KENYAN TEA EXPORTS AND EXCHANGE RATE VOLATILITY

BY

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DECLARATION

This paper is my original work and has not been presented for a degree in any other university.

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DEDICATION

I wish to dedicate this paper to my beloved mother, Helena Jeptoo Sang, my brother Mwalimu John Kipleting Kosgei (Durrell) and all my brothers and sisters (Titus, Jane, Susan, Noel, Stellah, Abel, Roseline and Festus) for their sacrifice to facilitate my education, their love and thirst for education is beyond explanation.

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ACRONYMS and ABBREVIATIONS

ADF-Augmented Dicky-Fuller

ARCH-Autoregressive Conditional Heteroskedastcity

ARDL-Autoregressive Distributed Lag

ARIMA-Autoregressive Integrated Moving Average

CBK-Central Bank of Kenya

CBKMERs-Central Bank of Kenya Monthly Economic Reviews

CPI-Consumer Price Index

DF-Dicky-Fuller

ECM-Error Correction Model

ER-Exchange Rate

GARCH-Generalized Autoregressive Conditional Heteroscedasticity

GDP-Gross Domestic Product

KNBS-Kenya National Bureau of Statistics

KRA-Kenya Revenue Authority

KTDA-Kenya Tea Development Agency

LEIs-Leading Economic Indicators

MASD-Moving Average Standard Deviation

OECD- Organisation for Economic Co-operation and Development

OLS-Ordinary Least Squares

RER-Real Exchange Rate

ROW-Rest of the world

UK-United Kingdom

VAR-Vector Autoregressive

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ABSTRACT

The study investigates the impact of real exchange rate volatility on Kenya's exports of tea in an export demand framework which includes foreign incomes (foreign economic demand), domestic tea prices, domestic coffee prices (tea substitute) and the RER volatility. The study applies GARCH model as a measure of Real exchange rate volatility and cointegration techniques to investigate the impact of RER volatility on Kenya's tea exports. The study covers the post-liberalization period 1993:7 to 2008:12. The results indicate a negative though relatively significant relationship between the RER volatility and the volume of tea exported. Foreign incomes and tea prices were found to be significant variables in the study.

CHAPTER ONE

INTRODUCTION

1.1 Background

Since the breakdown of the Bretton-Wood agreement, the trading nations have embraced a regime of floating exchange rate. This transition brought up the issue of exchange rate volatility in general and its impact on foreign trade in particular. Volatility is a measure that intends to capture the uncertainty faced by exporters due to unpredictable fluctuations in the exchange rates (Todani, Munyama, 2005). It is a statistical measure of the tendency of the exchange rate to rise or fall (in our case refers to atleast 10% rise or fall of the exchange rate from one month to another) and is important in understanding foreign exchange market behaviour. Regardless of the exchange rate being nominal or real, volatility creates uncertainty in macroeconomic policy formulation, investment decisions and international trade flows (Musonda, 2008).

The statistical relationship between exports and real exchange-rate uncertainty has been examined extensively in recent years for a variety of industrial countries for instance studies by Chit & Judge (2008), Soric (2007), Moccero & Winograd (2006), Frey (2005) among others. Other studies include Arize et al (2003), Musonda (2008), Todani and Munyama (2005), and Kihangire et al (2002) for the developing economies and Kiptui (2008) specifically for Kenya. Nonetheless, there is no real consensus about the effects of exchange risk on trade volume.

Generally, there is conflicting evidence about the relationship between exchange rate volatility and trade flows in the existing literature. On the one hand, Kenen and Rodrick (1986), Koray and Lastrapes (1989), and Arize (1995) among other studies have found that an increase in exchange rate volatility reduces the volume of international trade. The argument is that with exchange rate uncertainty, risk averse market participants tend to reduce their activities in order to minimize their exposure to the effects of exchange rate volatility.

