ANALYSIS OF THE VOLATILITY OF REAL EXCHANGE RATE AND EXPORTS IN KENYA USING THE GARCH MODEL: 2005-2012.

Mustapha Wasseja
KEMRI-Wellcome Trust Research Programme

Musundi Sammy Wabomba
Chuka University

Elizabeth Njoroge
Chuka University

Ngugi Mwenda
Food and Agriculture Organization of the United Nations

Journal of Multidisciplinary Scientific Research, 2015,3(4):27-38
ISSN: 2307-6976
Available Online: http://jmsr.rstpublishers.com/

ANALYSIS OF THE VOLATILITY OF REAL EXCHANGE RATE AND EXPORTS IN KENYA USING THE GARCH MODEL: 2005-2012.

[1]MOHAMMED MUSTAPHA WASSEJA*, [1]MWENDA SAMWEL N., [2]MUSUNDI SAMMY W., [2]NJOROGE ELIZABETH.
[1]Production Statistics Directorate, Kenya National Bureau of Statistics, P. O. Box 30266-00100, Kenya.
[2] Chuka University, P.O. Box 109-60400, Kenya.
Emails: muswaseja@gmail.com
swmusundi@chuka.ac.ke, enjoroge@chuka.ac.ke

Received:12,Jul,2015 **Accepted: 16, Aug,2015**

Abstract
The real exchange rate has proven to be an important factor in international trade because it is expected that exports respond to real exchange rate movements with respect to the characteristics of the importing and exporting countries. Exchange rate volatility increases uncertainty of profits on contracts denominated in foreign currency and subsequently dampens trade and economic growth. This study investigated how real exchange rate volatility affected exports of key Kenyan commodities to the European Union and United Kingdom, namely; tea, coffee and horticulture to the European Union. The presence of exchange rate volatility was determined using the GARCH model. A Bounds testing and Autoregressive Distributed Lag model was used to establish the presence of a long run relationship between exchange rate volatility and commodity exports. Findings revealed that exchange rate volatility affected tea exports to the UK and horticulture exports to the European Union. Foreign income played an important role in explaining tea and coffee exports to the UK and EU respectively.

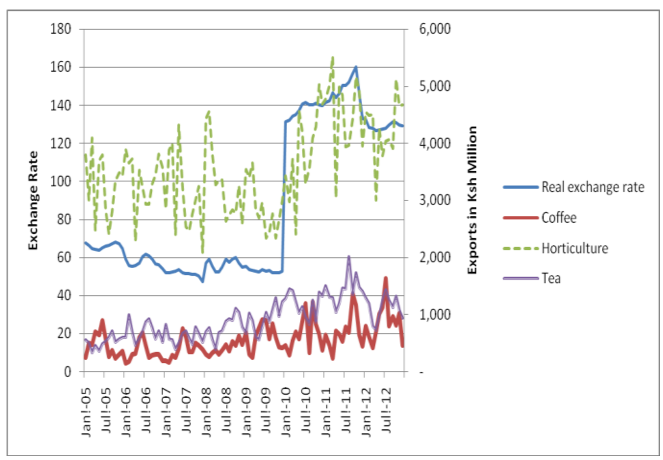
Keywords: *Real Exchange Rate, Real Exchange Rate Volatility, The GARCH model, Bounds testing and Autoregressive Distributed Lag model, commodity exports.*

INTRODUCTION

Kenya moved from a fixed exchange rate to a crawling peg regimein the early 1980s and finally to a floating exchange rate in the early 1990s,to provide efficient signals to both domestic and international economic agents.Real exchange rate volatility refers to short term fluctuations of the real exchange rate about their long term trends (Musyoki et al, 2012).Concerns over exchange rate volatility emanates from the fact that it raises the degree of uncertainty regarding international trade and capital flows. It generally increases uncertainty of profits on contracts denominated in foreign currency and subsequently reduces economic growth to levels that wouldn't have been attained in its absence (Haile and Pugh, 2011).In addition to that, exchange rate volatility impacts on international price competitiveness of commodities leading to reallocation of resources among sectors thus influencinga country's economic efficiency (Chegee*et al*, 2014).

Aftera liberalized exchange rate was adopted in 1993, Kenya hasoccasionally had to grapple withits adverse effects.A graphical inspection of figure 1 shows thatduring the period under review, there have been phases of real exchange rate appreciation (January 2005 to October 2009) and depreciation (January 2010 to November 2012) coupled with episodes of wild fluctuations. On the other hand,though the value oftea, coffee and horticultural exportsappear to have increased over time it is observable that there have been quite a number of fluctuations in terms of export earnings for the aforementioned commodities. This begs the question as to whether there is an empirical association between real exchange rate volatility and exports for Kenya's key commodities.

Quite a number of studies have been carried out over the subject matter but there is still no consensus on the effect of real exchange rate volatility on commodity exports. Some were unable to establish a relationship between exchange rate volatility(Hondroyiannis*et al,* 2008).Other studies found a negative relationship between exchange rate volatility and exports (Kandil, 2009; Wang and Barett, 2007;Berthou, 2008; Nabli and Varoudakis, 2002; Mehare and Edriss, 2010).



Fig(1)Real exchange rate and Kenya's Tea, Coffee and Horticultural exports 2005-2012

It is from the above background that this study intends to establish an empirical relationship between real exchange rate volatilityand exports of key Kenyan commodities namely; coffee, tea and horticulture to the European Union (EU) and United Kingdom (UK). It seeks to answer the question as to whether real exchange rate volatility is important in explaining the value of exports in Kenya. On top of that, it ascertains whether different export commodities are affected differentlyby real exchange rate volatility.Finally, it informs the readers on whether export commodities are affected differently by the distinct features of various importing countries. The real exchange rate volatility was determined via the GARCH methodology, while the presence of a short or long run relationship between real exchange rate volatility and commodity exports was done using the Autoregressive Distributed Lag (ARDL) model.

We first give an overview of exchange rate and exports in Kenya since independence.Section twoprovides a general review of both theoretical and empirical literature of the study whilethe methodologyused is presentedin section three. In section four, we discuss themain results and eventually give the conclusions as well as policy recommendations in section five.

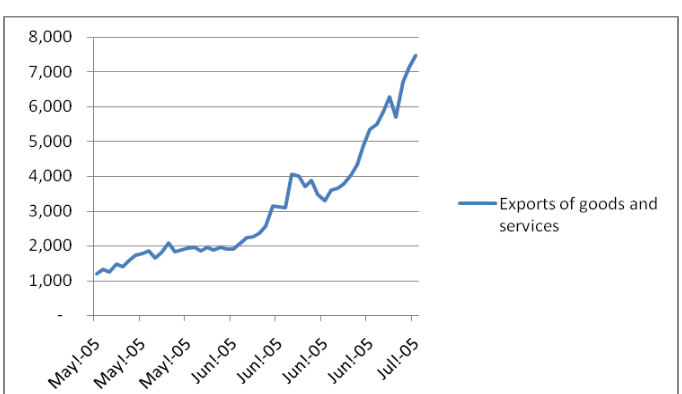
Export Growth and Exchange Rates in Kenya

Exports in Kenya

Kenya's key export commodities since independence have been tea and coffee, followed by horticultural products that have experienced rapid growth over the last few decades. Manufactured exports still constitute a small proportion of Kenya's total export. This situation has made the export sector vulnerable to fluctuations in world prices (Were *et al*, 2002).The decade following independence saw the country adopt an import substitution strategy that helped diversify the export sector from dependence on primary commodities (Kinuthia, undated). The most prominent feature of this strategy was the high level of protection accorded to the infant industries by thetrade barriers in force at the time. Due to the fact that the major objective of promoting the infant industries was import substitution, most of the products that came from these industries targeted the domestic market to displace imports. The end result was a poor export performance in the country's manufacturing sector and a bias towards production of consumer goods (Were et al, 2002). This explains the low value of Kenyan exports (in US$) in the post-independence decadeas shown in figure 1.2.

The oil shocks of the 1970s coupled with the mismanagement of the coffee boom and the collapse of the East Africa Community caused some acute balance of payment problems in the country. These developments prompted the country to embark on a restructuring program meant to make the economy more competitive and reduce direct government participation in production activities. It is for this reason thatin the early 1980's, the government had to shift from the import substitution strategy to an export promotion strategy that focused on gradually eliminating the anti-export bias. Based on the Sessional paper No.1 of 1986 on Economic management for Renewed Growth and other national development plans,the trade policy reforms began in earnest in the year 1986 (Republic of Kenya, 1986). As evident from figure 1.2, Kenyan exports were relatively low at the time of the adoption of the outward-looking development strategy (Kiringai, undated and Were et al, 2002).

