	2.829868	0.0048	INFL	0.006823	0.002380	2.866777	0.0043
	LM2	-8.733161	3.019478	-2.892276	0.0039	LM2	-8.460544	2.988146	-2.831369	0.0048	LM2	-8.291330	2.970343	-2.791372	0.0054
	VOL	-3.623789	5.287538	-0.685345	0.4934	VOL	5.11E-08	1.71E-07	0.298260	0.7656	VOL	-0.001390	0.004125	-0.337008	0.7362
	C	31.93030	29.82602	1.070552	0.2847	C	32.28587	29.81894	1.082730	0.2793	C	31.56209	29.81913	1.058451	0.2902
	R-squared	0.140156				R-squared	0.139632				R-squared	0.139648			
	Adjusted R-squared	0.131483				Adjusted R-squared	0.130954				Adjusted R-squared	0.130970			

Table 4.24: Random effects regression Model for Imports, Exports and Trade Balance-Model 1[17]

[17] The cross-section random effects for imports, exports and trade balance for Model 1 are presented in Appendix M,N,O respectively

	STANDARD DEVIATION VOLATILITY MEASURE					GARCH VOLATILITY MEASURE					HP-FILTER VOLATILITY MEASURE				
	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob
IMPORTS MODEL	LGDP	0.893911	0.017150	52.12288	0.0000	LGDP	0.900143	0.017086	52.68366	0.0000	LGDP	0.905513	0.017401	52.03734	0.0000
	INFL	6.46E-05	3.68E-05	1.753535	0.0799	INFL	-3.24E-05	2.36E-05	-1.374125	0.1698	INFL	-3.12E-05	2.37E-05	-1.313733	0.1894
	LM2	0.360035	0.031626	11.38429	0.0000	LM2	0.358569	0.031916	11.23468	0.0000	LM2	0.373680	0.031460	11.87784	0.0000
	VOL	-0.188790	0.055063	-3.428620	0.0006	VOL	5.77E-09	1.94E-09	2.968931	0.0031	VOL	9.08E-05	4.68E-05	1.939596	0.0528
	C	8.171198	0.051363	159.0867	0.0000	C	8.147408	0.050222	162.2287	0.0000	C	8.127904	0.049972	162.6507	0.0000
	R-squared	0.844860				R-squared	0.844224				R-squared	0.843095			
	Adjusted R-squared	0.843970				Adjusted R-squared	0.843330				Adjusted R-squared	0.842195			
EXPORTS MODEL	LUSGDP	2.795011	0.107655	25.96276	0.0000	LUSGDP	2.819339	0.108694	25.93824	0.0000	LUSGDP	2.783839	0.108974	25.54593	0.0000
	LG7I	-2.207181	0.356879	-6.184668	0.0000	LG7I	-2.190106	0.359877	-6.085715	0.0000	LG7I	-2.122400	0.360121	-5.893573	0.0000
	INFL	0.000112	5.88E-05	1.897173	0.0582	INFL	-4.69E-05	3.81E-05	-1.231290	0.2186	INFL	-4.87E-05	3.80E-05	-1.281249	0.2005
	LM2	-0.126780	0.057511	-2.204447	0.0278	LM2	-0.083861	0.058147	-1.442220	0.1497	LM2	-0.088440	0.057413	-1.540419	0.1239
	VOL	-0.309440	0.087812	-3.523891	0.0005	VOL	-4.44E-09	3.19E-09	-1.393212	0.0000	VOL	-0.000154	7.41E-05	-2.081532	0.0378
	C	2.413412	0.513498	4.699940	0.0000	C	2.199380	0.515471	4.266740	0.0000	C	2.210776	0.514216	4.299315	0.0000
	R-squared	0.657427				R-squared	0.651994				R-squared	0.653427			
	Adjusted R-squared	0.654966				Adjusted R-squared	0.649328				Adjusted R-squared	0.650938			
TRADE BALANCE MODEL	LGDP	19.15648	2.120354	9.034567	0.0000	LGDP	19.48869	2.128639	9.155470	0.0000	LGDP	19.15648	2.120354	9.034567	0.0000
	LUSGDP	-49.71626	7.981985	-6.228559	0.0000	LUSGDP	-50.47168	8.052043	-6.268182	0.0000	LUSGDP	-49.71626	7.981985	-6.228559	0.0000
	LG7I	84.26878	20.49717	4.111240	0.0000	LG7I	86.05573	20.52375	4.192983	0.0000	LG7I	84.26878	20.49717	4.111240	0.0000
	INFL	0.008053	0.003253	2.475633	0.0135	INFL	0.004407	0.002087	2.111414	0.0351	INFL	0.008053	0.003253	2.475633	0.0135
	LM2	-9.191762	3.008167	-3.055603	0.0023	LM2	-8.708739	2.994570	-2.908177	0.0038	LM2	-9.191762	3.008167	-3.055603	0.0023
	VOL	-7.079329	4.855581	-1.457978	0.1453	VOL	9.61E-08	1.70E-07	0.564544	0.5726	VOL	-7.079329	4.855581	-1.457978	0.1453
	C	21.54057	29.25726	0.736247	0.4618	C	19.44693	29.25668	0.664701	0.5065	C	21.54057	29.25726	0.736247	0.4618
	R-squared	0.136918				R-squared	0.134701				R-squared	0.136918			
	Adjusted R-squared	0.129467				Adjusted R-squared	0.127231				Adjusted R-squared	0.129467			

Table 4.25: Random effects regression Model for Imports, Exports and Trade Balance-Model 2[18]

[18] The cross-section random effects for imports, exports and trade balance for Model 2 are presented in Appendix P, Q, R respectively

Similarly to the pooled and the fixed effects model, the fixed effects model also reveals mixed outcomes relating to the direction of exchange rate volatility on imports, exports and trade balance respectively. For both models estimated (Model 1 and 2), only the trade balance model shows consistent results with the evidence of no significant relationship between exchange rate volatility and trade. Model 1 reveals that there is no significant relationship between exchange rate volatility and imports. However, Model 2 shows that there is evidence that imports are affected by exchange rate volatility. Explicitly, the results show that while SDVol shows a negative significant relationship with imports, GARCHVol shows a positive relationship. Hence, the conclusion is that the results are mixed and particularly dependent upon the measure of volatility use. For the exports model, the results indicate that there is a significant negative relationship between exchange rate volatility and exports considering volatility measured by standard deviation and HP-Filter respectively.

4.3.2.4 Choosing the Suitable Model

The pooled, fixed and random models were all estimated but through a general intuition, it is difficult to select the most suitable models. Therefore, with the aid of statistical tests, we will choose the most appropriate for each of the models of imports, exports and trade balance. The study notes that the appropriate model will be chosen for each separate model specification.

4.3.2.4.1 Testing between the Fixed and the Pooled Effects Regression Model (F-test)

Tables 4.26 and Table 4.27 report the results of the F-statistics test to determine which model between the pooled and the fixed effects regression model is appropriate for this study.

Table 4.26: F-statistics test results (Model 1)

Model		Standard Deviation			GARCH			HP-Filter		
		F-STATISTICS VALUE	D.F	PROB	F-STATISTICS VALUE	D.F	PROB	F-STATISTICS VALUE	D.F	PROB
IMPORTS	Cross-section F	55.918	(38,658)	0.0000	56.318	(38,658)	0.0000	55.710	(38,658)	0.0000
	Cross-section Chi-Square	1012.306	38	0.0000	1016.134	38	0.0000	1010.317	38	0.0000
Exports	Cross-section F	218.096	(38,657)	0.0000	211.620	(38,657)	0.0000	212.843	(38,657)	0.0000
	Cross-section Chi-Square	1833.011	38	0.0000	1813.427	38	0.0000	1817.167	38	0.0000
Trade balance	Cross-section F	27.469	(38,656)	0.0000	27.092	(38,656)	0.0000	27.519	(38,656)	0.0000
	Cross-section Chi-Square	668.385	38	0.0000	662.455	38	0.0000	669.185	38	0.0000

Table 4.27: F-statistics test results (Model 2)

Model		Standard Deviation			GARCH			HP-Filter		
		F-STATISTICS VALUE	D.F	PROB	F-STATISTICS VALUE	D.F	PROB	F-STATISTICS VALUE	D.F	PROB
IMPORTS	Cross-section F	46.469312	(38,659)	0.0000	46.098358	(38,659)	0.0000	45.584964	(38,659)	0.0000
	Cross-section Chi-Square	914.561912	38	0.0000	910.469085	38	0.0000	904.765017	38	0.0000
Exports	Cross-section F	233.230276	(38,658)	0.0000	226.320911	(38,658)	0.0000	231.141267	(38,658)	0.0000
	Cross-section Chi-Square	1875.760866	38	0.0000	1856.129707	38	0.0000	1869.883175	38	0.0000
Trade balance	Cross-section F	27.266043	(38,657)	0.0000	27.062093	(38,657)	0.0000	27.267940	(38,657)	0.0000
	Cross-section Chi-Square	664.539961	38	0.0000	661.319224	38	0.0000	664.569850	38	0.0000

For all three models under both model specifications, the F-statistics is statistically significant which indicates that the countries are not homogenous. In other terms, the outcome indicates that the 39 SSA countries under examination in this study are not identical. In lieu of this, the study must then consider the distinct specific effects of each country. The F-statistics results therefore show that the pooled effects model is not appropriate and the fixed model should be estimated.

The next section will now test between the pooled and the random effects regression model.

4.3.2.4.2 Testing between the Random and the Pooled Effects Regression Model (BP LM test)

Tables 4.28 and Table 4.29 for both model specifications (1 and 2) report the results of the BP-LM test statistics test to determine which model between the pooled and the pooled effects regression model is appropriate for this study. The probability values are reported in parentheses.

Table 4.28: BP-LM test results (Model 1)

Model	Standard Deviation			GARCH			HP-Filter		
	Cross-section One-sided	Period One-sided	Both	Cross-section One-sided	Period One-sided	Both	Cross-section One-sided	Period One-sided	Both
IMPORTS	2690.581 (0.0000)	21.9121 (0.0000)	2712.493 (0.0000)	2667.576 (0.0000)	22.510 (0.0000)	2690.087 (0.0000)	2677.123 (0.0000)	24.339 (0.0000)	2701.463 (0.0000)
EXPORTS	4903.961 (0.0000)	5.138 (0.0234)	4909.099 (0.0000)	4896.353 (0.0000)	4.956 (0.0260)	4901.309 (0.0000)	4898.394 (0.0000)	5.143 (0.0233)	4903.538 (0.0000)
TRADE BALANCE	1944.884 (0.0000)	1.374 (0.2411)	1946.258 (0.0000)	1879.879 (0.0000)	1.516155 (0.2182)	1881.395 (0.0000)	1941.783 (0.0000)	1.520462 (0.2175)	1943.304 (0.0000)

Table 4.29: BP-LM test results (Model 2)

Model	Standard Deviation			GARCH			HP-Filter		
	Cross-section One-sided	Period One-sided	Both	Cross-section One-sided	Period One-sided	Both	Cross-section One-sided	Period One-sided	Both
IMPORTS	2854.643 (0.0000)	10.25204 (0.0014)	2864.895 (0.0000)	2813.472 (0.0000)	12.54556 (0.0004)	2826.018 (0.0000)	2873.611 (0.0000)	11.11752 (0.0009)	2884.729 (0.0000)
EXPORTS	4888.272 (0.0000)	4.264127 (0.0389)	4892.536 (0.0000)	4932.896 (0.0000)	4.232087 (0.0397)	4937.128 (0.0000)	4978.071 (0.0000)	4.846689 (0.0277)	4982.917 (0.0000)
TRADE BALANCE	1953.103 (0.0000)	1.217693 (0.2698)	1954.321 (0.0000)	1913.254 (0.0000)	1.360452 (0.2435)	1914.614 (0.0000)	1950.006 (0.0000)	1.423999 (0.2327)	1951.430 (0.0000)

As it was explained previously, the main aim of the BP-LM test is to test the presence of random effects model. So, the null hypothesis is the presence of no random effects. If the probability value is less than the significance value, then the null hypothesis of no random effects will rejected and the random effects regression will be more appropriate than the pooled regression model. Considering both specifications (model 1 and 2), for all three models of imports, exports and trade balance, the null hypothesis of no random effects is rejected as the P-value is less than the 5% critical value. In this regard, the random effects model is preferred compared to the fixed effects model.

The results of the F-statistics tests and BP-LM tests indicate that the pooled effects regression model is not appropriate and choosing it as the most appropriate model will lead to the interpretation of biased estimates. Both tests respectively revealed that the fixed and the random effects are most suitable for this study. However, the Hausman test will assist the researcher to distinguish which model between the fixed and the random effects model will be more appropriate

4.3.2.4.3 Testing between the Fixed and the Random Effects Regression Model (HAUSMAN TEST)

The Hausman test will assist in distinguishing which model between the fixed and the random regression model is most appropriate for this study. Regarding this, the null hypothesis states that the coefficient estimates of the random effects model are same to the estimates of the fixed effects model and vice versa. Hence, if the probability value is significant, the null hypothesis will be rejected and the fixed effects model will be preferred in favour of the random effects model. On the other hand, if the probability value is not significant, this will imply the random effects models will be more appropriate. Tables 4.30 and 4.31 present the results of the Hausman test for model 1 and 2 respectively.

Table 4.30: Hausman test results (Model 1)

Model	**Standard Deviation**			**GARCH**			**HP-Filter**		
	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
IMPORTS	39.225	5	0.0000	39.310	5	0.0000	38.081	5	0.0000
EXPORTS	0.000000	6	1.0000	0.000000	6	1.0000	0.000000	6	1.0000
TRADE BALANCE	0.000000	7	1.0000	0.000000	7	1.0000	0.000000	7	1.0000

Table 4.31: Hausman test results (Model 2)

Model	Standard Deviation			GARCH			HP-Filter		
	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
IMPORTS	5.401555	4	0.2485	5.923337	4	0.2049	4.706318	4	0.3188
EXPORTS	0.000000	5	1.0000	0.000000	5	1.0000	0.000000	5	1.0000
TRADE BALANCE	0.000000	6	1.0000	0.000000	6	1.0000	0.000000	6	1.0000

The study first presents the results of the analysis for the model specification that includes both exchange rate and volatility (Model 1). The results of the import model reject the null hypothesis at 5%; hence the fixed effects model is appropriate. On the other hand, the export and trade balance models reveal different results compared to the import model. The results of the exports and the trade balance model do not reject the null hypothesis at 5% significance level. Regarding this, it is therefore concluded that the random effects regression model is the most suitable for the model of exports and trade balance. The study now proceeds with the interpretation of the results of the model specification with the measure of volatility only (Model 2). The results of the import, export and trade balance models respectively do not reject the null hypothesis at 5% significance. Hence, the study concludes that the random effects model is the most appropriate model in regard to this model specification.

With the most suitable models chosen, the study can therefore provide a detailed result analysis. In this regard, the following paragraphs report the suitable models of imports, exports and trade balance respectively that will considered in this thesis in analysing the effects of exchange rate volatility on international trade.

4.3.2.4.4 Detailed Discussion of the Results

The statistical tests conducted above suggested that the fixed effects model is the most suitable model for imports.

Table 4.32: Suitable model for Imports (FIXED EFFECTS REGRESSION)-Model 1

Dependent variable: Imports

Variables	SDVol	GARCHVol	HPVol
LGDP	0.892449 [52.23996][19] (0.017084)[20]	0.891560 [52.51885] (0.016976)	0.892485 [51.46472] (0.017342)
LNER	0.163758 [10.38514] (0.015768)	0.153536 [10.70438] (0.014343)	0.156020 [10.78997] (0.014460)
INFL	0.000102 [2.961654] (3.44E-05)	0.000121 [4.609440] (2.62E-05)	0.000123 [4.702384] (2.63E-05)
LM2	0.297296 [9.465814] (0.031407)	0.282798 [8.870593] (0.031880)	0.295051 [9.393588] (0.031410)
Volatility	0.056716 [1.001686] (0.056620)	3.88E-09 [2.095608] (1.85E-09)	2.06E-05 [0.470213] (4.38E-05)
C	7.905936 [163.9297] (0.048228)	7.948433 [180.2328] (0.044101)	7.929428 [183.2427] (0.043273)
R-squared Adjusted R-squared	0.970944 0.969046	0.971093 0.969204	0.970910 0.969009

Table 4.33: Suitable model for Imports (RANDOM EFFECTS REGRESSION)-Model 2

Dependent variable: Imports

Variables	SDVol	GARCHVol	HPVol
LGDP	0.893911 [52.12288][21] (0.017150)[22]	0.900143 [52.68366] (0.017086)	0.905513 [52.03734] (0.017401)
INFL	6.46E-05 [1.753535] (3.68E-05)	-3.24E-05 [-1.374125] (2.36E-05)	-3.12E-05 [-1.313733] (2.37E-05)
LM2	0.360035 [11.38429] (0.031626)	0.358569 [11.23468] (0.358569)	0.373680 [11.87784] (0.031460)
Volatility	-0.188790 [-3.428620] (0.055063)	5.77E-09 [2.968931] (1.94E-09)	9.08E-05 [1.939596] (4.68E-05)
C	8.171198 [159.0867] (0.051363)	8.147408 [162.2287] (0.050222)	8.127904 [162.6507] 0.049972 ()
R-squared Adjusted R-squared	0.844860 0.843970	0.844224 0.843330	0.843095 0.842195

[19] Values in [] represent the respective test-statistics
[20] Values in () represent the respective standard errors
[21] Values in [] represent the respective test-statistics
[22] Values in () represent the respective standard errors

The study begins with the interpretation of the first model specification (Model 1). The imports model indicates an overall good goodness of fit with a very high coefficient of determination of 0.97 considering all measures of volatility. In lieu of this, the study then concludes that 97% of the disparity in imports is described by the independent variables. Exchange rate volatility is one of the core variables in this study; hence the study will start with its interpretation. It is thus of great significance to recall that exchange volatility, also called exchange rate risk, represents uncertainty that traders (importers and exporters) face and this may have great effects of their activities. There is no conclusive agreement in regards to the impact of exchange rate uncertainty on trade in the literature. While some studies came to the conclusion of a negative impact, some studies found a positive impact while others even found no relationship. In this study, the results indicate that there is a positive relationship between exchange rate volatility and imports in SSA. In other terms, the three models (with exchange rate volatility measured by standard deviation, GARCH and HP-Filter), the results indicate the existence of a positive connection between uncertainties in exchange rates and imports. Nevertheless, not all coefficients are significant. Only the volatility measured by GARCH (1,1) appears to be significant with a significant test statistics. Regarding this, it is concluded that a 1% increase in exchange rate volatility measured by GARCH (1,1) will result to an increase in imports by 3.88E-09%. Hence, with these disparities in results, this indicates that the outcome of the results is altered in regard to the measure of volatility used. However, the literature is silent as to which measure is more efficient. Hence no plausible conclusion can be done regarding which measure of volatility is best to be used when estimating the models.

With regard to the second model specification (Model 2), which is modelling exchange rate volatility and imports excluding exchange rate as a variable, the overall model indicates an overall good goodness of fit. With a coefficient of determination of 0.84, this indicates 84% of the variation in imports is explained by the independent variables. Looking at the variable of interest which is exchange rate volatility, the results of the analysis indicate mixed outcomes. Explicitly, while the standard deviation measure indicates a negative relationship with imports, the GARCH and HP-Filter approaches instead indicate a positive relationship. It is however also observed that except for the HP-Filter volatility measure, all other measures are significant. Based on the significance of the results, the study concludes when volatility is measure by standard deviation, a one percent increase in exchange rate volatility will decrease imports by 0.18%. The evidence of this negative relationship is also consistent with the results of Anderton and Skudelny (2001) who found that extra-area exchange rate volatility have decreased extra-euro area imports by 10%. On the other hand, the results also justified that when volatility is measured by GARCH, a percentage increase in exchange rate volatility will cause imports to increase by 5.77E-09% (which is very minimal). Based on the results, it can well be argued that the magnitude of the results is very much determined by the measure of volatility used. In addition, the outcome of the results is dependent on how the model is specified as it is clear that both model specifications yield different results.

It should also be noted that assessing the effects of exchange rate volatility on imports is mainly what is of interest in this section. However, recognizing the role that other variables play in affecting imports, the direction of the impact of other variables is also assessed. So, following is a brief summary of the impact of the other variables on imports and evaluating if the results estimates are affected by the measure of volatility used.

As expected, for both model specifications, the results indicate a positive significant relationship between domestic income (proxied by national GDP), money supply and imports. It is advocated that as income of the domestic country as well as money supply increases respectively, imports will also. Hence, this hypothesis is confirmed in this study where for all models (with exchange rate volatility measured by standard deviation, GARCH and HP-Filter), imports are encouraged as the respective coefficients rise. It is fascinating to find that the magnitude of the coefficients (LGDP, LM2) is closely identical for all three distinct volatility measures considering both model specifications. Hence, ceteris paribus, it is concluded that as domestic income increases by 1%, imports also increase by 0.89%. Likewise, as money supply increases, imports will similarly increase simultaneously by 0.29% and 0.36% for both model specifications respectively.

The following section shows the suitable model for exports as it was indicated by the Hausman test. Tables 4.34 and 4.35 therefore present the appropriate model (Random Effects model) for exports considering both model specifications (Model 1 and 2).

Table 4.34: Suitable model for Exports (RANDOM EFFECTS REGRESSION)-Model 1

Dependent variable: Exports

Variables	SDVol	GARCHVol	HPVol
LUSGDP	2.856700 [26.17217] (0.109150)	2.841311 [25.69561] (0.110576)	2.804788 [25.16730] (0.111446)
LG7I	-2.140166 [-6.010899] (0.356048)	-2.162796 [-5.993071] (0.360883)	-2.104378 [-5.831525] (0.360862)
LNER	-0.082387 [-2.997329] (0.027487)	-0.027891 [-1.096100] (0.025446)	-0.023367 [-0.912801] (0.025599)
INFL	9.60E-05 [1.632579] (5.88E-05)	-7.31E-05 [-1.624516] (4.50E-05)	-7.05E-05 [-1.568515] (4.49E-05)
LM2	-0.118602 [-2.069167] (0.057319)	-0.078336 (-1.342061) (0.058370)	-0.083417 [-1.446306] (0.057676)
Volatility	-0.429634 [-4.465854] (0.096204)	-4.05E-09 [-1.264305] (3.21E-09)	-0.000143 [-1.900506] (7.52E-05)
C	2.194393 [4.249974] (0.516331)	2.104000 [4.024707} (0.522771)	2.129984 [4.082622] (0.521720)
R-squared Adjusted R-squared	0.661585 0.658663	0.652329 0.649328	0.653379 0.650386

Table 4.35: Suitable model for Exports (RANDOM EFFECTS REGRESSION)-Model 2

Dependent variable: Exports

Variables	SDVol	GARCHVol	HPVol
LUSGDP	2.795011 [25.96276] (0.107655)	2.819339 [25.93824] (0.108694)	2.783839 [25.54593] (0.108974)
LG7I	-2.207181 [-6.184668] (0.356879)	-2.190106 [-6.085715] (0.359877)	-2.122400 [-5.893573] (0.360121)
INFL	0.000112 [1.897173] (5.88E-05)	-4.69E-05 [1.231290] (0.359877)	-4.87E-05 [-1.281249] (3.80E-05)
LM2	-0.126780 [-2.204447] (0.057511)	-0.083861 (-1.442220) (0.058147)	-0.088440 [-1.540419] (0.057413)
Volatility	-0.309440 [-3.523891] (0.087812)	-4.44E-09 [-1.393212] (3.19E-09)	-0.000154 [-2.081532] (7.41E-05)
C	2.413412 [4.699940] (0.513498)	2.199380 [4.266740] (0.515471)	2.210776 [4.299315] (0.514216)
R-squared Adjusted R-squared	0.657427 0.654966	0.651994 0.649328	0.653427 0.650938

Considering both model specifications, the coefficient of determination for the exports model indicates a fair goodness of fit which indicates that 65% of the variation in exports explained by the independent variables. As it was earlier emphasized, the impact of exchange rate volatility on exports is what is of primary importance in this section; hence minimal attention will be directed to the other variables. For both model specifications, with the three measures of volatility used, the results confirm that that as instability in exchange rates escalates, this will discourage exporters for engaging more into foreign transactions, hence exportation will grow lower. However, for the three measures of volatility used, the magnitude of the coefficients are different as well as their respective statistical significance. The results indicates that exchange rate volatility measured by standard deviation is significant while the volatility measured by GARCH and HP-Filter are both insignificant (Model 1). On the other hand, Model 2 indicates that only the measure of volatility by standard deviation and HP-Filter are significant while the GARCH volatility measure is insignificant. This therefore points out that the proxies used as measures of volatility are distinct and in this regard the results of the analysis will also be different depending on the proxy used. The study therefore concentrates on the significant effects as the insignificant effects indicate no conclusive relationship. Hence, based on the results, it is postulated that exchange rate volatility estimated by the standard deviation and HP-Filter methods have a significant negative relationship on exports. This negative relationship is again confirmed by Chit (2008) that also found a negative relationship between exports and exchange rate volatility.

Similar to the model of exchange changes and exports, LUSGDP which is a proxy for foreign income (as the US represents one of the major trading partners of SSA) indicates a positive correlation with exports. This still confirm the hypothesis stated by economic theory. With coefficients all significant, the study observes that the magnitude of the coefficients is slightly a bit different but not to a higher degree. The model measuring volatility by standard deviation and GARCH indicates that as LUSGDP increases by a percentage, exports will increase by 2.85% while the HP-Filter volatility indicates that a percentage increase will change exports by 2.80%. Model 2 however indicates that a percentage increase in LUSGDP increases exports by 2.80%. LG7I is also a proxy used to account for foreign income in this study. For the distinct model specifications, the coefficients of LG7I are not in line with economic theory as it is advocated that production in advanced countries usually leads to an increase in the exports of trading partners. The model with standard deviation, GARCH and HP-Filter as volatility measures shows that a 1% increase in LG7I will decrease exports by 2.14%, 2.16% and 2.10% respectively for model 1. For model 2, the results indicates that as LG7I increases by a percentage, exports instead decreases by 2.20%, 2.19%, 2.12% considering volatility measure by standard deviation, GARCH and HP-Filter respectively. Inflation also displays insignificant negative relationship with exports for all three distinct models. LM2 as indicated by the theory is to be negatively related with exports and this statement was found true in this study. Solely dependent on the significant coefficients, the models (1 and 2) suggest as LM2 increase by 1%, exports will decrease by 0.12% (standard deviation as a volatility measure).

Table 4.36: Suitable model for Trade Balance (RANDOM EFFECTS REGRESSION)-Model 1

Dependent variable: Trade Balance

Variables	SDVol	GARCHVol	HPVol
LGDP	20.38761 [9.105990] (2.238923)	20.65162 [9.397829] (2.197488)	20.53010 [9.324162] (2.201817)
LUSGDP	-54.82430 [-6.425350] (8.532500)	-55.78090 [-6.610069] (8.438778)	-55.65085 [-6.610053] (8.419123)
LG7I	86.39042 [4.218997] (20.47653)	87.39195 [4.272813] (20.45303)	87.34814 [4.270540] (20.45365)
LNER	2.128033 [1.615589] (1.317187)	2.429383 [2.002754] (1.213021)	2.522232 [2.084337] (1.210088)
INFL	0.008325 [2.563772] (0.003247)	0.006746 [2.829868] (0.002384)	0.006823 [2.866777] (0.002380)
LM2	-8.733161 [-2.892276] (3.019478)	-8.460544 [-2.831369] (2.988146)	-8.291330 [-2.791372] (2.970343)
Volatility	-3.623789 [-0.685345] (5.287538)	5.11E-08 [0.298260] (1.71E-07)	-0.001390 [-0.337008] (0.004125)
C	31.93030 [1.070552] (29.82602)	32.28587 [1.082730] (29.81894)	31.56209 [1.058451] (29.81913
R-squared Adjusted R-squared	0.140156 0.131483	0.139632 0.130954	0.139648 0.130970

Table 4.37: Suitable model for Trade Balance (RANDOM EFFECTS REGRESSION)-Model 2

Dependent variable: Trade Balance

Variables	SDVol	GARCHVol	HPVol
LGDP	19.15648 [9.034567] (2.120354)	19.48869 [9.155470] (2.128639)	19.15648 [9.034567] (2.120354)
LUSGDP	-49.71626 [-6.228559] (7.981985)	-50.47168 [-6.268182] (8.052043)	-49.71626 [-6.228559] (7.981985)
LG7I	84.26878 [4.111240] (20.49717)	86.05573 [4.192983] (20.52375)	84.26878 [4.111240] (20.49717)
INFL	0.008053 [2.475633] (0.003253)	0.004407 [2.111414] (0.002087)	0.008053 [2.475633] (0.003253)
LM2	-9.191762 [-3.055603] (3.008167)	-8.708739 [2.994570] (2.994570)	-9.191762 [-3.055603] (4.855581)
Volatility	-7.079329 [-1.457978] (4.855581)	9.61E-08 [0.564544] (1.70E-07)	-7.079329 [-1.457978] (0.004125)
C	21.54057 [0.736247] (29.25726)	19.44693 [0.664701] (29.25668)	21.54057 [0.736247] (29.25726)
R-squared Adjusted R-squared	0.136918 0.129467	0.134701 0.127231	0.136918 0.129467

For Model 1[23] and 2[24], the coefficient of determination for the trade balance model is low compared to the previous models. The model shows that approximately 14% of the variation in trade balance is explained by the selected explanatory variables. For Model 1 and 2, it is observed that the outcome of the trade balance model indicates that exchange rate uncertainty display negative effects for the standard deviation measure and the HP-Filter measure but the GARCH measure shows instead a positive effect. However, the results show that none of the volatility measures are statistically significant which permit the study to conclude that for all three volatility measures used in this study; trade balance in SSA is insensitive to exchange rate volatility.

Having examined the impact of exchange rate changes as well volatility on trade, the following chapter provides a comparative analysis between the distinct trade blocs of SSA

[23] Model 1: Model of exchange rate volatility and exports (including both LNER and Volatility measures).

[24] Model 2: Model of exchange rate volatility and exports (excluding LNER as a variable)

considered in this study. Explicitly, the impact of exchange rate changes and volatility will be investigated taking into account the separate trade blocs of SSA.

CHAPTER 5

EMPIRICAL RESULTS – COMPARATIVE ANALYSIS OF THE IMPACT OF EXCHANGE RATE CHANGES AND VOLATILITY ON TRADE

5.1 Introduction

One of the main objectives of this thesis is to provide a comparative analysis of the impact of exchange rate changes and volatility on trade (imports, exports and trade balance) between the different regional trade blocs of Sub-Saharan Africa. As explained in the previous chapter, the study considers four separate trade blocs of Sub-Saharan Africa namely the EAC, CEMAC, ECOWAS and SADC trade blocs. Conducting a comparative analysis on the impact of exchange rate changes on imports, exports and trade balance thereby distinguish between the distinct trade blocs of Sub-Saharan Africa brings novelty to the literature. To the best of our knowledge, this empirical comparison stands among the first study to do such an analysis and this will contribute enormously to the body of knowledge in this area of study. In this regard, this section therefore provides a comparative analysis of the different trade blocs of SSA relating to the response of trade (imports, exports and trade Balance) towards exchange changes and volatility.

5.2 Estimation Results: Comparative Analysis of the Impact of Exchange Rate Changes on Trade

The study notes that, as the respective trade blocs is made up of different countries, a separate analysis of the panel unit root tests for each trade bloc needs to be conducted as the study cannot rely on the unit root test done previously on the whole set data of data (involving the whole set of SSA countries). In this regard, this study therefore starts the analysis with the EAC trade bloc. The first step will therefore to conduct the panel unit root analysis for this region of SSA to find the level of integration of the variables.

5.2.1 Panel Unit Root Test

5.2.1.1 Panel Unit Root Test for EAC Trade Bloc

The results of the panel unit root test for each variable for the EAC trade bloc are presented in Table 5.1-5.12.