In contrast, Franke (1991), Giovannini (1988), and Sercu and Vanhulle (1992) found that exchange rate volatility has a positive effect on trade translating to an increase in trade volume. They argued that trade can be considered as an option[1] held by firms and like any other option, such as stocks[2], the value of trade can rise with volatility. In the view of Franke (1992), a firm evaluates the entry and exit costs associated with entering and leaving a foreign market against losses or profits created by exports. However, others find no evidence to suggest that exchange rate volatility has any significant impact on trade; see for example, Aristotelous (2001).

1.2 Exchange rate movements

The term exchange rate refers to the price at which one currency is exchanged for another e.g. the value or price of Kenyan shilling expressed in terms of the US dollars. Among other things, the exchange rate helps to determine how many shillings would be payable for imported goods and services and how many shillings would be received from exports of goods and services.

With globalization, there has been increased emphasis on export orientation. Consequently, the 1990s were associated with a greater degree of liberalization of the financial, foreign exchange and domestic goods markets in Africa. The shift from a fixed to a flexible exchange rate regime was gradual in many developing countries, including those in Africa. Although such a shift in the developed countries dates back to the early 1970s, when the Bretton Woods system collapsed, most developing countries continued to peg their exchange rates either to a single key currency (especially the US-dollar or the French franc) or to a basket of currencies such as the IMF's special drawing rights. It was not until 1980s that developing countries started moving explicitly towards more flexible exchange rate arrangements (see Karingi et al 2001).

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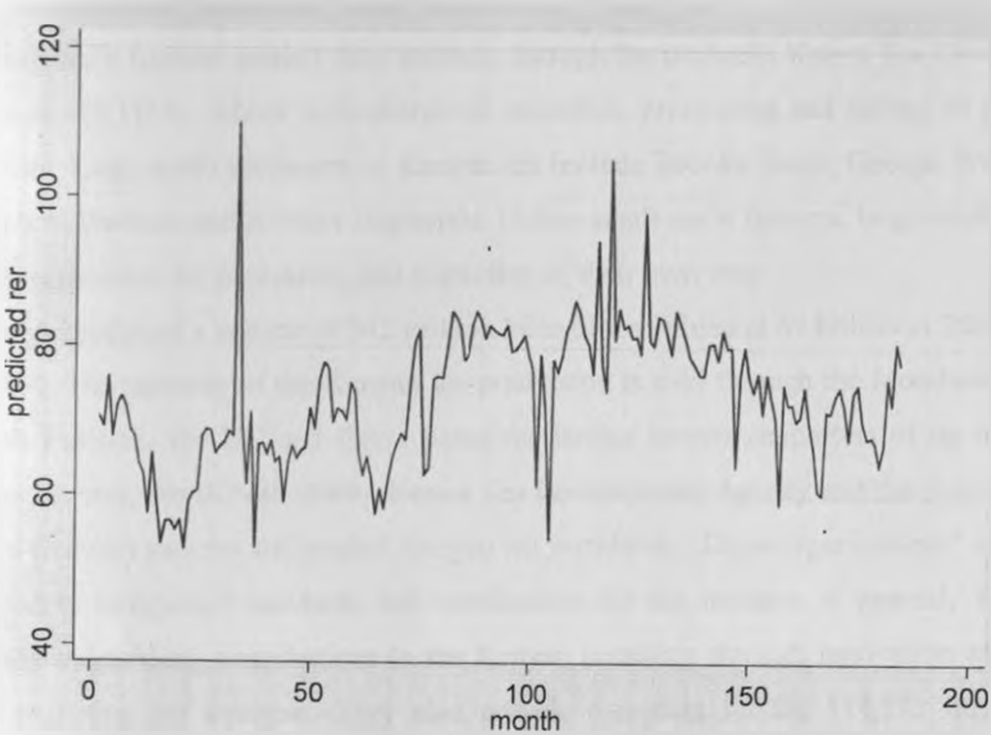
[1] An option gives the holder the right to buy or sell an underlying asset on a future date at a price agreed now. However, the purchaser is not obliged to buy or sell at that price, he will only do so if it is profitable.
[2] A stock is an equity security that represents ownership interest in the issuing firm and is issued only by business firms.