The economic crisis that was characterized by reduced economic performance (GDP fell from 5% in 1989 to 2.1% and 0.5% in 1991 and 1992 respectively), budgetary and financial constraints following reduced donor funding compelled the government to yield to donor pressure and embrace wide ranging economic reforms. The government instituted a number of tariff reductions over the 1987-1992 period followed by a lifting of all current and capital account restrictions in 1993-1994.



Fig(2)Graph showing Kenya's exports of Goods and Services in US$ millions 1963-2012

Source: World Development Indicators

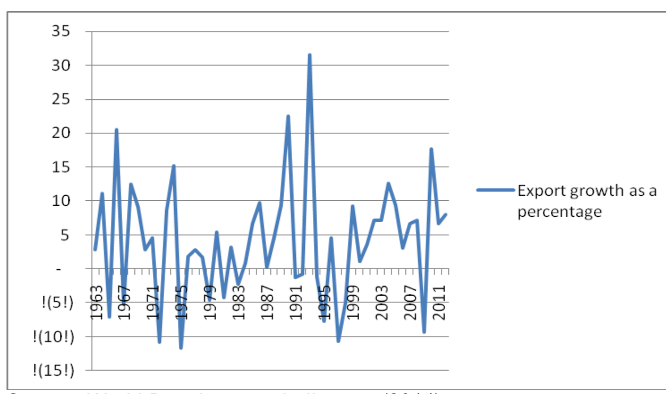
Exports responded massively to the trade liberalization measures undertaken in the mid 1990s and have been on an upward trend ever since. Though slightly affected by the global financial crisis between 2008 and 2009, they rebounded on the upward in the subsequent years that followed to an all time high.

Regional integration agreements like COMESA and EAC have resulted in an increase in Kenya's manufactured exports and consequently total exports. Signing of the interim Economic Partnership Agreements with the EU in 2010contributed to Kenya's growth in the export sector.

The country's export structure has remained more or less the same over time. Tea and Coffee have been Kenya's key export products since independence. Horticultural exports grew in the last few decades to be among the top three export commodities in the country. Tea, Coffee and Horticultural products thus remain to be the country's key export commodities (Were *et al*, 2002). The three commodities together with articles of apparel and clothing accessories account for 47 per cent of the total domestic earnings (Republic of Kenya, 2013).

According to the Economic Survey (Republic of Kenya, 2014), Kenya's leading export destination after the EAC is the EU. Horticulture and coffee forms the bulk of Kenya's exports to the EU, while Egypt is the main export destination for Kenyan tea.

As indicated in figure 1.3 below, Kenya's export growth has been erratic as a result of fluctuations in earnings from a few traditional primary exports and the tourism sector. Most notable is the rapid growth in exports in the 70's attributed to the sharp increase in international prices of tea and coffee and in the early 90's when the country adopted a liberalized trade policy (Republic of Kenya, 1977 and Republic of Kenya, 1995).



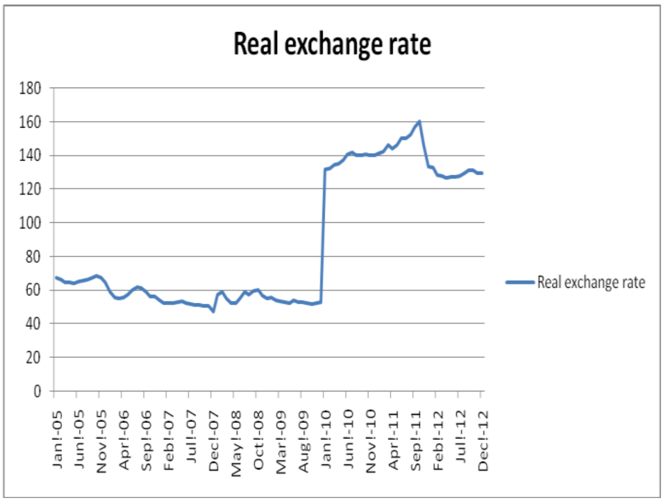
Source: World Development Indicators (2014)

Fig(3)Kenya's export growth (in percentage) 1963-2012

Exchange Rate Policy in Kenya

Kenya's exchange rate regime since independence has been characterized by three different regimes; fixed exchange, crawling peg and the floating exchange rate era.The fixed exchange rate era was implemented from independence to 1982 before the country moved the crawling peg era. The exchange rate controls had been instituted since the early 1970's to deal with the balance of payments crisis of 1971/72. This move was aimed atconserving foreign exchange and managing the balance of payment pressures (Ndung'u, 1999).These controls had to be abandoned in 1982 due to frequent exchange rate depreciations and devaluations the Shilling suffered between 1974 and 1981.

The crawling peg regime was implemented between 1982 and 1990 when a dual exchange rate regime was adopted. The official exchange rate was eventually abolished in 1993 to mitigate the problem of real exchange rate misalignment. The shilling strengthened briefly against the Dollar up to 1995 then slid back into depreciation until 2004. Due to increased foreign exchange flows, growth in remittances, increased export earnings and favorable macroeconomic conditions, the Shilling appreciated consistently from the year 2004 to 2007. This was then followed by a weakening of the currency from 2008 to 2011. The currency depreciation during this period was majorly attributed to effects of the global financial crisis (Republic of Kenya, 2012). It later on stabilized in 2012 as a result ofthe restrictive monetary policy stance adopted by the Central Bank in the first half of the year (World Bank, 2013). Figure 1.4 below gives a picture of real exchange rate movements within years 2005-2012.



Source: World Development Indicators

Fig(4)Real exchange rate movement in Kenya 2005 – 2012

Overview of exchange rate volatility and exports in Kenya

Trade and exchange rate liberalization served as a turning point for commodity exports in Kenya. Exchange rate liberalization was meant to salvage exports from the negative effects of frequent exchange devaluations. Exports seem to have responded well to exchange rate liberalization and this is evident from the increase in export volumes over time, irrespective of episodes of exchange rate appreciation, depreciation or volatility. Agricultural commodities namely; tea, coffee and horticultural products form the bulk of Kenya's commodity exports. These are the products that are most vulnerable to exchange rate volatility and price fluctuations. Graphical evidence from available data seems insufficient to help the study determine whether exchange rate movements and or volatility influences exports, more so Kenya's key export commodities.

LITERATURE REVIEW

Theoretical Literature

Musonda (2008) postulated that the effects of exchange rate volatility can be analyzed in terms of risk or uncertainty. Exporters are either risk averse or less risk averse and this would determine their reaction to exchange rate volatility.Chegee*t al* (2014) went further and explained that the effect of exchange rate volatility on exports can be explained by two schools of thought, namely; the traditional and risk portfolio paradigms. The traditionalschool hypothesizes that higher exchange rate volatility increases risk and thus dampens trade while the risk portfolio school holds that higher risk presents greater opportunities for profit and would thus promote trade. According to the traditional school of thought, the uncertainty of returns would result in the risk averse and risk neutral producers reallocating resources from the high risk foreign markets to the lower risk domestic markets effectively lowering international trade (Oyovwi, 2012).

The risk portfolio theory's departure from the traditional school of thought is based on the premise that the effect of an increase in exchange rate volatility depends on the convexity ofthe utility function, which is in turn influenced by the firm's level of risk aversion. Highly risk averse firms for example, will find it attractive to increase exports in the event that exchange rate volatility increases the expected marginal utility of export revenue (De Grauwe, 1987). This is termed as the income effect of exchange rate volatility. The risk seeking agents on the other hand consider exchange rate volatility as a high risk. Increased exchange rate volatility therefore prompts them to reduce exports and reallocate resources to other sub sectors. This is the phenomenon referred to as the substitution effect of exchange rate volatility. When exports increase with an increase in volatility, the greater the income effect; while if they decline with an increase in volatility, then the substitution effect outweighs the income effect. Models of hysteresis in international trade have also shown that increased uncertainty impacts on international trade especially if large amounts of sunk costs are involved in international transactions (Arizee*t al*, 2000).