Table 5.1: Panel unit root test for LM_{it}

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	2.97860	0.9986			-2.40108	0.0082	I(1)*[25]
	IPS	4.11007	1.0000			-1.76612	0.0387	I(1)**
	ADF - Fisher	0.24034	1.0000			14.9896	0.0593	I(1)***
	PP - Fisher	0.13003	1.0000			25.9297	0.0011	I(1)*
Intercept + Trend	LLC	-1.54553	0.0611	I(0)***		-2.07357	0.0191	
	IPS	0.24281	0.5959			-0.96233	0.0679	I(1)***
	ADF - Fisher	5.22987	0.7327			10.6712	0.0210	I(1)**
	PP - Fisher	7.26716	0.5081			21.8219	0.0053	I(1)*

[25] *,**,*** represents significance at 1%, 5% and 10% respectively and this reasoning goes for all subsequent tables

Table 5.2: Panel unit root test for LX_{it}

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	2.65400	0.9960			-2.00385	0.0225	I(1)**
	IPS	4.02241	1.0000			-1.31365	0.0945	I(1)***
	ADF - Fisher	0.18378	1.0000			12.0550	0.0488	I(1)**
	PP - Fisher	0.63503	0.9997			35.8136	0.0000	I(1)*
Intercept + Trend	LLC	-1.93587	0.0264	I(0)**		-2.04089	0.0206	
	IPS	-0.27361	0.3922			-0.85139	0.0973	I(1)***
	ADF - Fisher	9.73676	0.2840			10.4783	0.0330	I(1)**
	PP - Fisher	21.9143	0.0051			33.6781	0.0000	I(1)*

Table 5.3: Panel unit root test for LTB_{it}

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	1.95348	0.9746			-5.32585	0.0000	I(1)*
	IPS	2.98534	0.9986			-4.26998	0.0000	I(1)*
	ADF - Fisher	0.86882	0.9989			32.4404	0.0001	I(1)*
	PP - Fisher	0.62122	0.9997			43.0380	0.0000	I(1)*
Intercept + Trend	LLC	-0.74468	0.2282			-4.66269	0.0000	I(1)*
	IPS	-0.09237	0.4632			-2.99689	0.0014	I(1)*
	ADF - Fisher	7.63080	0.4703			23.0174	0.0033	I(1)*
	PP - Fisher	10.2743	0.2463			40.6797	0.0000	I(1)*

Table 5.4: Panel unit root test for $LGDP_{it}$

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	2.20548	0.9863			-1.78764	0.0369	I(1)**
	IPS	3.71007	0.9999			-1.01482	0.0551	I(1)***
	ADF - Fisher	0.23253	1.0000			11.4876	0.0756	I(1)***
	PP - Fisher	0.17937	1.0000			15.4663	0.0507	I(1)***
Intercept + Trend	LLC	-0.36510	0.3575			-2.80535	0.0025	I(1)*
	IPS	1.18933	0.8828			-1.04355	0.0483	I(1)**
	ADF - Fisher	2.72550	0.9504			11.2272	0.0892	I(1)****
	PP - Fisher	1.70891	0.9887			11.5308	0.0734	I(1)***

Table 5.5: Panel unit root test for $LUSGDP_{it}$

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	-2.85572	0.0021	I(0)*		-2.16475	0.0152	
	IPS	0.04063	0.5162			-1.51109	0.0654	I(1)***
	ADF - Fisher	5.31063	0.7239			13.0846	0.0090	I(1)*
	PP - Fisher	15.2785	0.0540	I(0)**		12.6378	0.1249	
Intercept + Trend	LLC	-1.02146	0.1535			-1.33063	0.0917	I(1)***
	IPS	0.61900	0.7320			-1.10629	0.0343	I(1)**
	ADF - Fisher	3.77515	0.8768			11.2605	0.0874	I(1)***
	PP - Fisher	0.56189	0.9998			9.06891	0.0365	I(1)**

Table 5.6: Panel unit root test for $LG7I_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-3.53051	0.0002	I(0)*	-5.54326	0.0000	
	IPS	-2.30122	0.0107	I(0)*	-3.58141	0.0002	
	ADF - Fisher	18.1212	0.0203	I(0)*	27.1621	0.0007	
	PP - Fisher	19.0905	0.0144	I(0)*	41.7453	0.0000	
Intercept + Trend	LLC	-3.37382	0.0004	I(0)*	-4.66515	0.0000	
	IPS	-0.70327	0.2409		-2.39224	0.0084	I(1)**
	ADF - Fisher	9.15347	0.3295		18.7264	0.0164	I(1)**
	PP - Fisher	6.50360	0.5910		53.1411	0.0000	I(1)*

Table 5.7: Panel unit root test for $LNER_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-2.23949	0.0126	I(0)**	-1.23030	0.0093	
	IPS	-0.39074	0.3480		-1.05815	0.0450	I(1)**
	ADF - Fisher	7.25323	0.5096		11.0433	0.0993	I(1)**
	PP - Fisher	13.8824	0.0849	I(0)***	21.1047	0.0069	
Intercept + Trend	LLC	-1.35189	0.0882	I(0)***	-0.67875	0.2486	
	IPS	0.39491	0.6535		-0.10782	0.0571	I(1)***
	ADF - Fisher	4.71909	0.7871		7.33621	0.0008	I(1)*
	PP - Fisher	3.02403	0.9328		15.5530	0.0492	I(1)**

Table 5.8: Panel unit root test for $LINFL_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-1.90868	0.0282	I(0)**	-7.40749	0.0000	
	IPS	-2.08803	0.0184	I(0)**	-6.87997	0.0000	
	ADF - Fisher	19.6119	0.0119	I(0)**	51.1417	0.0000	
	PP - Fisher	26.9730	0.0007	I(0)*	104.836	0.0000	
Intercept + Trend	LLC	-2.41451	0.0079	I(0)*	-8.42070	0.0000	
	IPS	-1.49768	0.0671	I(0)***	-7.33551	0.0000	
	ADF - Fisher	14.9687	0.0598	I(0)***	50.3761	0.0000	
	PP - Fisher	22.6440	0.0039	I(0)**	74.9968	0.0000	

Table 5.9: Panel unit root test for $LM2_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-0.68649	0.2462		-2.65876	0.0039	I(1)*
	IPS	0.48582	0.6865		-4.03723	0.0000	I(1)*
	ADF - Fisher	3.88760	0.8671		31.1039	0.0001	I(1)*
	PP - Fisher	11.6932	0.1654		55.2884	0.0000	I(1)*
Intercept + Trend	LLC	-1.37423	0.0847	I(0)***	-1.80794	0.0353	
	IPS	-1.49462	0.0675	I(0)***	-2.32659	0.0100	
	ADF - Fisher	14.6885	0.0655	I(0)**	20.1392	0.0098	
	PP - Fisher	18.5819	0.0173	I(0)**	47.2189	0.0000	

Table 5.10: Panel unit root test for $SDVol_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-2.27176	0.0116	I(0)**	-5.88879	0.0000	
	IPS	-2.88669	0.0019	I(0)**	-6.25146	0.0000	
	ADF - Fisher	23.2011	0.0031	I(0)**	46.8410	0.0000	
	PP - Fisher	87.6263	0.0000	I(0)*	191.628	0.0000	
Intercept + Trend	LLC	-1.53933	0.0619	I(0)***	-5.64721	0.0000	
	IPS	-1.70294	0.0443	I(0)**	-4.83214	0.0000	
	ADF - Fisher	16.2658	0.0387	I(0)**	34.7959	0.0000	
	PP - Fisher	37.8452	0.0000	I(0)*	62.3163	0.0000	

Table 5.11: Panel unit root test for $GARCHVol_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	2.84233	0.9978		9.20417	0.0000	I(1)*
	IPS	3.15753	0.9992		-0.79784	0.0125	I(1)**
	ADF - Fisher	1.43802	0.9937		9.44465	0.0062	I(1)**
	PP - Fisher	1.07448	0.9977		237.853	0.0000	I(1)*
Intercept + Trend	LLC	5.30422	1.0000		11.6111	0.0000	I(1)*
	IPS	1.96655	0.9754		0.34996	0.0368	I(1)**
	ADF - Fisher	1.58401	0.9912		5.53177	0.0995	I(1)***
	PP - Fisher	34.1305	0.0000		60.6585	0.0000	I(1)*

Table 5.12: Panel unit root test for $HPVol_{it}$

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	-1.21745	0.1117			-1.37408	0.0847	I(1)***
	IPS	-1.85060	0.0321	I(0)**		-2.25884	0.0119	
	ADF - Fisher	15.6075	0.0484	I(0)**		18.1491	0.0201	
	PP - Fisher	12.1603	0.1442			31.9866	0.0001	I(1)*
Intercept + Trend	LLC	-0.23796	0.4060			0.00781	0.0031	I(1)*
	IPS	-0.38296	0.3509			-0.68685	0.0461	I(1)**
	ADF - Fisher	8.13545	0.4204			9.55034	0.0980	I(1)***
	PP - Fisher	5.78383	0.6714			19.2321	0.0137	I(1)**

Similar to the panel unit root tests earlier conducted for the entire SSA, the results of the tests also reveal mixed results. In lieu of this, this study will rely upon the most consistent results as well as the majority. As reported in the table, if the probability value is significant, then the null hypothesis is rejected which implies that the variables has a unit root and needs to be difference. If that is the case, the variable will be an I(1) variable. Considering the model of intercept and intercept and trend, variables that show consistent results are LIMP, LTB, LGDP and GARCHVol which indicates that the variables are I(1). INFL and SDVol also display consistent results of I(0) variables. The remaining variables indicate inconsistency in the results, while some tests will show that variables are I(0), other tests indicate that the variables are I(1) which makes it difficult for the researcher to come to a definite conclusion. How to proceed is therefore left at the discretion of the researcher to conclude as to whether the variables are stationary or not.

For simplicity, the majority of the results will be taken for each benchmark of the model of intercept and intercept and trend. After a cautious look, the results based on majority of the results show that the variables are non-stationary at their level and needed to be differenced to achieve stationarity. Hence, based on the argument that the majority of the results confirm the non-stationarity of the variables, the study concludes that the variables are I(1). Performing regression on I(1) variables will lead to spurious regression and therefore biased estimates. The literature promotes that if variables are non-stationary, there may be a linear combination existing between them. This implies that the variables may move together in the long run, hence cointegrated. Hence, at this stage, it is important to test if the variables move together in the long run. Thus, the panel cointegration analysis will be estimated. The three most widely cointegration tests used in the literature are the Kao (1999), Pedroni (1999, 2004) and the Johansen test. However, the survey of the literature indicates that the Johansen cointegration is barely applied in empirical research while the Kao and Pedroni tests are the two tests mostly applied when dealing with cointegration analysis in panel data. In this regard, based on the literature, this study also uses the two widely employed cointegration tests namely the Pedroni (1999, 2004) and the Kao (1999).

The next step of the analysis will therefore be to test for cointegration in the variables for the respective models (imports, exports and trade balance).

5.2.1.2 Panel Cointegration Testing for EAC Trade Bloc

The results of the panel cointegration tests for all models are presented as follows and the values in parentheses indicate the probability values:

Table 5.13: Panel cointegration test Results for EAC trade bloc

	Model	IMPORTS	EXPORTS	TRADE BALANCE
	PEDRONI TEST			
Intercept only	Panel v-Statistic	-0.201357 (0.5798)	1.526077 (0.0635)	-0.488029 (0.6872)
	Panel rho-Statistic	-0.107881 (0.4570)	0.027353 (0.5109)	1.910436 (0.9720)
	Panel PP-Statistic	-2.707062 (0.0034)	-3.818021 (0.0001)	-3.928626 (0.0000)
	Panel ADF-Statistic	-0.116122 (0.4538)	1.947764 (0.9743)	-3.008306 (0.0013)
	Group rho-Statistic	1.984774 (0.9764)	1.498182 (0.9330)	2.793315 (0.9974)
	Group PP-Statistic	-1.328197 (0.0921)	-1.987742 (0.0234)	-8.489847 (0.0000)
	Group ADF-Statistic	-1.913996 (0.0278)	1.694679 (0.9549)	-4.717022 (0.0000)
Intercept and trend	Panel v-Statistic	-1.126861 (0.8701)	2.330151 (0.0099)	-1.433512 (0.9241)
	Panel rho-Statistic	0.853527 (0.8033)	0.590614 (0.7226)	2.573293 (0.9950)
	Panel PP-Statistic	-2.836128 (0.0023)	-6.587409 (0.0000)	-3.818719 (0.0001)
	Panel ADF-Statistic	-0.412693 (0.3399)	-0.330175 (0.3706)	-2.868514 (0.0021)
	Group rho-Statistic	2.886793 (0.9981)	2.792139 (0.9974)	3.303224 (0.9995)
	Group PP-Statistic	-2.602713 (0.0046)	-5.361820 (0.0000)	-9.007495 (0.0000)
	Group ADF-Statistic	-2.947040 (0.0016)	-2.522039 (0.0058)	-4.153103 (0.0000)
	KAO TEST			
	Kao ADF stats	-3.780449 (0.0001)	-2.588797 (0.0048)	-2.945576 (0.0016)

Both Pedroni and Kao cointegration tests test the null hypothesis that there is no cointegration against the alternative of presence of cointegration among the variables. So, if the corresponding probability value of each test statistics is significant (where P<1%, 5%, 10%), then the null hypothesis of no cointegration will be rejected and there will evidence of cointegration among the variables. Otherwise, if the probability value is not significant (P>1%, 5%, 10%), then the null hypothesis is not be rejected and there will be no evidence of cointegration among the variables.

Based on the results of the Pedroni and Kao cointegration tests, the results confirm that for the model of imports under the benchmark of hoth intercept and intercept and trend, the majority of results reject the evidence of cointegration. It is noticed that for all benchmarks, only three out of the seven results confirm the evidence of cointegration among the variables while the remaining four results reject the evidence of cointegration. On the other hand, the Kao cointegration test results justify that there is cointegration among the variables as this is confirmed with a P-value of 0.0001 which is less than the 5% significance value. In lieu of this, based on the information that at least one of the panel cointegration tests justified the presence of cointegration, this study therefore concludes that there is evidence of cointegration in the imports model. For the model of exports, the pedroni test results are mixed. For the model of intercept, the results show that the null hypothesis of no cointegration cannot be rejected; hence the variables are not cointegrated. However, for the model of intercept and trend, four out of the seven results confirm the existence of cointegration as the p-value is significant at 5% significance value. Hence, the study concludes that the variables are cointegrated, thus moving together in the long run. This evidence of cointegration is also confirmed by the Kao cointegration test with a probability of 0.0048. Despite the fact that the model of intercept displays no evidence of cointegration, this study will assume the results proposed by the model of intercept and trend as well as the Kao cointegration test. Thus, it is concluded that for the model of exports, the variables move together in the long run. The results for the trade balance model shows that the variables are cointegrated as majority of the results of the Pedroni test shows evidence of cointegration as well as the Kao cointegration test. Regarding this, the therefore conclude that the variables have a long run stable relationship.

Based on previous interpretations, all models of imports, exports and trade balance acknowledge that the respective variables move together in the long run, hence the estimation of a long run cointegrating relationship is needed to be able to see the effects of the explanatory variables on the dependent variable. Hence, the next step of the analysis will be to estimate the long run cointegrating relationship using the Dynamic Ordinary Least Squares (DOLS). It is stated in the previous chapter that DOLS is a better estimator than the Fully Modified Ordinary Least Squares (FMOLS), hence this thesis uses the DOLS to estimate the long run cointegrating equation. In lieu of this, this study uses the DOLS in estimating the single cointegrating equation. The results are presented as follows for each of the model of imports, exports and trade balance.

Table 5.14: DOLS estimates for EAC trade bloc

IMPORTS MODEL						
Variables	LGDP	LNER	INFL	LM2		
Coefficients	1.216927	0.488159	0.005957	0.054635		
Standard Error	0.072378	0.106244	0.002654	0.180871		
T-statistics	16.81349	4.594715	2.244792	0.302064		
Probability	0.0000	0.0000	0.0282	0.7636		
R-squared	0.994313					
Adjusted R-squared	0.993691					
EXPORTS MODEL						
Variables	LUSGDP	LG7I	LNER	INFL	LM2	
Coefficients	3.294351	-3.129439	-0.416795	0.012041	-0.060874	
Standard Error	0.373618	0.827946	0.217351	0.004062	0.334806	
T-statistics	8.817439	-3.779764	-1.917615	2.964056	-0.181818	
Probability	0.0000	0.0196	0.0000	0.7441	0.0253	
R-squared	0.993134					
Adjusted R-squared	0.992383					
TRADE BALANCE MODEL						
Variables	LGDP	LUSGDP	LG7I	LNER	INFL	LM2
Coefficients	-4.327978	6.798367	-10.08331	-4.082725	-0.046873	-0.395838
Standard Error	0.978734	3.470070	4.295346	1.110786	0.017775	1.381779
T-statistics	-4.422016	1.959144	-2.347497	-3.675530	-2.637001	-0.286470
Probability	0.0000	0.0545	0.0220	0.0005	0.0105	0.7754
R-squared	0.960790					
Adjusted R-squared	0.956501					

The above results represent the long run cointegrating equation (for imports, exports, and trade balance) for the EAC trade bloc. As earlier stated, one of the main core aims of this thesis is to do a comparative analysis of the impact of exchange rate changes and volatility between the different regions of SSA. Thus, instead of analysing the results of the regions separately, this study estimates the models for all trade blocs considered in this study and then compares the results together. In this regard, only a brief interpretation is provided.

As one of the main variables of this study, exchange rate does not have the expected sign in all the estimated models as stated by the theory. Theoretically, a depreciation of exchange rate will cause a decrease in imports, an increase in exports, an increase in the trade balance. However, this scenario was not found to be hold for the case of the EAC trade bloc. The outcome of the results shows that an increase in exchange which indicates a depreciation will instead cause imports to increase along. This positive link between exchange rate depreciation and imports can again be confirmed by the high dependence of countries in the EAC trade bloc on imports. Most of these countries' local production is limited and is not able to satisfy local production, hence explaining their dependence in imports. On the other hand, the positive nexus is perhaps due to the fact that exports in the EAC trade bloc are not sufficiently diversified, causing imports to still grow despite a scenario of a depreciation in exchange rate. Overall, based on the significance of the coefficient, the study concludes, a percentage increase in exchange rate by 1% will cause imports to increase by 0.48%. An increase in domestic income proxy by LGDP is observed to contribute to imports. While a positive sign was expected in the coefficient of exchange rate in the exports model, the outcome instead revealed a negative relationship. This negative relationship indicates that as exchange rate depreciates, exports also decrease which is totally contrary to economic theory. However, based on the significance of the test statistics, the results indicates that a 1% depreciation in exchange rate will cause exports to decrease by approximately 0.41%. This result can also be attributed to the fact as most countries in SSA, notably in the EAC have a non-competitive and low-quality export base, a depreciation in the currency is also unlikely to boost exports. Furthermore, the low demand of the countries' export products may also result in a decrease in exports, despite a depreciation of the currency. On the other hand, the Marshall-Lerner theory which states that a depreciation of the currency will lead to an improvement in trade balance does not hold in this case. The results justify that as exchange rate depreciates by 1%, trade balance instead deteriorates by 4.08%. This result comes in at no surprise given the fact that exchange rate depreciation was found to decrease exports and improve imports. Hence, the heavily reliance of countries on imports and poor exports products could explain these contradictory results. Hence, the conclusion that as exchange rate depreciates, trade balance will worsen instead, as the growth in imports will outpace the growth in exports. In lieu of this brief interpretation, it is of no argument to say depreciation of exchange rate in EAC countries do not yield results as expected by the theory. Based on the results, it will be interesting to see how other trade blocs respond to exchange rate changes.

The following section conducts the panel unit root tests for the CEMAC, ECOWAS and SADC trade blocs respectively and based on the conclusion of the results, one will decide whether to use the pooled/fixed/random or whether to go for the panel cointegration test. The results of the panel unit root tests for CEMAC trade bloc are presented as follows:

5.2.1.3 Panel Unit Root Test for CEMAC Trade Bloc

Table 5.15: Panel unit root test for LM_{it}

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	0.48824	0.6873			-4.06480	0.0000	I(1)**
	IPS	2.61483	0.9955			-4.19138	0.0000	I(1)*
	ADF - Fisher	3.43562	0.9916			40.6065	0.0001	I(1)*
	PP - Fisher	10.9771	0.5309			78.2740	0.0000	I(1)*
Intercept + Trend	LLC	-1.23427	0.1086			-4.44991	0.0000	I(1)**
	IPS	-0.18384	0.4271			-3.34751	0.0004	I(1)**
	ADF - Fisher	11.2821	0.5049			33.4031	0.0008	I(1)**
	PP - Fisher	17.8562	0.1201			60.4733	0.0000	I(1)*

Table 5.16: Panel unit root test for LX_{it}

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-1.72076	0.0426	I(0)**	-6.82147	0.0000	
	IPS	1.00796	0.8433		-5.24351	0.0000	I(1)*
	ADF - Fisher	9.08058	0.6960		48.7528	0.0000	I(1)*
	PP - Fisher	29.7261	0.0031	I(0)**	66.1583	0.0000	
Intercept + Trend	LLC	-2.75579	0.0029	I(0)**	-6.54261	0.0000	
	IPS	-0.57798	0.2816		-4.54885	0.0000	I(1)*
	ADF - Fisher	13.0604	0.3647		41.5539	0.0000	I(1)*
	PP - Fisher	9.48316	0.6612		79.6395	0.0000	I(1)*

Table 5.17: Panel unit root test for LTB_{it}

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-2.63621	0.0042	I(0)**	-10.8155	0.0000	
	IPS	-1.26897	0.1022		-8.65374	0.0000	I(1)*
	ADF - Fisher	16.9964	0.1497		78.6102	0.0000	I(1)*
	PP - Fisher	34.1243	0.0006	I(0)*	559.670	0.0000	
Intercept + Trend	LLC	-4.82307	0.0000	I(0)*	-9.20524	0.0228	
	IPS	-2.96875	0.0015	I(0)**	-6.83672	0.0000	
	ADF - Fisher	29.6848	0.0031	I(0)*	58.7864	0.0000	
	PP - Fisher	70.2813	0.0000	I(0)*	113.320	0.0000	

Table 5.18: Panel unit root test for $LGDP_{it}$

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	-0.09111	0.4637			-4.28848	0.0000	I(1)*
	IPS	2.64813	0.9960			-3.21857	0.0006	I(1)*
	ADF - Fisher	3.16582	0.9943			31.0837	0.0019	I(1)*
	PP - Fisher	13.6205	0.3256			44.5962	0.0000	I(1)*
Intercept + Trend	LLC	-2.17819	0.0147	I(0)**		-3.38022	0.0004	
	IPS	-0.17610	0.4301			-1.80382	0.0356	I(1)**
	ADF - Fisher	12.0030	0.4454			21.4821	0.0438	I(1)**
	PP - Fisher	6.92928	0.8623			44.2884	0.0000	I(1)*

Table 5.19: Panel unit root test for $LUSGDP_{it}$

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	-3.49753	0.0002	I(0)*		-2.65127	0.0040	
	IPS	0.04976	0.5198			-1.85070	0.0321	I(1)***
	ADF - Fisher	7.96594	0.7878			19.6269	0.0745	I(1)***
	PP - Fisher	22.9178	0.0284	I(0)**		18.9567	0.0896	
Intercept + Trend	LLC	-1.25102	0.1055			-1.62968	0.0516	I(1)***
	IPS	0.75812	0.7758			-1.35492	0.0877	I(1)***
	ADF - Fisher	5.66273	0.9321			16.8907	0.0538	I(1)***
	PP - Fisher	0.84283	1.0000			13.6034	0.0268	I(1)**

Table 5.20: Panel unit root test for $LG7I_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-4.32398	0.0000	I(0)*	-6.78908	0.0000	
	IPS	-2.81841	0.0024	I(0)*	-4.38631	0.0000	
	ADF - Fisher	27.1818	0.0073	I(0)*	40.7431	0.0001	
	PP - Fisher	28.6357	0.0045	I(0)*	62.6179	0.0000	
Intercept + Trend	LLC	-4.13207	0.0000	I(0)*	-5.71362	0.0000	
	IPS	-0.86133	0.1945		-2.92989	0.0017	I(1)**
	ADF - Fisher	13.7302	0.3183		28.0896	0.0054	I(1)**
	PP - Fisher	9.75540	0.6374		79.7117	0.0000	I(1)*

Table 5.21: Panel unit root test for $LNER_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-1.36378	0.0863	I(0)***	-5.03020	0.0000	
	IPS	-0.70369	0.2408		-2.87385	0.0020	I(1)**
	ADF - Fisher	11.9108	0.4529		27.6584	0.0062	I(1)***
	PP - Fisher	6.49405	0.8892		21.0715	0.0493	I(1)**
Intercept + Trend	LLC	-2.31048	0.0104	I(0)*	-3.59147	0.0002	
	IPS	-1.43183	0.0761	I(0)***	-0.28276	0.3887	
	ADF - Fisher	17.3279	0.1377		10.4984	0.0723	I(1)***
	PP - Fisher	6.94776	0.8610		10.2950	0.0901	I(1)***

Table 5.22: Panel unit root test for $LINFL_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	0.96744	0.8833		-5.16670	0.0000	I(1)*
	IPS	-4.98960	0.0000	I(0)*	-8.23745	0.0000	
	ADF - Fisher	47.0848	0.0000	I(0)*	75.1650	0.0000	
	PP - Fisher	357.079	0.0000	I(0)*	806.320	0.0000	
Intercept + Trend	LLC	1.23743	0.8920		-4.44847	0.0000	I(1)*
	IPS	-3.24480	0.0006	I(0)*	-6.77685	0.0000	
	ADF - Fisher	32.0955	0.0013	I(0)**	58.4651	0.0000	
	PP - Fisher	95.8476	0.0000	I(0)*	115.630	0.0000	

Table 5.23: Panel unit root test for $LM2_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-0.34409	0.3654		-5.30587	0.0000	I(1)*
	IPS	0.16794	0.5667		-5.10479	0.0000	I(1)*
	ADF - Fisher	17.2816	0.1393		48.8580	0.0000	I(1)*
	PP - Fisher	7.22854	0.8421		87.1359	0.0000	I(1)*
Intercept + Trend	LLC	-1.56724	0.0585	I(0)***	-5.34415	0.0000	
	IPS	-0.51500	0.3033		-4.86391	0.0000	I(1)*
	ADF - Fisher	16.7074	0.1609		43.7663	0.0000	I(1)*
	PP - Fisher	28.0560	0.0054	I(0)**	95.7195	0.0000	

Table 5.24: Panel unit root test for $SDVol_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	0.58352	0.7202		-5.03155	0.0000	I(1)*
	IPS	-2.13918	0.0162	I(0)**	-5.37902	0.0000	
	ADF - Fisher	21.7546	0.0404	I(0)**	49.7313	0.0000	
	PP - Fisher	58.5408	0.0000	I(0)*	112.469	0.0000	
Intercept + Trend	LLC	2.66734	0.9962		-3.51475	0.0002	I(1)*
	IPS	-0.46948	0.3194		-3.38794	0.0004	I(1)*
	ADF - Fisher	11.4640	0.4896		31.5835	0.0016	I(1)*
	PP - Fisher	36.0748	0.0003	I(0)*	84.5952	0.0000	

Table 5.25: Panel unit root test for $GARCHVol_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	0.46186	0.6779		-1.45492	0.0728	I(1)***
	IPS	0.07148	0.5285		-2.52727	0.0057	I(1)*
	ADF - Fisher	7.86716	0.7954		24.8313	0.0156	I(1)**
	PP - Fisher	8.40663	0.7526		61.8596	0.0000	I(1)*
Intercept + Trend	LLC	-1.10899	0.1337		0.14504	0.0577	I(1)**
	IPS	-0.58427	0.2795		-1.09377	0.0370	I(1)**
	ADF - Fisher	12.1072	0.4371		15.2333	0.0289	I(1)**
	PP - Fisher	5.51466	0.9385		48.8402	0.0000	I(1)*

Table 5.26: Panel unit root test for $HPVol_{it}$

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	-1.21874	0.1115			-6.15085	0.0000	I(1)*
	IPS	-1.47326	0.0703	I(0)***		-3.72116	0.0001	
	ADF - Fisher	16.8632	0.1548			34.8736	0.0005	I(1)*
	PP - Fisher	8.85680	0.7151			28.5712	0.0046	I(1)*
Intercept + Trend	LLC	0.11129	0.5443			-5.21879	0.0000	I(1)*
	IPS	-0.62363	0.2664			-1.87518	0.0304	I(1)**
	ADF - Fisher	12.3307	0.4195			20.3982	0.0599	I(1)***
	PP - Fisher	3.13813	0.9945			14.9198	0.0459	I(1)**

In order to interpret the results of the panel unit root test, the study follows the same logic as previously. Thus, the majority of the results are taken into account. For both models of intercept and intercept and trend, the results that show some consistency reveal that the variables are I(1), that is non-stationary at their level and needed to be differenced to achieve stationarity. Specifically, variables that display consistent results of I(1) variables are LIMP, LGDP, GARCHVol and HPVol. On the other hand, INFL is the only variable under both benchmark of intercept and intercept and trend that show consistent results of I(0) variables. The remaining variables are mixed in their results as some reveal that 50% results display that the variables are I(0) while the other 50% display that the variables are I(1). Hence, based on these differences in the results, the conclusion as to whether the variables are stationarity or not is solely based on majority and consistency. In this regard, based on the majority of results, it emerges that all the variables are non-stationary. The next step of the analysis will be to conduct panel cointegration analysis to check the evidence of cointegration between the variables. The results of the Pedroni and Kao cointegration tests are presented as follows:

5.2.1.4 Panel Cointegration Testing for CEMAC Trade Bloc

The results of the panel cointegration tests for all models are presented as follows and the values in parentheses indicate the probability values:

Table 5.27: Panel cointegration test results for CEMAC trade bloc

	Model	IMPORTS	EXPORTS	TRADE BALANCE
	PEDRONI TEST			
Intercept only	Panel v-Statistic	-0.751010 (0.7737)	-0.424056 (0.6642)	-2.213120 (0.9866)
	Panel rho-Statistic	0.973399 (0.8348)	2.243314 (0.9876)	1.947835 (0.9743)
	Panel PP-Statistic	-3.251842 (0.0006)	0.336534 (0.6318)	-7.332591 (0.0000)
	Panel ADF-Statistic	-1.033473 (0.1507)	-1.022739 (0.1532)	-4.152153 (0.0000)
	Group rho-Statistic	2.485924 (0.9935)	3.215160 (0.9993)	2.555775 (0.9947)
	Group PP-Statistic	-7.506213 (0.0000)	-0.567852 (0.2851)	-10.73207 (0.0000)
	Group ADF-Statistic	-1.827445 (0.0338)	-0.856074 (0.1960)	-2.677662 (0.0037)
Intercept and trend	Panel v-Statistic	-1.945578 (0.9741)	-0.948457 (0.8286)	-3.056773 (0.9989)
	Panel rho-Statistic	1.794993 (0.9637)	3.225926 (0.9994)	2.707652 (0.9966)
	Panel PP-Statistic	-3.291467 (0.0005)	-1.140115 (0.1271)	-13.32384 (0.0000)
	Panel ADF-Statistic	-0.617924 (0.2683)	-2.657902 (0.0039)	-6.013780 (0.0000)
	Group rho-Statistic	3.020605 (0.9987)	4.083575 (1.0000)	3.047343 (0.9988)
	Group PP-Statistic	-8.281908 (0.0000)	-2.343927 (0.0095)	-17.65398 (0.0000)
	Group ADF-Statistic	-1.965044 (0.0247)	-3.205099 (0.0007)	-3.782682 (0.0001)
	KAO TEST			
	Kao ADF stats	-1.944241 (0.0259)	-1.811113 (0.0351)	-1.659485 (0.0485)

Both Pedroni and Kao cointegration were conducted for the CEMAC trade bloc to check if cointegration exist.

Based on the results of the Pedroni and Kao cointegration tests, the results confirm that for the model of imports under the model of both intercept and intercept and trend, the majority of results reject the evidence of cointegration. Just as the case of the EAC trade bloc, it is observed that for all model (intercept and intercept and trend), only three out of the seven results confirms the evidence of cointegration among the variables while the remaining four results reject the evidence of cointegration. On the other hand, the Kao cointegration test results justify that there is cointegration among the variables as this is confirmed with a P-value of 0.0259. Hence, based on the fact that at least one of the cointegration tests confirms the evidence of cointegration, this study therefore concludes that for the model of imports, there is stable long run relationship that exists. However, the exports model display mixed results in regards to the Pedroni test. For the model of intercept, all seven test results show that the null hypothesis of no cointegration cannot be rejected, hence it can be concluded that the variables are not cointegrated. However, for the model of intercept and trend, three out of the seven test results confirm the existence of cointegration as the probability value is significant while the four remaining test results suggests that there is no cointegration. In lieu of this, it is concluded that the variables are not cointegrated, thus not moving together in the long run. Nonetheless, the Kao cointegration test supports the evidence of cointegration at 5% significance level with a probability value of 0.0351. Even though the Pedroni test could not support a long run relationship among the variables, the study concludes that the variables are cointegrated as the Kao test confirms that there is evidence of cointegration. The results for the trade balance model show that the variables are cointegrated as majority of the results of the Pedroni test shows evidence of cointegration as well as the Kao cointegration test. Regarding this, the study therefore concludes that the variables have a long run stable relationship.

With the supporting evidence that the variables move together in the long run for all distinct models (imports, exports and trade balance), the estimation of the long run cointegrating equation is conducted in the next step. Hence, the next section presents the long run cointegrating equation using the Dynamic Ordinary Least Squares (DOLS).
The results are presented as follows for each of the model of imports, exports and trade balance in Table 5.28.

Table 5.28: DOLS estimates for CEMAC trade bloc

IMPORTS MODEL						
Variables	LGDP	LNER	INFL	LM2		
Coefficients	0.640694	-0.557459	0.003889	0.246494		
Standard Error	0.061612	0.316892	0.005556	0.183850		
T-statistics	10.39893	-1.759142	0.699838	1.340732		
Probability	0.0000	0.0817	0.4857	0.1832		
R-squared	0.961648					
Adjusted R-squared	0.957253					
EXPORTS MODEL						
Variables	LUSGDP	LG7I	LNER	INFL	LM2	
Coefficients	3.153125	-1.287166	-1.583520	-0.007643	-0.852848	
Standard Error	0.646052	2.020614	0.494139	0.011085	0.388548	
T-statistics	4.880608	-0.637017	-3.204602	-0.689487	-2.194963	
Probability	0.0000	0.5256	0.0018	0.4922	0.0306	
R-squared	0.936829					
Adjusted R-squared	0.929590					
TRADE BALANCE MODEL						
Variables	LGDP	LUSGDP	LG7I	LNER	INFL	LM2
Coefficients	46.21793	-147.2353	167.5484	-8.205242	-1.042178	-34.67924
Standard Error	5.518829	26.70292	66.72567	18.87572	0.400410	13.05247
T-statistics	8.374589	--5.513828	2.511003	-0.434698	-2.602776	-2.656910
Probability	0.0000	0.0000	0.0137	0.6648	0.0107	0.0092
R-squared	0.836289					
Adjusted R-squared	0.817531					

A brief interpretation of the results regarding one of the main variables of this study (exchange rate) is provided as follows. The sign of the coefficient of exchange rate bear the correct sign in the imports model. As theoretically hypothesized, as exchange rate depreciates, imports decrease. Hence, a negative coefficient is expected. This expected negative coefficient was seen to hold in the CEMAC trade bloc but however, the coefficient is not statistically significant. Based on this, the study concludes that no significant relationship was found to exist between exchange rate changes and imports in CEMAC trade bloc. It is also hypothesized that as exchange rate depreciates, this will encourage foreigners to buy local products, hence an increase in exports. However, the empirical test in this study does not justify this assertion. It is instead shown that as exchange rate depreciates by 1%, exports also decreases by 1.58% which is not in line with the economic theory. The result of the trade balance model in regard to the effects of exchange rate changes is also seen not to be in line with economic theory. It is shown that as exchange rate depreciates by a percentage, trade balance also deteriorates by 8.20%. However, this coefficient was not significant which permits the study to justify that there is no evidence of a significant relationship between exchange rate depreciation and trade balance. In other words, the theory of the Marshall-Lerner does not hold in the case of CEMAC. Following these disparities in the results, it will be curious again to see how the other remaining trade blocs respond to exchange rate changes.

Therefore, following the same logic like that of the two previous trade blocs, the analysis of the ECOWAS trade bloc will first be done before interpreting the results simultaneously. Thus the analyses for ECOWAS are presented below. Following the same procedure as previously, the panel unit root tests are first conducted and the next of the analysis will be based on the conclusion of whether the variables are stationary or non-stationary.