Similarly, liberalization of the foreign exchange market in Kenya moved from being fixed to a crawling peg[3] before a flexible exchange rate regime was adopted in July 1993. The graph below shows the real exchange rate movements since July 1993 when it was fully liberalized:

Figure 1: Predicted RER versus the period (months) since July 1993-Dec 2008.



Source: Own derivation from KNBS Leading Economic Indicators (monthly forex rates).

1.3 Kenya's Tea Exports

The role of exports in economic development has been widely acknowledged, for instance by the export led growth hypothesis (ELGH) studies done by Jung and Marshall (1985), Dutt and Ghosh (1996), and Otinga (2009) among others. Ideally, export activities stimulate growth in a number of ways including production and demand linkages, economies of scale due to larger international markets, increased efficiency, adoption of superior technologies embodied in foreign produced capital goods, learning effects and improvements of human resources, creation of employment and increased productivity through specialization (Alemayehu et al 2002). This supports the fact that

[3] Crawling peg is a system in which the fixed rate in a fixed exchange rate regime is changed at regular intervals. A currency with a fixed exchange rate is allowed to fluctuate within a band of rates.

exports are important for a country's development. However, like most sub-Saharan African countries, Kenya's export structure is predominantly composed of primary commodities including tea and this makes the export sector more vulnerable to exchange rate fluctuations.

Tea amounts to 17 – 20 % of Kenya's total export revenue and the small-scale farmers grow more than 60% of it while the rest is by large-scale producers, (KNBS 2009). Small-scale farmers market their produce through the umbrella Kenya Tea Development Agency (KTDA), which is in charge of collection, processing and selling of processed leaves. Large-scale producers of Kenyan tea include Brooke Bond, George Williamson, Eastern Produce and African Highlands. Unlike small-scale farmers, large-scale growers are responsible for processing and marketing of their own crop.

Kenya produced a volume of 342 million kilos of tea valued at 69 billion in 2009 (KNBS 2009). The majority of the Kenyan tea production is sold through the Mombasa auction, with Pakistan, the UK and Egypt being the largest buyers (importers of up to 60% of Kenyan tea), see (KNBS 2009). Kenya Tea Development Agency and the Association of Tea Growers process and market Kenyan tea worldwide. These organizations' aims are to promote recognized standards and certification for the industry in general. They have made outstanding contributions to the Kenyan economy through innovation and quality in exporting tea overseas. They also provide a market for the 314,875 farmers who depend on tea growing for their livelihood.

1.4 Problem statement

Changes in income earnings of the export crop producers come as a result of fluctuations in international world price. Such price changes, however, may lead to a major decline in future output if they are unpredictable and erratic. These fluctuations (whether positive or negative) therefore are not desirable since they increase risk and uncertainty in international transactions and thus discourage trade, that is, higher exchange risks lowers the expected revenue from exports thus reducing the incentives to trade (Clark,1973; Baron,1976), and this therefore hampers economic growth in a country. A study by Canzoneri et al (1984) indicates that exchange rate variability tends to induce undesirable macroeconomic phenomena such as inflation and also the giving of subsidies for instance by the government when prices of products are low which ultimately yields to a welfare loss.

However the relationship between exchange rate volatility and trade flows in the existing literature is still controversial. While there are empirical studies which have established a significant negative relationship between them (Doroodian and Caporale. 1994: and Arize ,1995), other studies have instead concluded a positive relationship (Franke, 1991; Sercu and Vanhullle, 1992). A negative relationship would imply that a tea grower is negatively affected and therefore he responds by reducing his tea production and shifting his resources to other sectors. A positive relationship on the other hand would imply that he responds by producing more tea with a view to earn more income.

In the case of Kenya, there is a vacuum of empirical evidence. A study by Kiptui (2008) on the impact of real exchange rate volatility on exports (Horticulture and tea) did not focus on any particular destination of the specific exports for a specific conclusion and also used a different estimation method of exchange rate volatility (MASD). Therefore there is need to adequately address these issues and consequently inform policy makers on the empirical impact of exchange rate volatility on tea exports..Specifically, there is need to inform the Kenyan tea grower on the impact of exchange rate volatility to allow them make informed decisions concerning tea production.