Empirical Literature

A number of studies carried out on the subject matter observed that there has been no conclusive evidence on how the real exchange rate volatility affects export growth (Wang and Barett, 2007; Musonda, 2008 and Essien*et al*, 2011). In fact very few studies made efforts to assess the role played by exchange rate volatility on domestic macroeconomic variables particularly exports. Essien*et al* (2007) found that exchange rate volatility had stronger negative effects on cocoa exports in Nigeria. They arrived at this conclusion after running an OLS regression for an export supply function for cocoa. Wang and Barett (2007) emphasized on the importance of choice on how to proxy exchange rate risk. They gave indication that a change in the expected exchange rate alongside changes in the in industrial output levels mattered for trade volumes in the long run equilibrium in the Taiwanese economy. Traders responded more to changes in the expected exchange rate than to changes in actual output. Similar to Berthou (2008), the study found that trade flowswerenegatively affected by high frequency exchange rate volatility and was less responsive toincomes from importer destinations than other sectors in the economy.

Hondroyaiannis*et al* (2008) using a sample of 12 industrial countries in a study aimed at shedding light on differences in results obtained by other scholars, used a different analytical framework to obtain findings.While previous studies had used time series and OLS estimation to conduct their analysis, this one extended the work of previous authors by using two additional estimation techniques namely; GMM estimation applied to dynamic panel data specifications and a random coefficient estimation. The authors argued that exchange rate variability could increase trade. His findings pointed to the fact that the negative and significant effect of volatility on trade could most likely have arisen from omitted variable biases or measurement error biases.Musonda(2008) after estimating an error correction model of the impact of exchange rate volatility on Zambia's nontraditional exports showed that exchange rate volatility depressed exports both in the long and short run. He proposed that supportive macroeconomic variables be used to enhance nontraditional exports in the country.

Eichengeenand Gupta (2012) investigated the effect of exchange rate volatility on service exports in developing countriesby distinguishing modern from traditional services. They found that real exchange rate affected exports of merchandise and traditional services similarly but affected modern services by a larger percentage. The reason for the above findings was that modern services used fewer imported inputs subsequently lowering fixed entry costs. Exports from this sector were thus more price elastic than the others. The study pointed out that currency depreciation could be employed as an instrument for growth only in the short term because an economy couldn't sustain a depreciated exchange rate indefinitely.

Dincer and Kandil (2009) examined the effects of exchange rate fluctuations on disaggregated data consisting of 21 export sectors in Turkey. The study intended to uncover the asymmetric effects of random fluctuations due to exchange rate movements on export sectors in Turkey. It postulated that there were supply and demand channels that followed currency appreciation/depreciation. The end result of this asymmetry would depend on which channel dominates with respect to currency appreciation/depreciation (Kandil*et al*, 2007).Evidence from the study showed that increased contraction of export demand came as a result of currency appreciation over time. The lesser the variability of the exchange rate, the more likely it was to improve sectoral export growth in Turkey over time.

Freund and Pierola (2008) observed that export surges were associated with lower exchange rate volatility and greater exchange rate depreciation influenced the reconstitution of production, towards the most efficient manufacturing industries in the developing countries.Bonroy, Gervais and Larue (2007)similarly held that export price volatility had a bearing on production capacity hence exports, depending on the assumptions about export price. The study added that since exchange rate volatility increased the degree of risk for firms, it prompted risk averse firms to reduce capacity hence exports. Liu, Lu and Zhou (2013) on the contrary found no evidence of export deflection after a currency appreciation.

Using a sample of 136 countries, (comprising 34 high income and 102 developing) Collaceli (2008) investigated the response of exports to real exchange rate fluctuations using the gravity model of trade. Some of the variables that were considered included; bilateral trade flows, importers GDP, exporter's GDP, the time variable measure of trade resistance, country pair specific measures of trade resistance affecting bilateral trade, time specific effect on trade and country year specific error. Results indicated that there were sectoral differentials in elastic cities such that differentiated sectors had greater elastic cities than homogenous ones.

In Nigeria, Essien et al (2011) found that exchange rate volatility was significant and impacted negatively on cocoa exports in Nigeria after running an OLS regression for an export supply function for the commodity. In addition to this, agricultural credit was found to have a positive effect on cocoa exports while the relative price[1] of cocoa was insignificant relative to the quantity of exports. Collaceli (2008) found results indicating that the presence of credit constraints in developing countries hindered them from exporting larger trade volumes as per the results. Bonroy et al (2007) through their study's findings demonstrated that export price volatility could either decrease, leave constant or increase production capacity and consequently exports depending on assumptions about the export price.

Musonda (2008)attempted to empirically asses the degree and direction of the impact of exchange rate volatility on nontraditional exports by considering the following variables; demand for exports, real foreign income, prices of exports abroad and terms of trade. After running, demand factors were found not to have a significant role in the performance of Zambia's nontraditional exports. Dincer and Kandil (2010) likewise found evidence of increased sensitivity of export demand to exchange rate appreciation.

Hondroyiannis*et al* (2008), Wang and Barett (2007) and Musyoki, Pokhariyal and Pundo (2012) used the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) system to proxy real exchange rate Volatility. The latter in a study carried out in Kenya, got evidence that the conditional volatility of the real exchange rate depended on both domestic and external shocks, real exchange rate fundamentals and macroeconomic changes.

Fang et al (2006) on the other hand used a dynamic conditional correlation bivariate GARCH model to investigate whether foreign exchange intervention stimulated exports. Findings revealed that it was important to reduce exchange rate fluctuations due to its negative net effect on exports.

Demand factors proxied by importing country's GDP did not play a major role in the performance of Zambia's non traditional exports (Ibid). The study therefore concluded that Zambia was a price taker in the international export markets. Similarly, Kandil et al (2007) in their study of exports and exchange rates revealed that the conflicting paths of demand and supply factors made the effects of unanticipated currency appreciation insignificant in Turkey.

In Kenya, Oduor and Khainga (2010) estimated the equilibrium exchange rate in to help the government make informed decisions when intervening in the foreign exchange market during episodes of exchange rate misalignment. The study found that long run household expenditure strongly influenced exchange rate variations in Kenya. The authors recommended that there was need to set up policies aimed at stabilizing inflationary pressures.

An investigation of Kenya's export performance since independence revealed that the real exchange rate had a potent effect on export performance (Were et al, 2002).Kiptui (2007) equally found that the real exchange rate had positive effects on exports in the short run though statistically insignificant for Kenya's key export products namely; tea, coffee, horticulture and manufactured goods. This was done by running an ARDL model to asses for the presence of both a long and short run relationship between the real exchange rate and exports. In addition to this, the destination country's income was established to be important in explaining both the short and long run export elasticities.

Chege et al (2014) concluded that exchange rate fluctuations had negative long run effects on horticultural exports, with both advocating for the use of hedging as a means to protect exporters from the effects of volatility. The study used GARCH methodology to model exchange rate volatilityand concluded that it had a negative relationship with French beans exports to the EU.

The study advocated for the government to maintain stability and competitiveness of the exchange rate. It further added that the country should boost competitiveness and diversify its export markets while improving on the quality of export products.

Kiptui (2008) obtained results indicating that exchange rate volatility had a negative long and short run relationship with Kenya's tea and horticulture exports. The study used the 12-month moving average of the standard deviation of absolute changes in the real effective exchange rate to model exchange rate volatility. The presence of a long run relationship between commodity exports and volatility was tested using the Johansen multivariate approach. The paper recommended the use of hedging as a means of protecting exporters from the negative effects of volatility and monitoring of the exchange rate movements to ensure stability in the exchange rates.

Overview of literature

The literature surveyed suggests that the traditional and risk portfolio paradigms best explains the relationship between real exchange rate volatility and commodity exports since it is based on the exporter's risk attitude. The other theories like; Absolute advantage, Hecksher-Ohlin and gravity model among others do not provide a good account of the hypothesized relationship because they don't consider the risk element in international trade.

Quite a number of studies were conducted using panel data while majority used time series analysis. The common factor between all these studies was the frequency of the data. The use of disaggregated data on a monthly basis has been widely used to bring out both the short and long run effects of exchange rate volatility on commodity exports. This suggests that the concept of exchange rate volatility is best captured by monthly data. Other studies however used annual data in the analysis.

While there are studies that used standard deviation of the exchange rate as a measure of volatility, the GARCH methodology has been widely used bymost studiesto establish its magnitude. Volatility was furthermore found to be sensitive to the time period and methodology of calculation. In addition to this, the currency being used to measure volatility was also important in determining its degree.

The Autoregressive Distributed Lag (ARDL) model is increasingly becoming popular as a means of testing for the presence of a long run relationship between exchange rate volatility and exports. The Johansen cointegration techniqueis still being used, the only challenge being that it can only be applied when all the variables are integrated of the same order. The ARDL model is applicable whether the variables are I(0) or I(1).