5.2.1.5 Panel Unit Root Test for ECOWAS Trade Bloc

Table 5.29: Panel unit root test for LM_{it}

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	2.52931	0.9943		-1.91078	0.0280	I(1)**
	IPS	5.74056	1.0000		-4.15520	0.0000	I(1)*
	ADF - Fisher	2.41193	1.0000		60.8915	0.0001	I(1)*
	PP - Fisher	1.96119	1.0000		112.742	0.0000	I(1)*
Intercept + Trend	LLC	-1.32620	0.0924	I(0)***	-0.31135	0.0778	
	IPS	-0.24896	0.4017		-1.83059	0.0336	I(1)**
	ADF - Fisher	27.2432	0.3967		37.4141	0.0686	I(1)***
	PP - Fisher	19.5400	0.8128		87.1821	0.0000	I(1)*

Table 5.30: Panel unit root test for LX_{it}

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	3.99048	1.0000		-3.79439	0.0001	I(1)*
	IPS	6.62980	1.0000		-3.98166	0.0000	I(1)*
	ADF - Fisher	2.21782	1.0000		60.8784	0.0001	I(1)*
	PP - Fisher	2.09302	1.0000		160.378	0.0000	I(1)*
Intercept + Trend	LLC	-1.30759	0.0955	I(0)*	-2.55361	0.0053	
	IPS	0.54477	0.7070		-2.48800	0.0064	I(1)***
	ADF - Fisher	21.8075	0.6992		44.3739	0.0138	I(1)**
	PP - Fisher	26.3941	0.4416		125.212	0.0000	I(1)*

Table 5.31: Panel unit root test for LTB_{it}

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-0.38828	0.3489		-4.95191	0.0000	I(1)*
	IPS	1.18755	0.8825		-7.66282	0.0000	I(1)*
	ADF - Fisher	16.7647	0.9160		105.481	0.0000	I(1)*
	PP - Fisher	36.2705	0.0868	I(0)***	565.481	0.0000	
Intercept + Trend	LLC	-0.39593	0.3461		-2.64049	0.0041	I(1)**
	IPS	-1.81555	0.0347	I(0)**	-4.63230	0.0000	
	ADF - Fisher	38.2458	0.0575	I(0)***	67.2187	0.0000	
	PP - Fisher	63.2019	0.0001	I(0)*	156.024	0.0000	

Table 5.32: Panel unit root test for $LGDP_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	2.14124	0.9839		-6.27439	0.0000	I(1)*
	IPS	5.18073	1.0000		-4.03638	0.0000	I(1)*
	ADF - Fisher	2.24473	1.0000		58.9590	0.0002	I(1)*
	PP - Fisher	1.42714	1.0000		75.8548	0.0000	I(1)*
Intercept + Trend	LLC	-3.88682	0.0001	I(0)**	-5.08418	0.0000	
	IPS	-1.19370	0.1163		-1.85011	0.0321	I(1)**
	ADF - Fisher	31.4954	0.2103		38.0327	0.0601	I(1)***
	PP - Fisher	11.2658	0.9946		64.7480	0.0000	I(1)*

Table 5.33: Panel unit root test for $LUSGDP_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-5.24170	0.0000	I(0)*	-4.45469	0.0000	
	IPS	0.05234	0.5209		-2.90031	0.0019	I(1)*
	ADF - Fisher	17.4077	0.8962		44.6233	0.0129	I(1)**
	PP - Fisher	49.5486	0.0036	I(0)**	40.6164	0.0339	
Intercept + Trend	LLC	-2.01884	0.0218	I(0)**	-3.15560	0.0008	
	IPS	0.81301	0.7919		-2.12298	0.0169	I(1)**
	ADF - Fisher	14.6840	0.9628		37.9964	0.0606	I(1)**
	PP - Fisher	1.71558	1.0000		29.3369	0.0960	I(1)***

Table 5.34: Panel unit root test for $LG7I_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-6.52522	0.0000	I(0)*	-9.79869	0.0000	
	IPS	-4.07482	0.0000	I(0)*	-6.24010	0.0000	
	ADF - Fisher	58.1030	0.0003	I(0)*	85.7577	0.0000	
	PP - Fisher	60.9355	0.0001	I(0)*	133.167	0.0000	
Intercept + Trend	LLC	-6.13572	0.0000	I(0)*	-8.37464	0.0000	
	IPS	-1.15091	0.1249		-4.19458	0.0000	I(1)*
	ADF - Fisher	28.8819	0.3165		59.8602	0.0002	I(1)*
	PP - Fisher	20.3503	0.7747		166.625	0.0000	I(1)*

Table 5.35: Panel unit root test for $LNER_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-3.07204	0.0011	I(0)**	-6.84407	0.0000	
	IPS	-0.77752	0.2184		-3.98594	0.0000	I(1)*
	ADF - Fisher	25.3644	0.4984		57.9157	0.0003	I(1)**
	PP - Fisher	19.4283	0.8178		65.1163	0.0000	I(1)*
Intercept + Trend	LLC	-3.31591	0.0005	I(0)**	-5.31185	0.0000	
	IPS	-1.44403	0.0744	I(0)***	-1.16856	0.0213	
	ADF - Fisher	33.7679	0.1410		30.3644	0.0528	I(1)***
	PP - Fisher	15.9701	0.9369		43.8504	0.0157	I(1)**

Table 5.36: Panel unit root test for $LINFL_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-4.78876	0.0000	I(0)*	-10.1455	0.0000	
	IPS	-7.41272	0.0000	I(0)*	-11.2398	0.0000	
	ADF - Fisher	102.982	0.0000	I(0)*	151.342	0.0000	
	PP - Fisher	338.241	0.0000	I(0)*	765.246	0.0000	
Intercept + Trend	LLC	-4.10818	0.0000	I(0)*	-8.45556	0.0000	
	IPS	-4.81033	0.0000	I(0)*	-8.59086	0.0000	
	ADF - Fisher	69.3365	0.0000	I(0)*	111.769	0.0000	
	PP - Fisher	189.825	0.0000	I(0)*	218.282	0.0000	

Table 5.37: Panel unit root test for $LM2_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-1.47169	0.0706	I(0)***	-6.86866	0.0000	
	IPS	1.18921	0.8828		-5.80144	0.0000	I(1)*
	ADF - Fisher	16.8292	0.9142		81.0449	0.0000	I(1)*
	PP - Fisher	13.6901	0.9769		238.545	0.0000	I(1)*
Intercept + Trend	LLC	-2.49914	0.0062	I(0)***	-6.04010	0.0000	
	IPS	-1.03201	0.1510		-3.80329	0.0001	I(1)*
	ADF - Fisher	34.1364	0.1316		58.1687	0.0003	I(1)*
	PP - Fisher	59.4205	0.0002	I(0)*	137.632	0.0000	

Table 5.38: Panel unit root test for $SDVol_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-2.78074	0.0027	I(0)**	-8.62882	0.0000	
	IPS	-3.64182	0.0001	I(0)*	-7.91428	0.0000	
	ADF - Fisher	55.7939	0.0006	I(0)*	108.227	0.0000	
	PP - Fisher	97.5577	0.0000	I(0)*	210.961	0.0000	
Intercept + Trend	LLC	-0.57013	0.2843		-5.92002	0.0000	I(1)*
	IPS	-1.03567	0.1502		-5.18241	0.0002	I(1)*
	ADF - Fisher	31.6899	0.2036		72.6432	0.0007	I(1)*
	PP - Fisher	56.2740	0.0005	I(0)*	179.394	0.0000	

Table 5.39: Panel unit root test for $GARCHVol_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	3.08977	0.9990		0.05985	0.0239	I(1)**
	IPS	2.70736	0.9966		50.9502	0.0024	I(1)*
	ADF - Fisher	12.6738	0.9867		215.471	0.0000	I(1)*
	PP - Fisher	14.7291	0.9621		215.471	0.0000	I(1)*
Intercept + Trend	LLC	0.28794	0.6133		2.52895	0.0943	I(1)***
	IPS	0.95710	0.8307		-1.13241	0.0287	I(1)**
	ADF - Fisher	19.9435	0.7942		32.8057	0.0678	I(1)***
	PP - Fisher	35.9612	0.0924	I(0)***	129.120	0.0000	

Table 5.40: Panel unit root test for $HPVol_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-10.3348	0.0000	I(0)*	-5.25860	0.0000	
	IPS	-5.71373	0.0000	I(0)*	-5.80176	0.0000	
	ADF - Fisher	92.3696	0.0000	I(0)*	80.2935	0.0000	
	PP - Fisher	28.2632	0.3456		73.2883	0.0000	I(1)*
Intercept + Trend	LLC	-5.54419	0.0000	I(0)*	-8.18376	0.0000	
	IPS	-2.78793	0.0027	I(0)*	-4.27221	0.0000	
	ADF - Fisher	48.1243	0.0052	I(0)*	60.5700	0.0001	
	PP - Fisher	11.1788	0.9949		44.8838	0.0121	I(1)**

Likewise previous tests, the majority of the results are taken into account. The results of the panel unit root tests confirmed again mixed results whereby while some results show that the variables are I(0), others instead show that the variables are I(1). Because the majority of the results show that the variables are non-stationary, hence the study draws the conclusion that the variables are I(1). In this regard, performing regression on these non-stationarity variables will result to biased estimates. The next step of the analysis will be to conduct panel cointegration analysis to check the evidence of cointegration between the variables.

5.2.1.6 Panel Cointegration Testing for ECOWAS Trade Bloc

The results of the panel cointegration tests for all models are presented as follows and the values in parentheses indicate the probability values:

Table 5.41: Panel cointegration test results for ECOWAS trade bloc

	Model	IMPORTS	EXPORTS	TRADE BALANCE
	PEDRONI TEST			
Intercept only	Panel v-Statistic	0.162715 (0.4354)	0.195417 (0.4225)	-0.766101 (0.7782)
	Panel rho-Statistic	1.582300 (0.9432)	2.475769 (0.9934)	0.921476 (0.8216)
	Panel PP-Statistic	-2.082801 (0.0186)	1.384877 (0.9170)	-19.07244 (0.0000)
	Panel ADF-Statistic	0.199247 (0.5790)	3.186454 (0.9993)	-2.322339 (0.0101)
	Group rho-Statistic	2.702385 (0.9966)	4.123793 (1.0000)	3.986663 (1.0000)
	Group PP-Statistic	-1.973145 (0.0242)	-0.675585 (0.2497)	-11.22851 (0.0000)
	Group ADF-Statistic	0.995581 (0.8403)	2.150657 (0.9842)	-2.838620 (0.0023)
Intercept and trend	Panel v-Statistic	-0.557363 (0.7114)	2.167263 (0.0151)	-1.854747 (0.9682)
	Panel rho-Statistic	2.456271 (0.9930)	4.394758 (1.0000)	2.557051 (0.9947)
	Panel PP-Statistic	-2.718294 (0.0033)	-4.426075 (0.0000)	-60.69957 (0.0000)
	Panel ADF-Statistic	0.262182 (0.6034)	-2.208776 (0.0136)	-5.360325 (0.0000)
	Group rho-Statistic	2.781193 (0.9973)	5.134334 (1.0000)	5.090299 (1.0000)
	Group PP-Statistic	-4.815757 (0.0000)	-7.494400 (0.0000)	-20.81434 (0.0000)
	Group ADF-Statistic	0.381772 (0.6487)	-1.835615 (0.0332)	-2.731558 (0.0032)
	KAO TEST			
	Kao ADF stats	-4.022384 (0.0000)	-2.324392 (0.0101)	-5.699352 (0.0000)

The Pedroni and the Kao cointegration tests were conducted to check for evidence of cointegration among the variables. For the model of imports, the Pedroni test does not support the evidence of cointegration among the variables. On the other hand, the results of the Kao cointegration test confirm the evidence of coinetgration at 5% significance level. Therefore, based on the argument that at least one of the tests supports that there is cointegration, the study therefore concludes that there is cointegration for the imports. The next section therefore presents the DOLS estimates for ECOWAS trade bloc. For the exports model, the Pedroni test does not support that there is cointegration while for the benchmark of the intercept and trend, majority of the results (four of the seven tests) confirms that cointegration exist among the variables. This affirmation is also established by the results of the Kao cointegration test at 5% significance level. For the trade balance model, both the Pedroni and Kao test results justify that there is a long run relationship that exist among the variables. With these conclusions, it can be stated that for all distinct models of imports, exports and trade balance, there is a long run relationship that exist between the variables. It is therefore of great significance to estimate the long run relationship where the study will be able to capture how imports, exports and trade balance are affected by exchange rate changes and other related variables. The estimates the long run cointegrating relationship is therefore presented in Table 5.42 as follows:

Table 5.42: DOLS estimates for ECOWAS trade bloc

IMPORTS MODEL

Variables	LGDP	LNER	INFL	LM2
Coefficients	0.993693	0.019612	-0.003563	0.258480
Standard Error	0.032743	0.042824	0.001560	0.057739
T-statistics	30.34808	0.457973	-2.284611	4.476675
Probability	0.0000	0.6475	0.0234	0.0000
R-squared	0.991105			
Adjusted R-squared	0.990026			

EXPORTS MODEL

Variables	LUSGDP	LG7I	LNER	INFL	LM2
Coefficients	3.435522	-4.091261	-0.108253	0.003143	-0.505033
Standard Error	0.238091	0.734560	0.076089	0.002187	0.132986
T-statistics	14.42946	-5.569674	-1.422715	1.437212	-3.797626
Probability	0.0000	0.0000	0.1563	0.1522	0.0002
R-squared	0.981188				
Adjusted R-squared	0.978905				

TRADE BALANCE MODEL

Variables	LGDP	LUSGDP	LG7I	LNER	INFL	LM2
Coefficients	8.061518	-17.05492	20.11367	11.31910	0.236495	-8.776820
Standard Error	3.025621	10.50229	20.16648	2.003449	0.065901	3.284611
T-statistics	2.664418	-1.623923	0.997381	5.649808	3.588648	-2.672104
Probability	0.0083	0.1059	0.3197	0.0000	0.0004	0.0081
R-squared	0.960031					
Adjusted R-squared	0.955181					

A brief interpretation of the results regarding the impact of exchange rate changes is provided in this section. The outcome of the results indicates the hypothesis of economic regarding the impact of exchange rate changes on imports, exports and trade balance is not fulfilled in this case. The coefficient of exchange rate on imports and exports respectively do not bear the correct negative sign and is also statistically insignificant in both models. In regards to this, the study concludes that there is no significant relationship between exchange rate changes and imports as well as exports. It is interesting to see that in ECOWAS trade bloc, as exchange rate depreciates, trade balance improves which is consistent with economic theory. Based on the statistical significance of the coefficient, the results confirm that a 1% increase in exchange rate which indicates a depreciation leads to A 11.31% increase in trade balance. The outcome of this result confirms that the Marshall-Lerner is seen to hold in ECOWAS trade bloc.

Based on the results, it is shown that imports, exports and trade balance in each trade bloc respond differently to exchange rate changes. Hence, resulting from these inconsistencies in the results, it will be curious again to see how trade in SADC responds to exchange rate changes.

Therefore, following the same logic like that of preceding trade blocs, the analysis of SADC trade bloc is presented below. In this regard, the panel unit root tests are first conducted and the next step of the analysis will be based on the conclusion of whether the variables are stationary or non-stationary.

5.2.1.7 Panel Unit Root test for SADC Trade Bloc

Table 5.43: Panel unit root test for LM_{it}

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	2.06612	0.9806		-7.05423	0.0000	I(1)*
	IPS	5.30782	1.0000		-6.36720	0.0000	I(1)*
	ADF - Fisher	2.95977	1.0000		91.5959	0.0000	I(1)*
	PP - Fisher	7.72808	0.9999		193.597	0.0000	I(1)*
Intercept + Trend	LLC	-2.28768	0.0111	I(0)**	-6.65782	0.0000	
	IPS	-0.09899	0.4606		-4.85685	0.0000	I(1)*
	ADF - Fisher	23.8382	0.6900		71.9966	0.0000	I(1)*
	PP - Fisher	35.6562	0.1516		154.033	0.0000	I(1)*

Table 5.44: Panel unit root test for LX_{it}

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	1.52969	0.9370		-5.51674	0.0000	I(1)*
	IPS	4.75879	1.0000		-5.50119	0.0000	I(1)*
	ADF - Fisher	4.11080	1.0000		77.3489	0.0000	I(1)*
	PP - Fisher	13.5718	0.9782		151.672	0.0000	I(1)*
Intercept + Trend	LLC	-3.14800	0.0008	I(0)*	-4.26256	0.0000	
	IPS	-0.70213	0.2413		-3.66566	0.0001	I(1)*
	ADF - Fisher	29.5954	0.2847		56.2269	0.0005	I(1)*
	PP - Fisher	46.2816	0.0085	I(0)*	117.820	0.0000	

Table 5.45: Panel unit root test for LTB_{it}

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-1.33162	0.0915	I(0)***	-8.21400	0.0000	
	IPS	-0.45012	0.3263		-8.41796	0.0000	I(0)*
	ADF - Fisher	27.5137	0.4904		119.114	0.0000	I(0)*
	PP - Fisher	42.6755	0.0374	I(0)*	576.845	0.0000	
Intercept + Trend	LLC	-2.42718	0.0076	I(0)*	-5.93656	0.0000	
	IPS	-1.23990	0.1075		-5.75083	0.0000	I(1)*
	ADF - Fisher	34.0999	0.1976		82.1189	0.0000	I(1)*
	PP - Fisher	55.3005	0.0016	I(0)*	167.257	0.0000	

Table 5.46: Panel unit root test for $LGDP_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	1.87515	0.9696		-5.41445	0.0000	I(1)*
	IPS	4.62541	1.0000		-5.05390	0.0000	I(1)*
	ADF - Fisher	4.61216	1.0000		74.4961	0.0000	I(1)*
	PP - Fisher	4.15420	1.0000		108.017	0.0000	I(1)*
Intercept + Trend	LLC	-1.53352	0.0626	I(0)**	-5.37798	0.0000	
	IPS	-0.49693	0.3096		-3.26759	0.0005	I(1)*
	ADF - Fisher	26.5046	0.5453		53.8332	0.0023	I(1)*
	PP - Fisher	18.2021	0.9209		88.5129	0.0000	I(1)*

Table 5.47: Panel unit root test for $LUSGDP_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-5.34257	0.0000	I(0)*	-4.04987	0.0000	
	IPS	0.07600	0.5303		-2.82699	0.0023	I(1)*
	ADF - Fisher	18.5872	0.9104		45.7962	0.0183	I(1)**
	PP - Fisher	53.4748	0.0026	I(0)*	44.2323	0.0263	
Intercept + Trend	LLC	-1.91097	0.0280	I(0)**	-2.48938	0.0064	
	IPS	1.15805	0.8766		-2.06967	0.0192	I(1)**
	ADF - Fisher	13.2130	0.9919		39.4117	0.0745	I(1)***
	PP - Fisher	1.96660	1.0000		31.7412	0.0678	I(1)**

Table 5.48: Panel unit root test for $LG7I_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-6.60498	0.0000	I(0)*	-10.3705	0.0000	
	IPS	-4.30519	0.0000	I(0)*	-6.70021	0.0000	
	ADF - Fisher	63.4243	0.0001	I(0)*	95.0672	0.0000	
	PP - Fisher	66.8166	0.0001	I(0)	146.108	0.0000	
Intercept + Trend	LLC	-6.31184	0.0000	I(0)	-8.72770	0.0000	
	IPS	-1.31570	0.0941	I(0)***	-4.47548	0.0000	
	ADF - Fisher	32.0371	0.2730		65.5423	0.0001	I(1)*
	PP - Fisher	22.7626	0.7448		185.994	0.0000	I(1)*

Table 5.49: Panel unit root test for $LNER_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-4.53272	0.0000	I(0)	-4.82811	0.0000	
	IPS	-2.16910	0.0150	I(0)*	-3.98797	0.0000	
	ADF - Fisher	44.0788	0.0273	I(0)**	61.9455	0.0002	
	PP - Fisher	325.337	0.0000	I(0)*	89.8388	0.0000	
Intercept + Trend	LLC	-1.91260	0.0279	I(0)**	-5.87558	0.0000	
	IPS	0.31166	0.6223		-3.58407	0.0002	I(1)*
	ADF - Fisher	21.9883	0.7818		57.3727	0.0009	I(1)*
	PP - Fisher	25.7005	0.5895		81.6730	0.0000	I(1)*

Table 5.50: Panel unit root test for $LINFL_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-36.8324	0.0000	I(0)*	-47.4497	0.0000	
	IPS	-17.0500	0.0000	I(0)*	-22.4865	0.0000	
	ADF - Fisher	378.371	0.0000	I(0)*	176.591	0.0000	
	PP - Fisher	153.017	0.0000	I(0)*	429.037	0.0000	
Intercept + Trend	LLC	-50.2555	0.0000	I(0)*	-37.3139	0.0000	
	IPS	-20.6021	0.0000	I(0)*	-18.1377	0.0000	
	ADF - Fisher	121.936	0.0000	I(0)*	134.595	0.0000	
	PP - Fisher	92.5135	0.0000	I(0)*	205.634	0.0000	

Table 5.51: Panel unit root test for $LM2_{it}$

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	-0.30004	0.3821			-3.23034	0.0006	I(1)*
	IPS	1.50484	0.9338			-4.83606	0.0000	I(1)*
	ADF - Fisher	15.6588	0.9706			71.9186	0.0000	I(1)*
	PP - Fisher	18.1524	0.9222			279.933	0.0000	I(1)*
Intercept + Trend	LLC	-0.01338	0.4947			-2.28380	0.0112	I(1)*
	IPS	1.01824	0.8457			-2.93578	0.0017	I(1)*
	ADF - Fisher	18.4910	0.9131			51.2543	0.0047	I(1)*
	PP - Fisher	33.2961	0.2250			151.671	0.0000	I(1)*

Table 5.52: Panel unit root test for $SDVol_{it}$

		Level				Difference		
Model	Method	Statistics	Probability	Decision		Statistics	Probability	Decision
Intercept	LLC	-9.50976	0.0000	I(0)*		-8.07058	0.0000	
	IPS	-4.68533	0.0000	I(0)*		-6.22836	0.0000	
	ADF - Fisher	82.7523	0.0000	I(0)*		89.6060	0.0000	
	PP - Fisher	65.1457	0.0001	I(0)*		146.027	0.0000	
Intercept + Trend	LLC	-6.08057	0.0000	I(0)*		-6.25650	0.0000	
	IPS	-1.89107	0.0293	I(0)**		-3.61227	0.0002	
	ADF - Fisher	43.3958	0.0319	I(0)*		57.9124	0.0007	
	PP - Fisher	30.0819	0.3593			107.894	0.0000	I(1)*

Table 5.53: Panel unit root test for $GARCHVol_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	0.85836	0.8047		-3.54771	0.0002	I(1)*
	IPS	1.92198	0.9727		-5.67119	0.0000	I(1)*
	ADF - Fisher	22.2270	0.7707		82.6150	0.0000	I(1)*
	PP - Fisher	17.3728	0.9409		310.572	0.0000	I(1)*
Intercept + Trend	LLC	-0.21290	0.4157		-2.08373	0.0186	I(1)**
	IPS	0.22499	0.5890		-3.65654	0.0001	I(1)
	ADF - Fisher	24.3055	0.6653		58.5143	0.0006	I(1)*
	PP - Fisher	60.3987	0.0004	I(0)*	197.499	0.0000	

Table 5.54: Panel unit root test for $HPVol_{it}$

		Level			Difference		
Model	Method	Statistics	Probability	Decision	Statistics	Probability	Decision
Intercept	LLC	-5.66840	0.0000	I(0)*	-7.44938	0.0000	
	IPS	-5.57930	0.0000	I(0)*	-6.53195	0.0000	
	ADF - Fisher	81.2842	0.0000	I(0)*	94.3629	0.0000	
	PP - Fisher	54.0485	0.0022	I(0)*	133.036	0.0000	
Intercept + Trend	LLC	-4.20023	0.0000	I(0)*	-5.63163	0.0000	
	IPS	-2.98986	0.0014	I(0)*	-3.72283	0.0001	
	ADF - Fisher	50.5771	0.0056	I(0)*	60.6877	0.0003	
	PP - Fisher	27.2269	0.5059		93.4137	0.0000	I(1)*

Like other panel unit root test results, the majority of results states that the variables are non-stationary at their level and needed to be differenced to achieve stationarity. The variables are therefore I (1). Regarding this, the results of the Pedroni and Kao cointegration tests results are presented as follows as the next step of the analysis. As previously explained, the main essence is to test the presence of a long run stable relationship among the variables of interest. The results of the Pedroni and Kao cointegration tests are thus presented as follows.

5.2.1.8 Panel Cointegration Testing for SADC Trade Bloc

The results of the panel cointegration tests for all models are presented as follows and the values in parentheses indicate the probability values:

Table 5.55: Panel cointegration test results for SADC trade bloc

	Model	IMPORTS	EXPORTS	TRADE BALANCE
	PEDRONI TEST			
Intercept only	Panel v-Statistic	0.044245 (0.4824)	-114.6810 (1.000)	-1.637392 (0.9492)
	Panel rho-Statistic	0.460043 (0.6773)	2.341318 (0.9904)	2.612601 (0.9955)
	Panel PP-Statistic	-7.708290 (0.0000)	-5.923823 (0.0000)	-8.862617 (0.0000)
	Panel ADF-Statistic	-4.935641 (0.0000)	-3.236236 (0.0006)	-1.458903 (0.0723)
	Group rho-Statistic	2.228448 (0.9871)	3.464295 (0.9997)	4.763142 (1.0000)
	Group PP-Statistic	-6.319529 (0.0000)	-7.848429 (0.0000)	-12.47293 (0.0000)
	Group ADF-Statistic	-1.958818 (0.0251)	-2.761085 (0.0029)	-2.343104 (0.0096)
Intercept and trend	Panel v-Statistic	-0.954204 (0.8300)	-128.5715 (1.0000)	-2.971992 (0.9985)
	Panel rho-Statistic	1.872152 (0.9694)	3.514454 (0.998)	3.632023 (0.9999)
	Panel PP-Statistic	-11.57174 (0.0000)	-6.418267 (0.0000)	-10.27751 (0.0000)
	Panel ADF-Statistic	-3.085404 (0.0010)	-2.825559 (0.0024)	-1.286435 (0.0991)
	Group rho-Statistic	3.626533 (0.9999)	4.608764 (1.0000)	5.784872 (1.0000)
	Group PP-Statistic	-6.359849 (0.0000)	-12.29541 (0.0000)	-14.67003 (0.0000)
	Group ADF-Statistic	-1.199966 (0.0151)	-2.699509 (0.0035)	-1.824954 (0.0340)
	KAO TEST			
	Kao ADF stats	-3.744189 (0.0001)	-2.411992 (0.0079)	0.104494 (0.4584)

Based on the results of the Pedroni and Kao cointegration tests, the results confirm that for the model of imports under the benchmark of both intercept and intercept and trend, the majority of results confirm the evidence of cointegration. The evidence of cointegration for the imports model is also confirmed with the results of the Kao cointegration test results with a significant P-value of 0.0001. Likewise, the model of exports, both the Pedroni and the Kao cointegration tests approves that cointegration exists among the variables. This therefore brings to the conclusion that for the model of exports, there is a stable long run relationship. For the model of trade balance, the majority of results from the Pedroni test confirm that there is cointegration among the variables. However, the Kao cointegration test rejects the evidence of cointegration at all respective significance levels of 1%, 5% and 10% respectively. Nevertheless, based on the fact that the Pedroni test for both benchmark of intercept and intercept and trend suggest that there is cointegration, this study therefore concludes that there is evidence of cointegration in the trade balance model.

In lieu of this, this study uses the DOLS in estimating the single cointegrating equation. The results are presented as follows in Table 5.56 for each of the model of imports, exports and trade balance.

Table 5.56: DOLS estimates for SADC trade bloc

IMPORTS MODEL

Variables	LGDP	LNER	INFL	LM2
Coefficients	0.940144	0.137150	-4.65E-05	0.270925
Standard Error	0.039440	0.022895	5.06E-05	0.059969
T-statistics	23.83737	5.990333	-0.918745	4.517772
Probability	0.0000	0.0000	0.3592	0.0000
R-squared	0.986707			
Adjusted R-squared	0.985104			

EXPORTS MODEL

Variables	LUSGDP	LG7I	LNER	INFL	LM2
Coefficients	2.454981	-1.741851	-0.061717	0.000215	0.145598
Standard Error	0.212471	0.639417	0.035317	6.42E-05	0.088156
T-statistics	11.55441	-2.724123	-1.747522	3.350963	1.651590
Probability	0.0000	0.0070	0.0819	0.0009	0.1000
R-squared	0.976778				
Adjusted R-squared	0.973979				

TRADE BALANCE MODEL

Variables	LGDP	LUSGDP	LG7I	LNER	INFL	LM2
Coefficients	13.41055	-43.16326	32.82517	10.40128	0.010051	-35.57921
Standard Error	11.01419	34.47614	63.85370	4.194526	0.006325	8.241242
T-statistics	1.217570	-1.251975	0.514068	2.479726	1.589005	-4.317214
Probability	0.2247	0.2119	0.6077	0.0139	0.1135	0.0000
R-squared	0.766399					
Adjusted R-squared	0.738242					

Likewise the results of the analysis of previous trade blocs, the analysis reveals that the hypotheses stated by economic theory are not all fulfilled in SADC. Imports which are expected to respond negatively to exchange rate changes are instead seen to move in a positive direction. Explicitly, based on the significance of the results, the results indicate that a percentage increase in exchange rate which is a depreciation, leads a 0.13% increase in imports. On the other hand, exports do not carry the expected coefficient and is statistically insignificant. In lieu of this, the study concludes the non-evidence of a significant relationship between exchange rate changes and exports. Similarly to ECOWAS trade bloc, the Marshall-Lerner condition is also justified in SADC trade bloc. With a statistically significant coefficient, the study concludes that a 1% increase in exchange rate which indicates a depreciation leads to A 10.40% increase in trade balance. The outcome of this result is consistent with economic theory.

For each respective trade bloc (EAC, CEMAC, ECOWAS AND SADC), the respective models of imports, exports and trade balance were estimated and the study now proceeds with the detailed interpretation of the results.

5.2.1.9 Detailed Discussion of the Results

In this section, a detailed discussion of the results is presented. The study starts by analyzing the coefficients of the import model for each region and see how they differ.

5.2.1.9.1 Comparison of Results for the Imports Model

Table 5.57: Imports model of respective trade blocs

Imports (EAC)				
Variables	LGDP	LNER	INFL	LM2
Coefficients	1.216927	0.488159	0.005957	0.054635
Standard Error	0.072378	0.106244	0.002654	0.180871
T-statistics	16.81349	4.594715	2.244792	0.302064
Probability	0.0000	0.0000	0.0282	0.7636
R-squared	**0.994313**			
Adjusted R-squared	**0.993691**			
Imports (CEMAC)				
Variables	LGDP	LNER	INFL	LM2
Coefficients	0.640694	-0.557459	0.003889	0.246494
Standard Error	0.061612	0.316892	0.005556	0.183850
T-statistics	10.39893	-1.759142	0.699838	1.340732
Probability	0.0000	0.0817	0.4857	0.1832
R-squared	**0.961648**			
Adjusted R-squared	**0.957253**			
Imports (ECOWAS)				
Variables	LGDP	LNER	INFL	LM2
Coefficients	0.993693	0.019612	-0.003563	0.258480
Standard Error	0.032743	0.042824	0.001560	0.057739
T-statistics	30.34808	0.457973	-2.284611	4.476675
Probability	0.0000	0.6475	0.0234	0.0000
R-squared	**0.991105**			
Adjusted R-squared	**0.990026**			
Imports (SADC)				
Variables	LGDP	LNER	INFL	LM2
Coefficients	0.940144	0.137150	-4.65E-05	0.270925
Standard Error	0.039440	0.022895	5.06E-05	0.059969
T-statistics	23.83737	5.990333	-0.918745	4.517772
Probability	0.0000	0.0000	0.3592	0.0000
R-squared	**0.766399**			
Adjusted R-squared	**0.738242**			

The main aim of this comparative analysis is to be able to see if for each of the separate trade blocs considered in this study, how imports, exports and trade balance respectively respond to exchange rate changes. For each of the trade blocs, it is observed that the coefficient of determination is very high. The results show 0.94 for the EAC trade bloc, 0.96 for CEMAC, 0.99 and 0.76 for ECOWAS and SADC trade blocs. This therefore implies that for each of the trade blocs of SSA considered in this study, imports are well explained by the explanatory variables. The analysis reveals that for some coefficients, the results are mixed as per trade bloc. For all four trade blocs, as hypothesized by economic theory, as the domestic income increases, imports are also bound to increase. This coefficient was found positive and significant. Despite the fact that the magnitude of the coefficient is not almost the same, this draws to the conclusion that a 1% increase in domestic income proxied by LGDP in this study will results to 1.21%, 0.64%, 0.99% and 0.94% increase in LIMP for the EAC, CEMAC, ECOWAS and SADC trade blocs respectively. This positive coefficient eventually reflects reality as it is common that as the GDP of a country increases, this will imply more income in the country and therefore, this will encourage nationals to imports more. This result confirms that when economies of the separate trade blocs perform well, they will experience increase in their level of imports. In addition, the coefficient of exchange rate which represents one of the main variables in this study has mixed signs per trade under study. While the coefficient of exchange rate shows a positive sign in one trade bloc, a negative sign is observed in other trade blocs. Economic theory states that as exchange rate depreciates, imports will become more expensive, hence a negative sign is expected. The result of the analysis clearly indicates that imports respond differently to exchange rate movements in the respective trade blocs. While EAC, ECOWAS and SADC imports show consistent positive relationship with exchange rate movements, CEMAC imports instead display a negative relationship. Based on the results, it is therefore postulated that EAC, ECOWAS and SADC coefficients are not consistent with economic theory, despite the non-significance displayed by ECOWAS. This positive link between exchange rate depreciation and imports can be attributed to the high dependence of these countries on imports. More intuitively, as with most African countries, local production in these aforementioned trade blocs may not be able to able to satisfy local demand. Hence, these imports tend to be very essential for these countries, and will consequently continue to increase despite a depreciation of their exchange rate. Furthermore, it is important to note as food constitutes the essential imports, many of these countries had suffered from drought in the past, which has increased their reliance on foreign food to meet local demand. That said, despite the assertion by economic theory, a curb in imports will not always take place in an event of exchange rate depreciation, if the countries' imports tend to be very essential for their economic survival.

Hence, the study concludes that a percentage increase in exchange rate which indicates a depreciation of the currency will increase imports by 0.48% and 0.13% in EAC and SADC trade blocs respectively. In lieu of these results, it is therefore reliable to conclude that there is a positive relationship between increases in exchange rate changes (depreciation) and imports in EAC and SADC trade blocs.

When inflation increases, this means that prices of goods and services also increase in the country. When goods have become very expensive in the country; imports will increase as nationals will want to buy foreign goods at a cheaper price. The coefficient of this variable is then expected to have a positive sign but however this expectation was not met for all trade blocs. While the coefficient of inflation for the EAC and CEMAC displays expected positive coefficients, that of ECOWAS and SADC display surprising negative coefficients. Except for CEMAC trade blocs, all other coefficients are statistically significant. The non-significance of the results as shown by the CEMAC trade bloc permits the study to draw the conclusion that there is no significant effect of inflation changes on imports in CEMAC region. On the other hand, for EAC, it is observed as inflation increases by a percentage, imports will also rise. However this scenario is not the same for ECOWAS and SADC which instead show a negative relationship. For both trade blocs, as inflation increases by a percentage, imports will decrease by 0.003% and 4.65% respectively. Despite the fact the theory may assume that as inflation rises, imports will also raise but this scenario might not always be real. The negative connection between the two variables might be also due to the fact that as inflation rises which means increase in prices of goods and services, nationals of the domestic countries may spend almost all of their income in purchasing theses goods and services and hence no more available income to purchase goods from abroad which will therefore discourage imports. Hence, a negative relationship will be experienced.

Money supply was incorporated in the models to account for the theory of the monetary approach to balance of payments. It is hypothesized that increase in money supply will encourage imports. The results reveal that all trade blocs have the correct positive sign but not all are significant. While EAC and CEMAC display non-statistical relationships, ECOWAS and SADC show that the coefficients are significant. Hence, the study concludes that there is no significant relationship existing between money supply and imports in EAC and CEMAC. For ECOWAS and SADC trade blocs, the study sustains the argument that as money supply increase by 1%, imports also increase by 0.25% and 0.27% respectively.

Having interpreted the coefficients of the imports model for each of the regions, the same procedure is done for the exports model. The results for each trade bloc are summarized in the table below.

5.2.1.9.2 Comparison of Results for the Exports Model

Table 5.58: Exports model of respective trade blocs

Exports (EAC)					
Variables	LUSGDP	LG7I	LNER	INFL	LM2
Coefficients	3.294351	-3.129439	-0.416795	0.012041	-0.060874
Standard Error	0.373618	0.827946	0.217351	0.004062	0.334806
T-statistics	8.817439	-3.779764	-1.917615	2.964056	-0.181818
Probability	0.0000	0.0196	0.0000	0.7431	0.0253
R-squared	**0.993134**				
Adjusted R-squared	**0.992383**				
Exports (CEMAC)					
Variables	LUSGDP	LG7I	LNER	INFL	LM2
Coefficients	3.153125	-1.287166	-1.583520	-0.007643	-0.852848
Standard Error	0.646052	2.020614	0.494139	0.011085	0.388548
T-statistics	4.880608	-0.637017	-3.204602	-0.689487	-2.194963
Probability	0.0000	0.5256	0.0018	0.4922	0.0306
R-squared	**0.936829**				
Adjusted R-squared	**0.929590**				
Exports (ECOWAS)					
Variables	LUSGDP	LG7I	LNER	INFL	LM2
Coefficients	3.435522	-4.091261	-0.108253	0.003143	-0.505033
Standard Error	0.238091	0.734560	0.076089	0.002187	0.132986
T-statistics	14.42946	-5.569674	-1.422715	1.437212	-3.797626
Probability	0.0000	0.0000	0.1563	0.1522	0.0002
R-squared	**0.981188**				
Adjusted R-squared	**0.978905**				
Exports (SADC)					
Variables	LUSGDP	LG7I	LNER	INFL	LM2
Coefficients	2.454981	-1.741851	-0.061717	0.000215	0.145598
Standard Error	0.212471	0.639417	0.035317	6.42E-05	0.088156
T-statistics	11.55441	-2.724123	-1.747522	3.350963	1.651590
Probability	0.0000	0.0070	0.0819	0.0009	0.1000
R-squared	**0.976778**				
Adjusted R-squared	**0.973979**				

The high coefficient of determination R^2 indicates that the exports model is well explained by the respective explanatory variables in all trade blocs. The coefficients do not all bear the signs that the theory suggest and not all appear to be significant. Foreign income is an important component of exports as it is suggested by theory that as income of the trading partners increases, exports will also increase thereby leading to a positive coefficient. As income of trading partners could not easily measured, LUSGDP (as the US constitutes one of the main trading partners of SSA), and LG7I (production index of advanced economies) was used as proxies. It should be noted that the use of these proxies was also guided by the literature. The results suggest as income is the US income increases, exports will also increase for each of the distinct trade blocs under consideration in this study. The statistical significance of the coefficients permits the researcher to conclude that as LUSGDP increases by one percentage, exports will also escalate in EAC, CEMAC, CEMAC and SADC trade blocs by 3.29%, 3.15%, 3.43% and 2.45% respectively. The industrial production index proxied by the LG7I in this study instead displays a negative significant coefficient with exports. This is not what is expected but based on the significance of the results except for CEMAC trade bloc which display an insignificant coefficient, the study concludes that as industrial production index of advanced economies increase, exports tend to decrease on the other hand. The magnitude of the coefficients suggests that as LG7I increases by 1%, exports decrease by 3.12% in EAC, 4.09% in ECOWAS and 1.74% in SADC respectively.

As one of the core variables of this study, economic theory suggests that as domestic currency depreciates, exports will increase, that is exports will be made cheaper. In other words, if domestic currency appreciates, exports will decrease. Thus, in case of a depreciation, a positive sign is expected while in the case of an appreciation, a negative sign is expected. The results of the analysis reveal that the sign of the coefficient in each trade bloc are not consistent with economic theory and are all significant except for ECOWAS trade bloc. Hence, the study concludes that as exchange rate depreciates, exports in EAC CEMAC and SADC will instead decrease. While this scenario may seem unreal, this can be intuitively explained by the fact that the countries' export base tends to be weakly diversified and may suffer from poor quality produces. Hence, even in an event of a depreciation in the exchange rate, if the countries' exports ae not solicited by foreign demand, exports will be instead falling. Furthermore, plunging commodity prices experienced by most of the countries in past years may explain this negative relationship as majority of the countries' exports appear to be raw in nature.

In addition, it is observed that the effects of high inflation rates have no significant impact on exports in CEMAC and ECOWAS respective blocs. Nevertheless, a positive significant relationship is observed in both EAC and SADC regions. The theory suggests that as inflation increases, exports will instead decrease but this assumption does not seem to hold in these aforementioned trade blocs as the results show that as inflation rate increases by 1%, EAC exports will decrease by 0.01% while SADC exports decrease by 0.0002%. Lastly, the coefficient of money supply is expected to be negative as increase in money supply discourages exports. No significant effect was found in EAC and SADC regions but for the two remaining trade blocs (CEMAC and ECOWAS), a negative significant relationship was established as hypothesized by the theory. Hence, it is established that as money supply increases by a percentage, exports decrease by 0.85% in CEMAC and 0.50% in SADC.

Based on the results, one can really see the effects of the explanatory variables on the dependent variable are really different per trade bloc concerned.

The next section presents the results of the trade balance model for each separate trade bloc.

5.2.1.9.3 Comparison of Results for the Trade Balance Model

Table 5.59: Trade balance model of respective trade blocs

Trade Balance (EAC)						
Variables	LGDP	LUSGDP	LG7I	LNER	INFL	LM2
Coefficients	-4.327978	6.798367	-10.08331	-4.082725	-0.046873	-0.395838
Standard Error	0.978734	3.470070	4.295346	1.110786	0.017775	1.381779
T-statistics	-4.422016	1.959144	-2.347497	-3.675530	-2.637001	-0.286470
Probability	0.0000	0.0545	0.0220	0.0005	0.0105	0.7754
R-squared	**0.960790**					
Adjusted R-squared	**0.956501**					
Trade Balance (CEMAC)						
Variables	LGDP	LUSGDP	LG7I	LNER	INFL	LM2
Coefficients	46.21793	-147.2353	167.5484	-8.205242	-1.042178	-34.67924
Standard Error	5.518829	26.70292	66.72567	18.87572	0.400410	13.05247
T-statistics	8.374589	--5.513828	2.511003	-0.434698	-2.602776	-2.656910
Probability	0.0000	0.0000	0.0137	0.6648	0.0107	0.0092
R-squared	**0.836289**					
Adjusted R-squared	**0.817531**					
Trade Balance (ECOWAS)						
Variables	LGDP	LUSGDP	LG7I	LNER	INFL	LM2
Coefficients	8.061518	-17.05492	20.11367	11.31910	0.236495	-8.776820
Standard Error	3.025621	10.50229	20.16648	2.003449	0.065901	3.284611
T-statistics	2.664418	-1.623923	0.997381	5.649808	3.588648	-2.672104
Probability	0.0083	0.1059	0.3197	0.0000	0.0004	0.0081
R-squared	**0.960031**					
Adjusted R-squared	**0.955181**					
Trade Balance (SADC)						
Variables	LGDP	LUSGDP	LG7I	LNER	INFL	LM2
Coefficients	13.41055	-43.16326	32.82517	10.40128	0.010051	-35.57921
Standard Error	11.01419	34.47614	63.85370	4.194526	0.006325	8.241242
T-statistics	1.217570	-1.251975	0.514068	2.479726	1.589005	-4.317214
Probability	0.2247	0.2119	0.6077	0.0139	0.1135	0.0000
R-squared	**0.766399**					
Adjusted R-squared	**0.738242**					

The coefficient of determination R^2 for all trade blocs considered is high which indicates that the model is very well explained by the explanatory variables. This further explains that the variation in trade balance in all regions considered is explained by the corresponding independent variables. The sign of the coefficients of domestic income (represented by LGDP) and foreign income (represented by LUSGDP and LG7I) is ambiguous as anticipated by the theory. It is assumed that the sign of these respective coefficients can either be positive or negative. A significant positive relationship is observed except for CEMAC and ECOWAS while a negative relationship is observed in EAC while SADC display an insignificant relationship. Thus, the study concludes that domestic income increases trade balance will decrease by 4.32% while in the CEMAC and ECOWAS, trade balance will instead increase by 46.21% and 8.06% respectively. It is interesting to see mixed results as regarding the effects of foreign income on trade balance. Based on the significance of the coefficients, it is concluded that there is no significant relationship between foreign income and trade balance in EAC, ECOWAS and SADC trade blocs. Only the CEMAC trade bloc displays significant results as it suggest that as GDP in the US increases by a percentage, trade balance will instead decrease by 147.23% while when the production index of advanced economies increases, trade balance will also increase by 167.54%.

One of the core variables of this research which is LNER is expected to have a positive relationship with trade balance as stipulated by economic theory. Not all trade blocs carry the expected positive sign. While EAC and CEMAC display a negative relationship, ECOWAS and SADC indicate a positive relationship. Except for CEMAC, all coefficients are shown to be significant. Hence the conclusion that there is an insignificant relationship between exchange rate changes and trade balance in CEMAC trade bloc. As suggested by the Marshall-Lerner theory, a depreciation of domestic currency will lead to an increase in the trade balance in ECOWAS and SADC. Though agreeing with the literature, this result is rather unexpected. This is largely because it was previously indicated that an exchange rate depreciation will cause imports to increase in ECOWAS and SADC, while exports will be falling. Hence, stating that imports outpaced exports, causing a spontaneous expectation that exchange rate depreciation will cause trade balance to instead worsen. However, based on the statistical significance of the results, we conclude that exchange rate depreciation in both ECOWAS and SADC causes trade balance to improve. On the other hand, the significant negative relationship in EAC again confirms that besides the heavy reliance of the countries on imports, the non-diversified and non-competiveness of their export base will cause the trade balance to worsen even in an event of an exchange rate depreciation. Hence, the study concludes that the Marshall-Lerner theory does not hold in the case of EAC.

LM2 also bears the precise negative sign and is also statistically significant for all distinct regions except for EAC which display insignificant. Hence, the conclusion that there is an insignificant relationship between money supply and trade balance in EAC trade bloc. As LM2 increases by one percentage, LTB decreases by 34.67% in CEMAC, 8.77% in ECOWAS and 35.57% in SADC. This means that as more money is supplied to the economy, the purchasing power also increases; this will in turn boost the buying of foreign goods (imports) and depress exports. This scenario will cause a reduction in the trade balance.

5.3 Estimation Results: Comparative Analysis of the Impact of Exchange rate Volatility on Trade

Having compared the impact of exchange rate changes on trade, the next analysis will be to investigate the effect of exchange rate volatility on imports, exports and trade balance between the distinct trade blocs of SSA considered in this study. In this section, three measures of volatility are also employed to do the comparative analysis. Similarly to the previous section which main aim was to investigate if the impact of exchange rate changes differ per trade bloc, this section also has the main goal of examining if the impact of exchange rate volatility on trade differs per trade bloc under study. The panel unit root having been conducted previously displaying the presence of unit root among the variables; the cointegration analysis is therefore conducted. The results of the panel cointegration tests for all models are presented as follows and the values in parentheses indicate the probability values:

5.3.1 Panel Cointegration Testing for EAC Trade Bloc

It is important to highlight that even in this section two model specification of exchange rate volatility and trade are considered. To recall, the first model specification (henceforth Model 1) is estimating the equation taking into account nominal exchange rate and volatility together. However, the study acknowledges the fact that estimating this equation might lead to correlation issues considering that volatility measures are derived from the nominal exchange rate. Therefore to counterpart this issue, the study also considers estimating the second model (Model 2) of exchange rate volatility and trade considering only the measure of volatility (that is nominal exchange rate will be excluded as a variable). The main essence of doing that is to be able to distinguish if the coefficient of volatility is affected. Table 5.60 and 5.61 therefore presents the panel cointegration test for Model 1[26] and 2[27].

[26] Modelling exchange rate volatility and trade including both nominal exchange rate and volatility as variables

[27] Modelling exchange rate volatility and trade excluding nominal exchange rate as a variable

	STANDARD DEVIATION MEASURE				GARCH MEASURE				HP FILTER MEASURE			
	Models	Imports	Exports	Trade Balance	Models	Imports	Exports	Trade Balance	Models	Imports	Exports	Trade Balance
INTERCEPT ONLY	PEDRONI TEST				PEDRONI TEST				PEDRONI TEST			
	Panel v-Statistic	-0.589453 (0.7222)	-0.977764 (0.8359)		Panel v-Statistic	-0.530854 (0.7022)	-0.714924 (0.7627)		Panel v-Statistic	-0.584710 (0.7206)	-0.046347 (0.5185)	
	Panel rho-Statistic	0.695617 (0.7567)	1.813925 (0.9652)		Panel rho-Statistic	0.575522 (0.7175)	1.724501 (0.9577)		Panel rho-Statistic	0.417844 (0.6620)	0.481758 (0.6850)	
	Panel PP-Statistic	-2.151618 (0.0157)	-1.051387 (0.1465)		Panel PP-Statistic	-1.952907 (0.0254)	-0.576945 (0.2820)		Panel PP-Statistic	-2.757375 (0.0029)	-3.310915 (0.0005)	
	Panel ADF-Statistics	-2.371252 (0.0089)	1.070349 (0.8578)		Panel ADF-Statistics	0.787540 (0.7845)	1.519006 (0.9356)		Panel ADF-Statistics	0.398945 (0.6550)	2.068516 (0.9807)	
	Group rho-Statistic	2.222935 (0.9869)	2.614454 (0.9955)		Group rho-Statistic	2.480551 (0.9934)	2.566289 (0.9949)		Group rho-Statistic	2.427984 (0.9924)	1.751587 (0.9601)	
	Group PP-Statistic	-7.889374 (0.0000)	-2.225583 (0.0130)		Group PP-Statistic	-1.168669 (0.1213)	-0.196069 (0.4223)		Group PP-Statistic	-0.781501 (0.2173)	-2.122356 (0.0169)	
	Group ADF-Statistics	-4.092240 (0.0000)	0.898423 (0.8155)		Group ADF-Statistics	-1.928012 (0.0269)	1.543555 (0.9397)		Group ADF-Statistics	-0.858302 (0.1954)	2.162884 (0.9847)	
INTERCEPT+TREND	Panel v-Statistic	-1.226579 (0.8900)	-0.976676 (0.8356)		Panel v-Statistic	-1.121226 (0.8689)	0.357043 (0.3605)		Panel v-Statistic	-1.394670 (0.9184)	1.172934 (0.1204)	
	Panel rho-Statistic	1.666797 (0.9522)	2.719079 (0.9967)		Panel rho-Statistic	1.613364 (0.9467)	2.655820 (0.9960)		Panel rho-Statistic	1.321022 (0.9068)	1.479281 (0.9305)	
	Panel PP-Statistic	-1.561503 (0.0592)	-2.224296 (0.0131)		Panel PP-Statistic	-1.264588 (0.1030)	-1.859564 (0.0315)		Panel PP-Statistic	-2.392542 (0.0084)	-10.30357 (0.0000)	
	Panel ADF-Statistics	-1.881169 (0.0300)	0.157221 (0.5625)		Panel ADF-Statistics	0.511223 (0.6954)	-0.017609 (0.4930)		Panel ADF-Statistics	0.510674 (0.6952)	-0.835472 (0.2017)	
	Group rho-Statistic	2.956338 (0.9984)	3.674232 (0.9999)		Group rho-Statistic	3.323496 (0.9996)	3.695377 (0.9999)		Group rho-Statistic	3.150185 (0.9992)	2.787573 (0.9973)	
	Group PP-Statistic	-9.786246 (0.0000)	-4.997284 (0.0000)		Group PP-Statistic	-2.210822 (0.0135)	-4.925504 (0.0000)		Group PP-Statistic	-3.788890 (0.0001)	-8.225586 (0.0000)	
	Group ADF-Statistics	-5.083342 (0.0000)	-1.728893 (0.0419)		Group ADF-Statistics	-2.417526 (0.0078)	-2.099288 (0.0179)		Group ADF-Statistics	-1.185208 (0.1180)	-2.430614 (0.0075)	
	KAO TEST				KAO TEST				KAO TEST			
	Kao ADF stats	-4.246326 (0.0000)	-2.672406 (0.0038)	-2.635236 (0.0042)	Kao ADF stats	-3.471525 (0.0003)	-2.662984 (0.0039)	-2.548975 (0.0045)	Kao ADF stats	-3.773984 (0.0001)	-2.397735 (0.0082)	-2.839764 (0.0023)

Table 5.60: Panel cointegration test results of Imports, Exports and Trade Balance (EAC)-Model 1

	STANDARD DEVIATION MEASURE				GARCH MEASURE				HP FILTER MEASURE			
	Models	Imports	Exports	Trade Balance	Models	Imports	Exports	Trade Balance	Models	Imports	Exports	Trade Balance
INTERCEPT ONLY	**PEDRONI TEST**				**PEDRONI TEST**				**PEDRONI TEST**			
	Panel v-Statistic	-0.530734 (0.7022)	-0.770048 (0.7794)	-0.471336 (0.6813)	Panel v-Statistic	-0.028305 (0.5113)	-0.881744 (0.8110)	-0.208932 (0.5827)	Panel v-Statistic	-0.511355 (0.6954)	0.640324 (0.2610)	-0.570998 (0.7160)
	Panel rho-Statistic	-0.056493 (0.4775)	1.268572 (0.8977)	1.451433 (0.9267)	Panel rho-Statistic	-0.415639 (0.3388)	1.206335 (0.8862)	1.546057 (0.9390)	Panel rho-Statistic	0.280202 (0.6103)	-0.099321 (0.4604)	1.530011 (0.9370)
	Panel PP-Statistic	-2.484475 (0.0065)	-0.299774 (0.3822)	-2.990205 (0.0014)	Panel PP-Statistic	-2.898693 (0.0019)	-0.075256 (0.4700)	-2.072140 (0.0191)	Panel PP-Statistic	-1.705716 (0.0440)	-4.307260 (0.0005)	-2.209991 (0.0136)
	Panel ADF-Statistics	0.003657 (0.5015)	2.482664 (0.9935)	-0.050671 (0.4798)	Panel ADF-Statistics	0.456262 (0.6759)	1.896806 (0.9711)	-0.175489 (0.4303)	Panel ADF-Statistics	0.254855 (0.6006)	2.060083 (0.9803)	-1.165677 (0.1219)
	Group rho-Statistic	1.834821 (0.9667)	2.053406 (0.9800)	2.684471 (0.9964)	Group rho-Statistic	1.658368 (0.9514)	1.929437 (0.9732)	2.718623 (0.9967)	Group rho-Statistic	2.211799 (0.9865)	1.682981 (0.9538)	2.514463 (0.9940)
	Group PP-Statistic	-3.107533 (0.0009)	-0.194851 (0.4228)	-2.705826 (0.0034)	Group PP-Statistic	-1.711207 (0.0435)	-0.082044 (0.4673)	-2.031715 (0.0211)	Group PP-Statistic	-0.917148 (0.1795)	-1.216333 (0.1119)	-9.932386 (0.0000)
	Group ADF-Statistics	-2.392852 (0.0087)	2.291926 (0.9890)	0.354126 (0.6384)	Group ADF-Statistics	-1.928012 (0.0359)	1.875616 (0.9696)	-0.375237 (0.3537)	Group ADF-Statistics	-1.809654 (0.0352)	1.961263 (0.9751)	-3.852737 (0.0001)
INTERCEPT+TREND	Panel v-Statistic	-0.937600 (0.8528)	-1.576359 (0.9425)	-0.516403 (0.6972)	Panel v-Statistic	-0.988618 (0.8386)	-1.421877 (0.9225)	-0.563332 (0.7134)	Panel v-Statistic	-1.284646 (0.9005)	0.574379 (0.2829)	-0.638207 (0.7383)
	Panel rho-Statistic	0.830907 (0.7970)	1.986282 (0.9765)	1.808150 (0.9647)	Panel rho-Statistic	0.669099 (0.7483)	1.727040 (0.9579)	2.497608 (0.9934)	Panel rho-Statistic	0.585029 (0.7207)	0.742588 (0.7711)	2.017169 (0.9782)
	Panel PP-Statistic	-2.146391 (0.0159)	0.410294 (0.6592)	-9.409862 (0.0000)	Panel PP-Statistic	-2.089796 (0.0183)	-0.082044 (0.4673)	-3.046066 (0.0012)	Panel PP-Statistic	-3.049551 (0.0011)	-6.798564 (0.0000)	-7.910884 (0.0000)
	Panel ADF-Statistics	1.143009 (0.8735)	3.357387 (0.9996)	-2.260613 (0.0119)	Panel ADF-Statistics	0.894490 (0.8145)	2.449499 (0.9928)	-2.682490 (0.0037)	Panel ADF-Statistics	0.249999 (0.5987)	0.558839 (0.7119)	-3.557656 (0.0002)
	Group rho-Statistic	2.199669 (0.9861)	3.023770 (0.9988)	2.883876 (0.9980)	Group rho-Statistic	2.369955 (0.9911)	2.642427 (0.9959)	3.485529 (0.9998)	Group rho-Statistic	2.677897 (0.9963)	2.742785 (0.9970)	3.090845 (0.9990)
	Group PP-Statistic	-7.382603 (0.0000)	-1.563670 (0.0589)	-13.04794 (0.0000)	Group PP-Statistic	-0.871232 (0.1918)	-2.330891 (0.0099)	-5.135036 (0.0000)	Group PP-Statistic	-1.631228 (0.0514)	-4.318847 (0.0000)	-12.35345 (0.0000)
	Group ADF-Statistics	-1.791199 (0.0366)	1.101935 (0.8648)	-3.039668 (0.0012)	Group ADF-Statistics	-0.852056 (0.1971)	0.035010 (0.5140)	-3.897122 (0.0000)	Group ADF-Statistics	-1.482133 (0.0692)	-1.853484 (0.0319)	-5.077781 (0.0000)
	KAO TEST				**KAO TEST**				**KAO TEST**			
	Kao ADF stats	-3.143483 (0.0008)	-2.380138 (0.0087)	-2.351744 (0.0093)	Kao ADF stats	-2.659711 (0.0039)	-2.053665 (0.0200)	-2.508037 (0.0061)	Kao ADF stats	-2.909667 (0.0018)	-1.972973 (0.0242)	-2.585004 (0.0049)

Table 5.61: Panel cointegration test results of Imports, Exports and Trade Balance (EAC)-Model 2

Considering both model specification (Model 1 and 2), the results of the panel cointegration test for all models of imports, exports and trade balance taking into consideration all distinct measures of volatility are presented in the previous tables. For Model 1, the results of the cointegration test for the imports model sustain the existence of cointegration with standard deviation as the volatility measure. Specifically, the majority of the results for the Pedroni test under both benchmarks of intercept and intercept and trend justify that there is cointegration among the variables. With a probability value of 0.0000, the Kao cointegration test also sustains the existence of cointegration among the variables. However, the results of the Pedroni test for the imports model with the GARCH and HP-Filter as volatility measures do not justify the existence of cointegration as majority of the results accepts the null hypothesis of no cointegration. On the other hand, the Kao cointegration results reject the null hypothesis of no cointegration with a probability-value of 0.0003 and 0.0001 respectively. Because of the conflicting results displayed by the results of the model of GARCH and HP-Filter measures, the study assumes that, because at least one of the cointegration test supports the evidence of cointegration, it is therefore concluded that the variables are cointegrated. For all three distinct measures of volatility, the results of the Pedroni cointegration test for the exports model concludes that no cointegration exist between the variables as it is observed that majority of the results accepts the null hypothesis of no cointegration. The Kao cointegration test on the other hand justifies that there is indeed cointegration despite the measure of volatility used in the estimation. In lieu of this, because of the evidence of cointegration found in at least one of the cointegration tests used in this study, this study concludes that for the exports model, there is evidence of a stable long run relationship. It should be noted that the econometric software used in this study (EVIEWS8) could not compute the Pedroni test for the trade balance model in spite of the volatility measure used in estimating the models. However, the Kao test could be computed. In this regard, this study solely relies on the results of the Kao cointegration test to determine whether cointegration exist in the trade balance model. For all the measures of volatility, the Kao test results justify that cointegration exists with the probability values of 0.0042, 0.0045 and 0.0023 respectively. Hence, it is concluded that for the trade balance model, the variables are cointegrated. For Model 2, the results of the pedroni test for all measures of volatility indicate that the variables are not cointegrated at 5% significance level considering the imports model. This is justified as it is observed that the majority of results accept the null hypothesis of no cointegration. However, the Kao cointegration test rejects the null hypothesis of no cointegration at 5% significance. Because of the conflicting results, the study therefore assumes that based on the evidence of cointegration in at least on the cointegration test, the study concludes the variables are cointegration. The exports model also displays similar results like that of the imports model. While the Pedroni test rejects the evidence of cointegration among the variables, the Kao cointegration test justified the evidence of cointegration with a significant probability value. Hence, assuming that at least one of the tests accepts the presence of cointegration, the study therefore concludes that exports and its corresponding variables move together in the long run. The trade balance model reveals mixed per volatility measure use. The Pedroni test accepts of the null hypothesis of no cointegration with the model estimated with standard deviation volatility. It is also observed that the model with GARCH and HP-Filter volatility measures accepts the null hypothesis of no cointegration with the model of intercept only. On the other hand, the model with intercept and trend rejects the null hypothesis of cointegration. Considering all measures of volatility, the results also revealed that the Kao cointegration test rejects the null hypothesis of no cointegration. Based on the consistency of the results presented by the Kao cointegration test, the study concludes that there is evidence of cointegration in the trade balance model.

The evidence of a long run stable relationship was found to exist among the variables for all models. Hence, the next step of the analysis will be the estimation of the long run relationship using the DOLS and the results of the estimates are therefore presented as follows. Table 5.62 and 5.63 indicates the DOLS estimates for Model 1 ad 2.

	STANDARD DEVIATION VOLATILITY MEASURE					GARCH VOLATILITY MEASURE					HP-FILTER VOLATILITY MEASURE				
	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob
IMPORTS MODEL	LGDP	1.227403	0.071818	17.09038	0.0000	LGDP	1.203826	0.066458	18.11409	0.0000	LGDP	1.164346	0.083148	14.00329	0.0000
	LNER	0.581419	0.105947	5.487841	0.0000	LNER	0.626562	0.112381	5.575345	0.0000	LNER	0.511840	0.166713	3.070194	0.0031
	INFL	0.009883	0.002922	3.381919	0.0012	INFL	0.006809	0.002459	2.769418	0.0073	INFL	0.005897	0.002581	2.284737	0.0257
	LM2	-0.166039	0.194729	-0.852666	0.3970	LM2	0.213207	0.187727	1.135727	0.2603	LM2	0.098446	0.240197	0.409854	0.6833
	VOL	0.685345	0.548358	1.249813	0.2159	VOL	-4.43E-08	3.11E-08	-1.424912	0.1590	VOL	-0.000168	0.000110	-1.532375	0.1304
	R-squared	0.995075				**R-squared**	0.995280				**R-squared**	0.995294			
	Adjusted R-squared	0.994536				**Adjusted R-squared**	0.994764				**Adjusted R-squared**	0.994790			
EXPORTS MODEL	LUSGDP	3.316738	0.351009	9.449144	0.0000	LUSGDP	3.371622	0.384588	8.766829	0.0000	LUSGDP	3.190883	0.277999	11.47804	0.0000
	LG7I	-3.087442	0.778512	-3.965824	0.0002	LG7I	-3.307426	0.824099	-4.013386	0.0002	LG7I	-3.061489	0.437136	-7.003518	0.0000
	LNER	-0.546351	0.216561	-2.522849	0.0141	LNER	-0.449877	0.287033	-1.567337	0.1220	LNER	-0.078737	0.190731	-0.412818	0.6811
	INFL	0.010991	0.004081	2.693024	0.0090	INFL	0.011973	0.004686	2.555199	0.0130	INFL	0.011502	0.002313	4.971988	0.0000
	LM2	0.090545	0.326132	0.277632	0.7822	LM2	-0.070953	0.373181	-0.190130	0.8498	LM2	-0.064192	0.235716	-0.272328	0.7862
	VOL	-0.641878	0.817727	-0.784953	0.4354	VOL	-3.49E-09	5.56E-08	-0.062874	0.9501	VOL	-0.000523	0.000106	-4.950858	0.0000
	R-squared	0.994195				**R-squared**	0.993709				**R-squared**	0.997073			
	Adjusted R-squared	0.993560				**Adjusted R-squared**	0.993021				**Adjusted R-squared**	0.996753			
TRADE BALANCE MODEL	LGDP	-4.334658	0.837237	-5.177340	0.0000	LGDP	-4.574594	0.995686	-4.594414	0.0000	LGDP	-4.816624	1.474758	-3.266044	0.0018
	LUSGDP	5.967396	3.026547	1.971685	0.0530	LUSGDP	8.658383	3.486973	2.483066	0.0157	LUSGDP	7.091939	5.771977	1.228685	0.2237
	LG7I	-9.001816	3.674575	-2.449757	0.0170	LG7I	-12.33860	4.202008	-2.936357	0.0046	LG7I	-11.27827	5.283703	-2.134539	0.0366
	LNER	-4.551712	0.988973	-4.602462	0.0000	LNER	-4.834624	1.341153	-3.604827	0.0006	LNER	-3.778031	1.905738	-1.982451	0.0517
	INFL	-0.066188	0.016456	-4.022174	0.0002	INFL	-0.043860	0.018414	-2.381823	0.0202	INFL	-0.045965	0.018725	-2.454683	0.0168
	LM2	0.987811	1.239752	0.796781	0.4285	LM2	-1.668167	1.501977	-1.110647	0.2709	LM2	1.064795	1.912697	0.556698	0.5797
	VOL	-9.819317	3.022630	-3.248600	0.0018	VOL	1.34E-07	2.11E-07	0.635785	0.5272	VOL	-0.000421	0.000884	-0.475964	0.6357
	R-squared	0.971725				**R-squared**	0.968080				**R-squared**	0.962668			
	Adjusted R-squared	0.968632				**Adjusted R-squared**	0.964589				**Adjusted R-squared**	0.958585			

Table 5.62: DOLS estimates of Imports, Exports and Trade Balance models (EAC)-Model 1

	STANDARD DEVIATION VOLATILITY MEASURE					GARCH VOLATILITY MEASURE					HP-FILTER VOLATILITY MEASURE				
	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob
IMPORTS MODEL	LGDP	1.302038	0.074015	17.59163	0.0000	LGDP	1.266815	0.070569	17.95155	0.0000	LGDP	1.266095	0.096804	13.07890	0.0000
	INFL	-0.006050	0.002241	-2.700013	0.0089	INFL	-0.004371	0.002188	-1.998073	0.0500	INFL	-0.005831	0.002138	-2.728073	0.0082
	LM2	0.630032	0.176810	3.563331	0.0007	LM2	0.516707	0.228552	2.260789	0.0272	LM2	0.794160	0.223489	3.553461	0.0007
	VOL	0.114097	0.648841	0.175848	0.8610	VOL	3.78E-08	3.60E-08	1.050428	0.2975	VOL	-6.10E-05	0.000123	-0.495401	0.6220
	R-squared	0.990798				**R-squared**	0.992052				**R-squared**	0.991061			
	Adjusted R-squared	0.989791				**Adjusted R-squared**	0.991183				**Adjusted R-squared**	0.990083			
EXPORTS MODEL	LUSGDP	2.732465	0.316716	8.627497	0.0000	LUSGDP	2.861934	0.302865	9.449526	0.0000	LUSGDP	2.756105	0.190545	14.46432	0.0000
	LG7I	-2.435116	0.793261	-3.069755	0.0031	LG7I	-2.593977	0.763153	-3.399027	0.0002	LG7I	-3.260711	0.509942	-6.394275	0.0000
	INFL	0.017983	0.002877	6.250292	0.0000	INFL	0.017557	0.002759	6.364422	0.0000	INFL	0.010140	0.001895	5.352427	0.0000
	LM2	0.034982	0.319073	0.109637	0.9130	LM2	0.132696	0.345742	0.383801	0.7024	LM2	0.211180	0.195211	1.081804	0.2834
	VOL	0.067735	0.807399	0.083893	0.9334	VOL	-3.74E-08	4.31E-08	-0.868055	0.3886	VOL	-0.000695	9.03E-05	-7.700058	0.0000
	R-squared	0.992841				**R-squared**	0.992847				**R-squared**	0.996258			
	Adjusted R-squared	0.992058				**Adjusted R-squared**	0.992065				**Adjusted R-squared**	0.995849			
TRADE BALANCE MODEL	LGDP	-2.336989	0.813069	-2.874281	0.0055	LGDP	-2.334974	0.926717	-2.519619	0.0143	LGDP	-3.102534	1.190490	-2.606098	0.0114
	LUSGDP	-3.669076	2.318726	-1.582367	0.1185	LUSGDP	-1.922926	2.698888	-0.712488	0.4788	LUSGDP	-2.386868	3.387231	-0.704666	0.4836
	LG7I	-0.133126	3.756920	-0.035435	0.9718	LG7I	-2.758132	4.284149	-0.643799	0.5220	LG7I	-2.267660	4.966040	-0.456633	0.6495
	INFL	-0.002284	0.015142	-0.150829	0.8806	INFL	-0.002988	0.017523	-0.170515	0.8651	INFL	-0.003575	0.019253	-0.185670	0.8533
	LM2	0.213555	1.381012	0.154637	0.8776	LM2	-0.350305	1.683111	-0.208130	0.8358	LM2	0.117130	1.926769	0.060791	0.9517
	VOL	-10.97470	3.250234	-3.376588	0.0013	VOL	-2.46E-07	2.09E-07	-1.176210	0.2439	VOL	-0.001027	0.000830	-1.236669	0.2207
	R-squared	0.950783				**R-squared**	0.954388				**R-squared**	0.942923			
	Adjusted R-squared	0.945399				**Adjusted R-squared**	0.949399				**Adjusted R-squared**	0.936680			

Table 5.63: DOLS estimates of Imports, Exports and Trade Balance models (EAC)-Model 2

For each of the volatility measures considered in this study, the DOLS of the imports, exports and trade balance models were estimated for model 1 and 2. The study therefore proceeds with the interpretation of the results beginning with the imports model. For both models 1 and 2, it is observed that for the EAC trade bloc, the coefficient of determination is very high which signifies that imports are very well explained by the explanatory variables considered in this study. In this section, a detailed explanation of all the coefficients will not be provided as one of the main purposes of this section is to be able to depict if per trade bloc considered in this study, there is indeed some differences associated in utilizing the different measures of volatility. Thus, the impact of exchange rate volatility on imports, exports and trade balance is the main focus in this section in addition to depicting whether the results of the estimation are affected by the type of volatility measure used.

The results of the imports model show that for EAC trade bloc, there is no significant effects of exchange rate volatility on imports considering both model specifications. In other words, as the volatility of exchange rate increases in EAC trade bloc, their respective imports are not significantly affected. This insignificant effect is particularly revealed by the non-significance of the test-statistics as the absolute value for all measures is less than two. Despite the insignificance of the volatility measure on imports, the results clearly differ as per volatility measure used in the estimation of the respective models. While some measures display a positive relationship, other measures display a negative relationship, which permit the researcher to conclude that the results of the models really differ as per measure of volatility used. These mixed signs in regards to the coefficient of exchange rate volatility are in accordance with previous studies which were unable to identify the clear effects of exchange rate volatility on trade.

In both model 1 and 2, the high coefficient of determination R^2 indicates that the exports model is well explained by the respective explanatory variables in EAC trade bloc. As it was previously explained, the main variable of interest in this section is the exchange rate volatility measure impact on exports. For both model specifications, the results indicate that while the model specified with standard deviation indicate a positive relationship, the model with GARCH and HP-Filter measures display a negative relationship with exports. However, not all of these measures have significant coefficients. While the standard deviation and GARCH volatility measures display insignificant coefficients, the HP-Filter volatility measure display significant coefficient with the evidence of a significant test statistic. Regarding this, it is concluded that as exchange rate uncertainty/volatility (HP-Filter calculation) rises by a percentage, exports decrease by 0.0005% in model 1 and 0.0006% in model 2. This scenario was hypothesized by Hooper and Kohlagen (1978) who sustains the evidence of a negative relationship between exchange rate uncertainty and international trade. It is observed that the disparity in the effects of exchange rate volatility on exports is not much which means that the results were not much altered by the model specification. However, based on the mixed signs of the coefficients of exchange rate volatility, the study concludes that the outcome of the results is dependent upon the measure of volatility use. The trade balance model also shows non-consistent results like that of the exports models. With the high coefficient of determination, it is also concluded that the trade balance is well explained by the explanatory variables. For both model 1 and 2, the results show that the volatility measured by GARCH and HP-Filter approaches display non-significant coefficients. Only the volatility measured by the standard deviation approach displays a significant coefficient for both model specifications. In this regard, it is therefore concluded that as exchange rate volatility increases, trade balance decreases by 9.81% in model 1 and 10.97% in model 2. Likewise other models, following the differences in the magnitude of the coefficients, it is concluded that the results are indeed determined by the type of the volatility measure used in the estimation of the models.

In summary, the study concludes that, while imports are not affected by exchange rate volatility in EAC trade bloc, exports and their respective trade balance are negatively affected when exchange rate volatility increases.

The impact of exchange rate volatility on imports, exports and trade balance was discussed for the EAC trade bloc. In addition, it was assessed whether the results of the analysis differ for each of the volatility measure used. Considering that this section deals with the comparative analysis, the next section deals with investigating the same effects in the CEMAC trade bloc.