There were mixed results in terms of the influence of export demand factors especially foreign economic activity. Some studies found these variables significant while others did not. More importantly, there were pointers towards the fact that the effects of exchange rate volatility on exports depended on the sector and export destination. There were export destinations that were more sensitive to volatility than others and this came out explicitly in studies that approached the subject matter by identifying the export commodity as per destination.

Different from previous works, this study used the ARDL model which can be applied to test for a long run relationship between variables that are not necessarily integrated of the same order. It is applicable whether variables are I(0) or I(1). Like Kiptui (2008) and Chegee*t al* (2014), the study uses monthly disaggregated data. The point of departure from the Kitpui's study is the time frame, methodology and products considered in the analysis. While Kiptui (2008) looked at exports of Tea and Coffee over the 1997-2007 period, this study investigated exports of tea, coffee and horticulture over the 2005-2012 period. Secondly, whileKiptuiconducted cointegration tests via the maximum eigenvalue likelihood ratio test statistic to establish a long run relationship between exchange rate volatility and export of Teaand Coffee, this study used the Autoregressive Distributed Lag Model to establish a long run relationship between real exchange volatility and exports of coffee, tea and horticultural products.

Finally, while Chege et al (2014) considered how real exchange rate volatility affectedFrench bean exports from Kenya to the EU, this study investigated the effect of exchange rate volatility on Kenyanexports of Tea to the UK, Coffee and Horticulture to the EU.The presence of a long run relationship was also tested using different estimation techniques. While Chegee*t al* (2014) used the Johansen multivariate cointegration test to check for a long run relationship between real exchange rate volatility and French bean exports, this study used the Autoregressive Distributed Lag model to test for the presence of a long run relationship between real exchange rate volatility and Tea exports to the UK, Coffee and Horticultural exports to the EU.

The aforementioned provides a basis for analysis and justifies the needfor the study to be carried out in Kenya. It adds to the existing body of knowledge and will be useful in guiding future researchers on methodological approaches to be explored.

METHODOLOGY

Bounds Testing and Autoregressive Distributed Lag Model

The autoregressive distributed lag model refers to a mathematical expression where the dependent variable y is partly explained by lagged values of itself, current and successive lags of the explanatory variables. This approachhas been widely used following findings by Perasan et al (1999) that it was applicable whether variables were I(0) or I(1).

The first step involves ascertaining that there are noI(2) variables in the model. Thisis followed by conducting bounds tests for the null hypothesis of no co integration. To achieve this, the calculated F statistic is compared to the tabulated value developed by Pesaran et al (2001). Fora given number of variables,lower bounds and upper bounds are provided on the critical values. If the computed F statistic falls below the lower bound it is concluded that there is no co-integration, if it falls above the upper bound, it is concluded that there is co-integration. In the event that the computed F statistic falls between the upper and lower bounds, the test is rendered inconclusive (Pesaran*et al*, 2001). Upon ascertaining the existence of a long run relationship, a model of the form presented below was estimated;

$$\Delta y_t = \varphi_0 + \sum_{i=1}^{m-1} \varphi_i \Delta y_{t-i} + \Sigma_{i=0}^{n-1} \theta_{ji} \Delta x_{jt-i} + \varphi_m y_{t-m} + \theta_{jn} x_{jt-n} + \varepsilon_t \text{.....} \quad (1)$$

The study tested for a null hypothesis of $H_0: \varphi_m = \theta_{jn} = 0$ against an alternative hypothesis of $H_A: \varphi_m \neq \theta_{jn} \neq 0$

The resultant long run multiplier μ_j refers to the long run effect of a change in x_j on *y* and by Bardsen's transformation,

$$\mu_j = \frac{\theta_{jn}}{-\varphi_m} \text{.......................................} \quad (2)$$

The long run effect can then be estimated by equation (4). The dynamics are included to ensure that the estimates are unbiased even with the presence of endogeneity amongst some variables. The lag length is determined using the Schwartz Bayesian or Akaike Information criteria.

Empirical Model

Thestudy took a bilateral approach in estimating the effects of exchange rate volatility on Key Kenyan exports namely; Coffee and Horticulture to the European Unionand tea to the United Kingdom. The study adopted the methodology used byChege*et al* (2014)andColacelli (2008) to estimate the relationship between exports and exchange rate fluctuations. In a study examining export responses to exchange rate fluctuations, the author used a bilateral sample of 136 countries to estimate the relationship. The ARDL model as presented in section 3.1 was employed to establish the empirical relationship. The disaggregated export responses by product will inform stakeholders on how to predict the behavior of trading partners. Kenya being a developing country is expected to have more export responses to exchange rate fluctuations than the developed countries.

Equation 3 below was run for all the three commodities; coffee, tea and horticulture

$$\Delta logXP_t = \alpha_0 + \sum_{i=1}^{m-1} \alpha_{1i} \Delta logXP_{t-i} + \sum_{i=0}^{l-1} \beta_{1i} \Delta logY_{jt-i} + \sum_{i=0}^{n-1} \beta_{2i} \Delta logY_{kt-i} + \sum_{i=0}^{l-1} \beta_{3i} \Delta logEV_{jt-i} + \sum_{i=0}^{l-1} \beta_{4i} \Delta logRER_{jt-i} + \alpha_{2i} logXP_{t-i} + \beta_{5i} logY_{jt-i} + \beta_{6i} logY_{kt-i} + \beta_{7i} logEV_{jt-i} + \beta_{8i} logRER_{jt-i} + \varepsilon_t \quad .....(3)$$

XP_t representscommodity exports and will be the regressand. Similar studies have used this variable as the dependent variable in their estimation of the effect of exchange rate variability on exports. Fountas and Aristotelous (2003) and Collaceli (2008) used it to represent the real exports while estimating the effects of the European monetary system on intra EU exports, Mehare and Edriss (2012) used it to represent the value of oilseed exportsin an attempt to relate it to exchange rate variability.

Y_{jt} represents the importer's GDP at time t. This is a proxy for the foreign importing country's income.Consumption of export commodities is a function of the importer's income (Essien, Dominic and Sunday, 2011; Hondroyiannis et al, 2008). Y_{kt} represents the GDP of exporter at time t.

RER_t refers to the Real exchange rate and is a measure of external competitiveness (Were et al, 2002). The general real exchange rate is computed as

$$RER_t = \frac{ep*}{p} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. \quad (4)$$

wheree is the nominal exchange rate, *p** refers to the world price index (US wholesale price) and *p* is the domestic price (consumer price index). This variable is expected to have a direct relationship with exports with a positive sign. µ is the real exchange rate elasticity of exports and measures the degree of responsiveness of exports to changes in the real exchange rate.

EV_t Measuresexchange rate volatility in time *t* as measured using the Generalized Autoregressive Conditional Heteroscedasticity(GARCH)model. In its simplest form, the GARCH model can be written as;

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \alpha_2 \sigma_{t-1}^2 \quad \ldots\ldots\ldots\ldots\ldots.. \quad (5)$$

It essentially means that the conditional variance of *u* at time *t* depends on both the squared error term in the previous period ARCH (1)) and the conditional variance in the previous time period. This is what is referred to as the general GARCH (*p,q*) model, with *p* lagged terms of the squared error term and *q* terms of the lagged conditional variance (Gujarati *et al*, 2009). ε_t represents the error term.

Data sources

Tea coffee and Horticultural export data was gotten from Kenya National Bureau of Statistics, exchange rate data from Central Bank of Kenya and finally, foreign exchange rate and GDP data from the International Financial Statistics website.

RESULTS

Descriptive Statistics

The descriptive statistics for all the variables in real terms are as presented in table (1). The mean value of coffee exports to the European Union between January 2005 and December 2012 was Ksh. 357 million with a seemingly high standard deviation of Ksh. 265 million. Horticulture exports to EU had a mean value of Ksh. 2,240 million with a standard deviation 1,110 million while tea exports to the UK had a mean of Ksh.593 million and a standard deviation of 388 million. The monthly GDPs of Kenya, UK and EU had means of Ksh.215,050,£17,910,578 and € 141(million)with standard deviations of 86,035, 5,684,341 and 52,776,383respectively. The Kenya shilling's real exchange rate to the Euro and sterling Pound had means of 116.81 and 146.09 with standard deviations of 54.24 and 57.74 respectively. Coffee, Tea, Horticulture and EU GDP are in millions.