5.3.2 Panel Cointegration Testing for CEMAC Trade Bloc

It is noted that the unit root test results were already conducted previously and the results confirmed that based on majority, the variables are I (1), hence non-stationary. In lieu of this, the next step of the analysis is to investigate whether cointegration exist among the variables. In achieving this, this study employs both the Pedroni and the Kao cointegration test to test the existence of cointegration among the variables. The results of the Pedroni and Kao cointegration tests are therefore as follows:

	STANDARD DEVIATION MEASURE				GARCH MEASURE				HP FILTER MEASURE			
	Models	Imports	Exports	Trade	Models	Imports	Exports	Trade	Models	imports	Exports	Trade
INTERCEPT ONLY	PEDRONI TEST				PEDRONI TEST				PEDRONI TEST			
	Panel v-Statistic	-0.784022 (0.7835)	-0.620755 (0.7326)		Panel v-Statistic	-1.299033 (0.9030)	-0.552043 (0.7095)		Panel v-Statistic	-1.472482 (0.9296)	-1.218057 (0.8884)	
	Panel rho-Statistic	1.706785 (0.9561)	2.810577 (0.9975)		Panel rho-Statistic	0.543044 (0.7065)	2.783343 (0.9973)		Panel rho-Statistic	1.106900 (0.8658)	2.153884 (0.9844)	
	Panel PP-Statistic	-2.487153 (0.0064)	0.583379 (0.7202)		Panel PP-Statistic	-5.153177 (0.0000)	0.013875 (0.5055)		Panel PP-Statistic	-4.703915 (0.0000)	-2.471847 (0.0067)	
	Panel ADF-Statistics	0.062672 (0.5250)	-0.545041 (0.2929)		Panel ADF-Statistics	-0.789446 (0.2149)	-0.960587 (0.1684)		Panel ADF-Statistics	-1.137251 (0.1277)	-0.834335 (0.2020)	
	Group rho-Statistic	2.996995 (0.9986)	3.799662 (0.9999)		Group rho-Statistic	2.501086 (0.9938)	3.762518 (0.9999)		Group rho-Statistic	2.789271 (0.9974)	3.379388 (0.9996)	
	Group PP-Statistic	-4.774676 (0.0000)	-1.014651 (0.1551)		Group PP-Statistic	-8.675861 (0.0000)	-0.332125 (0.3699)		Group PP-Statistic	-8.280703 (0.0000)	-6.275393 (0.0000)	
	Group ADF-Statistics	-0.126082 (0.4498)	-0.014598 (0.4942)		Group ADF-Statistics	-1.919397 (0.0275)	-0.224735 (0.4111)		Group ADF-Statistics	-1.924509 (0.0271)	-1.167047 (0.1216)	
INTERCEPT+TREND	Panel v-Statistic	-1.872496 (0.9694)	-1.125678 (0.8698)		Panel v-Statistic	-2.368007 (0.9911)	-0.883704 (0.8116)		Panel v-Statistic	-2.526507 (0.9942)	-1.941008 (0.9739)	
	Panel rho-Statistic	2.518616 (0.9941)	3.840656 (0.9999)		Panel rho-Statistic	1.538813 (0.9381)	3.615958 (0.9999)		Panel rho-Statistic	2.008830 (0.9977)	3.053858 (0.9989)	
	Panel PP-Statistic	-2.402286 (0.0081)	-0.502579 (0.3076)		Panel PP-Statistic	-5.584712 (0.0000)	-0.891805 (0.1862)		Panel PP-Statistic	-4.317255 (0.0000)	-4.411761 (0.0000)	
	Panel ADF-Statistics	0.536747 (0.7043)	-1.924176 (0.0272)		Panel ADF-Statistics	-0.487339 (0.3130)	-0.818215 (0.2066)		Panel ADF-Statistics	-0.643635 (0.2599)	-1.277160 (0.1008)	
	Group rho-Statistic	3.596072 (0.9998)	4.531355 (1.0000)		Group rho-Statistic	3.369633 (0.9996)	4.430915 (1.0000)		Group rho-Statistic	3.473109 (0.9997)	4.037698 (1.0000)	
	Group PP-Statistic	-6.007551 (0.0000)	-2.156175 (0.0155)		Group PP-Statistic	-8.348302 (0.0000)	-1.240684 (0.1074)		Group PP-Statistic	-9.477242 (0.0000)	-10.55748 (0.0000)	
	Group ADF-Statistics	-0.226070 (0.4106)	-1.292875 (0.0980)		Group ADF-Statistics	-1.855099 (0.0318)	-0.472317 (0.3184)		Group ADF-Statistics	-1.592557 (0.0556)	-1.742348 (0.0407)	
	KAO TEST				KAO TEST				KAO TEST			
	Kao ADF stats	-1.912962 (0.0279)	-1.826865 (0.0339)	-0.110005 (0.0562)	Kao ADF stats	-1.119701 (0.0314)	-1.529273 (0.0631)	-2.665861 (0.0038)	Kao ADF stats	-1.660411 (0.0484)	-1.417491 (0.0782)	-1.375359 (0.0845)

Table 5.64: Panel cointegration test results of Imports, Exports and Trade Balance (CEMAC)-Model 1

	STANDARD DEVIATION MEASURE				GARCH MEASURE				HP FILTER MEASURE			
	Models	Imports	Exports	Trade	Models	Imports	Exports	Trade	Models	Imports	Exports	Trade
INTERCEPT ONLY	**PEDRONI TEST**				**PEDRONI TEST**				**PEDRONI TEST**			
	Panel v-Statistic	-1.003957 (0.8423)	-1.342022 (0.9102)	-2.298324 (0.9892)	Panel v-Statistic	-0.719497 (0.7641)	0.084747 (0.4662)	-2.105396 (0.9824)	Panel v-Statistic	-1.018564 (0.8458)	-0.575814 (0.7176)	-2.251719 (0.9878)
	Panel rho-Statistic	1.277508 (0.8993)	2.735363 (0.9969)	2.056237 (0.9801)	Panel rho-Statistic	-0.380447 (0.3518)	1.629890 (0.9484)	2.052336 (0.9799)	Panel rho-Statistic	1.224676 (0.8897)	2.058683 (0.9802)	2.179965 (0.9854)
	Panel PP-Statistic	-1.138752 (0.1274)	1.540547 (0.9383)	-4.306685 (0.0000)	Panel PP-Statistic	-6.105849 (0.0000)	-2.110463 (0.0174)	-6.953223 (0.0000)	Panel PP-Statistic	-1.710340 (0.0436)	0.386582 (0.6505)	-5.422235 (0.0000)
	Panel ADF-Statistics	0.369376 (0.6441)	0.709236 (0.7609)	-2.575307 (0.0050)	Panel ADF-Statistics	-1.629676 (0.0516)	-0.810887 (0.2087)	-4.202291 (0.0000)	Panel ADF-Statistics	0.003993 (0.5016)	0.066462 (0.5265)	-3.242915 (0.0006)
	Group rho-Statistic	2.374702 (0.9912)	3.569132 (0.9998)	2.963574 (0.9985)	Group rho-Statistic	1.731153 (0.9583)	3.045664 (0.9988)	2.825037 (0.9976)	Group rho-Statistic	2.578080 (0.9950)	3.353259 (0.9996)	2.740501 (0.9969)
	Group PP-Statistic	-2.181563 (0.0146)	1.401555 (0.9195)	-5.821010 (0.0000)	Group PP-Statistic	-9.083764 (0.0000)	-2.287741 (0.0111)	-7.724295 (0.0000)	Group PP-Statistic	-2.988378 (0.0014)	0.444330 (0.6716)	-9.351451 (0.0000)
	Group ADF-Statistics	-0.003807 (0.4985)	-0.809011 (0.2093)	-1.542983 (0.0614)	Group ADF-Statistics	-2.656823 (0.0039)	-1.538085 (0.0620)	-2.775304 (0.0028)	Group ADF-Statistics	-0.236309 (0.4066)	-0.278423 (0.3903)	-2.180543 (0.0146)
INTERCEPT+TREND	Panel v-Statistic	-1.750630 (0.9600)	-2.401416 (0.9918)	-3.292718 (0.9995)	Panel v-Statistic	-2.026363 (0.9736)	-0.808602 (0.7906)	-3.075544 (0.9989)	Panel v-Statistic	-2.047805 (0.9797)	-0.983387 (0.8373)	-3.153549 (0.9992)
	Panel rho-Statistic	1.786757 (0.9630)	3.522520 (0.9998)	2.626666 (0.9957)	Panel rho-Statistic	0.415259 (0.6610)	2.214974 (0.9866)	2.605422 (0.9954)	Panel rho-Statistic	1.675796 (0.9531)	2.981327 (0.9986)	2.948624 (0.9984)
	Panel PP-Statistic	-1.653790 (0.0491)	2.464379 (0.9931)	-4.875396 (0.0000)	Panel PP-Statistic	-6.230231 (0.0000)	-1.739411 (0.0410)	-9.466408 (0.0000)	Panel PP-Statistic	-1.939093 (0.0262)	-0.149001 (0.4408)	-6.340853 (0.0000)
	Panel ADF-Statistics	0.594267 (0.7238)	1.939270 (0.9738)	-2.840795 (0.0023)	Panel ADF-Statistics	-1.062188 (0.1982)	0.865999 (0.8068)	-5.403132 (0.0000)	Panel ADF-Statistics	0.266439 (0.6050)	-0.823697 (0.2051)	-4.030601 (0.0000)
	Group rho-Statistic	2.788238 (0.9974)	3.949413 (1.0000)	3.401548 (0.9997)	Group rho-Statistic	2.364656 (0.9910)	3.153601 (0.9992)	3.215120 (0.9993)	Group rho-Statistic	2.921721 (0.9983)	3.988912 (1.0000)	3.124410 (0.9991)
	Group PP-Statistic	-3.307954 (0.0005)	2.140103 (0.9838)	-7.970694 (0.0000)	Group PP-Statistic	-8.727589 (0.0000)	-1.971434 (0.0243)	-11.06056 (0.0000)	Group PP-Statistic	-5.019463 (0.0000)	0.802702 (0.7889)	-11.44692 (0.0000)
	Group ADF-Statistics	-0.219915 (0.4130)	1.046701 (0.8524)	-1.746651 (0.0403)	Group ADF-Statistics	-2.153453 (0.0156)	0.581404 (0.7195)	-3.120410 (0.0009)	Group ADF-Statistics	-0.871564 (0.1917)	-0.785617 (0.2160)	-2.530491 (0.0057)
	KAO TEST				**KAO TEST**				**KAO TEST**			
	Kao ADF stats	-1.613634 (0.0533)	-2.221790 (0.0131)	-0.160966 (0.0689)	Kao ADF stats	-1.216312 (0.0359)	-1.547133 (0.0609)	-2.630486 (0.0043)	Kao ADF stats	-1.234157 (0.0569)	-1.781026 (0.0375)	-1.411685 (0.0790)

Table 5.65: Panel cointegration test results of Imports, Exports and Trade Balance (CEMAC)-Model 2

The previous tables present the results of the panel cointegration test for all models taking into account all distinct measures of volatility. The Pedroni and the Kao cointegration tests were conducted in this regard. The study starts with the interpretation of the imports model. In model 1 and 2, for all volatility measures, the outcome of the analysis accepts the null hypothesis of no cointegration at 5% significance level for the Pedroni test. Explicitly, in model 1, under the Pedroni test, only two out of the seven test results rejects the null hypothesis and hence based on majority of the results, the study concludes that for the pedroni test, there is no evidence of cointegration among the variables. However, the Kao test result opposes this conclusion. The results of the Kao test for the import model with all measures of volatility reject the null hypothesis of no cointegration at 10% significance level in model 1 and 2. In this regard, it is concluded that there is evidence of cointegration based on the Kao cointegration test. The results reveal that the two cointegration tests display conflicting results on the evidence of cointegration. In regards to this, this study concludes that based on the fact the Kao test supports the evidence of cointegration among the variables, hence the study supports the existence of a long run relationship among the variables. The exports model also displays similar conflicting results like that of the imports model in regards to the cointegration results. In model 1 and 2, while the Pedroni cointegration test results reject the evidence of cointegration, the Kao cointegration test results admits the evidence of cointegration among the variables at 10% significance level. In lieu of this, as one of the tests support that there is cointegration, this study therefore concludes that there is a long run stable relationship among exports and related explanatory variables based on the Kao cointegration test. The study also notes that like the case of the EAC trade bloc, the econometric software used in this study could not compute the Pedroni cointegration test for the trade balance model for model 1. In this regard, only the test results for the Kao cointegration test are reported in the table. Hence, based on the results, it is resolved that there is evidence of a long run stable relationship between trade balance and other related explanatory variables at 10% significance for all volatility measures included in the estimation of the models. It should be noted that in model 2, the Pedroni test was computed for the trade balance model. Considering all volatility measures, the majority of results accept the null hypothesis of no cointegration at 5% significance. The Kao cointegration test on the other hand indicates that for all volatility measures, cointegration exist among the variables. Hence, as cointegration was confirmed by at least one of the test, the study supports that there is evidence of cointegration in the trade balance model.

For all models, the evidence of cointegration among the variables was supported by the Kao cointegration test. Hence, the next step of the analysis will be to estimate the long run stable cointegrating relationship that will enable the researcher to see how respectively imports, exports and trade balance are affected by exchange rate volatility. In addition, the estimated equation will aid us to determine whether the estimates differ in terms of the volatility measure used. The next section therefore provides the estimates of the DOLS equation for model 1 and 2.

	STANDARD DEVIATION VOLATILITY MEASURE					GARCH VOLATILITY MEASURE					HP-FILTER VOLATILITY MEASURE				
	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob
IMPORTS MODEL	LGDP	0.628520	0.059234	10.61073	0.0000	LGDP	0.591644	0.064283	9.203793	0.0000	LGDP	0.597192	0.072756	8.208204	0.0000
	LNER	-0.658497	0.371303	-1.773478	0.0793	LNER	-4.067509	1.921577	-2.116755	0.0369	LNER	-1.263758	0.457220	-2.764006	0.0068
	INFL	0.006001	0.005774	1.039405	0.3012	INFL	-0.001554	0.005865	-0.264952	0.7916	INFL	0.010548	0.002998	3.518946	0.0007
	LM2	0.213900	0.196453	1.088811	0.2790	LM2	0.197310	0.169656	1.163001	0.2477	LM2	0.299729	0.120191	2.493760	0.0143
	VOL	0.337435	1.253307	0.269236	0.7883	VOL	3.43E-06	1.87E-06	1.834110	0.0697	VOL	0.001144	0.000427	2.681146	0.0086
	R-squared	0.963482				R-squared	0.964715				R-squared	0.995294			
	Adjusted R-squared	0.959297				Adjusted R-squared	0.960672				Adjusted R-squared	0.994790			
EXPORTS MODEL	LUSGDP	3.414412	0.648899	5.261853	0.0000	LUSGDP	2.637120	0.709271	3.718072	0.0003	LUSGDP	2.338079	0.572418	4.084567	0.0001
	LG7I	-1.516743	2.100302	-0.722155	0.4720	LG7I	0.267004	2.124987	0.125650	0.9003	LG7I	-1.026666	1.496211	-0.686177	0.4943
	LNER	-2.223169	0.638794	-3.480259	0.0008	LNER	-12.10203	6.860724	-1.763959	0.0809	LNER	-3.897797	1.159068	-3.362870	0.0011
	INFL	-0.010766	0.011133	-0.967087	0.3359	INFL	-0.011779	0.011732	-1.004062	0.3179	INFL	-0.000941	0.007279	-0.129323	0.8974
	LM2	-1.139683	0.417863	-2.727408	0.0076	LM2	-0.915275	0.357576	-2.559668	0.0120	LM2	-0.655339	0.295416	-2.218356	0.0289
	VOL	3.941924	2.513323	1.568411	0.1201	VOL	1.04E-05	6.71E-06	1.544272	0.1258	VOL	0.002594	0.001216	2.132468	0.0355
	R-squared	0.940762				R-squared	0.945446				R-squared	0.975316			
	Adjusted R-squared	0.933975				Adjusted R-squared	0.939195				Adjusted R-squared	0.972487			
TRADE BALANCE MODEL	LGDP	47.56968	5.598507	8.496851	0.0000	LGDP	46.39590	5.773704	8.035726	0.0000	LGDP	30.90130	10.92215	2.829232	0.0057
	LUSGDP	-149.4475	28.05377	-5.327180	0.0000	LUSGDP	-181.1305	29.29793	-6.182363	0.0000	LUSGDP	-76.82647	38.27684	-2.007127	0.0475
	LG7I	147.9884	72.03362	2.054435	0.0427	LG7I	264.5973	76.00657	3.481242	0.0008	LG7I	268.7690	80.28832	3.347548	0.0012
	LNER	11.23289	24.07345	0.466609	0.6418	LNER	-552.6710	253.1024	-2.183586	0.0314	LNER	37.82437	65.72198	0.575521	0.5663
	INFL	-0.870735	0.412458	-2.111087	0.0374	INFL	-1.585598	0.451031	-3.515494	0.0007	INFL	-0.820533	0.429563	-1.910156	0.0591
	LM2	-31.44458	14.85715	-2.116462	0.0369	LM2	-30.95840	13.02295	-2.377219	0.0194	LM2	-18.12143	15.11429	-1.198960	0.2335
	VOL	-85.29697	87.79595	-0.971536	0.3337	VOL	0.000533	0.000246	2.165099	0.0329	VOL	-0.064511	0.064314	-1.003064	0.3184
	R-squared	0.843669				R-squared	0.846437				R-squared	0.857558			
	Adjusted R-squared	0.825756				Adjusted R-squared	0.828841				Adjusted R-squared	0.841237			

Table 5.66: DOLS estimates of Imports, Exports and Trade Balance models (CEMAC)-Model 1

	STANDARD DEVIATION VOLATILITY MEASURE					GARCH VOLATILITY MEASURE					HP-FILTER VOLATILITY MEASURE				
	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob
IMPORTS MODEL	LGDP	0.685995	0.055478	12.36518	0.0000	LGDP	0.686466	0.058178	11.79943	0.0000	LGDP	0.668874	0.058986	11.33962	0.0000
	INFL	0.006951	0.006124	1.134960	0.2592	INFL	0.003294	0.005583	0.589977	0.5566	INFL	0.003317	0.005536	0.599094	0.5505
	LM2	0.298997	0.211040	1.416780	0.1598	LM2	0.247051	0.187644	1.316597	0.1911	LM2	0.351757	0.197448	1.781518	0.0780
	VOL	-0.851285	1.156257	-0.736242	0.4634	VOL	-3.56E-07	2.92E-07	-1.218919	0.2259	VOL	-0.000226	0.000343	-0.659988	0.5108
	R-squared	0.958241				R-squared	0.959497				R-squared	0.960453			
	Adjusted R-squared	0.953456				Adjusted R-squared	0.954856				Adjusted R-squared	0.955921			
EXPORTS MODEL	LUSGDP	3.844531	0.810611	4.742756	0.0000	LUSGDP	3.312340	0.622613	5.320063	0.0000	LUSGDP	3.476768	0.729114	4.768484	0.0000
	LG7I	-2.137485	2.581798	-0.827906	0.4098	LG7I	-1.066199	1.948486	-0.547194	0.5855	LG7I	-2.251667	2.273525	-0.990386	0.3245
	INFL	-0.002230	0.013437	-0.165953	0.8685	INFL	-6.03E-05	0.010654	-0.005658	0.9955	INFL	-0.003289	0.012399	-0.265234	0.7914
	LM2	-0.705115	0.474526	-1.485937	0.1406	LM2	-0.939306	0.361999	-2.594776	0.0109	LM2	-0.815599	0.440928	-1.849732	0.0674
	VOL	-1.762984	2.394518	-0.736258	0.4634	VOL	-1.34E-06	4.30E-07	-3.104560	0.0025	VOL	-0.001377	0.000607	-2.268714	0.0255
	R-squared	0.916257				R-squared	0.939130				R-squared	0.923732			
	Adjusted R-squared	0.906662				Adjusted R-squared	0.932156				Adjusted R-squared	0.914993			
TRADE BALANCE MODEL	LGDP	49.37965	5.221419	9.457132	0.0000	LGDP	51.76377	5.784253	8.949086	0.0000	LGDP	44.30096	5.257762	8.425820	0.0000
	LUSGDP	-142.0343	28.37174	-5.006190	0.0000	LUSGDP	-152.3854	27.86095	-5.469499	0.0000	LUSGDP	-131.9472	26.81340	-4.920941	0.0000
	LG7I	120.2428	74.10457	1.622609	0.1080	LG7I	156.9157	68.58106	2.288033	0.0243	LG7I	165.5870	63.57671	2.604523	0.0107
	INFL	-0.562092	0.374397	-1.501325	0.1366	INFL	-0.730371	0.376762	-1.938548	0.0555	INFL	-0.693285	0.348045	-1.991942	0.0492
	LM2	-43.58024	14.28201	-3.051408	0.0029	LM2	-35.10288	13.10572	-2.678439	0.0087	LM2	-36.15389	13.20683	-2.737514	0.0074
	VOL	13.72616	69.87335	0.196443	0.8447	VOL	8.29E-06	1.70E-05	0.486185	0.6279	VOL	-0.006542	0.018760	-0.348746	0.7280
	R-squared	0.825766				R-squared	0.821625				R-squared	0.840288			
	Adjusted R-squared	0.805801				Adjusted R-squared	0.801186				Adjusted R-squared	0.821987			

Table 5.67: DOLS estimates of Imports, Exports and Trade Balance models (CEMAC)-Model 2

For each distinct measure of volatility considered in this study, the DOLS of the imports, exports and trade balance models were estimated. The study consequently progresses with the analysis of the results. Considering both model specifications 1 and 2, it is observed that for the CEMAC trade bloc, the coefficient of determination is very high which signifies that imports are indeed very well explained by the related explanatory variables. Likewise the case of the EAC trade bloc, likewise in this section, a detailed explanation of all the coefficients will not be provided as the core goal of this section is to be able to portray if for each trade bloc considered in this study, there is indeed some dissimilarities associated while using the distinct measures of volatility in the estimation of the models. Thus, the impact of exchange rate volatility on imports, exports and trade balance is the main focus in this section in addition to depicting whether the results of the estimation are affected by the type of volatility measure used.

Model 1 and 2 show conflicting results in regards to the impact of exchange rate volatility on imports. While Model 1 shows that as exchange rate volatility increases, exports also increases, Model 2 instead indicates that as exchange rate volatility increases, imports decreases. The conflicting results clearly show that one should be careful in estimating the model as it is shown that the results are clearly affected. In model 1, volatility measured by standard deviation and GARCH display insignificant coefficient while the volatility measure by the HP-Filter display significant coefficient. Hence, the study concludes that as exchange rate volatility (HP-Filter) increases by a percentage, imports also increase by 0.001%. Model 2 however display no significant coefficients like the case of the EAC trade blocs. This therefore implies that as exchange rate volatility increases, imports are not affected. It is recalled that the main essence of estimating these two models (model 1 and 2) was to solve the problem of correlation which might be present in model 1. Hence, in model 2, it is evident that there is no correlation problem as exchange rate was removed as a variable. Therefore, the results in model 2 are preferred to the results in model 1. In regards to the exports model, the high coefficient of determination R^2 indicates that the exports model is well explained by the respective explanatory variables in CEMAC trade bloc. The results of the exports model are similar to that of the imports model. While model 1 shows that exchange rate volatility has a positive relationship with exports, model 2 indicate exchange rate volatility has a negative relationship with exports. Likewise the imports model, only the volatility measure by the HP-filter approach shows a significant coefficient which indicates that as exchange rate increases by 1%, imports also increases by 0.002%. On the other hand, model 2 indicates that except for the volatility measure by standard deviation, the remaining volatility measures are significant. The magnitude of the coefficient shows that as volatility in exchange rate measured by GARCH and HP-Filter respectively increases by a percentage, exports will deteriorate by 1.34E-06% and 0.001% respectively. This negative relationship is also consistent with some studies such as Aftab, Abbas and Kayani (2012) who found a negative relationship between exchange rate volatility and exports in Pakistan.

The trade balance model also shows non-consistent outcomes similar to the exports models. With the high coefficient of determination, it is also established that the trade balance is well explained by the explanatory variables. The variable of interest that is exchange rate volatility is very contradictory in terms of its impact on trade balance. The results in model 1 indicate that while the standard deviation and HP-Filter measures show that as exchange rate volatility becomes very volatile, trade balance decreases, the GARCH measure instead a positive relationship with trade balance. The study however highlights that not all these measures display significant coefficients. Based on the statistical significance of the HP-filter volatility measure, the study concludes that as exchange rate volatility increases, trade balance also increases in CEMAC trade bloc. Similarly to other models, resulting from the differences in the degree of the coefficients, it is established that the outcomes of the results are truly determined by the nature of the volatility approach used in the estimation of the models. The resnlts in model 2 have different results compared to model 1. In model 2, the results indicate a positive relationship between exchange rate volatility and trade balance with volatility measured by standard deviation and GARCH. On the other hand, when volatility is measure is measure by HP-Filter approach, the results show that there is a negative relationship. It should be noted that none of these coefficients are statistically significant which allows the study to conclude that exchange rate volatility has no significant effects on trade balance in CEMAC region.

In summary, it was revealed that the results of the estimation are different for each model specification. Hence, this study will particularly rely on the results of model 2 as it is more convenient than model 1. Considering model might expose the outcome of the results with some correlation problems with the two variables of exchange rate and volatility and therefore lead to some interpretation of biased estimates. For this reason, Model 2 estimates are preferred. Based on this conclusion, it is therefore established that there is no significant relationship between exchange rate volatility and imports as well as trade balance. However, it was established that as exchange rate volatility increases, exports will be negatively affected.

The response of imports, exports and trade balance to exchange rate volatility was discussed for the CEMAC trade bloc. Furthermore, it was evaluated as to whether the results of the analysis were dependent on the approach of the volatility measure used. The results of the analysis permitted the study to conclude that the results are very much affected by the nature of the volatility measure used.

As this is a comparative analysis, the next section deals with investigating the same effects in the ECOWAS and SADC trade bloc.

5.3.3 Panel Cointegration Testing for ECOWAS Trade Bloc

It is also noted that the unit root test results were already conducted previously for both trade blocs and the results confirmed that based on majority, the variables are I(1), hence non-stationary. In this regard, the next step of the analysis is to investigate whether cointegration exist among the variables. In achieving this, this study employs both the Pedroni and the Kao cointegration test to test the existence of cointegration among the variables. The results of the Pedroni and Kao cointegration tests are therefore presented as follows:

	STANDARD DEVIATION MEASURE				GARCH MEASURE				HP FILTER MEASURE			
	Models	Imports	Exports	Trade	Models	Imports	Exports	Trade	Models	Imports	Exports	Trade
	PEDRONI TEST				PEDRONI TEST				PEDRONI TEST			
INTERCEPT ONLY	Panel v-Statistic	-0.356684 (0.6393)	-0.058234 (0.0532)		Panel v-Statistic	-0.471306 (0.6813)	-0.568432 (0.7151)		Panel v-Statistic	1.353981 (0.0879)	0.054827 (0.4781)	
	Panel rho-Statistic	2.664421 (0.9961)	2.930268 (0.9983)		Panel rho-Statistic	1.902760 (0.9715)	2.978088 (0.9985)		Panel rho-Statistic	2.039037 (0.9793)	3.154836 (0.9992)	
	Panel PP-Statistic	-1.033015 (0.1508)	1.044957 (0.8520)		Panel PP-Statistic	-2.763943 (0.0029)	-0.845134 (0.1990)		Panel PP-Statistic	-3.742778 (0.0001)	-0.241656 (0.4045)	
	Panel ADF-Statistics	1.450338 (0.9265)	4.207902 (1.0000)		Panel ADF-Statistics	1.254277 (0.8951)	2.257370 (0.9880)		Panel ADF-Statistics	-1.073312 (0.1416)	2.575738 (0.9950)	
	Group rho-Statistic	3.813944 (0.9999)	4.629997 (1.0000)		Group rho-Statistic	3.243171 (0.9994)	5.031418 (1.0000)		Group rho-Statistic	3.631613 (0.9999)	4.849395 (1.0000)	
	Group PP-Statistic	-1.129979 (0.1292)	-0.963480 (0.1677)		Group PP-Statistic	-3.309364 (0.0005)	-1.343555 (0.0895)		Group PP-Statistic	-4.584115 (0.0000)	-5.065454 (0.0000)	
	Group ADF-Statistics	1.924764 (0.9729)	4.051944 (1.0000)		Group ADF-Statistics	1.206855 (0.8863)	1.505858 (0.9339)		Group ADF-Statistics	-1.238045 (0.1078)	0.856739 (0.8042)	
INTERCEPT+TREND	Panel v-Statistic	-0.905306 (0.8173)	2.395772 (0.0083)		Panel v-Statistic	-0.686678 (0.7539)	1.643146 (0.0502)		Panel v-Statistic	0.784836 (0.2163)	1.710672 (0.0436)	
	Panel rho-Statistic	3.595695 (0.9998)	4.730958 (1.0000)		Panel rho-Statistic	3.432855 (0.9997)	4.552644 (1.0000)		Panel rho-Statistic	3.461122 (0.9997)	4.693928 (1.0000)	
	Panel PP-Statistic	-1.074309 (0.1413)	-3.908643 (0.0000)		Panel PP-Statistic	-2.021423 (0.0216)	-5.535646 (0.0000)		Panel PP-Statistic	-4.449798 (0.0000)	-8.326657 (0.0000)	
	Panel ADF-Statistics	1.325467 (0.9075)	-1.250116 (0.1056)		Panel ADF-Statistics	0.896121 (0.8149)	-1.582490 (0.0568)		Panel ADF-Statistics	-1.220016 (0.1112)	-2.887663 (0.0019)	
	Group rho-Statistic	4.035276 (1.0000)	5.930920 (1.0000)		Group rho-Statistic	3.816527 (0.9999)	5.735367 (1.0000)		Group rho-Statistic	4.332693 (1.0000)	5.709501 (1.0000)	
	Group PP-Statistic	-3.936867 (0.0000)	-7.299756 (0.0000)		Group PP-Statistic	-7.746273 (0.0000)	-8.108106 (0.0000)		Group PP-Statistic	-7.162705 (0.0000)	-12.18197 (0.0000)	
	Group ADF-Statistics	1.489493 (0.9318)	-0.628209 (0.2649)		Group ADF-Statistics	0.401133 (0.6568)	-1.564302 (0.0589)		Group ADF-Statistics	-1.567119 (0.0585)	-2.124920 (0.0168)	
	KAO TEST				KAO TEST				KAO TEST			
	Kao ADF stats	-4.235497 (0.0000)	-2.256217 (0.0120)	-5.680392 (0.0000)	Kao ADF stats	-3.569152 (0.0000)	-4.058423 (0.0000)	-6.541063 (0.0000)	Kao ADF stats	-3.331818 (0.0004)	-1.671624 (0.0473)	-8.316349 (0.0000)

Table 5.68: Panel cointegration test results of Imports, Exports and Trade Balance (ECOWAS)-Model 1

	STANDARD DEVIATION MEASURE				GARCH MEASURE				HP FILTER MEASURE			
	Models	Imports	Exports	Trade	Models	Imports	Exports	Trade	Models	Imports	Exports	Trade
INTERCEPT ONLY	**PEDRONI TEST**				**PEDRONI TEST**				**PEDRONI TEST**			
	Panel v-Statistic	0.695266 (0.2434)	-0.510160 (0.6950)	-1.833456 (0.9666)	Panel v-Statistic	1.040255 (0.1491)	-0.494249 (0.6894)	1.057451 (0.1452)	Panel v-Statistic	1.400501 (0.0807)	-0.266069 (0.6049)	-0.668394 (0.7481)
	Panel rho-Statistic	1.187713 (0.8825)	2.633878 (0.9958)	0.958324 (0.8311)	Panel rho-Statistic	0.439930 (0.6700)	1.966779 (0.9754)	0.836708 (0.7986)	Panel rho-Statistic	1.013268 (0.8445)	2.582786 (0.9951)	1.548144 (0.9392)
	Panel PP-Statistic	-3.185169 (0.0007)	1.063419 (0.8562)	-7.857308 (0.0000)	Panel PP-Statistic	-6.155101 (0.0000)	-1.108579 (0.1338)	-10.13810 (0.0000)	Panel PP-Statistic	-3.654722 (0.0001)	1.196685 (0.8843)	-20.33445 (0.0000)
	Panel ADF-Statistics	-0.508298 (0.3056)	2.388659 (0.9915)	0.090680 (0.5361)	Panel ADF-Statistics	-0.995184 (0.1598)	1.861390 (0.9687)	-0.141720 (0.4437)	Panel ADF-Statistics	-1.179059 (0.1192)	2.868045 (0.9979)	-3.718515 (0.0001)
	Group rho-Statistic	2.980132 (0.9986)	4.179635 (1.0000)	4.317167 (1.0000)	Group rho-Statistic	2.224188 (0.9869)	4.008370 (1.0000)	3.809481 (0.9999)	Group rho-Statistic	2.940838 (0.9984)	3.876864 (0.9999)	4.534687 (1.0000)
	Group PP-Statistic	-2.203205 (0.0138)	-0.843623 (0.1994)	-6.090663 (0.0000)	Group PP-Statistic	-5.890152 (0.0000)	-4.203621 (0.0000)	-9.366000 (0.0000)	Group PP-Statistic	-3.713593 (0.0001)	0.258084 (0.6018)	-12.93470 (0.0000)
	Group ADF-Statistics	0.163563 (0.5650)	1.404974 (0.9200)	-0.712236 (0.2382)	Group ADF-Statistics	-0.377717 (0.3528)	0.746102 (0.7722)	-1.595823 (0.0553)	Group ADF-Statistics	-0.344490 (0.3652)	3.542931 (0.9998)	-2.968599 (0.0015)
INTERCEPT+TREND	Panel v-Statistic	-0.443596 (0.6713)	-0.113471 (0.5452)	-3.056002 (0.9989)	Panel v-Statistic	0.577893 (0.2817)	0.445916 (0.3278)	-0.681481 (0.7522)	Panel v-Statistic	1.945336 (0.0259)	0.813898 (0.2079)	-1.990095 (0.9767)
	Panel rho-Statistic	2.931612 (0.9983)	3.476608 (0.9997)	2.604138 (0.9954)	Panel rho-Statistic	2.198194 (0.9860)	2.902139 (0.9981)	2.376405 (0.9913)	Panel rho-Statistic	2.444885 (0.9928)	3.783656 (0.9999)	3.068193 (0.9989)
	Panel PP-Statistic	-0.828497 (0.2037)	-0.533657 (0.2968)	-10.85317 (0.0000)	Panel PP-Statistic	-3.256277 (0.0006)	-2.986166 (0.0014)	-11.44600 (0.0000)	Panel PP-Statistic	-4.505500 (0.0000)	-1.040011 (0.1492)	-43.41808 (0.0000)
	Panel ADF-Statistics	0.803747 (0.7892)	0.702809 (0.7589)	-0.627591 (0.2651)	Panel ADF-Statistics	-0.368514 (0.3562)	-0.179071 (0.4289)	0.055334 (0.5221)	Panel ADF-Statistics	-1.487438 (0.0684)	0.009246 (0.5037)	-4.145153 (0.0000)
	Group rho-Statistic	3.786831 (0.9999)	5.113597 (1.0000)	5.404179 (1.0000)	Group rho-Statistic	3.002592 (0.9987)	4.753482 (1.0000)	5.174029 (1.0000)	Group rho-Statistic	3.710191 (0.9999)	4.756972 (1.0000)	5.437893 (1.0000)
	Group PP-Statistic	-1.686268 (0.0459)	-1.874877 (0.0304)	-10.57313 (0.0000)	Group PP-Statistic	-6.912112 (0.0000)	-7.715146 (0.0000)	-16.35694 (0.0000)	Group PP-Statistic	-5.316530 (0.0000)	-4.643667 (0.0000)	-18.80207 (0.0000)
	Group ADF-Statistics	1.119948 (0.8686)	0.335120 (0.6312)	-2.380259 (0.0087)	Group ADF-Statistics	-0.013143 (0.4948)	-0.950907 (0.1708)	-4.036074 (0.0000)	Group ADF-Statistics	-1.256124 (0.1045)	-0.148626 (0.4409)	-3.247472 (0.0006)
	KAO TEST				**KAO TEST**				**KAO TEST**			
	Kao ADF stats	-4.285821 (0.0000)	-2.414264 (0.0079)	-5.060877 (0.0000)	Kao ADF stats	-3.171532 (0.0008)	-5.324876 (0.0009)	-7.254512 (0.0000)	Kao ADF stats	-4.285821 (0.0000)	-1.772932 (0.0381)	-7.749534 (0.0000)

Table 5.69: Panel cointegration test results of Imports, Exports and Trade Balance (ECOWAS)-Model 2

For all measures of volatility, Models 1 and 2 test if indeed cointegration exists among the variables considering the models of imports, exports and trade balance respectively in ECOWAS trade bloc. Regarding this, the Pedroni and Kao cointegration tests were considered. The Pedroni and the Kao cointegration tests were conducted in this regard. Taking a look at the imports model, the results of the analysis reveal that for all individual measures of volatility considered in this study, the Pedroni test accepts the null hypothesis of no cointegration in both model 1 and 2. This conclusion is justified as it is observed that the majority of results accept the null hypothesis of no cointegration at 5% significance level. Based on these results, it is therefore acknowledged that under the Pedroni test, there is no evidence of cointegration among the variables. On the other hand, in model 1 and 2, the Kao cointegration test fails to accept the null hypothesis of no cointegration for each separate measure of volatility. The results show that at 5% significance level, there is evidence of a stable long relationship. Hence, the study proceeds to conclude that because the existence of cointegration was justified by at least one of the test results, the final conclusion that imports and its corresponding variables move together in the long run is therefore acceptable. The results of the Pedroni test in regards to the exports model display mixed results for each measure of volatility. In model 1, while the exports model with standard deviation as a measure of volatility shows that the variables are not cointegrated, the same model with GARCH and HP-Filter volatility measures shows that the variables are cointegrated as the majority of the results have their probability values less than the significance level. Hence, the study concludes that except for the exports model with standard deviation as a volatility measure, the model with GARCH and HP-Filter justifies the evidence of cointegration. In addition, for all the three volatility measures, the Kao test validates that at 5% significance level, the variables move together in the long run. The study therefore concludes that for the exports model, variables move together in the long run. In model 2, the Pedroni test shows that the null hypothesis of no cointegration is accepted. However, the Kao cointegration test rejects the null hypothesis of no cointegration. In this regards, the study concludes that exports is cointegrated based on the evidence of cointegration provided by the Kao cointegration test. Likewise previous trade blocs, the econometric software failed to compute the Pedroni cointegration test for the trade balance model in model 1. Regarding this, only the test results for the Kao cointegration test are reported in the table. Hence, as established by the results, it is decided that there is an indication of a long run stable relationship between trade balance and other related explanatory variables at 5% significance for each unique volatility measure included in the estimation of the models. The Pedroni test was however able to run the trade balance model in model 2. While the model with standard deviation and GARCH accepts the confirmation of no cointegration, the model with HP-Filter rejects the null hypothesis of no cointegration. In lieu of this, the study concludes that the trade balance is cointegrated at 5% significance level. With the evidence of a long run stable relationship found among the variables, the next step is the estimation of the long run cointegrating equation using the DOLS.

	STANDARD DEVIATION VOLATILITY MEASURE					GARCH VOLATILITY MEASURE					HP-FILTER VOLATILITY MEASURE				
	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob
IMPORTS MODEL	LGDP	0.986130	0.031206	31.60085	0.0000	LGDP	0.981563	0.031086	31.57608	0.0000	LGDP	1.019959	0.030395	33.55709	0.0000
	LNER	-0.016526	0.042684	-0.387170	0.6990	LNER	-0.059598	0.044904	-1.327243	0.1859	LNER	0.049979	0.039549	1.263721	0.2078
	INFL	-0.002562	0.001606	-1.595509	0.1121	INFL	-0.004689	0.001578	-2.971519	0.0033	INFL	-0.001708	0.001258	-1.357396	0.1761
	LM2	0.240492	0.055429	4.338764	0.0000	LM2	0.231250	0.055993	4.130003	0.0001	LM2	0.200982	0.049822	4.033983	0.0001
	VOL	-0.434324	0.148339	-2.927925	0.0038	VOL	7.67E-09	2.43E-09	3.160692	0.0018	VOL	3.75E-05	4.14E-05	0.906297	0.3658
	R-squared	0.991949				**R-squared**	0.992527				**R-squared**	0.994069			
	Adjusted R-squared	0.990972				**Adjusted R-squared**	0.991620				**Adjusted R-squared**	0.993349			
EXPORTS MODEL	LUSGDP	3.325392	0.241948	13.74427	0.0000	LUSGDP	3.436772	0.221759	15.49775	0.0000	LUSGDP	3.633357	0.261915	13.87227	0.0000
	LG7I	-3.820095	0.775930	-4.923247	0.0000	LG7I	-4.082219	0.691908	-5.899943	0.0000	LG7I	-3.656042	0.810818	-4.509081	0.0000
	LNER	-0.085320	0.076013	-1.122429	0.2630	LNER	-0.076429	0.079501	-0.961357	0.3375	LNER	-0.194605	0.102008	-1.907745	0.0578
	INFL	0.004570	0.002258	2.023549	0.0443	INFL	0.003220	0.002096	1.536652	0.1259	INFL	0.004581	0.002393	1.914162	0.0570
	LM2	-0.472237	0.132255	-3.570642	0.0004	LM2	-0.550002	0.127168	-4.325002	0.0000	LM2	-0.524350	0.137150	-3.823184	0.0002
	VOL	-0.486562	0.248751	-1.956021	0.0518	VOL	5.84E-09	4.34E-09	1.343475	0.1806	VOL	-4.03E-05	0.000110	-0.367115	0.7139
	R-squared	0.982333				**R-squared**	0.983411				**R-squared**	0.983182			
	Adjusted R-squared	0.980190				**Adjusted R-squared**	0.981398				**Adjusted R-squared**	0.981141			
TRADE BALANCE MODEL	LGDP	3.517877	2.395561	1.468498	0.1436	LGDP	7.419254	3.340280	2.221147	0.0275	LGDP	17.27206	4.420128	3.907592	0.0001
	LUSGDP	-3.188359	8.300747	-0.384105	0.7013	LUSGDP	-10.15006	11.60072	-0.874951	0.3827	LUSGDP	-36.09962	14.89173	-2.424140	0.0163
	LG7I	5.833301	16.98596	0.343419	0.7317	LG7I	3.791287	22.85867	0.165858	0.8684	LG7I	8.866246	25.12307	0.352913	0.7245
	LNER	6.571167	1.746136	3.763262	0.0002	LNER	15.52941	2.571168	6.039827	0.0000	LNER	24.05945	3.629226	6.629361	0.0000
	INFL	0.233557	0.059566	3.921011	0.0001	INFL	0.304819	0.077835	3.916211	0.0001	INFL	0.170785	0.084270	2.026640	0.0441
	LM2	-10.94761	2.559073	-4.277958	0.0000	LM2	-10.30497	3.689414	-2.793118	0.0057	LM2	-12.02327	3.999932	-3.005869	0.0030
	VOL	1.706452	6.967887	0.244902	0.8068	VOL	-7.31E-08	1.26E-07	-0.579423	0.5630	VOL	0.003465	0.002892	1.198246	0.2323
	R-squared	0.978438				**R-squared**	0.961854				**R-squared**	0.964968			
	Adjusted R-squared	0.974058				**Adjusted R-squared**	0.954105				**Adjusted R-squared**	0.957852			

Table 5.70: DOLS estimates of Imports, Exports and Trade Balance models (ECOWAS)-Model 1

	STANDARD DEVIATION VOLATILITY MEASURE					GARCH VOLATILITY MEASURE					HP-FILTER VOLATILITY MEASURE				
	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob
IMPORTS MODEL	LGDP	0.990336	0.032940	30.06510	0.0000	LGDP	1.004017	0.032304	31.07985	0.0000	LGDP	0.982530	0.028712	34.22020	0.0000
	INFL	0.000946	0.001227	0.770484	0.4419	INFL	-0.000518	0.001186	-0.436750	0.6628	INFL	-0.001111	0.000983	34.22020	0.2601
	LM2	0.294987	0.053497	5.514129	0.0000	LM2	0.204453	0.056772	3.601291	0.0004	LM2	0.251942	0.046803	5.383041	0.0000
	VOL	-0.283425	0.149607	-1.894463	0.0596	VOL	9.35E-09	2.15E-09	4.357707	0.0000	VOL	2.94E-05	4.55E-05	0.646621	0.5186
	R-squared	0.989865				R-squared	0.991062				R-squared	0.992606			
	Adjusted R-squared	0.988635				Adjusted R-squared	0.989977				Adjusted R-squared	0.991709			
EXPORTS MODEL	LUSGDP	3.353877	0.252295	13.29350	0.0000	LUSGDP	3.491386	0.242997	14.36805	0.0000	LUSGDP	3.525737	0.253364	13.91568	0.0000
	LG7I	-3.959938	0.733565	-5.398212	0.0000	LG7I	-4.391521	0.688127	-6.381843	0.0000	LG7I	-4.502477	0.756828	-5.949140	0.0000
	INFL	0.004066	0.002155	1.887006	0.0606	INFL	0.002104	0.002103	1.000780	0.3181	INFL	0.002970	0.002182	1.361456	0.1749
	LM2	-0.504942	0.132633	-3.807066	0.0002	LM2	-0.597214	0.136112	-4.387669	0.0000	LM2	-0.559896	0.130414	-4.293207	0.0000
	VOL	-0.550910	0.256129	-2.150907	0.0326	VOL	4.44E-09	4.20E-09	1.055318	0.2925	VOL	-4.55E-05	0.000110	-0.413679	0.6795
	R-squared	0.980733				R-squared	0.980914				R-squared	0.980589			
	Adjusted R-squared	0.978395				Adjusted R-squared	0.978598				Adjusted R-squared	0.978233			
TRADE BALANCE MODEL	LGDP	1.265896	1.929031	0.656234	0.5124	LGDP	5.096525	2.859583	1.782262	0.0762	LGDP	7.228580	3.131233	2.308541	0.0220
	LUSGDP	-2.262662	6.928214	-0.326587	0.7443	LUSGDP	-11.65181	10.22262	-1.139806	0.2557	LUSGDP	-14.83592	10.95989	-1.353656	0.1773
	LG7I	11.57331	14.45427	0.800685	0.4242	LG7I	21.87663	20.58208	1.062897	0.2891	LG7I	26.13813	22.73371	1.149752	0.2516
	INFL	0.061264	0.032396	1.891094	0.0600	INFL	0.061285	0.048242	1.270375	0.2054	INFL	0.033996	0.052340	0.649515	0.5167
	LM2	-8.429304	2.240317	-3.762550	0.0002	LM2	-6.911769	3.396569	-2.034927	0.0431	LM2	-6.182854	3.551231	-1.741045	0.0832
	VOL	3.828131	4.352696	0.879485	0.3802	VOL	-1.35E-07	9.75E-08	-1.381292	0.1687	VOL	0.005708	0.002733	2.088568	0.0380
	R-squared	0.974909				R-squared	0.952857				R-squared	0.954162			
	Adjusted R-squared	0.971864				Adjusted R-squared	0.947136				Adjusted R-squared	0.948599			

Table 5.71: DOLS estimates of Imports, Exports and Trade Balance models (ECOWAS)-Model 2

The DOLS of the imports, exports and trade balance models were estimated taking into consideration each distinctive measure of volatility. Starting with the imports model, it is observed that for this trade bloc, the coefficient of determination is very high (in model 1 and 2) which denotes that imports are undeniably very well explained by the associated independent variables. Similarly to previous trade blocs, this section does not provide an exhaustive interpretation of all the coefficients as the core goal is to depict the impact of exchange volatility on the distinct components of trade. The dissimilarities associated while using the distinct measures of volatility in the estimation of the models is also taken into account. Thus, the impact of exchange rate volatility on imports, exports and trade balance is the main focus in this section in addition to depicting whether the results of the estimation are affected by the type of volatility measure used.

The results of the imports model show conflicting results on the effects of exchange rate volatility on imports in both model specifications. In both model 1 and 2, while some results show significant effects, other results show insignificant effects. Specifically, the results of the analysis reveal that for the model of imports with volatility measured by GARCH and HP-Filter approach, there a positive relationship while volatility measure by standard deviation shows a negative relationship. However, in model 1, volatility measured by standard deviation and GARCH is significant which indicates that as exchange rate volatility increases by 1%, imports decreases by 0.43% and increases by 7.67E-09% respectively. Model 2 displays different results compared to model 1. Only the model measuring volatility by GARCH is significant which indicates that as exchange rate volatility increases by 1%, imports also increases by 9335E-09%. Despite the mixed results on the imports model, it is observed that the results clearly differ as per volatility measure used in the estimation of the respective models.

With regard to the exports model, the high coefficient of determination R^2 also directs that the exports model is well explained by the respective explanatory variables in ECOWAS trade bloc. It is interesting to see that in this particular trade bloc, there are no significant effects of exchange rate volatility on exports for each measure of volatility used. This non-significant effect is particularly seen with the non-significance of the test –statistics and the respective probability values. Hence, it is concluded as exchange rate uncertainty increases, exports are not affected by in countries of ECOWAS. These results have been established in model 1. In model 2, the results instead display that only the volatility measured by standard deviation display a significant negative coefficient. In lieu of this, the study concludes that when exchange rate increases by a percentage, exports will deteriorate by 0.55%. The trade balance model also shows non-consistent outcomes similar to the exports models. With the high coefficient of determination, it is also established that the trade balance is well explained by the explanatory variables in both model specification. The variable of interest, that is exchange rate volatility, displays similar effects like that of the exports in model 1. Each measure of volatility shows non-statistical significant relationship. Hence, the study concludes that there is no statistical significant relationship between exchange rate volatility and exports in ECOWAS trade bloc. Model 2 however display different results. Volatility measured by the HP-Filter approach displays a statistical significant coefficient. Based on the magnitude of the coefficient, the results indicate that a 1% increase in exchange rate volatility also causes trade balance by 0.005%. Similarly to previous models, resulting from the differences in the degree of the coefficients, it is established that the outcomes of the results are truly determined by the nature of the volatility approach used in the estimation of the models.

To recapitulate, it was exposed that the results of the estimation are different for each model specification. Hence, as earlier stipulated, this study will particularly rely on the results of model 2 to eradicate the problem of correlation which may be present in model 1. Therefore, it was therefore established that there is no significant relationship between exchange rate volatility and imports. However, it was established that as exchange rate volatility increases, exports will be negatively affected while trade balance will be negatively affected.

The response of imports, exports and trade balance to exchange rate volatility was discussed for the ECOWAS trade bloc. Furthermore, it was evaluated as to whether the results of the analysis were dependent on the approach of the volatility measure used. The results of the analysis permitted the study to conclude that the results are very much affected by the nature of the volatility measure used. With the interpretation of the results of CEMAC trade bloc, the next section deals with investigating the same effects in the SADC trade bloc.

5.3.4 Panel Cointegration Testing For SADC Trade Bloc

It was already noted that unit root test was conducted for SADC trade bloc and the nature of the variables were concluded to be I(1). In this regard, the next step of the analysis is to investigate whether cointegration exist among the variables. In achieving this, this study employs both the Pedroni and the Kao cointegration test to test the existence of cointegration among the variables. The results of the Pedroni and Kao cointegration tests are therefore as follows:

	STANDARD DEVIATION MEASURE				GARCH MEASURE				HP FILTER MEASURE			
	Models	Imports	Exports	Trade	Models	Imports	Exports	Trade	Models	Imports	Exports	Trade
INTERCEPT ONLY	PEDRONI TEST				PEDRONI TEST				PEDRONI TEST			
	Panel v-Statistic	-0.479408 (0.6842)	-119.6729 (1.0000)		Panel v-Statistic	-0.949046 (0.8287)	-120.4329 (1.0000)		Panel v-Statistic	-0.993859 (0.8399)	-117.4691 (1.0000)	
	Panel rho-Statistic	1.475304 (0.9299)	3.126552 (0.9991)		Panel rho-Statistic	1.778665 (0.9624)	3.239662 (0.9994)		Panel rho-Statistic	1.716347 (0.9570)	3.389154 (0.9996)	
	Panel PP-Statistic	-8.737623 (0.0000)	-6.611789 (0.0000)		Panel PP-Statistic	-7.453810 (0.0000)	-7.318263 (0.0000)		Panel PP-Statistic	-7.965763 (0.0000)	-4.860048 (0.0000)	
	Panel ADF-Statistics	-3.985181 (0.0000)	-2.032316 (0.0211)		Panel ADF-Statistics	-4.132847 (0.0000)	-2.887155 (0.0019)		Panel ADF-Statistics	-5.107125 (0.0000)	-2.438911 (0.0074)	
	Group rho-Statistic	3.100030 (0.9990)	3.965914 (1.0000)		Group rho-Statistic	3.452380 (0.9997)	4.294883 (1.0000)		Group rho-Statistic	3.432698 (0.9997)	4.643846 (1.0000)	
	Group PP-Statistic	-11.19445 (0.0000)	-9.896515 (0.0000)		Group PP-Statistic	-6.940366 (0.0000)	-9.880689 (0.0000)		Group PP-Statistic	-9.635613 (0.0000)	-6.070861 (0.0000)	
	Group ADF-Statistics	-1.680052 (0.0465)	-1.017039 (0.1546)		Group ADF-Statistics	-1.151294 (0.1248)	-1.872962 (0.0305)		Group ADF-Statistics	-2.094896 (0.0181)	-2.177681 (0.0147)	
INTERCEPT+TREND	Panel v-Statistic	-1.135524 (0.8719)	-134.2765 (1.0000)		Panel v-Statistic	-1.695226 (0.9550)	-138.8448 (1.0000)		Panel v-Statistic	-1.530636 (0.9371)	-129.8860 (1.0000)	
	Panel rho-Statistic	2.612052 (0.9955)	4.412719 (1.0000)		Panel rho-Statistic	2.754235 (0.9971)	4.439739 (1.0000)		Panel rho-Statistic	2.926188 (0.9383)	4.542629 (1.0000)	
	Panel PP-Statistic	-12.11107 (0.0000)	-6.201739 (0.0000)		Panel PP-Statistic	-14.64742 (0.0000)	-7.773985 (0.0000)		Panel PP-Statistic	-13.91667 (0.0000)	-6.282127 (0.0000)	
	Panel ADF-Statistics	-2.279230 (0.0113)	-1.110715 (0.1333)		Panel ADF-Statistics	-4.415129 (0.0000)	-3.160812 (0.0008)		Panel ADF-Statistics	-3.531320 (0.0002)	-1.615362 (0.0531)	
	Group rho-Statistic	4.073255 (1.0000)	4.931365 (1.0000)		Group rho-Statistic	4.448676 (1.0000)	5.447771 (1.0000)		Group rho-Statistic	4.665040 (1.0000)	5.485197 (1.0000)	
	Group PP-Statistic	-10.40152 (0.0000)	-16.78748 (0.0000)		Group PP-Statistic	-10.02169 (0.0000)	-19.85282 (0.0000)		Group PP-Statistic	-10.88128 (0.0000)	-13.45350 (0.0000)	
	Group ADF-Statistics	-0.551507 (0.2906)	-1.240751 (0.1073)		Group ADF-Statistics	-0.406806 (0.3421)	-3.098458 (0.0010)		Group ADF-Statistics	-1.587269 (0.0562)	-2.025358 (0.0214)	
	KAO TEST				KAO TEST				KAO TEST			
	Kao ADF stats	-4.290937 (0.0000)	-2.177429 (0.0147)	-0.078146 (0.0689)	Kao ADF stats	-3.955470 (0.0000)	-1.887638 (0.0295)	-0.897683 (0.0847)	Kao ADF stats	-3.697702 (0.0001)	-2.398819 (0.0082)	-0.088704 (0.0647)

Table 5.72: Panel cointegration test results of Imports, Exports and Trade Balance (SADC)-Model 1

	STANDARD DEVIATION MEASURE				GARCH MEASURE				HP FILTER MEASURE			
	Models	Imports	Exports	Trade	Models	Imports	Exports	Trade	Models	Imports	Exports	Trade
INTERCEPT ONLY	**PEDRONI TEST**				**PEDRONI TEST**				**PEDRONI TEST**			
	Panel v-Statistic	-2.025776 (0.9786)	-58.07098 (1.0000)	-2.262162 (0.9882)	Panel v-Statistic	-1.244413 (0.8933)	-58.93808 (1.0000)	-0.759800 (0.7763)	Panel v-Statistic	-2.037963 (0.9792)	-79.71585 (1.0000)	-1.466699 (0.9288)
	Panel rho-Statistic	1.664427 (0.9520)	2.746085 (0.9970)	3.203548 (0.9993)	Panel rho-Statistic	0.421794 (0.6634)	2.446689 (0.9928)	2.801652 (0.9975)	Panel rho-Statistic	2.449305 (0.9928)	2.458772 (0.9930)	2.829672 (0.9977)
	Panel PP-Statistic	-1.390350 (0.0822)	-0.844453 (0.1992)	-3.277104 (0.0005)	Panel PP-Statistic	-4.532991 (0.0000)	-1.598592 (0.0550)	-5.069432 (0.0000)	Panel PP-Statistic	-0.831290 (0.2029)	-4.026815 (0.0000)	-6.467660 (0.0000)
	Panel ADF-Statistics	1.416182 (0.9216)	0.693744 (0.7561)	-0.451294 (0.3259)	Panel ADF-Statistics	0.057982 (0.5231)	0.447283 (0.6727)	-1.166185 (0.1218)	Panel ADF-Statistics	-0.034000 (0.4864)	-2.871689 (0.0020)	-1.725252 (0.0422)
	Group rho-Statistic	2.567559 (0.9949)	3.922380 (1.0000)	4.571578 (1.0000)	Group rho-Statistic	2.353349 (0.9907)	3.977077 (1.0000)	4.475385 (1.0000)	Group rho-Statistic	2.820337 (0.9976)	3.679475 (0.9999)	4.861339 (1.0000)
	Group PP-Statistic	-4.408879 (0.0000)	-2.934269 (0.0017)	-12.07980 (0.0000)	Group PP-Statistic	-8.332227 (0.0000)	-3.124288 (0.0009)	-9.557541 (0.0000)	Group PP-Statistic	-5.729482 (0.0000)	-4.518852 (0.0000)	-11.33236 (0.0000)
	Group ADF-Statistics	0.705802 (0.7598)	-0.725318 (0.2341)	-0.582775 (0.2800)	Group ADF-Statistics	-1.151534 (0.1248)	-0.089137 (0.4645)	-0.669092 (0.2517)	Group ADF-Statistics	-1.397342 (0.0812)	-1.186054 (0.1178)	-1.547657 (0.0609)
INTERCEPT+TREND	Panel v-Statistic	-0.112742 (0.5449)	-74.30106 (1.0000)	-2.405942 (0.9919)	Panel v-Statistic	0.038123 (0.4848)	-65.13319 (1.0000)	-1.329416 (0.9081)	Panel v-Statistic	-0.100205 (0.5399)	-93.96850 (1.0000)	-2.012185 (0.9779)
	Panel rho-Statistic	1.743476 (0.9594)	4.064326 (1.0000)	3.698137 (0.9999)	Panel rho-Statistic	1.838847 (0.9670)	3.846722 (0.9999)	4.165314 (1.0000)	Panel rho-Statistic	2.018115 (0.9782)	3.610364 (0.9998)	3.698632 (0.9999)
	Panel PP-Statistic	-11.49868 (0.0000)	-0.351309 (0.3627)	-7.265815 (0.0000)	Panel PP-Statistic	-11.73059 (0.0000)	-0.598458 (0.2748)	-6.400238 (0.0000)	Panel PP-Statistic	-10.94637 (0.0000)	-4.013692 (0.0000)	-10.33939 (0.0000)
	Panel ADF-Statistics	-2.889442 (0.0019)	0.835160 (0.7982)	-0.602978 (0.2733)	Panel ADF-Statistics	-4.689594 (0.0000)	1.586813 (0.9437)	-0.352045 (0.3624)	Panel ADF-Statistics	-3.876217 (0.0001)	-2.043532 (0.0205)	-1.843983 (0.0326)
	Group rho-Statistic	3.181889 (0.9993)	5.314582 (1.0000)	5.340747 (1.0000)	Group rho-Statistic	3.389851 (0.9997)	5.295894 (1.0000)	5.876477 (1.0000)	Group rho-Statistic	3.565684 (0.9998)	4.835661 (1.0000)	5.756697 (1.0000)
	Group PP-Statistic	-11.03821 (0.0000)	-5.118213 (0.0000)	-14.52645 (0.0000)	Group PP-Statistic	-8.675348 (0.0000)	-3.783998 (0.0001)	-9.905541 (0.0000)	Group PP-Statistic	-10.01949 (0.0000)	-5.038534 (0.0000)	-14.37083 (0.0000)
	Group ADF-Statistics	-1.311398 (0.0949)	-1.357770 (0.0873)	-0.615894 (0.2690)	Group ADF-Statistics	-1.104818 (0.1346)	-0.665648 (0.2528)	-0.380166 (0.3519)	Group ADF-Statistics	-2.048960 (0.0202)	-1.244726 (0.1066)	-1.490498 (0.0680)
	KAO TEST				**KAO TEST**				**KAO TEST**			
	Kao ADF stats	-3.898587 (0.0000)	-2.225656 (0.0130)	-0.016062 (0.0358)	Kao ADF stats	-4.212372 (0.0000)	-1.792886 (0.0365)	-0.863094 (0.0482)	Kao ADF stats	-4.344722 (0.0000)	-2.305031 (0.0106)	-0.067475 (0.0231)

Table 5.73: Panel cointegration test results of Imports, Exports and Trade Balance (SADC)-Model 2

The previous tables show the panel cointegration test for the SADC trade bloc. The study starts with the interpretation of model 1. In regards to the imports model, the Pedroni test shows that for the benchmark of intercept only, the variables are cointegrated (only for the model with standard deviation and H-filter volatility measures) while for the benchmark of the intercept and trend, the null hypothesis of no cointegration is rejected except for the model with HP-Filter measure of volatility which instead confirms the existence of cointegration. The Pedroni test therefore reveals mixed results in regards to the imports model. Nevertheless, the Kao cointegration model shows that for all different measures of volatility, the variables are cointegrated at 5% significance level. This therefore permits the researcher to conclude that based on the results of the existence of cointegration by at least one of the test results, the study concluded that the variables move together in the long run. Model 2 display different results. The Pedroni test shows that the model with standard deviation and HP-Filter volatility measures (model with intercept only) accepts the null hypothesis of no cointegration. However, the model of intercept and trend rejects the null hypothesis of no cointegration (based on the majority of the results). However, the model with GARCH volatility measure (both intercept and intercept and trend) accepts the null hypothesis at 5% significance level. It is also observed that for all volatility measures, the Kao cointegration test rejects the null hypothesis of no cointegration at 5%. Based on these results, the study concludes that the imports model is cointegrated based on the results of the Kao cointegration test.

For the exports model as well, the Pedroni cointegration test display mixed results. In model 1, for both models of intercept and intercept and trend, while the model with standard deviation shows that the variables are not cointegrated, the model with GARCH and HP-Filter shows that the variables are cointegrated. In addition, for all the three volatility measures, the Kao test validates that at 5% significance level, the variables move together in the long run. The study therefore concludes that for the exports model, variables move together in the long run. Model 2 results indicate that the variables are not cointegrated at 5% significance level considering all measures of volatility. However, the Kao cointegration test indicates that the variables are cointegrated at 5% significance level. In lieu of this, the study therefore concludes that for the exports model, variables move together in the long run.

Likewise previous trade blocs, the econometric software could not compute the Pedroni cointegration test for the trade balance model in the case of SADC in model. Hence, only the test results for the Kao cointegration test are reported in the table. As established by the results, it is decided that there is an indication of a long run stable relationship between trade balance and other related explanatory variables at 10% significance for each unique volatility measures included in the estimation of the models. The Pedroni test was able to run in Model 2. The majority of the results of the Pedroni test show that the null hypothesis of no cointegration was accepted while the Kao test results indicate that the null hypothesis is rejected at 5%. Therefore, based on the evidence of cointegration at the 5% significance level, the study concludes that the variables are cointegrated.

With the evidence of a long run stable relationship found among the variables, the next step is the estimation of the long run cointegrating equation using the DOLS.

	STANDARD DEVIATION VOLATILITY MEASURE					GARCH VOLATILITY MEASURE					HP-FILTER VOLATILITY MEASURE				
	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob
IMPORTS MODEL	LGDP	0.932920	0.037450	24.91106	0.0000	LGDP	0.894702	0.036024	24.83608	0.0000	LGDP	0.928024	0.039650	23.40549	0.0000
	LNER	0.171646	0.027373	6.270551	0.0000	LNER	0.116199	0.020618	5.635862	0.0000	LNER	0.128231	0.023543	5.446635	0.0000
	INFL	-0.000109	5.35E-05	-2.027106	0.0438	INFL	-3.55E-05	4.37E-05	-0.812191	0.4175	INFL	-4.51E-05	4.48E-05	-1.004971	0.3160
	LM2	0.255973	0.070736	3.618689	0.0004	LM2	0.254947	0.051838	4.918158	0.0000	LM2	0.264045	0.056643	4.661556	0.0000
	VOL	0.243940	0.085688	2.846827	0.0048	VOL	1.27E-07	2.36E-08	5.397652	0.0000	VOL	-2.18E-05	0.000145	-0.150358	0.8806
	R-squared	0.988731				R-squared	0.989229				R-squared	0.988636			
	Adjusted R-squared	0.987373				Adjusted R-squared	0.987931				Adjusted R-squared	0.987267			
EXPORTS MODEL	LUSGDP	2.430398	0.209872	11.58041	0.0000	LUSGDP	2.267805	0.215078	10.54409	0.0000	LUSGDP	2.748523	0.184261	14.91649	0.0000
	LG7I	-2.006694	0.647437	-3.099442	0.0022	LG7I	-1.683287	0.613024	-2.745875	0.0065	LG7I	-1.597230	0.494198	-3.231966	0.0014
	LNER	-0.077411	0.036257	-2.135045	0.0338	LNER	-0.022648	0.034251	-0.661224	0.5091	LNER	-0.040423	0.028741	-1.406440	0.1610
	INFL	0.000308	7.08E-05	4.350142	0.0000	INFL	0.000223	5.86E-05	3.799680	0.0002	INFL	0.000150	5.02E-05	2.993443	0.0031
	LM2	0.019280	0.098475	0.195781	0.8450	LM2	0.150468	0.081030	1.856936	0.0646	LM2	0.136481	0.069395	1.966732	0.0504
	VOL	-0.342666	0.135066	-2.537026	0.0119	VOL	3.47E-08	4.03E-08	0.858774	0.3914	VOL	-6.36E-05	0.000184	-0.346406	0.7294
	R-squared	0.979469				R-squared	0.979784				R-squared	0.984766			
	Adjusted R-squared	0.976994				Adjusted R-squared	0.977347				Adjusted R-squared	0.982930			
TRADE BALANCE MODEL	LGDP	23.52768	12.17287	1.932796	0.0545	LGDP	10.40443	10.07911	1.032277	0.3031	LGDP	16.46607	11.67697	1.410132	0.1599
	LUSGDP	-66.87213	37.17265	-1.798961	0.0734	LUSGDP	-17.93177	32.02484	-0.559933	0.5761	LUSGDP	-60.06297	40.60569	-1.479176	0.1405
	LG7I	53.85505	67.26053	0.800693	0.4242	LG7I	-19.81139	59.52669	-0.332815	0.7396	LG7I	32.50691	63.87372	0.508925	0.6113
	LNER	14.77835	5.317538	2.779172	0.0059	LNER	9.127776	3.751174	2.433312	0.0157	LNER	10.99381	4.259311	2.581125	0.0105
	INFL	0.001257	0.007962	0.157897	0.8747	INFL	0.009025	0.005553	1.625164	0.1055	INFL	0.012162	0.005909	2.058013	0.0407
	LM2	-32.47354	12.00699	-2.704552	0.0074	LM2	-35.55166	7.243679	-4.907956	0.0000	LM2	-35.57831	7.977480	-4.459844	0.0000
	VOL	23.76533	14.41038	1.649181	0.1005	VOL	-3.33E-07	3.57E-06	-0.093453	0.9256	VOL	-0.012157	0.019966	-0.608860	0.5432
	R-squared	0.777129				R-squared	0.807376				R-squared	0.799810			
	Adjusted R-squared	0.750265				Adjusted R-squared	0.784158				Adjusted R-squared	0.775680			

Table 5.74: DOLS estimates of Imports, Exports and Trade Balance models (SADC)-Model 1

	STANDARD DEVIATION VOLATILITY MEASURE					GARCH VOLATILITY MEASURE					HP-FILTER VOLATILITY MEASURE				
	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob	Variable	Coefficient	S.Error	T-stat	Prob
IMPORTS MODEL	LGDP	0.812024	0.042582	19.06944	0.0000	LGDP	0.788885	0.039474	19.98479	0.0000	LGDP	0.814860	0.045823	17.78293	0.0000
	INFL	-2.27E-06	6.44E-05	-0.035208	0.9719	INFL	-5.55E-05	3.42E-05	-1.619765	0.1067	INFL	-5.84E-05	4.03E-05	-1.450612	0.148
	LM2	0.613612	0.076954	7.973707	0.0000	LM2	0.492182	0.063691	7.727639	0.0000	LM2	0.553743	0.074053	7.477645	0.0000
	VOL	-0.166582	0.099795	-1.669235	0.0965	VOL	1.79E-07	3.20E-08	5.586736	0.0000	VOL	0.000124	0.000212	0.585524	0.5588
	R-squared	0.977014				R-squared	0.978762				R-squared	0.974381			
	Adjusted R-squared	0.974243				Adjusted R-squared	0.976202				Adjusted R-squared	0.971294			
EXPORTS MODEL	LUSGDP	2.600057	0.245100	10.60815	0.0000	LUSGDP	2.619865	0.243344	10.76610	0.0000	LUSGDP	2.643445	0.216413	12.21484	0.0000
	LG7I	-2.026824	0.784138	-2.584781	0.0104	LG7I	-1.837162	0.759191	-2.419896	0.0163	LG7I	-2.501393	0.701853	-3.563985	0.0004
	INFL	0.000207	8.32E-05	2.487513	0.0136	INFL	1.30E-05	4.88E-05	0.265624	0.7908	INFL	-4.02E-05	4.89E-05	-0.821069	0.4125
	LM2	-0.032587	0.112969	-0.288454	0.7733	LM2	0.134321	0.094793	1.416990	0.1579	LM2	0.013479	0.096114	0.140241	0.8886
	VOL	-0.370382	0.124928	-2.964750	0.0034	VOL	1.16E-08	4.91E-08	0.236170	0.8135	VOL	-1.85E-05	0.000254	-0.072869	0.9420
	R-squared	0.972789				R-squared	0.972597				R-squared	0.975553			
	Adjusted R-squared	0.969509				Adjusted R-squared	0.969293				Adjusted R-squared	0.972606			
TRADE BALANCE MODEL	LGDP	12.58894	7.820602	1.609715	0.1089	LGDP	5.966674	7.213021	0.827209	0.4090	LGDP	11.39351	7.765855	1.467128	0.1437
	LUSGDP	-21.98414	29.05402	-0.756664	0.4500	LUSGDP	12.33595	25.27954	0.487982	0.6260	LUSGDP	-12.56242	26.99406	-0.465377	0.6421
	LG7I	38.86151	68.50541	0.567277	0.5711	LG7I	-22.86722	61.27796	-0.373172	0.7094	LG7I	33.92832	66.83436	0.507648	0.6122
	INFL	-0.004918	0.007373	-0.666997	0.5055	INFL	0.001802	0.003390	0.531653	0.5955	INFL	0.004023	0.004031	0.998050	0.3193
	LM2	-20.97655	12.28650	-1.707285	0.0892	LM2	-34.46233	7.692973	-4.479715	0.0000	LM2	-33.37538	8.796685	-3.794086	0.0002
	VOL	10.44647	11.51579	0.907144	0.3653	VOL	-1.63E-06	3.70E-06	-0.440899	0.6597	VOL	-0.003332	0.022910	-0.145453	0.8845
	R-squared	0.740403				R-squared	0.774161				R-squared	0.752015			
	Adjusted R-squared	0.709113				Adjusted R-squared	0.746940				Adjusted R-squared	0.722124			

Table 5.75: DOLS estimates of Imports, Exports and Trade Balance models (SADC)-Model 2

The DOLS of the imports, exports and trade balance models were estimated taking into consideration each distinctive measure of volatility. Starting with the imports model, it is observed that for this trade bloc, the coefficient of determination is very high in both models 1 and 2 which denote that imports are undeniably very well explained by the associated independent variables. Similarly to the cases of previous trade blocs, this section will not provide a thorough interpretation of all the coefficients as the core goal is to depict the impact of exchange volatility on the distinct components of trade. The dissimilarities associated while using the distinct measures of volatility in the estimation of the models are also taken into account. Thus, the impact of exchange rate volatility on imports, exports and trade balance is the main focus in this section in addition to depicting whether the results of the estimation are affected by the type of volatility measure used.