Table (1) Descriptive Statistics

	Coffee	EU GDP	Euro	Horticult ure	Kenya GDP	Pound	Tea	UK GDP
Mean	357	141	116.805	22,400	215,050	146.09	593	17,910,578
Median	270	129	82.1969	1,800	159,306	115.48	388	17,619,670
Maximum	1240	332	219.344	4,820	351,745	252.02	1,630	31,952,092
Minimum	69.3	8272390	64.1160	867	135,855	75.64	169	10,038,767
Std. Dev.	265	5277638	54.237	1,110	86,035	57.74	388	5,684,341
Skewness	1.38474	2.02766	0.62715	0.67098	0.55738 9	0.5028	0.825768	0.43492
Kurtosis	4.45868	6.69013	1.62624	2.1029	1.421	1.543	2.263627	2.415833
Jarque-Bera	39.1913	120.251	13.8419	10.4227	14.9394	12.54	13.07927	4.39149
Probability	0	0	0.00098	0.00545	0.00057	0.0019	0.001445	0.111276
Sum	3.42E+10	1.35E+1 0	11213.	2.15E+1 1	2064476 1	14025.04	5.70E+10	1.72E+09
Sum Sq. Dev.	6.66E+18	2.65E+1 7	279457	1.17E+2 0	7.03E+1 1	316726.9	1.43E+19	3.07E+15
Observation s	96	96	96	96	96	96	96	96

Diagnostic tests

The following diagnostic tests were conducted for the three equations; Breusch Godfrey serial correlation test, White heteroskedasticity test and the normality test. Results for the diagnostic tests are shown in the appendix.

Breusch Godfrey serial correlation test

The Breusch Godfrey serial correlation tests the null hypothesis that there is no serial correlation among the residuals. In this test, an OLS regression is run and once the residuals are obtained, they are regressed against the explanatory variables.

$$u_t = \alpha_1 + \alpha_2 X_t + \rho_1 u_{t-1} + \rho_2 u_{t-2} + \ldots + \rho_p u_{t-p} + \varepsilon_t \quad ....(6)$$

The null hypothesis to be tested appears as $H_0: \rho_1 = \rho_2 = \ldots = \rho_p = 0$

The alternative hypothesis is $H_1: \rho_1 = \rho_2 = \ldots = \rho_p \neq 0$

This means that the residuals aren't serially correlated. Upon estimation of the equation, the R^2 is obtained and if the sample is large, the formula provides that $(n-p)R^2 \sim X_p^2$ meaning that

n-p times the R^2 value resulting from equation ... above follows a chi-square distribution with p degrees of freedom. If the $(n-p)R^2$ value is larger than critical chi-square value at a given level of significance, the null hypothesis of no serial correlation is rejected whereby at least one of the coefficients in equation 8 is statistical significantly different from zero (Gujarati *et al,* 2009).

The tables in appendix 4, 5 and 6 show that the probability values of the chi-square distributions in all the Breusch Godfrey serial correlation tests are larger than the 5 per cent critical values and therefore the null hypothesis of no serial correlation cannot be rejected.

White general heteroskedasticity test

The White's general heteroskedasticity involves estimating an equation for purposes of obtaining residuals as shown in equation 9.

$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + u_i \quad \text{.......................} \quad (7)$$

This is followed by running an auxiliary regression like in equation 10.

$$u_i^2 = \alpha_1 + \alpha_2 X_{2i} + \alpha_3 X_{3i} + \alpha_4 X_{2i}^2 + \alpha_5 X_{3i}^2 + \alpha_6 X_{2i} X_{3i} + v_i \quad \text{.......} \quad (8)$$

The squared residuals from equation 9 are regressed against the explanatory variables in equation 9, their squared values and cross products. The resultant R^2 from this equation is then obtained. With a null hypothesis of no heteroskedasticity it is demonstrated that the sample size *n* multiplied by R^2 from equation 10 asymptotically follows the chi-square distribution with a degree of freedom equal to the number of regressors that doesn't include the constant term in equation 10.

$$n.R^2 \sim X_{df}^2 \quad \text{....................................} \quad (9)$$

If the chi-square value obtained above exceeds the critical chi-square value at a given level of significance, it is concluded that heteroskedasticity is present. If not, then there is no heteroskedasticity, meaning that

$$\alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 0 \quad \text{....................} \quad (10)$$

Looking at the probability values of the chi-square distributions in all the white heteroskedasticity tests for the three equations in appendix 1 to appendix 3, they are larger than the 5 per cent critical value hence null hypothesis of homoscedasticity is not rejected.

White general heteroskedasticity test

The White's general heteroskedasticity involves estimating an equation for purposes of obtaining residuals as shown in equation 9.

$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + u_i \quad \text{.......................} \quad (7)$$

This is followed by running an auxiliary regression like in equation 10.

$$u_i^2 = \alpha_1 + \alpha_2 X_{2i} + \alpha_3 X_{3i} + \alpha_4 X_{2i}^2 + \alpha_5 X_{3i}^2 + \alpha_6 X_{2i} X_{3i} + v_i \quad \text{............} \quad (8)$$

The squared residuals from equation 9 are regressed against the explanatory variables in equation 9, their squared values and cross products. The resultant R^2 from this equation is then obtained. With a null hypothesis of no heteroskedasticity it is demonstrated that the sample size *n* multiplied by R^2 from equation 10 asymptotically follows the chi-square distribution with a degree of freedom equal to the number of regressors that doesn't include the constant term in equation 10.

$$n.R^2 \sim X_{df}^2 \quad \text{....................................} \quad (9)$$

If the chi-square value obtained above exceeds the critical chi-square value at a given level of significance, it is concluded that heteroskedasticity is present. If not, then there is no heteroskedasticity, meaning that

$$\alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = 0 \quad \text{....................} \quad (10)$$

Looking at the probability values of the chi-square distributions in all the white heteroskedasticity tests for the three equations in appendix 1 to appendix 3, they are larger than the 5 per cent critical value hence null hypothesis of homoscedasticity is not rejected.

Normality tests

The normality tests were conducted using the histogram test as presented in appendix 7 to 9. The residuals appear normally distributed. The JarqueBera tests for the three equations have a probability of less than 5 per cent and values lower than 5.99. The null hypothesis that the error terms are normally distributed can thus not be rejected.

Unit Root Tests

As shown in table (2), apart from coffee which was I(0) all the other variables were I(1).The variables Tea and horticulture were logged to make them stationary.

Table (2) Unit root tests

Variable	ADF test at levels	ADF test at first difference
Coffee	-5.219336***	N/A
Tea	-2.447438	-13.57633***
Horticulture	-2.119937	-11.81389***

Exchange Rate Volatility

Below are the results showing exchange rate volatility for the Kenyan Shilling against the pound and the Euro. Looking at the variance equation in Table (3), both the ARCH (RESID(-1)^2) and GARCH (GARCH(-1))probabilities are statisticallysignificant, indicating the presence of volatility. The implication is thatprevious month's exchange rate information (ARCH) can influence the present month's Kenya Shilling exchange rate volatility with respect to the Pound.

Furthermore,the GARCH term is also significant meaning that the previous month's exchange rate volatility can influence the present month's volatility.

Table (3) GARCH equation for the UK Pound volatility

Dependent Variable	UK Pound	
Variable	Coefficient	Prob.
C	0.156011	0.3233
LREALPOUNDLAG1	0.968693	0.0000
Variance Equation		
C	0.009280	0.4114
RESID(-1)^2	-0.014395	0.0000
GARCH(-1)	0.872808	0.0000
LREALPOUNDLAG1	-0.001541	0.5064
LTEA	-3.33E-05	0.9707
R-squared	0.927118	

Table (4) also shows that both the ARCH and GARCH terms are statistically significant hence volatility is present. The ARCH term (RESID(-1)^2) indicates that the previous month's volatility information influences the current month's volatility. The GARCH term (GARCH(-1)) is also significant showing that the previous period's volatility influences the present period's volatility.

Table (4)GARCH equation for Euro volatility

Dependant variable	EU Euro	
Variable	Coefficient	Prob.
C	-0.008759	0.7725
LREALEUROLAG1	1.000678	0.0000
Variance Equation		

C	0.000992	0.0000
RESID(-1)^2	-0.010712	0.0072
GARCH(-1)	1.017667	0.0000
LREALEUROLAG1	-0.000201	0.0000
R-squared	0.943684	

Bounds Testing and Analysis of Long Run Relationship

Having established the order of integration for all the variables to be either I(1) or I(0), the existence of a long run relationship between; each export commodity, the real exchange rate as per destination, exchange rate volatility and the host country's income was tested.Each commodity had a model containing five regressors and therefore the 95% critical value bounds given by Pesaran, Shin and Smith (1999) is (3.12, 4.25). For all the equations, the null hypothesis of no long run relationships is rejected because the calculated F-statistic exceeds the upper bound critical value of 4.25.