The results of the imports model show conflicting results on the effects of exchange rate volatility on imports considering each model specification. In model 1, the outcome of the analysis indicates that the model measuring volatility by standard deviation and GARCH show a positive relationship while volatility measured by HP-Filter show a positive relationship. However, only volatility measured by standard deviation and GARCH display statistical significant coefficients. With regards to this, the study concludes that as exchange rate volatility increases by a percentage, imports also increase by 0.24% and 1.27E-07 respectively. Model 2 on the other hand indicates that only the model estimated with GARCH volatility measure shows a statistically significant coefficient. Therefore, the study establishes that as exchange rate increases by 1%, imports increases by 1.97E-07%. The outcome also indicates that the results clearly differ as per volatility measure used in the estimation of the respective models.

In regards to the exports model, the high coefficient of determination R^2 also directs that the exports model is well explained by the respective explanatory variables in SADC trade bloc. In both model specification (1 and 2), the results of the analysis indicates that while models with standard deviation and HP-Filter measures display a negative, the model with GARCH volatility measure indicates a positive relationship. It should be noted that for both model 1 and 2, only model with standard deviation as the volatility shows a significant relationship. This therefore permits the researcher to conclude that for model 1 and 2, as exchange rate increases by 1%, exports decreases also by 0.34% and 0.37% respectively.

The high coefficient of determination shown in the trade balance model also indicates that the trade balance model is well explained by the explanatory variables. The variable of interest that is exchange rate volatility display similar effects for each of the model specified. Each measure of volatility shows non-statistical significant relationship. Hence, the study concludes that there is no statistical significant relationship between exchange rate volatility and exports in SADC trade bloc. Similarly to other models, resulting from the differences in the degree of the coefficients, it is established that the outcomes of the results are truly determined by the nature of the volatility approach used in the estimation of the models.

To review, it was shown that the results of the estimation are different for each model specification. Considering the results of Model 2 as the appropriate model, it was therefore established that there is a significant relationship between exchange rate volatility and imports. In addition, the study recognized that as exchange rate volatility increases, exports will be negatively affected. Lastly, trade balance showed no significant relationship between exchange rate volatility and trade balance.

5.4 Conclusion

This chapter provided a detailed empirical analysis of the impact of exchange changes as well as volatility on trade. Specifically, trade was divided into its main components of imports, exports and trade balance, and their respective response to exchange rate changes and volatility were empirically tested. Furthermore, a separate analysis was conducted by sub-dividing SSA into unique trade blocs and examining in great detail how they respectively respond to changes in exchange rate and volatility. Panel data models and panel cointegration models were used to build the model of imports, exports and trade balance respectively in a sample of 39 countries in SSA. Regarding the impact of exchange rate volatility on trade, three measures of volatility was used, namely the traditional standard deviation approach, the GARCH and the HP-Filter approaches. The outcome of this study reveals mixed results regarding the nature of the volatility measure used.

CHAPTER 6

CONCLUSION, POLICY IMPLICATIONS AND RECOMMENDATIONS

6.1 Introduction

At a macroeconomic level, deficits as well as surpluses in trade are occasionally attributed to deliberate high or low level of exchange rates. Hence, understanding the influence of exchange rate movements as well as its volatility on trade is therefore of great cognizance to both researchers and policymakers specifically in this present time of global imbalances. However, current studies examining these relationships have not been convincing enough regarding the precise impact of exchange rate changes as well as volatility on trade with specific concentration on Sub-Saharan Africa. Against this backdrop, the main objective of this thesis was to provide an empirical examination of the impact of exchange rate changes and its volatility from the perspective of imports, exports and trade balance. Compared to other studies, this study has really differentiated itself in many points.

This study provides an analysis of the affiliation between exchange rate changes on one hand and exchange rate volatility on the other hand on trade in Sub-Saharan Africa. This study has contributed enormously in the literature as there is still conflicting evidence as to what is the accurate effect of exchange rate changes and volatility on trade. The literature has revealed numerous flaws in the context of this study. The literature has exposed that there is still confusion in regards to the two concepts of exchange rate changes and volatility. As it was indeed explained in the preceding chapters, exchange rate changes imply fluctuations or movements in exchange rates while on the other hand, exchange volatility signifies that it is being unstable, uncertain overtime. So, the literature has revealed that these two distinct concepts are being theoretically and empirically misused. Thus, this study aimed at bringing a proper distinct analysis of the two concepts by bringing out a separate analysis of exchange rate changes on trade and exchange rate volatility on trade.

One of the objectives of this study was to examine the effects of exchange rate changes on the distinct components of trade which are imports, exports and trade balance. The literature has shown that majority of the studies have shown more interest into analyzing both exchange rate fluctuations and volatility on exports, while others concentrated only on trade balance and a few on imports. In this study, all components of trade that is, imports, exports and trade balance were all empirically examined so that through this study, one could be able to depict how they are separately affected by exchange rate fluctuations as well as volatility in Sub-Saharan Africa.

Thirdly, in regards to other studies, this study stands among the very few related studies to do such a large data set analysis in Africa. Concerning the impact of exchange rate volatility and trade, the various measures of volatility utilized in previous studies have received a bit of criticism and it has been argued that the results of the analysis typically depends on the type of volatility measure used. In this regard, this study employed three measures of volatility namely the standard deviation, the GARCH and the HP-Filter measures. It should be noted that this study is the first of its kind to use the HP-Filter as a volatility measure and the essence of utilizing all these measures is to be able to depict how these measures differ to each other and to examine their robustness. Explicitly, the main essence of utilizing these volatility measures is to get a clearer picture of the results and illustrate if the outcome of the regression results are dependent of the volatility measure used in the analysis.

The countries under investigation in this study are very significant in the sense it also stands among the limited studies to consider analyzing trade effects of exchange rate fluctuations and volatility in Sub-Saharan Africa. Furthermore, considering the fact that Sub-Saharan Africa consists of separate distinct trade blocs, this study provides a comparative analysis of the effects of exchange rate changes and volatility on trade between these different trade blocs of Sub-Saharan Africa and this stands to the best of our knowledge as the first of its kind to consider such a great comparison.

Finally, this study deals with the methodology of the panel data analysis. Several studies have shown more interest in analyzing the relationship between exchange rate changes and volatility on trade in a single-country framework. In regard to this, this study differs from the common methodology of time series used in the literature and used the panel data methodology which is a combination of both time-series and cross-sections.

This study uses annual data for 39 countries over the period 1995 to 2012, thus consisting of 702 observations. The imports, exports and trade balance models have been discussed in detail in the preceding chapters as well as the related explanatory variables. The summary of the results are therefore presented in the following section.

6.2 Summary of Findings

The key findings from the empirical analyses are presented as follows. Firstly, the study starts by summarizing the results with the general analysis of the impact of exchange rate changes and volatility on trade in the entire SSA (where all the 39 countries of SSA used in this study were grouped together and analyzed). Following that, the summary of the results of the comparative analysis (where the countries are grouped into 4 distinct trade blocs) will be presented.

As the main variable of this study, the results of the analysis suggested that a depreciation of the respective currencies in the entire SSA will lead to an increase in its imports. This finding was not consistent with economic theory which hypothesized that depreciation in domestic currency will cause imports to decrease. Though unexpected, the positive relationship was attributable to the fact that the vast majority of countries in SSA are underdeveloped and therefore tends to be heavily dependent on foreign imports. Being small in size, the local production of majority of SSA countries is not sufficient to cater for local demand, and will therefore have to lean on foreign markets. That said, the study concluded that the fact that SSA imports are mostly essential (food, machineries, hydrocarbon products) will mean that a depreciation of the exchange rate will not always cause a decrease in the imports, unless exports are further boosted. These results clearly portray that there is inconsistency between the theoretical foundation and the empirical findings. In line with economic theory, it was also affirmed that domestic income, money supply and inflation positively contribute to the increase in imports in SSA.

With regard to the export model, the outcome of the analysis could not justify the evidence of a statistical significant relationship between exchange rate changes and exports in SSA. Moreover, the analysis supported the assertion fact that as the income of trading partners increase (USA was taken in this study as one of the major trading partners of SSA); exports will be encouraged in SSA. On the other hand, the production index of advanced economies also used as a proxy to account for foreign income was found to have a negative relationship with exports. This negative relationship implies that as production index of advanced economies increase, exports decreases in SSA. The results also confirm the evidence of a significant negative relationship between money supply and inflation and exports. In other terms, it was confirmed that as inflation and money supply increases in the economy, exports will dampen.

Turning to the trade balance model, the theory of the Marshall-Lerner condition was found to hold in this study. The Marshall-Lerner condition advocates that as exchange rate depreciates, trade balance will improve. This assertion was justified in this study as the results supported that as exchange rate depreciates, trade balance will improve. In addition, the study also confirms the existence of a significant positive relationship between the income of trading partners and money supply. Moreover, a significant negative relationship was found to exist between domestic income, G7 production index, inflation and trade balance.

Concerning the effects of exchange rate volatility on trade, three distinct measures of volatility were used in this study. The three measures of volatility used in this study were the two common measures namely the standard deviation and the GARCH measures in addition to the HP-Filter volatility measure. As formerly noted, this study stands among the very few related studies to use the HP-Filter volatility measure. Two model specifications were used to investigate the effects of exchange rate volatility on trade. The first model included both exchange rate and volatility measures. The second model specification excluded exchange rate as a variable. The main idea of specifying these two models was to eradicate the problem of serial correlation which may arise of having exchange rate and volatility as variables in a single model. Therefore, Model 2 (model specification with exchange rate volatility only) was preferred compared to model 1 (model specification with both exchange rate and volatility). In lieu of this, the final conclusion will rely on the estimates of model 2.

The results of the analysis revealed mixed signs per measure of volatility used in the imports model. While the model with standard deviation volatility shows a negative relationship, the model with GARCH and HP-Filter show a positive relationship. All the coefficients were found to be significant except for exchange rate volatility measured by the HP-Filter approach. It was therefore concluded there is a positive and negative relationship between exchange rate volatility and imports when volatility is measured by GARCH and standard deviation approaches respectively. The differences produced by the results allow the study to conclude that the outcome of the results is particularly dependent upon the measure of volatility used.

The results of the exports model indicate that despite the measure of volatility used, as exchange rate volatility increases, exports will decrease. With regards to the significant coefficients, the results concluded that there is a significant negative relationship between exchange rate volatility and exports with volatility measured by standard deviation and HP-Filter. In addition, the results of trade balance suggest the evidence of no significant relationship between exchange rate volatility and trade balance. This was confirmed by the non-statistically coefficients of all three volatility measures.

One of the main aims of this thesis was also to provide a comparative analysis of the impact of exchange rate changes and volatility on trade between the distinct trade blocs of Sub-Saharan Africa. It was noted that the main essence of doing such a comparative analysis was to investigate in details if considering the distinct trade blocs of Sub-Saharan Africa, how is trade respondent to exchange rate changes and volatility. The trade blocs considered in this study are the EAC, CEMAC, ECOWAS and SADC trade blocs respectively. The unit root tests were conducted for each of the regions and based on the majority of the results, the variables were found to be non-stationarity. On the evidence of non-stationarity of the variables, cointegration tests by Pedroni and Kao were conducted for all models of imports, exports and trade balance in examining the effects of exchange rate changes and volatility on trade. The results confirmed the evidence of cointegration for all models of imports, exports and trade balance. In lieu of this, as the literature supports the estimation of the long run estimation using the DOLS compared to the FMOLS, the DOLS long run equation was therefore estimated for all regions to be able to capture how imports, exports and trade balance respond to exchange rate movements and volatility.

The results of the analysis confirm that trade was observed to respond differently per trade bloc considered in this study. In regard to the imports model, the study confirms the evidence of no statistical significant relationship between exchange rate changes and imports in ECOWAS. On the other hand, EAC, CEMAC and SADC trade blocs were found to display significant coefficients. While the coefficient for the EAC and SADC display a positive relationship, the coefficient for CEMAC instead displayed a negative relationship. The positive connection between exchange rate depreciation and imports in EAC and SADC was again ascribed to the high dependence of these countries on imports, as they tend to be very essential for their survival. As a result, even in an event of a depreciation of their exchange rates, imports are still bound increase. The study also found evidence of a no significant relationship existing between money supply and imports in EAC and CEMAC. For

ECOWAS and SADC trade blocs, the study sustains the argument that as money supply increase, imports also escalate.

The results of the exports model revealed that except for the ECOWAS trade bloc, there is a statistical significant negative relationship between exchange rate changes and exports. As well as being contrary to economic theory, the study highlighted that these findings may be explained by the fact that the countries' export base are likely to be undiversified and may suffer from poor quality produces. Hence, even in an incident of a depreciation in their exchange rate, if the countries' exports ae not solicited by foreign demand, exports are likely to decrease. Furthermore, the study explained that plunging commodity prices in past years experienced by most countries in past years may explain this negative relationship, as majority of the countries' exports appear to be raw in nature.

The results also justify the hypothesis that as the income of the trading partner's increases, exports in all trade blocs also increase simultaneously. This is particular true with foreign income proxied by US GDP which account for one of the major trading partners for the majority of countries in SSA. However, similar to the general analysis, a different direction was observed in regards to the G7 production index which instead display an unexpected negative relationship. Apart from the insignificant coefficient observed in CEMAC, it is concluded that as LG7I increases, exports decreases accordingly in EAC, ECOWAS and SADC. In regard to money supply, no significant effect was found in EAC and SADC regions but for the two remaining trade blocs (CEMAC and ECOWAS); a negative significant relationship was established as hypothesized by the theory.

Turning to the trade balance model, there was no significant effect found between exchange rate changes and trade balance in CEMAC trade bloc. The Marshall-Lerner theory was seen not to hold in this study particularly for EAC as it was observed from the results that as exchange rate depreciates, trade balance instead decreases. On the other hand, ECOWAS and SADC trade blocs instead indicate as currency depreciates, trade balance will improve. In lieu of this, the study concludes that the Marshall-Lerner theory was found to hold in the case of ECOWAS and SADC regions.

Regarding the results of the comparative analysis of the effects of exchange rate volatility on trade between the regions of SSA, only the effects of the variable of interest (exchange rate volatility) is reported. The panel cointegration tests by Pedroni and Kao were conducted and the results confirmed the evidence of cointegration for all models of imports, exports and trade balance. In lieu of this, the DOLS long run equation was therefore estimated for all trade blocs to capture how imports, exports and trade balance respond to exchange rate volatility.

The results of the imports model show that for EAC trade bloc, there is no significant effects of exchange rate volatility on imports. It was also shown that the results of the analysis differ upon the volatility measure used. In regards to the exports model, the outcome of the analysis revealed the evidence of a significant negative relationship between exchange rate volatility (HP-Filter measure) and exports. Volatility measured by standard deviation and GARCH were insignificant. Likewise previous models, the trade balance model also shows non-consistent results. The results confirm that as exchange rate volatility increases, trade balance decreases in EAC trade bloc. However, the volatility measured by GARCH and HP-Filter reveal no significant effects. Only the volatility measured by the standard deviation approach display a significant coefficient. Resulting from the differences in the magnitude of the coefficients, the study concludes that the results are indeed determined by the type of the volatility measure used in the estimation of the models.

Likewise the EAC trade bloc, there was no significant relationship found between exchange rate volatility and imports. Regarding the exports model, the model shows that exports respond negatively to exchange rate volatility. However, only the GARCH and HP-Filter volatility measures were significant. In lieu of this, with volatility measured by GARCH and HP-Filter, the study concludes that when exchange volatility increases, exports decreases accordingly in CEMAC. The results of the trade balance model exposed that in CEMAC trade bloc, trade balance are not significantly affected by exchange rate volatility.

The results of the imports model in ECOWAS trade bloc revealed that there was no significant effect of exchange rate volatility measured by standard deviation and HP-Filter on imports. Nevertheless, the evidence of a significant positive relation was supported between exchange rate volatility measured by GARCH approach and imports. With regards to the exports model, when volatility is measured by standard deviation, the analysis of the results revealed that there is a significant negative relationship with exports. It is noted that the other volatility measures revealed insignificant coefficients. The relationship between exchange rate volatility and trade balance in ECOWAS countries is ambiguous as some volatility measures divulge a positive relationship (standard deviation and HP-Filter) while other measures (GARCH) display a negative relationship. Nevertheless, only the HP-Filter appears to be significant. Hence, the conclusion, as exchange rate volatility increases, trade balance also increase considering exchange rate volatility measured by the HP-Filter approach.

For the SADC trade bloc, the results of the imports model also indicate inconsistent results concerning the effects of exchange rate volatility on imports. Explicitly, the results of the analysis divulge that with volatility measured by the standard deviation and HP-Filter approaches, there is no significant effect on imports. Conversely, the results portray that when volatility measured by GARCH approach increases, SADC imports are seen to be significantly positively affected. No significant relationship was found to exist between exchange rate volatility (GARCH and HP-Filter) but the study confirms the evidence of a significant negative relationship between exchange rate volatility (standard deviation) and exports. Detecting the dissimilarities in the magnitude of the coefficients, it is again confirmed that the results of the analysis are determinant of the measure of volatility. For the trade balance model, despite the measure of exchange rate volatility used, there was no evidence of a significant relationship between exchange rate volatility and exports.

6.3 Policy Implications and Recommendations

With the summary of the results done, now the interrogation is what can be drawn from this study in terms of policy implications. The outcome of this study therefore provides important policy implications to policy makers in SSA and they are listed as follows.

There was strong evidence from the results that a depreciation of exchange rate in SSA cause imports to increase, underpinned by the fact that these countries tend to be heavily reliant on foreign goods. One the policy approaches that should be pursued by each government is strategies that could imports. Cognisant of the difficulty of SSA countries to depend less on imports, this study recommends that policy makers should focus on strategies that will boost the local production of these essential goods. By boosting production, local demand will also be met, and will as well translate to less dependence on foreign markets.

It was also apparent from the results that increase in domestic income will boost imports in the entire SSA. Therefore, in an attempt to improve balance of payments, authorities of the respective SSA countries should focus on strategies to boost their GDP so as to maintain their imports at a considerable level. However, it is advisable that policy makers should monitor this strategy closely so that imports should not increase faster than exports. If the increase in imports is higher than the increase in exports, this will cause deterioration in the trade balance. It therefore follows that policy makers in SSA should pay closer attention to strategies which will ensure that the increase in imports does not deteriorate the balance of payments.

The results of the analysis justified that the coefficient of exchange rate changes was not statistically significant in affecting exports in SSA. The positive relationship found between USGDP and SSA exports demonstrates that SSA exports will proliferate in proportion with the GDP of their trading partners (USA). It is therefore advisable for SSA countries to engage in trading activities with countries that sustain high level of economic growth (this is usually the case with developed economies). The results confirm that as the production index in advanced economies increases, exports in the entire SSA will instead drop. The result of this coefficient gives light to policy makers in a sense that, as SSA rely upon these advanced economies to prosper, they face a high probability of being exposed to shocks encountered by these advanced economies. This means that as they partner, depend and engage in their major trading activities with these economies, they will also become very vulnerable when these respective economies face some turmoil. The negative relationship experienced in this study could be particularly due to the fact that these respective G7 countries (Canada, France, Germany, Great Britain, Japan, Italy and the US) greatly suffered the consequences of the global financial crisis and to a lesser extent the Eurozone debt crisis and this was translated to majority of the countries of SSA that are dependent on trade with these countries. In lieu of this it therefore advisable that SSA broaden their horizons in regards to their trading partners so as to avoid absorbing the shocks faced by these advanced economies.

The results of the trade balance model justify that as exchange depreciates, trade balance will improve. An improvement in SSA trade balance means that imports are lesser than exports which indicate that SSA countries are exporting more than they are importing. The results therefore justify that exchange rate depreciation have a very great role to play in improving SSA trade balance. In lieu of this, the fact that exchange rate depreciation contributes to the increase in trade balance implies that policy makers in SSA should give particular attention to strategies that will keep their currency competitive as it is seen that it will very useful in maintaining a positive balance of payment/trade surplus. This could be done by properly applying very judicious monetary, fiscal as well as exchange rate policies. Furthermore, it is essential for these countries to diversify their export base, as well as improving the quality of the exported products, as this will continue to attract foreign demand.

In regards to the impact of exchange rate volatility on imports, exports and trade balance, it was shown from the results that the three measures of volatility used in the estimation of the models have distinct results. While a measure displays a negative relationship, other will show a positive relationship while another will show insignificant results. However, the majority of the results show that exchange rate volatility negatively affects trade. In lieu of this, it is can be ascertain that SSA trade is very susceptible to higher exchange rate uncertainty. Hence, it is suggested that SSA countries respective policy makers should adopt macroeconomic policies that will enable them to maintain a stable exchange rate environment as this is important in order to maintain the growth of trade. This is particularly recommended for the reason that maintaining a stable exchange rate guarantees confidence/certainty. In doing so, this will create an environment that will attract investment to SSA and thereby increase the country's wealth.

There was evidence of a significant positive relationship between exchange rate and imports in both EAC and SADC trade blocs. While this was contrary to economic theory, the results suggest that exchange rate is not an efficient tool to curb imports in SSA, bearing in mind that these imports are indispensable to their survival. Hence, this study recommends that countries in both the EAC and SADC should adopt measures that will boost local manufacturing, which will cater local consumption. This in turn will reduce the countries' dependence on imports.

Similar to the results of the general analysis (entire SSA), the model of exports shows that for all trade blocs, the income of the trading partners plays a great role in affecting the level of exports of exports. This therefore accentuates the importance of countries in SSA to partner with countries that portray positive macroeconomic growth prospects. This also imply that it is important for countries in these trade blocs to maintain their exports competitive by producing high quality products that will attract countries to buy their goods. Except for CEMAC, the production index of advanced economies shows a significant negative relationship with exports. This scenario was not as expected from the theory. As explained in the case of the general analysis which also displayed a negative relationship, it was advocated that the dependence of most SSA countries on advanced economies make them vulnerable to negative shocks experienced in these economies. Hence, it therefore prudent for countries comprising these respective trade blocs to consider broadening their horizons in regards to their trading partners.

For ECOWAS and SADC trade blocs, the results have indicated that as exchange rate depreciates, trade balance will increase. This therefore suggests to policy makers that to maintain to positive balance of trade, ECOWAS and SADC should give particular attention to strategies that will keep their exchange rate as well as their exports competitive.

With regard to the impact of exchange rate volatility on imports, the results display mixed results. While some are negative, others are positive, while others are insignificant. But the summary of the results show that exchange rate volatility dampen trade per trade bloc studied.

Consistent results of a negative relationship between exchange rate volatility and exports were found in all trade blocs. This therefore advocates that careful attention should be given to exchange rate volatility as it is very important in modelling exports in these respective trade blocs. Based on these results, it is therefore recommended that any trade strategies instigated by respective countries in EAC, CEMAC, ECOWAS and SADC that improve exports could show ineffective if exchange rates are volatile. Hence, if policy makers ignore the volatility of exchange rates, policy actions aimed at stabilizing exports markets are likely to generate uncertain results. It is therefore important for countries encompassing these trade blocs to maintain stable exchange rates in order to promote their exports. In addition, policies aimed at reducing exchange rate volatility should be given attention. The study recommends enhanced hedging instruments that will help lighten volatility. Regarding this, this thesis notes the study conducted by Aizenmen et *al.* (2012) who noted that exchange rate volatility reducing policies generally go together with expenses comprising those linked with accruing a high level of international reserves. The existence of well-developed financial markets should allow agents to hedge exchange-rate risk, thus dampening or eliminating its negative effects on trade.

It has been evident from the results that the three measures of exchange rate volatility used in this model were each unique in explaining imports, exports and trade balance respectively. Following the mixed results encountered for each measure of volatility used, it is suggested that researchers should consider each volatility measure in their respective model estimation.

6.4 Areas for Future Research

The global economic environment is changing rapidly which implies that the drivers of imports and exports are also changing as well. Future studies should therefore give attention to other possible determinants of imports and exports that were not included in the estimated model.

In view of the fact that this study used nominal exchange rate because of lack of data on real exchange rates, future studies should consider calculating real exchange rates. This should be done so that researchers could be able to depict if there are differences in the outcome of the empirical results when using either nominal or real exchange rates.

Considering the fact that not all countries in SSA used the floating exchange rate system, future research should consider doing a comparative analysis of countries using the fixed exchange rate system versus countries adopting the floating exchange rate system.

Methodologically based, it is evident that three approaches in measuring exchange rate volatility differ. Based on the fact that these measures differ to each other and the literature is silent in regards to the best measure, hence, future studies should not only rely on one volatility estimate in the analysis for this might cause biased and unreliable estimates.

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APPENDICES

APPENDIX A: Cross-section fixed effects for imports

COUNTRIES	EFFECTS
Angola	0.323316
Burundi	-0.389206
Benin	-0.262602
Burkina F	-0.276166
Botswana	0.222926
Central A Rep	-0.346383
Cote d'Ivoire	-0.093586
Cameroon	-0.267608
Congo republic	0.114250
Congo Demo	-0.029060
Comoros	-0.213304
Cape Verde	-0.030509
Ethiopia	0.021157
Gabon	-0.129445
Ghana	0.393289
Guinea	-0.257783
Gambia	0.039481
Guinea EQ	0.530491
Kenya	-0.068122
Lesotho	0.587088
Madagascar	-0.165921
Mali	-0.145042
Mozambique	0.115089
Mauritius	0.151637
Malawi	0.063110
Namibia	0.269854
Niger	-0.137790
Nigeria	-0.128491
Sudan	0.062822
Senegal	-0.099328
Sierra Leone	-0.375903
Swaziland	0.482840
Seychelles	0.304145
Chad	-0.009914
Togo	-0.063406
Tanzania	-0.213566
Uganda	-0.310878
South Africa	0.094972
Zambia	0.237546

APPENDIX B: Cross-section fixed effects for exports

COUNTRIES	EFFECTS
Angola	1.044501
Burundi	-1.207148
Benin	-0.241517
Burkina F	-0.416744
Botswana	0.238635
Central A Rep	-0.847754
Cote d'Ivoire	0.712547
Cameroon	0.315239
Congo republic	0.411826
Congo Demo	0.213402
Comoros	-1.433507
Cape Verde	-0.713193
Ethiopia	0.047356
Gabon	0.499155
Ghana	0.417156
Guinea	-0.161696
Gambia	-0.931030
Guinea EQ	0.233393
Kenya	0.508798
Lesotho	-0.473245
Madagascar	-0.011882
Mali	-0.062215
Mozambique	-0.031986
Mauritius	0.430303
Malawi	-0.305880
Namibia	0.259004
Niger	-0.434227
Nigeria	1.332683
Sudan	0.257501
Senegal	0.165923
Sierra Leone	-0.822802
Swaziland	-0.002856
Seychelles	-0.512405
Chad	-0.160895
Togo	-0.283143
Tanzania	0.266058
Uganda	-0.042267
South Africa	1.601211
Zambia	0.141702

APPENDIX C: Cross-section fixed effects for trade balance

COUNTRIES	EFFECTS
Angola	7.916018
Burundi	5.363352
Benin	-6.105802
Burkina F	-9.934127
Botswana	20.41100
Central A Rep	7.260242
Cote d'Ivoire	17.19404
Cameroon	-6.764766
Congo republic	28.74718
Congo Demo	-20.76743
Comoros	23.22411
Cape Verde	16.52482
Ethiopia	-15.10645
Gabon	21.47562
Ghana	-13.06267
Guinea	-8.497424
Gambia	20.60734
Guinea EQ	9.793810
Kenya	-23.53630
Lesotho	14.44614
Madagascar	-13.69364
Mali	-9.665614
Mozambique	-6.645790
Mauritius	4.124172
Malawi	-1.181936
Namibia	1.895007
Niger	-6.716480
Nigeria	-6.292111
Sudan	-11.83045
Senegal	-15.14756
Sierra Leone	-0.684849
Swaziland	7.153237
Seychelles	26.39999
Chad	-2.307647
Togo	1.311523
Tanzania	-23.45566
Uganda	-21.59825
South Africa	-16.86984
Zambia	6.017194

APPENDIX D: Cross-section random effects for imports

COUNTRIES	EFFECTS
Angola	0.295975
Burundi	-0.346250
Benin	-0.232814
Burkina F	-0.243360
Botswana	0.163714
Central A Rep	-0.307716
Cote d'Ivoire	-0.066734
Cameroon	-0.230975
Congo republic	0.144229
Congo Demo	-0.006271
Comoros	-0.186290
Cape Verde	-0.046127
Ethiopia	-0.023289
Gabon	-0.095800
Ghana	0.300156
Guinea	-0.194160
Gambia	0.009940
Guinea EQ	0.559514
Kenya	-0.079888
Lesotho	0.526543
Madagascar	-0.117876
Mali	-0.116612
Mozambique	0.083666
Mauritius	0.108721
Malawi	0.060083
Namibia	0.211800
Niger	-0.099713
Nigeria	-0.129173
Sudan	0.003354
Senegal	-0.073426
Sierra Leone	-0.311820
Swaziland	0.429635
Seychelles	0.238792
Chad	0.027609
Togo	-0.037846
Tanzania	-0.173520
Uganda	-0.256480
South Africa	0.032607
Zambia	0.179800

APPENDIX E: Cross-section random effects for exports

COUNTRIES	EFFECTS
Angola	1.032779
Burundi	-1.191422
Benin	-0.232883
Burkina F	-0.406739
Botswana	0.222019
Central A Rep	-0.835001
Cote d'Ivoire	0.716949
Cameroon	0.322738
Congo republic	0.418865
Congo Demo	0.216494
Comoros	-1.420419
Cape Verde	-0.713413
Ethiopia	0.034730
Gabon	0.505662
Ghana	0.390379
Guinea	-0.144294
Gambia	-0.935269
Guinea EQ	0.242538
Kenya	0.503450
Lesotho	-0.485286
Madagascar	0.001271
Mali	-0.054224
Mozambique	-0.040206
Mauritius	0.418332
Malawi	-0.305399
Namibia	0.243046
Niger	-0.422657
Nigeria	1.325930
Sudan	0.238815
Senegal	0.172579
Sierra Leone	-0.802994
Swaziland	-0.015977
Seychelles	-0.526255
Chad	-0.150200
Togo	-0.274474
Tanzania	0.275601
Uganda	-0.028036
South Africa	1.577913
Zambia	0.125056

APPENDIX F: Cross-section random effects for trade balance

COUNTRIES	EFFECTS
Angola	10.55207
Burundi	2.785439
Benin	-5.844701
Burkina F	-9.003540
Botswana	18.76187
Central A Rep	4.574521
Cote d'Ivoire	20.28117
Cameroon	-2.980800
Congo republic	28.59122
Congo Demo	-16.69098
Comoros	16.35009
Cape Verde	11.25341
Ethiopia	-13.90113
Gabon	22.90189
Ghana	-13.05490
Guinea	-7.051256
Gambia	13.71658
Guinea EQ	8.853193
Kenya	-19.66402
Lesotho	8.435410
Madagascar	-11.62870
Mali	-8.687050
Mozambique	-7.262120
Mauritius	3.125202
Malawi	-2.897395
Namibia	0.176150
Niger	-6.792448
Nigeria	1.468745
Sudan	-10.04754
Senegal	-12.87341
Sierra Leone	-1.679865
Swaziland	3.090170
Seychelles	18.67143
Chad	-1.701263
Togo	-0.243529
Tanzania	-19.15035
Uganda	-17.74647
South Africa	-9.341241
Zambia	4.654155

APPENDIX G: Cross-section fixed effects for imports-Model 1

Standard Deviation volatility		GARCH Volatility		HP-Filter volatility	
COUNTRIES	**EFFECTS**	**COUNTRIES**	**EFFECTS**	**COUNTRIES**	**EFFECTS**
Angola	0.320564	Angola	0.324978	Angola	0.321728
Burundi	-0.391912	Burundi	-0.386344	Burundi	-0.387128
Benin	-0.266516	Benin	-0.256531	Benin	-0.261543
Burkina F	-0.280064	Burkina F	-0.271371	Burkina F	-0.275489
Botswana	0.232114	Botswana	0.224282	Botswana	0.221451
Central A Rep	-0.349239	Central A Rep	-0.342846	Central A Rep	-0.344933
Cote d'Ivoire	-0.098406	Cote d'Ivoire	-0.088375	Cote d'Ivoire	-0.093726
Cameroon	-0.272001	Cameroon	-0.265063	Cameroon	-0.267801
Congo republic	0.110579	Congo republic	0.117116	Congo republic	0.114799
Congo Demo	-0.039592	Congo Demo	-0.037269	Congo Demo	-0.030285
Comoros	-0.214708	Comoros	-0.207138	Comoros	-0.210871
Cape Verde	-0.028662	Cape Verde	-0.020458	Cape Verde	-0.029095
Ethiopia	0.030627	Ethiopia	0.022411	Ethiopia	0.019555
Gabon	-0.133558	Gabon	-0.126504	Gabon	-0.129254
Ghana	0.406198	Ghana	0.389611	Ghana	0.390338
Guinea	-0.267478	Guinea	-0.315899	Guinea	-0.254792
Gambia	0.046510	Gambia	0.041932	Gambia	0.040184
Guinea EQ	0.527630	Guinea EQ	0.530808	Guinea EQ	0.531345
Kenya	-0.066465	Kenya	-0.062932	Kenya	-0.069085
Lesotho	0.594893	Lesotho	0.589084	Lesotho	0.586998
Madagascar	-0.175190	Madagascar	-0.169098	Madagascar	-0.165039
Mali	-0.149069	Mali	-0.139471	Mali	-0.144355
Mozambique	0.118985	Mozambique	0.117016	Mozambique	0.114348
Mauritius	0.155761	Mauritius	0.160505	Mauritius	0.151296
Malawi	0.062611	Malawi	0.065170	Malawi	0.063497
Namibia	0.276477	Namibia	0.272522	Namibia	0.268747
Niger	-0.140998	Niger	-0.136096	Niger	-0.136973
Nigeria	-0.129488	Nigeria	-0.126655	Nigeria	-0.130644
Sudan	0.074096	Sudan	0.057697	Sudan	0.060018
Senegal	-0.103750	Senegal	-0.093308	Senegal	-0.098925
Sierra Leone	-0.383325	Sierra Leone	-0.399590	Sierra Leone	-0.374068
Swaziland	0.490533	Swaziland	0.482254	Swaziland	0.482209
Seychelles	0.312372	Seychelles	0.310757	Seychelles	0.304565
Chad	-0.013211	Chad	-0.009156	Chad	-0.009352
Togo	-0.066955	Togo	-0.056832	Togo	-0.062105
Tanzania	-0.217789	Tanzania	-0.211201	Tanzania	-0.213197
Uganda	-0.317483	Uganda	-0.317162	Uganda	-0.309709
South Africa	0.098944	South Africa	0.099025	South Africa	0.091594
Zambia	0.246965	Zambia	0.234132	Zambia	0.235698

APPENDIX H: Cross-section fixed effects for exports-Model 1

Standard Deviation volatility		**GARCH Volatility**		**HP-Filter volatility**	
COUNTRIES	**EFFECTS**	**COUNTRIES**	**EFFECTS**	**COUNTRIES**	**EFFECTS**
Angola	1.054703	Angola	1.042184	Angola	1.049408
Burundi	-1.177358	Burundi	-1.209458	Burundi	-1.216129
Benin	-0.207130	Benin	-0.247223	Benin	-0.248553
Burkina F	-0.384719	Burkina F	-0.421375	Burkina F	-0.421789
Botswana	0.166538	Botswana	0.237098	Botswana	0.248853
Central A Rep	-0.819027	Central A Rep	-0.850981	Central A Rep	-0.852035
Cote d'Ivoire	0.746031	Cote d'Ivoire	0.707250	Cote d'Ivoire	0.707136
Cameroon	0.343213	Cameroon	0.312308	Cameroon	0.311118
Congo republic	0.439837	Congo republic	0.408875	Congo republic	0.407693
Congo Demo	0.274878	Congo Demo	0.220021	Congo Demo	0.218013
Comoros	-1.407039	Comoros	-1.438767	Comoros	-1.438411
Cape Verde	-0.712013	Cape Verde	-0.722081	Cape Verde	-0.715733
Ethiopia	-0.029372	Ethiopia	0.045741	Ethiopia	0.055801
Gabon	0.528028	Gabon	0.496010	Gabon	0.494929
Ghana	0.309190	Ghana	0.420042	Ghana	0.436248
Guinea	-0.085645	Guinea	-0.102671	Guinea	-0.183100
Gambia	-0.974741	Gambia	-0.933044	Gambia	-0.925107
Guinea EQ	0.255606	Guinea EQ	0.232833	Guinea EQ	0.230557
Kenya	0.491838	Kenya	0.503452	Kenya	0.508887
Lesotho	-0.525610	Lesotho	-0.474908	Lesotho	-0.463836
Madagascar	0.060503	Madagascar	-0.008394	Madagascar	-0.019737
Mali	-0.028594	Mali	-0.067537	Mali	-0.067638
Mozambique	-0.062894	Mozambique	-0.034057	Mozambique	-0.026125
Mauritius	0.404790	Mauritius	0.422099	Mauritius	0.431872
Malawi	-0.300745	Malawi	-0.307994	Malawi	-0.305092
Namibia	0.208840	Namibia	0.256373	Namibia	0.267884
Niger	-0.408658	Niger	-0.436031	Niger	-0.437728
Nigeria	1.324038	Nigeria	1.329866	Nigeria	1.333433
Sudan	0.158243	Sudan	0.261472	Sudan	0.273434
Senegal	0.200846	Senegal	0.160097	Senegal	0.160230
Sierra Leone	-0.759752	Sierra Leone	-0.798427	Sierra Leone	-0.831680
Swaziland	-0.060063	Swaziland	-0.002403	Swaziland	0.007709
Seychelles	-0.560965	Seychelles	-0.518020	Seychelles	-0.505187
Chad	-0.137127	Chad	-0.161953	Chad	-0.163991
Togo	-0.248056	Togo	-0.289142	Togo	-0.288937
Tanzania	0.296651	Tanzania	0.263724	Tanzania	0.257763
Uganda	0.006671	Uganda	-0.035904	Uganda	-0.054876
South Africa	1.555974	South Africa	1.596524	South Africa	1.608975
Zambia	0.063088	Zambia	0.144403	Zambia	0.155742

APPENDIX I: Cross-section fixed effects for trade balance-Model 1

Standard Deviation volatility		GARCH Volatility		HP-Filter volatility	
COUNTRIES	**EFFECTS**	**COUNTRIES**	**EFFECTS**	**COUNTRIES**	**EFFECTS**
Angola	7.922277	Angola	7.895703	Angola	7.965373
Burundi	5.363607	Burundi	5.542000	Burundi	5.299038
Benin	-6.100861	Benin	-5.892468	Benin	-6.137785
Burkina F	-9.928968	Burkina F	-9.772502	Burkina F	-9.954100
Botswana	20.40003	Botswana	20.46621	Botswana	20.45493
Central A Rep	7.260182	Central A Rep	7.475501	Central A Rep	7.215146
Cote d'Ivoire	17.20408	Cote d'Ivoire	17.27645	Cote d'Ivoire	17.20058
Cameroon	-6.756218	Cameroon	-6.753515	Cameroon	-6.756646
Congo republic	28.75175	Congo republic	28.84743	Congo republic	28.73126
Congo Demo	-20.75484	Congo Demo	-21.07827	Congo Demo	-20.72832
Comoros	23.21885	Comoros	23.62076	Comoros	23.14706
Cape Verde	16.51922	Cape Verde	16.97458	Cape Verde	16.47916
Ethiopia	-15.11607	Ethiopia	-15.09418	Ethiopia	-15.05770
Gabon	21.48232	Gabon	21.53870	Gabon	21.47132
Ghana	-13.07797	Ghana	-13.19313	Ghana	-12.97379
Guinea	-8.485630	Guinea	-10.63915	Guinea	-8.587987
Gambia	20.59231	Gambia	20.86538	Gambia	20.58241
Guinea EQ	9.794912	Guinea EQ	9.864732	Guinea EQ	9.767889
Kenya	-23.53383	Kenya	-23.45477	Kenya	-23.50547
Lesotho	14.43135	Lesotho	14.65700	Lesotho	14.44552
Madagascar	-13.68124	Madagascar	-13.85006	Madagascar	-13.71913
Mali	-9.659991	Mali	-9.483875	Mali	-9.685872
Mozambique	-6.651048	Mozambique	-6.558759	Mozambique	-6.623941
Mauritius	4.120758	Mauritius	4.410685	Mauritius	4.133770
Malawi	-1.183843	Malawi	-1.045801	Malawi	-1.194754
Namibia	1.886412	Namibia	2.011196	Namibia	1.927382
Niger	-6.714180	Niger	-6.615694	Niger	-6.741119
Nigeria	-6.282420	Nigeria	-6.434040	Nigeria	-6.222595
Sudan	-11.84271	Sudan	-12.03788	Sudan	-11.74486
Senegal	-15.14002	Senegal	-14.98579	Senegal	-15.15859
Sierra Leone	-0.678182	Sierra Leone	-1.502171	Sierra Leone	-0.740659
Swaziland	7.139783	Swaziland	7.241600	Swaziland	7.170045
Seychelles	26.38465	Seychelles	26.77925	Seychelles	26.38311
Chad	-2.304547	Chad	-2.257705	Chad	-2.324078
Togo	1.314340	Togo	1.584904	Togo	1.271426
Tanzania	-23.44659	Tanzania	-23.46870	Tanzania	-23.46469
Uganda	-21.58740	Uganda	-21.90356	Uganda	-21.63193
South Africa	-16.86465	South Africa	-16.96782	South Africa	-16.76380
Zambia	6.004375	Zambia	5.937756	Zambia	6.072381

APPENDIX J: Cross-section fixed effects for imports-Model 2

Standard Deviation volatility		GARCH Volatility		HP-Filter volatility	
COUNTRIES	**EFFECTS**	**COUNTRIES**	**EFFECTS**	**COUNTRIES**	**EFFECTS**
Angola	0.255626	Angola	0.239127	Angola	0.228765
Burundi	-0.250080	Burundi	-0.238142	Burundi	-0.232432
Benin	-0.157293	Benin	-0.149161	Benin	-0.153447
Burkina F	-0.165072	Burkina F	-0.158180	Burkina F	-0.162108
Botswana	0.001166	Botswana	0.010268	Botswana	0.000111
Central A Rep	-0.222864	Central A Rep	-0.212411	Central A Rep	-0.210724
Cote d'Ivoire	0.009575	Cote d'Ivoire	0.012592	Cote d'Ivoire	0.004234
Cameroon	-0.149810	Cameroon	-0.147556	Cameroon	-0.151777
Congo republic	0.235362	Congo republic	0.241316	Congo republic	0.239971
Congo Demo	0.055536	Congo Demo	0.012866	Congo Demo	0.020808
Comoros	-0.116713	Comoros	-0.099926	Comoros	-0.098164
Cape Verde	-0.071849	Cape Verde	-0.053974	Cape Verde	-0.063911
Ethiopia	-0.166557	Ethiopia	-0.152202	Ethiopia	-0.162524
Gabon	-0.011399	Gabon	-0.007407	Gabon	-0.010521
Ghana	0.042982	Ghana	0.041906	Ghana	0.032324
Guinea	-0.021429	Guinea	-0.121372	Guinea	-0.013523
Gambia	-0.077743	Gambia	-0.061843	Gambia	-0.063244
Guinea EQ	0.668152	Guinea EQ	0.675240	Guinea EQ	0.679484
Kenya	-0.118095	Kenya	-0.109815	Kenya	-0.122770
Lesotho	0.395513	Lesotho	0.404187	Lesotho	0.399434
Madagascar	0.023811	Madagascar	0.007410	Madagascar	0.017578
Mali	-0.038240	Mali	-0.031146	Mali	-0.036302
Mozambique	-0.000271	Mozambique	0.003035	Mozambique	-0.004104
Mauritius	0.014635	Mauritius	0.027155	Mauritius	0.010574
Malawi	0.057037	Malawi	0.057649	Malawi	0.056049
Namibia	0.067509	Namibia	0.071360	Namibia	0.060841
Niger	-0.008332	Niger	-0.001415	Niger	0.000391
Nigeria	-0.148399	Nigeria	-0.151816	Nigeria	-0.164629
Sudan	-0.194412	Sudan	-0.192208	Sudan	-0.198199
Senegal	0.002932	Senegal	0.008651	Senegal	0.001453
Sierra Leone	-0.150812	Sierra Leone	-0.188436	Sierra Leone	-0.140879
Swaziland	0.302028	Swaziland	0.307515	Swaziland	0.304520
Seychelles	0.088678	Seychelles	0.103303	Seychelles	0.093309
Chad	0.123087	Chad	0.128613	Chad	0.130791
Togo	0.042030	Togo	0.052379	Togo	0.048391
Tanzania	-0.073880	Tanzania	-0.068478	Tanzania	-0.069715
Uganda	-0.121913	Uganda	-0.133184	Uganda	-0.116693
South Africa	-0.130884	South Africa	-0.137963	South Africa	-0.161175
Zambia	0.010390	Zambia	0.012060	Zambia	0.007813

APPENDIX K: Cross-section fixed effects for exports-Model 2

Standard Deviation volatility		**GARCH Volatility**		**HP-Filter volatility**	
COUNTRIES	**EFFECTS**	**COUNTRIES**	**EFFECTS**	**COUNTRIES**	**EFFECTS**
Angola	1.084681	Angola	1.051309	Angola	1.055734
Burundi	-1.239056	Burundi	-1.224970	Burundi	-1.226678
Benin	-0.257656	Benin	-0.259416	Benin	-0.256702
Burkina F	-0.436169	Burkina F	-0.433942	Burkina F	-0.430150
Botswana	0.266369	Botswana	0.260184	Botswana	0.264616
Central A Rep	-0.871727	Central A Rep	-0.864064	Central A Rep	-0.860760
Cote d'Ivoire	0.695163	Cote d'Ivoire	0.694916	Cote d'Ivoire	0.698941
Cameroon	0.290242	Cameroon	0.299111	Cameroon	0.302312
Congo republic	0.386884	Congo republic	0.395684	Congo republic	0.398892
Congo Demo	0.247896	Congo Demo	0.217148	Congo Demo	0.216041
Comoros	-1.448821	Comoros	-1.449022	Comoros	-1.445210
Cape Verde	-0.700388	Cape Verde	-0.719182	Cape Verde	-0.713582
Ethiopia	0.055765	Ethiopia	0.064315	Ethiopia	0.068505
Gabon	0.475289	Gabon	0.482931	Gabon	0.486206
Ghana	0.470734	Ghana	0.458324	Ghana	0.462268
Guinea	-0.192341	Guinea	-0.124254	Guinea	-0.200394
Gambia	-0.917877	Gambia	-0.920147	Gambia	-0.916251
Guinea EQ	0.200505	Guinea EQ	0.218746	Guinea EQ	0.221123
Kenya	0.509449	Kenya	0.506939	Kenya	0.511400
Lesotho	-0.437328	Lesotho	-0.453688	Lesotho	-0.449338
Madagascar	-0.028285	Madagascar	-0.028215	Madagascar	-0.033314
Mali	-0.079431	Mali	-0.079853	Mali	-0.075821
Mozambique	-0.010458	Mozambique	-0.021499	Mozambique	-0.017495
Mauritius	0.456681	Mauritius	0.434553	Mauritius	0.440495
Malawi	-0.295360	Malawi	-0.306210	Malawi	-0.303801
Namibia	0.297977	Namibia	0.277941	Namibia	0.282628
Niger	-0.462607	Niger	-0.449618	Niger	-0.446809
Nigeria	1.330117	Nigeria	1.330815	Nigeria	1.334194
Sudan	0.281509	Sudan	0.289565	Sudan	0.292534
Senegal	0.150470	Senegal	0.147978	Senegal	0.152186
Sierra Leone	-0.859483	Sierra Leone	-0.820878	Sierra Leone	-0.847805
Swaziland	0.026347	Swaziland	0.018053	Swaziland	0.021667
Seychelles	-0.468261	Seychelles	-0.495487	Seychelles	-0.489757
Chad	-0.191746	Chad	-0.175818	Chad	-0.173269
Togo	-0.298303	Togo	-0.301222	Togo	-0.296953
Tanzania	0.230293	Tanzania	0.246944	Tanzania	0.246400
Uganda	-0.080039	Uganda	-0.056665	Uganda	-0.069363
South Africa	1.646952	South Africa	1.618857	South Africa	1.624259
Zambia	0.172014	Zambia	0.169838	Zambia	0.173053

APPENDIX L: Cross-section fixed effects for trade balance-Model 2

Standard Deviation volatility		GARCH Volatility		HP-Filter volatility	
COUNTRIES	**EFFECTS**	**COUNTRIES**	**EFFECTS**	**COUNTRIES**	**EFFECTS**
Angola	7.901891	Angola	7.126313	Angola	7.074003
Burundi	7.065615	Burundi	7.695146	Burundi	7.596555
Benin	-3.772899	Benin	-3.497013	Benin	-3.674929
Burkina F	-7.401570	Burkina F	-7.164253	Burkina F	-7.288841
Botswana	15.62628	Botswana	15.77137	Botswana	15.55482
Central A Rep	8.502447	Central A Rep	9.096510	Central A Rep	8.917580
Cote d'Ivoire	21.02762	Cote d'Ivoire	20.91894	Cote d'Ivoire	20.87968
Cameroon	-3.036312	Cameroon	-3.081736	Cameroon	-3.033863
Congo republic	31.34428	Congo republic	31.59234	Congo republic	31.54167
Congo Demo	-18.44255	Congo Demo	-19.73085	Congo Demo	-19.36708
Comoros	22.57789	Comoros	23.53165	Comoros	23.13385
Cape Verde	14.35503	Cape Verde	15.02104	Cape Verde	14.48078
Ethiopia	-18.64351	Ethiopia	-18.39206	Ethiopia	-18.53384
Gabon	24.63185	Gabon	24.72403	Gabon	24.71358
Ghana	-20.45833	Ghana	-20.70047	Ghana	-20.79816
Guinea	-3.324298	Guinea	-6.053834	Guinea	-3.183973
Gambia	15.49947	Gambia	16.29573	Gambia	15.91637
Guinea EQ	11.73998	Guinea EQ	12.19777	Guinea EQ	12.18817
Kenya	-22.95826	Kenya	-23.00296	Kenya	-23.13457
Lesotho	8.311907	Lesotho	8.756998	Lesotho	8.379437
Madagascar	-9.023520	Madagascar	-9.493643	Madagascar	-9.181141
Mali	-7.094031	Mali	-6.877126	Mali	-7.026414
Mozambique	-9.296827	Mozambique	-9.244674	Mozambique	-9.433410
Mauritius	1.802974	Mauritius	1.967509	Mauritius	1.550819
Malawi	-2.178342	Malawi	-2.038813	Malawi	-2.211506
Namibia	-2.610768	Namibia	-2.602032	Namibia	-2.878247
Niger	-4.619114	Niger	-4.228279	Niger	-4.275595
Nigeria	-3.470997	Nigeria	-4.076425	Nigeria	-3.941471
Sudan	-16.95962	Sudan	-17.07472	Sudan	-17.02390
Senegal	-12.10390	Senegal	-12.01961	Senegal	-12.14867
Sierra Leone	3.239075	Sierra Leone	2.441288	Sierra Leone	3.606483
Swaziland	1.678903	Swaziland	1.983277	Swaziland	1.748714
Seychelles	19.74894	Seychelles	20.33672	Seychelles	19.75955
Chad	0.120486	Chad	0.438047	Chad	0.449670
Togo	3.000299	Togo	3.438155	Togo	3.185133
Tanzania	-19.07010	Tanzania	-19.03852	Tanzania	-18.92380
Uganda	-16.51599	Uganda	-16.87902	Uganda	-16.35772
South Africa	-17.74879	South Africa	-18.71518	South Africa	-18.76181
Zambia	0.554781	Zambia	0.578402	Zambia	0.502085

APPENDIX M: Cross-section random effects for imports-Model 1

Standard Deviation volatility		GARCH Volatility		HP-Filter volatility	
COUNTRIES	**EFFECTS**	**COUNTRIES**	**EFFECTS**	**COUNTRIES**	**EFFECTS**
Angola	0.296524	Angola	0.297881	Angola	0.294015
Burundi	-0.347080	Burundi	-0.344458	Burundi	-0.343760
Benin	-0.233393	Benin	-0.228166	Benin	-0.231703
Burkina F	-0.243994	Burkina F	-0.239731	Burkina F	-0.242944
Botswana	0.164813	Botswana	0.165390	Botswana	0.162515
Central A Rep	-0.308455	Central A Rep	-0.305210	Central A Rep	-0.306207
Cote d'Ivoire	-0.067246	Cote d'Ivoire	-0.062595	Cote d'Ivoire	-0.067481
Cameroon	-0.231681	Cameroon	-0.229077	Cameroon	-0.231985
Congo republic	0.143697	Congo republic	0.146531	Congo republic	0.144490
Congo Demo	-0.006644	Congo Demo	-0.012699	Congo Demo	-0.008592
Comoros	-0.186796	Comoros	-0.181632	Comoros	-0.183016
Cape Verde	-0.045849	Cape Verde	-0.038017	Cape Verde	-0.043627
Ethiopia	-0.022492	Ethiopia	-0.021830	Ethiopia	-0.024956
Gabon	-0.096432	Gabon	-0.093540	Gabon	-0.096160
Ghana	0.301902	Ghana	0.298129	Ghana	0.297277
Guinea	-0.195345	Guinea	-0.243807	Guinea	-0.190355
Gambia	0.010493	Gambia	0.012121	Gambia	0.011582
Guinea EQ	0.559058	Guinea EQ	0.559963	Guinea EQ	0.560256
Kenya	-0.079699	Kenya	-0.075489	Kenya	-0.081157
Lesotho	0.527729	Lesotho	0.528798	Lesotho	0.527516
Madagascar	-0.118769	Madagascar	-0.121056	Madagascar	-0.117454
Mali	-0.117152	Mali	-0.112286	Mali	-0.116101
Mozambique	0.084255	Mozambique	0.085594	Mozambique	0.083095
Mauritius	0.109506	Mauritius	0.116213	Mauritius	0.108995
Malawi	0.060159	Malawi	0.061915	Malawi	0.060771
Namibia	0.212890	Namibia	0.214512	Namibia	0.211152
Niger	-0.100418	Niger	-0.098520	Niger	-0.099184
Nigeria	-0.129194	Nigeria	-0.127418	Nigeria	-0.132498
Sudan	0.004443	Sudan	-0.000112	Sudan	8.58E-05
Senegal	-0.073918	Senegal	-0.068686	Senegal	-0.073310
Sierra Leone	-0.313027	Sierra Leone	-0.332502	Sierra Leone	-0.310200
Swaziland	0.430675	Swaziland	0.429799	Swaziland	0.429629
Seychelles	0.240024	Seychelles	0.244566	Seychelles	0.240656
Chad	0.026929	Chad	0.028140	Chad	0.027749
Togo	-0.038320	Togo	-0.032721	Togo	-0.036328
Tanzania	-0.174292	Tanzania	-0.171945	Tanzania	-0.173691
Uganda	-0.257518	Uganda	-0.262300	Uganda	-0.255574
South Africa	0.033730	South Africa	0.036544	South Africa	0.028515
Zambia	0.180888	Zambia	0.177701	Zambia	0.177986

APPENDIX N: Cross-section random effects for exports-Model 1

Standard Deviation volatility		GARCH Volatility		HP-Filter volatility	
COUNTRIES	**EFFECTS**	**COUNTRIES**	**EFFECTS**	**COUNTRIES**	**EFFECTS**
Angola	1.045350	Angola	1.030809	Angola	1.037563
Burundi	-1.164791	Burundi	-1.194392	Burundi	-1.200047
Benin	-0.200406	Benin	-0.239075	Benin	-0.239546
Burkina F	-0.376958	Burkina F	-0.411899	Burkina F	-0.411509
Botswana	0.154093	Botswana	0.221181	Botswana	0.231599
Central A Rep	-0.809013	Central A Rep	-0.838839	Central A Rep	-0.839088
Cote d'Ivoire	0.748654	Cote d'Ivoire	0.711281	Cote d'Ivoire	0.711987
Cameroon	0.348182	Cameroon	0.319339	Cameroon	0.318977
Congo republic	0.444376	Congo republic	0.415459	Congo republic	0.415107
Congo Demo	0.276889	Congo Demo	0.222925	Congo Demo	0.221028
Comoros	-1.395963	Comoros	-1.426272	Comoros	-1.425229
Cape Verde	-0.710855	Cape Verde	-0.722350	Cape Verde	-0.716014
Ethiopia	-0.038993	Ethiopia	0.033640	Ethiopia	0.042633
Gabon	0.532125	Gabon	0.502077	Gabon	0.501824
Ghana	0.289006	Ghana	0.394471	Ghana	0.408344
Guinea	-0.072695	Guinea	-0.084425	Guinea	-0.164570
Gambia	-0.977022	Gambia	-0.937074	Gambia	-0.929866
Guinea EQ	0.261538	Guinea EQ	0.241452	Guinea EQ	0.240019
Kenya	0.487501	Kenya	0.498204	Kenya	0.503560
Lesotho	-0.533795	Lesotho	-0.486403	Lesotho	-0.476566
Madagascar	0.070453	Madagascar	0.004285	Madagascar	-0.006053
Mali	-0.022567	Mali	-0.060016	Mali	-0.059310
Mozambique	-0.068814	Mozambique	-0.041963	Mozambique	-0.034727
Mauritius	0.396243	Mauritius	0.410542	Mauritius	0.419734
Malawi	-0.300041	Malawi	-0.307598	Malawi	-0.304703
Namibia	0.197189	Namibia	0.241075	Namibia	0.251358
Niger	-0.400109	Niger	-0.425048	Niger	-0.425924
Nigeria	1.317636	Nigeria	1.323216	Nigeria	1.326836
Sudan	0.143664	Sudan	0.243619	Sudan	0.253849
Senegal	0.205739	Senegal	0.166323	Senegal	0.167262
Sierra Leone	-0.744538	Sierra Leone	-0.778786	Sierra Leone	-0.811368
Swaziland	-0.069788	Swaziland	-0.014958	Swaziland	-0.006060
Seychelles	-0.569989	Seychelles	-0.531255	Seychelles	-0.519676
Chad	-0.129593	Chad	-0.151824	Chad	-0.153032
Togo	-0.241225	Togo	-0.280958	Togo	-0.279955
Tanzania	0.303245	Tanzania	0.272781	Tanzania	0.267860
Uganda	0.016993	Uganda	-0.022132	Uganda	-0.039906
South Africa	1.537892	South Africa	1.574097	South Africa	1.585331
Zambia	0.050388	Zambia	0.128493	Zambia	0.138280

APPENDIX O: Cross-section random effects for trade balance-Model 1

Standard Deviation volatility		GARCH Volatility		HP-Filter volatility	
COUNTRIES	**EFFECTS**	**COUNTRIES**	**EFFECTS**	**COUNTRIES**	**EFFECTS**
Angola	10.83615	Angola	10.55308	Angola	10.62447
Burundi	2.797300	Burundi	2.846185	Burundi	2.687128
Benin	-5.658011	Benin	-5.765656	Benin	-5.892803
Burkina F	-8.834863	Burkina F	-8.937974	Burkina F	-9.026664
Botswana	18.37440	Botswana	18.76075	Botswana	18.81604
Central A Rep	4.585770	Central A Rep	4.648434	Central A Rep	4.513804
Cote d'Ivoire	20.60677	Cote d'Ivoire	20.33139	Cote d'Ivoire	20.29386
Cameroon	-2.757101	Cameroon	-2.951125	Cameroon	-2.956918
Congo republic	28.73003	Congo republic	28.64003	Congo republic	28.57341
Congo Demo	-16.20007	Congo Demo	-16.76675	Congo Demo	-16.60825
Comoros	16.26103	Comoros	16.46620	Comoros	16.23125
Cape Verde	11.18812	Cape Verde	11.37757	Cape Verde	11.16723
Ethiopia	-14.33344	Ethiopia	-13.90642	Ethiopia	-13.83215
Gabon	23.09894	Gabon	22.94313	Gabon	22.90244
Ghana	-13.62089	Ghana	-13.12375	Ghana	-12.92741
Guinea	-6.632193	Guinea	-7.771899	Guinea	-7.203505
Gambia	13.25364	Gambia	13.77100	Gambia	13.66999
Guinea EQ	8.839193	Guinea EQ	8.890364	Guinea EQ	8.828139
Kenya	-19.63796	Kenya	-19.62848	Kenya	-19.61985
Lesotho	8.012617	Lesotho	8.469851	Lesotho	8.422584
Madagascar	-11.16135	Madagascar	-11.66449	Madagascar	-11.65498
Mali	-8.491652	Mali	-8.615640	Mali	-8.712302
Mozambique	-7.430803	Mozambique	-7.243730	Mozambique	-7.232706
Mauritius	3.079165	Mauritius	3.202451	Mauritius	3.121050
Malawi	-2.919492	Malawi	-2.856857	Malawi	-2.917468
Namibia	-0.070637	Namibia	0.192525	Namibia	0.213502
Niger	-6.755575	Niger	-6.746210	Niger	-6.816418
Nigeria	1.687699	Nigeria	1.452654	Nigeria	1.577203
Sudan	-10.59827	Sudan	-10.12467	Sudan	-9.916303
Senegal	-12.61918	Senegal	-12.80516	Senegal	-12.88495
Sierra Leone	-1.439198	Sierra Leone	-1.951089	Sierra Leone	-1.750630
Swaziland	2.654738	Swaziland	3.093692	Swaziland	3.110215
Seychelles	18.29849	Seychelles	18.75083	Seychelles	18.62261
Chad	-1.656815	Chad	-1.667533	Chad	-1.711347
Togo	-0.102454	Togo	-0.150999	Togo	-0.302405
Tanzania	-18.92438	Tanzania	-19.13098	Tanzania	-19.15638
Uganda	-17.43998	Uganda	-17.82526	Uganda	-17.79390
South Africa	-9.191895	South Africa	-9.366040	South Africa	-9.192798
Zambia	4.172158	Zambia	4.610591	Zambia	4.735193

APPENDIX P: Cross-section random effects for imports-Model 2

Standard Deviation volatility		GARCH Volatility		HP-Filter volatility	
COUNTRIES	**EFFECTS**	**COUNTRIES**	**EFFECTS**	**COUNTRIES**	**EFFECTS**
Angola	0.251926	Angola	0.236722	Angola	0.227554
Burundi	-0.247402	Burundi	-0.236571	Burundi	-0.231609
Benin	-0.154239	Benin	-0.147126	Benin	-0.150931
Burkina F	-0.161851	Burkina F	-0.155445	Burkina F	-0.159123
Botswana	0.002585	Botswana	0.010506	Botswana	0.001664
Central A Rep	-0.221112	Central A Rep	-0.211492	Central A Rep	-0.210448
Cote d'Ivoire	0.011566	Cote d'Ivoire	0.014712	Cote d'Ivoire	0.007275
Cameroon	-0.145386	Cameroon	-0.142191	Cameroon	-0.146287
Congo republic	0.229659	Congo republic	0.235754	Congo republic	0.234181
Congo Demo	0.052724	Congo Demo	0.015380	Congo Demo	0.021295
Comoros	-0.119028	Comoros	-0.104806	Comoros	-0.103501
Cape Verde	-0.071604	Cape Verde	-0.057609	Cape Verde	-0.065943
Ethiopia	-0.160768	Ethiopia	-0.147255	Ethiopia	-0.156324
Gabon	-0.010831	Gabon	-0.006367	Gabon	-0.009472
Ghana	0.044095	Ghana	0.043136	Ghana	0.034654
Guinea	-0.022341	Guinea	-0.112869	Guinea	-0.014851
Gambia	-0.079488	Gambia	-0.065935	Gambia	-0.067327
Guinea EQ	0.651366	Guinea EQ	0.658997	Guinea EQ	0.662066
Kenya	-0.112279	Kenya	-0.104620	Kenya	-0.115882
Lesotho	0.384960	Lesotho	0.391450	Lesotho	0.387299
Madagascar	0.023059	Madagascar	0.008009	Madagascar	0.017119
Mali	-0.037417	Mali	-0.031048	Mali	-0.035713
Mozambique	6.03E-05	Mozambique	0.002727	Mozambique	-0.003636
Mauritius	0.016723	Mauritius	0.026257	Mauritius	0.012276
Malawi	0.054164	Malawi	0.054479	Malawi	0.052795
Namibia	0.067052	Namibia	0.069485	Namibia	0.060408
Niger	-0.010103	Niger	-0.002937	Niger	-0.001910
Nigeria	-0.139897	Nigeria	-0.141530	Nigeria	-0.152936
Sudan	-0.188384	Sudan	-0.184980	Sudan	-0.190643
Senegal	0.003865	Senegal	0.008991	Senegal	0.002610
Sierra Leone	-0.150415	Sierra Leone	-0.184333	Sierra Leone	-0.141632
Swaziland	0.293920	Swaziland	0.298454	Swaziland	0.295613
Seychelles	0.085153	Seychelles	0.095757	Seychelles	0.087424
Chad	0.118861	Chad	0.125123	Chad	0.126408
Togo	0.039835	Togo	0.048609	Togo	0.045027
Tanzania	-0.070504	Tanzania	-0.064790	Tanzania	-0.065818
Uganda	-0.118611	Uganda	-0.127947	Uganda	-0.113031
South Africa	-0.120169	South Africa	-0.126964	South Africa	-0.146850
Zambia	0.010256	Zambia	0.012265	Zambia	0.008198

APPENDIX Q: Cross-section random effects for exports-Model 2

Standard Deviation volatility		**GARCH Volatility**		**HP-Filter volatility**	
COUNTRIES	**EFFECTS**	**COUNTRIES**	**EFFECTS**	**COUNTRIES**	**EFFECTS**
Angola	1.078647	Angola	1.045501	Angola	1.050315
Burundi	-1.233269	Burundi	-1.219321	Burundi	-1.221163
Benin	-0.256779	Benin	-0.258746	Benin	-0.255830
Burkina F	-0.434088	Burkina F	-0.432085	Burkina F	-0.428170
Botswana	0.264501	Botswana	0.257982	Botswana	0.262811
Central A Rep	-0.867195	Central A Rep	-0.859760	Central A Rep	-0.856449
Cote d'Ivoire	0.692078	Cote d'Ivoire	0.691511	Cote d'Ivoire	0.695791
Cameroon	0.289862	Cameroon	0.298369	Cameroon	0.301660
Congo republic	0.386077	Congo republic	0.394505	Congo republic	0.397813
Congo Demo	0.249068	Congo Demo	0.219141	Congo Demo	0.217727
Comoros	-1.442559	Comoros	-1.442898	Comoros	-1.438982
Cape Verde	-0.699399	Cape Verde	-0.718309	Cape Verde	-0.712211
Ethiopia	0.055298	Ethiopia	0.063256	Ethiopia	0.067787
Gabon	0.474016	Gabon	0.481292	Gabon	0.484685
Ghana	0.468347	Ghana	0.455779	Ghana	0.460058
Guinea	-0.190708	Guinea	-0.118276	Guinea	-0.198817
Gambia	-0.914087	Gambia	-0.916589	Gambia	-0.912471
Guinea EQ	0.201470	Guinea EQ	0.219268	Guinea EQ	0.221596
Kenya	0.506553	Kenya	0.503602	Kenya	0.508487
Lesotho	-0.436245	Lesotho	-0.452641	Lesotho	-0.447965
Madagascar	-0.028104	Madagascar	-0.027383	Madagascar	-0.032994
Mali	-0.079173	Mali	-0.079831	Mali	-0.075608
Mozambique	-0.010755	Mozambique	-0.021938	Mozambique	-0.017635
Mauritius	0.452254	Mauritius	0.429910	Mauritius	0.436507
Malawi	-0.293820	Malawi	-0.304698	Malawi	-0.302116
Namibia	0.295488	Namibia	0.275372	Namibia	0.280501
Niger	-0.459277	Niger	-0.446607	Niger	-0.443835
Nigeria	1.324648	Nigeria	1.324881	Nigeria	1.328598
Sudan	0.281230	Sudan	0.288842	Sudan	0.291976
Senegal	0.149528	Senegal	0.146797	Senegal	0.151243
Sierra Leone	-0.854833	Sierra Leone	-0.814405	Sierra Leone	-0.843389
Swaziland	0.026272	Swaziland	0.017819	Swaziland	0.021681
Seychelles	-0.468550	Seychelles	-0.495758	Seychelles	-0.489488
Chad	-0.189288	Chad	-0.173736	Chad	-0.171241
Togo	-0.297368	Togo	-0.300478	Togo	-0.296000
Tanzania	0.229552	Tanzania	0.245909	Tanzania	0.245323
Uganda	-0.078988	Uganda	-0.055212	Uganda	-0.068609
South Africa	1.637792	South Africa	1.609552	South Africa	1.615625
Zambia	0.171804	Zambia	0.169380	Zambia	0.172788

APPENDIX R: Cross-section random effects for trade balance-Model 2

Standard Deviation volatility		GARCH Volatility		HP-Filter volatility	
COUNTRIES	**EFFECTS**	**COUNTRIES**	**EFFECTS**	**COUNTRIES**	**EFFECTS**
Angola	10.78877	Angola	10.05533	Angola	10.07798
Burundi	3.703223	Burundi	4.189699	Burundi	4.069176
Benin	-4.378476	Benin	-4.215696	Benin	-4.318979
Burkina F	-7.494877	Burkina F	-7.317312	Burkina F	-7.378315
Botswana	15.90349	Botswana	15.97623	Botswana	15.87150
Central A Rep	5.202631	Central A Rep	5.617167	Central A Rep	5.466408
Cote d'Ivoire	22.59383	Cote d'Ivoire	22.57177	Cote d'Ivoire	22.58687
Cameroon	-0.892115	Cameroon	-0.802079	Cameroon	-0.736548
Congo republic	29.98881	Congo republic	30.23541	Congo republic	30.18612
Congo Demo	-15.32200	Congo Demo	-16.41187	Congo Demo	-16.19182
Comoros	15.98011	Comoros	16.51894	Comoros	16.19481
Cape Verde	10.29378	Cape Verde	10.52572	Cape Verde	10.18158
Ethiopia	-16.15435	Ethiopia	-15.86648	Ethiopia	-15.89323
Gabon	24.65437	Gabon	24.80736	Gabon	24.80448
Ghana	-17.50252	Ghana	-17.72258	Ghana	-17.72060
Guinea	-3.973618	Guinea	-5.395213	Guinea	-3.957767
Gambia	10.62392	Gambia	11.06851	Gambia	10.78196
Guinea EQ	9.695749	Guinea EQ	10.13498	Guinea EQ	10.08908
Kenya	-19.25715	Kenya	-19.24442	Kenya	-19.24223
Lesotho	4.884830	Lesotho	4.993569	Lesotho	4.736745
Madagascar	-8.700714	Madagascar	-9.035848	Madagascar	-8.855010
Mali	-7.104147	Mali	-6.960921	Mali	-7.031688
Mozambique	-8.790487	Mozambique	-8.838964	Mozambique	-8.928378
Mauritius	2.110184	Mauritius	2.050836	Mauritius	1.852482
Malawi	-3.466321	Malawi	-3.484977	Malawi	-3.607941
Namibia	-2.329454	Namibia	-2.482762	Namibia	-2.617242
Niger	-5.752799	Niger	-5.398584	Niger	-5.444737
Nigeria	3.072308	Nigeria	2.802962	Nigeria	2.988375
Sudan	-13.41692	Sudan	-13.36160	Sudan	-13.27769
Senegal	-10.96830	Senegal	-10.91381	Senegal	-10.95208
Sierra Leone	0.571573	Sierra Leone	0.250683	Sierra Leone	0.820808
Swaziland	-0.221081	Swaziland	-0.114551	Swaziland	-0.274041
Seychelles	15.05636	Seychelles	15.15470	Seychelles	14.78024
Chad	-0.524259	Chad	-0.181321	Chad	-0.189619
Togo	0.858263	Togo	1.095981	Togo	0.934036
Tanzania	-16.61286	Tanzania	-16.41672	Tanzania	-16.30893
Uganda	-14.80980	Uganda	-14.85549	Uganda	-14.56791
South Africa	-9.529658	South Africa	-10.26680	South Africa	-10.13284
Zambia	1.219712	Zambia	1.238140	Zambia	1.204934