Table (5) Bounds Tests

Export Commodity	**Calculated F-Statistic**
Tea	7.32
Horticulture	19.67
Coffee	11.65

Table (6) shows the estimated long run elasticities for the tea, horticulture and coffee equations.

Results indicated that real exchange rate appreciation affected horticultural exports positively both in the short and long run and these effects were statistically significant. Importer's income had a positive and significant effect on horticultural exports to the EU, with a multiplier effect of 1.87 percent. A unit increase in EU incomes would therefore lead to a 1.87 percent change in Kenya's horticultural exports to EU over time. On the other hand, increase in Kenya's income had a negative effect on export of horticultural products though statistically insignificant. Exchange rate volatility was found to have a negative and statistically significant long run effect on horticultural exports with a multiplier effect of -0.1. A unit increase in exchange rate volatility would therefore lead to a decrease in horticultural exports by 0.1 percent.

Importer income had a negative and statistically significant effect on tea exports to the UK, with a multiplier of -1.66 percent. This result depicts negative income demand elasticity for tea exports to the UK. It could be a pointer to the fact that in this case, the income effect outweighs the substitution effect and that with increase in incomes there could be other commodities that are consumed as opposed to Kenyan tea. Exporter income for this equation was found positive though statistically insignificant. Real exchange rate was positive and statistically significant for tea with a long run multiplier of 0.72. A unit change in real exchange rate would therefore increase exports by 0.72 percent. This was similar to findings by Freund and Pierola (2008) who observed that export surges were associated with greater exchange rate depreciation and further pointed out that currency depreciation could be employed as an instrument for growth only in the short term, because an economy couldn't sustain a depreciated exchange rate indefinitely. Eichengeen and Gupta (2012) stated that exchange rate depreciation could not be used as an instrument for export growth in the long term.

Real exchange rate volatility was found to have a positive relationship with tea exports to the UK. It had a coefficient of 0.23 and a multiplier of 0.21 percent. A unit increase in the level of volatility would therefore increase exports by 0.21 percent. According to Freund and Pierola, (2008) low exchange rate volatility is often associated with higher export surges.

Both importer and exporter incomes were found to be significant though with different signs for coffee exports to the EU. Importer income had a negative coefficient with a multiplier of -7.73. In terms of elasticity of demand for Kenyan coffee exports to the EU, perhaps the income effect outweighs the substitution effect hence the negative coefficient. Exporter income nevertheless took an expected sign with a multiplier of 6.17, indicating that a unit increase in national income would result to a 6.17 percent increase in coffee exports to the EU. Though insignificant, real exchange rate volatility and appreciation were observed to have a negative effect on coffee exports.

Importer's income was significant and negative for coffee and tea but positive and significant for horticultural products. The coefficient for exporter's income was positive for both coffee and tea, though significant for coffee but insignificant for tea. In the case of horticulture, importer's income was positive and significant.

The real exchange rate was negative and insignificant in the coffee equation but positive and significant for both Tea and horticulture. Real exchange rate volatility had a negative coefficient for both coffee and horticulture though significant for horticulture but insignificant for coffee. The real exchange rate volatility coefficient was however positive and significant for tea.

Table (6)Estimated Long run coefficients

Variable	Coffee	Tea	Horticulture
Importer's Income (Y_{jt})	-5.687*** (0.0004)	-1.483*** (0.0135)	2.138926*** (0.0059)
Exporter's income (Y_{kt})	4.5435*** (0.0001)	0.029 (0.9904)	-0.940248 (0.5786)
Real Exchange Rate (RER_t)	-0.146 (0.5516)	0.750586*** (0.0056)	0.219366*** (0.0287)
Real Exchange Rate Volatility (EV_t)	-0.0377 (0.6740)	0.2321*** (0.0189)	-0.105011*** (0.0030)

The figures in parenthesis represent standard errors.

The estimated long run multipliers for each commodity were as follows;

For the coffee equation, Y_{jt} = -7.73 Y_{kt} = 6.17

Tea Equation, Y_{jt} = -1.66 RER_t = 0.72 EV_t = 0.21

Horticulture equation, Y_{jt} = 1.87 Y_{kt} = -0.61 RER_t = 0.24 EV_t = -0.1

See equation 1 and 2 for computations.

CONCLUSION AND POLICY RECOMMENDATIONS

The study sought to establish how exchange rate volatility affected Kenya's key export commodities namely; Coffee, Tea and Horticulture. Bounds testing and ARDL modeling via General to specific method was applied to test for the existence of both a long and short run relationship. The null hypothesis of no long run relationships between the estimated variables was rejected for all the commodities.

Results from this study are mixed,real exchange rate volatility was found tohavea negative and significant effect on horticulture, negative and insignificant on coffee and a positive and significant effect for tea exports.These findings are partly in line with Chege*et al* (2014) and Kiptui (2008) to the extent that it found a negative and significant long run effect of real exchange volatility on horticultural exports. The rest of the findings contradict results from the two studies mentioned above. The monetary authorities should therefore strive to keep the exchange rates stable to ascertain predictability of profits for exporters. This can be done by monitoring exchange rate movements and adopting appropriate monetary and fiscal policy stances. In addition to this, the government should make efforts to establish a derivatives market in Kenya. This would ease the management of currency risk exposure on the part of producers transacting in the global market.The country currently lacks a financial derivatives exchange since most derivative securities are being traded over the counter by well established banking institutions. This can be done by reviewing the existing policy on the derivatives market. In addition to that, the government should provide a legal and regulatory framework to ensure that public interests are protected in the proposed market. Countries like South Africa and India are examples of developing countries that have successfully adopted the use of derivatives markets to protect exporters from short term exchange rate fluctuations.

Importers income has been found significant in determining the demand for certain export commodities. This study proposes that greater value addition be done on commodities like coffee and tea to ensure that there is increased consumption in their destination markets. The country also needs to diversify export destinations to reduce vulnerability emanating from having a few countries consuming our export products. Further research needs to be carried out on the income elasticity of Kenyan exports. Most studies have focused on supply side factors such as; commodity prices, the Gross Domestic Product among other factors while little has been done to investigate demand side factors such as foreign incomes.

Potential Conflicts of Interest

The authors declare no conflict of interest.

References

1) Arize, C.A., Osang, T and Slottje, J.D. (2000). Exchange Rate Volatility and Foreign Trade: Evidence from Thirteen LDCs. *Journal of Business and Economic Statistics*, Vol. 18, No.1 pp 10-17. American Statistical Association.

2) Berthou, A. (2008). An investigation on The Effect of Real Exchange Rate Movements onOECD Bilateral Exports. Working Paper Series No. 920, Kaisestrasse 29, 60311 Frankfurt am Main, Germany.

3) Bonroy, O., Gervais, J.P., and Larue, B. (2007). Are Exports a monotonic function of exchange rate volatility? Evidence from disaggregated porks. *The Canadian Journal of Economics*, *Vol. 40* No.1 (Feb 2007) pp 127-154. Canadian Economics Association.

4) Chege, M.S., Mbatia, O.L.E., and Nzuma, M.J. (2014). Effects of Exchange Rate Volatility onFrench Beans Exports in Kenya. *Journal of Agricultural Economics, Extension and Rural Development,* Vol. 1(1) pp 001-012, Spring Journals.

5) Colacelli, M. (2008). Export Responses to Real Exchange Rate Fluctuations: Development status andExported Goods Effects.Barnad College, Columbia University.

6) De Grauwe, P (1987). Exchange Rate Variability and the Slowdown in Growth of International Trade (May 22, 1987). *IMF Working Paper,* Vol., pp. 1-25.

7) Dincer, N. and Kandil, M.(2009). The Effects of Exchange Rate Fluctuations on Exports: A Sectoral Analysis for Turkey. State Planning Organization, Necatibly cad. No.108, Yucetepe, Ankara, 06 100 Turkey; International Monetary Fund, Washington DC, USA.

8) Essien, E.B., Dominic, A.O., and Sunday, E.R. (2011). Effects of Price and Exchange Rate Fluctuations on Agricultural Exports in Nigeria. *International Journal of Development Research and Investment*, Vol 2 No.1.

9) European Central Bank (2008) An Investigation on the Effect of Real Exchange Rate Movements on OECD Bilateral Exports Kaiserstrasse 29, 60311 Frankfurt am Main, Germany.

10) Fang, W., Lai, Y.H., and Miller, S.M. (2006). Export Promotion Through Exchange Rate Depreciation or Stabilization? *Southern Economic Journal*, Vol.72 No.3 (Jan 2006), pp 611-626.

11) Freund, C. and Pierola, D.M. (2008). Export Surges: The Power of Competitive Currency. The World Bank Development Research Group and Poverty Reduction and Economic Management Network.

12)Greenaway,D., Kneller, R. and Zhang, X. (2010). Exchange Rate Uncertainty and Export Decisions in the UK. *Journal of Economic Integration*, Vol. 25, No. 4 (December 2010), pp. 734-753, Center for Economic Integration, Sejong University.

13) Gujarati, D.N., Porter, D.C. and Gunasekar, S. (2009). Basic Econometrics. Fifth Edition. Tata McGraw Hill Education Private Limited, New Delhi.

14) Haile, M. G and Pugh, G. (2011). Does Exchange Rate Volatility Discourage International Trade? A Meta-regression Analysis. *The Journal of International Trade & EconomicDevelopment*, 1-30.

15) Hondroyiannis, G., Swamy, P.A.V.B., Tavlas, G. and Ulan, M. (2008). Some Further Evidence on Exchange Rate Volatility and Exports. Review of World Economics WeltwirtschafflichesArchiv, Vol. 44, No. 1, pp 151-180, Springer.

16) Kai-Li W. and Barrett, C. B. (2007). Estimating the Effects of Exchange Rate Volatility on Export Volumes. *Journal of Agricultural and Resource Economics*, Vol. 32, Number 2: pp. 225-255.

17) Kandil, M. (2009). Exchange Rate fluctuations and The Balance of Payments. Channels of interaction in Developing and Developed countries. Journal of Economic Integration, Vol. 24, No.1 pp 151-174

18)Kandil, M., Berument, H. and Dincer, N.N. (2007). The Effect of Exchange Rate Fluctuations on Economic Activity in Turkey. Journal of Asian Economics 18(2007) 466-489. The Western Hemisphere Department, International Monetary Fund, 700 19th Street, N.W. Washington DC.

19) Kemal, M.A and Qadir, U. (2005) Real Exchange Rate, Exports, and Imports Movements: A Trivariate Analysis. *The Pakistan Development Review*, Vol. 44, No. 2 (Summer 2005), pp. 177-195, Pakistan Institute of Development Economics, Islamabad.

20) Kinuthia, B.K. (2004) Export Structure and Catching Up: Kenya and Malaysia compared, School of Economics, University of Nairobi, Kenya.

21) Kiptui, M. (2007). Does the Exchange Rate Matter for Kenya's Exports? A bounds testing approach. African Econometric Society 2007 conference, Cape Town, July 4th to 6th 2007.

21)Kiptui, M. (2008). Does Exchange Rate Volatility harm Exports? Empirical evidence form Kenya's Tea and Horticulture Exports.CSAE Conferenceat Oxford University 16-18 March 2008.

21) Kiringai, J. (2002) Trade Policy and Transport Costs in Kenya. Centre for Research in Economic Development and International Trade, No. 06/11.University of Nottingham.

22) Kunst, M.R. and Nuroglu, E. (2012). The Effects of Exchange Rate Volatility on International Trade Flows: Evidence from Panel Data Analysis and Fuzzy Approach..Journal of Economic Integration,Vol.30 No.8

23) Mehare,A. and Edriss,A.K.(2012)Evaluation of Effect of Exchange Rate Variability on Export of Ethiopia's Agricultural Product: Case of

Oilseeds. Collaborative Masters Program in Agricultural and Applied Economics Research Theses. University of Minnesota Department of Applied Economics.
24) Musonda, A. (2008). Exchange Rate Volatility and Non-Traditional Exports Performance: Zambia, 1965-1999. Financial Markets Department, Bank of Zambia. AERC Research Paper 185African Economic Research Consortium, Nairobi November 2008.
25)Musyoki, D., Pokhariyal, G.P. and Pundo, M. (2012). Real Exchange Rate Volatility in Kenya. *Journal of Emerging Trends in Economics and Management Sciences* (JETEMS) 3 (2): 117-122 © Scholarlink Research Institute Journals, 2012 (ISSN: 2141-7024).
27) Nabli, M.K. and Véganzonès-Varoudakis, M.A. (2002). Exchange Rate Regime and Competitiveness of Manufactured Exports: The Case of MENA Countries. Centre National de la Recherche Scientifique Centre d'Etudes et de Recherchessur leDéveloppement International, Clermont Ferrand , France.
28) Oduor, J. and Khainga, D. (2010). Equilibrium Real Exchange Rates and Real Misalignment in Kenya:A Fundamental Equilibrium Approach.Kenya Institute for Public Policy Research and Analysis, Macroeconomics Division. KIPPRA Discussion Paper No. 108.
29) Oyovwi, O. D. (2012) Exchange Rate Volatility and Imports in Nigeria. *Academic Journal of Interdisciplinary Studies Vol. 1 No 2* November 2012.MCSER-CEMAS-Sapienza University of Rome.
30) Pesaran, M. H. and Y. Shin, (1999). An autoregressive distributed lag modelling approach to cointegration analysis. Chapter 11 in S. Strom (ed.), *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*. Cambridge University Press, Cambridge.
31) Pesaran. M.H., Shin, Y. and Smith, R.J., (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16, 289-326.
32) Republic of Kenya (1977) Economic Survey. Government Printer.
33)Republic of Kenya (1995) Economic Survey. Government Printer.
34)Republic of Kenya (2007) Kenya Vision 2030. A Globally Competitive and Prosperous Kenya.
35)Republic of Kenya (2012) Economic Survey. Government Printer.
36)Republic of Kenya (2014) Economic Survey. Government Printer.
37) Thai Tri Do, (2006) A Gravity Model For Trade Between Vietnam and Twenty-Three European Countries. Department of Economics and Society Thesis 2006.
38) Wang, K.L., and Barrett, C.B. (2007). Estimating the Effects of Exchange Rate Volatility on Export Volumes. *Journal of Agricultural and Resource Economics, Vol 32*, No.2 (August 2007), pp 225-255: Western Agricultural Economics Association.
39) Were, M., G. Alemayehu., Ndung'u, N.S., and S.N. Karingi, (2002). Analysis of Kenya's Export Performance: An Empirical Evaluation, KIPPRA Discussion Paper Series, DP No. 22. Nairobi: The Kenya Institute for Public Policy Research and Analysis.
40) World Bank (2013). The Kenya Economic Update: Time to Shift Gears; *Accelerating Growth and Poverty Reduction in the New Kenya*. June 2013, Edition No.8
41) Yarbrough, B.V. and Yarbrough, R.M. (2007). The World Economy: Trade and Finance. Thomson South Western.

Appendices

Appendix(1)White heteroskedasticity test for the tea equation

F-statistic	0.735661	Prob. F(10,82)		0.6889
C	7.656561	Prob. Chi-Square(10)		0.6623
@TREND	5.864776	Prob. Chi-Square(10)		0.8265
LTEALAG1	Coefficient	Std. Error	t-Statistic	Prob.
LPOUNDVOLATILITYLAG1	-3.420060	6.857391	-0.498741	0.6193
LUKGDPLAG1	-0.001367	0.002396	-0.570660	0.5698
LKENYAGDP1LAG1	-0.013611	0.031392	-0.433592	0.6657
LREALPOUNDLAG1	0.009572	0.025566	0.374388	0.7091
LAG1DLTEA	-0.062455	0.155261	-0.402255	0.6885
LAG1DLREALPOUND	0.359287	0.636278	0.564671	0.5738
DLPOUNDVOLATILITYLG1	0.017872	0.069772	0.256140	0.7985
LAG1DLUKGDP	-0.036502	0.027632	-1.321018	0.1902
	-0.060505	0.089867	-0.673273	0.5027
	0.003069	0.015558	0.197267	0.8441
	-0.239511	0.612800	-0.390848	0.6969

Appendix (2)White heteroskedasticity test for the coffee equation

Heteroskedasticity Test: Breusch-Pagan-Godfrey				
F-statistic	0.292227	Prob. F(5,88)		0.9161
Obs*R-squared	1.535264	Prob. Chi-Square(5)		0.9090
Scaled explained SS	1.153759	Prob. Chi-Square(5)		0.9492
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.278491	6.278150	0.203641	0.8391
LCOFFEELAG1	0.018056	0.045001	0.401234	0.6892
LKENYAGDP1LAG1	0.082404	0.386280	0.213327	0.8316
LEUGDPLAG1	-0.172930	0.639375	-0.270467	0.7874
LAG1DLKENYAGDP1	3.761162	3.989406	0.942787	0.3484
LAG1DLEUGDP	-0.375581	1.612077	-0.232980	0.8163
R-squared	0.016333	Mean dependent var		0.123636
Adjusted R-squared	-0.039558	S.D. dependent var		0.162777
S.E. of regression	0.165965	Akaike info criterion		-0.692374
Sum squared resid	2.423916	Schwarz criterion		-0.530036
Log likelihood	38.54157	Hannan-Quinn criter.		-0.626801
F-statistic	0.292227	Durbin-Watson stat		2.099705
Prob(F-statistic)	0.916091			

Appendix(3)White heteroskedasticity test for the horticulture equation

F-statistic	0.407257	Prob. F(6,87)		0.8724
Obs*R-squared	2.568022	Prob. Chi-Square(6)		0.8608
Scaled explained SS	1.901712	Prob. Chi-Square(6)		0.9285
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.443102	1.477746	0.299850	0.7650
DLREALEUROLAG1	-0.019126	0.036922	-0.518001	0.6058
LHORTICULTURELAG1	0.019930	0.021785	0.914826	0.3628
LEUROVOLATILITYLAG1	0.003090	0.007123	0.433831	0.6655
LKENYAGDP1LAG1	-0.056308	0.105824	-0.532092	0.5960
LREALEUROLAG1	-0.001127	0.020218	-0.055765	0.9557
LEUGDPLAG1	-0.007508	0.138177	-0.054334	0.9568
R-squared	0.027319	Mean dependent var		0.026889
Adjusted R-squared	-0.039762	S.D. dependent var		0.035546
S.E. of regression	0.036245	Akaike info criterion		-3.725454
Sum squared resid	0.114295	Schwarz criterion		-3.536059
Log likelihood	182.0963	Hannan-Quinn criter.		-3.648952
F-statistic	0.407257	Durbin-Watson stat		1.754434
Prob(F-statistic)	0.872396			

Appendix(4)Breusch-Godfrey Serial Correlation LM Test for the coffee equation

F-statistic	0.527119	Prob. F(2,86)		0.5922
Obs*R-squared	1.138353	Prob. Chi-Square(2)		0.5660
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	11.37292	17.71792	0.641888	0.5227
LCOFFEELAG1	-0.250781	0.264471	-0.948239	0.3457
LKENYAGDP1LAG1	1.327205	1.550136	0.856186	0.3943
LEUGDPLAG1	-1.559718	2.072559	-0.752557	0.4538
LAG1DLKENYAGDP1	-2.686982	9.228180	-0.291171	0.7716
LAG1DLEUGDP	2.679777	4.431345	0.604732	0.5469
RESID(-1)	0.285251	0.283374	1.006624	0.3169
RESID(-2)	0.081492	0.128304	0.635144	0.5270
R-squared	0.012110	Mean dependent var		-2.65E-15
Adjusted R-squared	-0.068300	S.D. dependent var		0.353504
S.E. of regression	0.365377	Akaike info criterion		0.905491
Sum squared resid	11.48103	Schwarz criterion		1.121942
Log likelihood	-34.55810	Hannan-Quinn criter.		0.992922
F-statistic	0.150606	Durbin-Watson stat		1.973689
Prob(F-statistic)	0.993470			

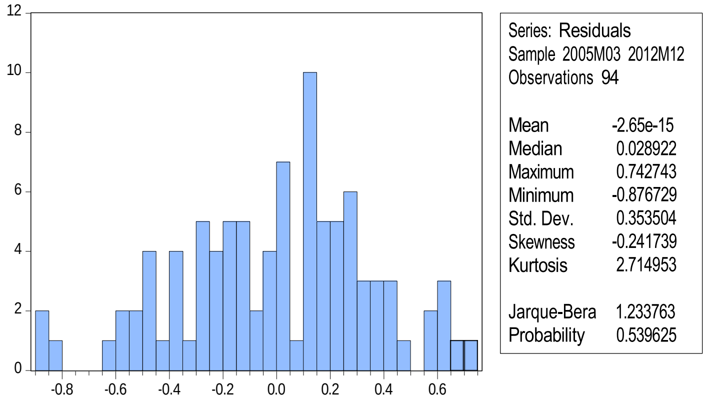
Appendix (5)Breusch-Godfrey Serial Correlation LM Test for theHorticulture equation

F-statistic	0.342311	Prob. F(2,85)		0.7111
Obs*R-squared	0.751063	Prob. Chi-Square(2)		0.6869
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.515199	7.129559	-0.072262	0.9426
DLREALEUROLAG1	-0.013489	0.176010	-0.076635	0.9391
LHORTICULTURELAG1	-0.367831	0.559929	-0.656924	0.5130
LEUROVOLATILITYLAG1	-0.034166	0.061867	-0.552250	0.5822
LKENYAGDP1LAG1	-0.182233	0.584171	-0.311951	0.7558
LREALEUROLAG1	0.081080	0.155483	0.521476	0.6034
LEUGDPLAG1	0.692747	1.270089	0.545432	0.5869
RESID(-1)	0.394749	0.588930	0.670282	0.5045
RESID(-2)	-0.045872	0.109247	-0.419893	0.6756
R-squared	0.007990	Mean dependent var		-2.61E-15
Adjusted R-squared	-0.085376	S.D. dependent var		0.164857
S.E. of regression	0.171750	Akaike info criterion		-0.594709
Sum squared resid	2.507332	Schwarz criterion		-0.351202
Log likelihood	36.95132	Hannan-Quinn criter.		-0.496350
F-statistic	0.085578	Durbin-Watson stat		1.934332
Prob(F-statistic)	0.999512			

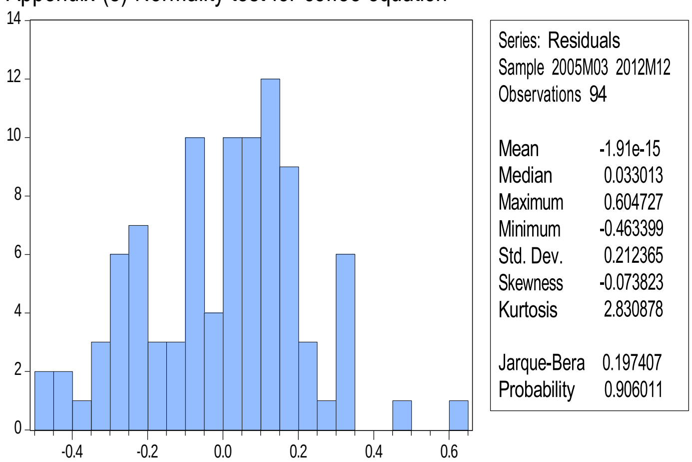
Appendix 6: Breusch-Godfrey Serial Correlation LM Test for the tea equation

F-statistic	0.117317	Prob. F(2,86)		0.8894
Obs*R-squared	0.255762	Prob. Chi-Square(2)		0.8800
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LTEALAG1	-0.075704	0.348815	-0.217033	0.8287
LPOUNDVOLATILITYLAG1	-0.000880	0.030681	-0.028668	0.9772
LUKGDPLAG1	-0.078121	0.453284	-0.172344	0.8636
LTEAPRICELAG1	0.012028	0.109533	0.109809	0.9128
C	2.495332	11.88524	0.209952	0.8342
@TREND	0.000701	0.003434	0.204089	0.8388
RESID(-1)	0.065922	0.366763	0.179740	0.8578
RESID(-2)	0.077729	0.182380	0.426194	0.6710
R-squared	0.002721	Mean dependent var		-1.91E-15
Adjusted R-squared	-0.078453	S.D. dependent var		0.212365
S.E. of regression	0.220538	Akaike info criterion		-0.104228
Sum squared resid	4.182782	Schwarz criterion		0.112222
Log likelihood	12.89873	Hannan-Quinn criter.		-0.016798
F-statistic	0.033519	Durbin-Watson stat		1.930982
Prob(F-statistic)	0.999952			

Appendix (7) Normality test for tea equation



Appendix (8) Normality test for coffee equation



Appendix (9) Normality test for horticulture equation