Moreover, in a developing country like Kenya where currency depreciation induces an increase in export price and thus expected to be an incentive for export growth, our primary concern is the nature and magnitude of risk introduced by the price or exchange rate movements. Infact, exporters are concerned with both the magnitude of the price they receive and stability of such prices as it relates to earning a consistent income.

This study therefore hopes to add to the literature in providing an insight on the impact of exchange rate volatility on the volume of tea exports in Kenya.

1.5 Research Objectives

The study will specifically:

1) Investigate the impact of exchange rate volatility on tea exports in Kenya.
2) Draw policy implications from the research findings.

The rest of the paper is organized as follows; Chapter two presents the literature review which focuses on theoretical and empirical studies and concludes with an overview of the literature. This is then followed in chapter three by a presentation of the theoretical framework to be used in the study. This chapter details the theory behind the exchange rate uncertainty and tea exports, which is followed by a presentation of the model to be used for the study, variables and their definitions, and the study hypothesis to be tested. The next chapter of the paper discusses the data and its sources. It is then followed by the discussion and analysis of the results and therefore concluding with policy implications.

CHAPTER TWO

LITERATURE REVIEW

This chapter presents the literature review which is divided into theoretical and empirical studies as well as an overview. We begin with theoretical followed by empirical literature.

2.1 Theoretical literature

A number of studies support the view that an increase in exchange rate volatility leads to a reduction in the level of international trade e.g. Clark,1973; Baron.1976; Hooper and Kohlhagen. 1978;. A typical argument in this literature is that higher exchange risk lowers the expected revenue from exports, and therefore reduces the incentives to export. This by extension affects the subsequent production of thcsc cxports in the same way. 95% of Tea produced in Kenya is exported (KNBS 2009) thus tea exports is directly determined by its production depending on the price level. Taking into account the firm's option to hedge its contractual exposure. Ethier (1973) and Baron (1976b) show that exchange rate volatility may not have any impact on trade volume if firms can hedge against volatility using forward contracts. Viaene and de Vries (1992) extend this analysis to allow for the endogenous determination of the forward rate; in this case. exchange rate volatility has opposing effects on importers and exporters who are on opposite sides of the forward contract and they find that the net effect of exchange rate volatility on trade takes different directions.

Risk aversion is not sufficient to obtain a negative relationship between exchange risk and expected trade volume since, in general, an increase in risk has both an income effect and a substitution effect that work in opposite directions, De Grauwe (1988) .The substitution effect reflects a decrease in export activities since an increase in exchange rate risk induces agents to shift away from risky export activities to less risky ones. that is production of domestic goods. The income effect, on the other hand, induces a shift of resources into the export sector when expected utility of export revenues decline as a result of the increase in exchange rate risk. Hence, if the income effect dominates the substitution effect, exchange rate volatility would have a positive impact on export activity i.e. might increase the export volume. In essence, a very risk averse individual may export more when risks are higher to minimize the decline on revenues while on the other hand, a less risk averse individual considering the return on exports as less attractive, may decide to export less even when risks are higher such that a country with more risk averse tea producers is likely to export more tea when risks are higher. It follows that if substitution effect is greater than the income effect then the same country is likely to export less tea when risks are higher.

The conclusion is that a risk averse individual can then export more tea when risks are more to remain in the same income level, or export less (when he shifts away from producing tea) to avoid losses due to high risks.

The assumption underlying this is that the real exchange rate volatility affects the subsequent production of tea such that a higher RER volatility this year reduces the tea production of the following year and thus its exports. A lower price this year would translate to lower tea incomes and bonuses for the tea grower in the year, hence a lower tea production and consequently exports in the following year – in this case the tea farmer would choose to abandon tea production for a domestic crop that is profitable.

It is vital to note that most of the studies on this area that were available and reviewed were empirical in nature and thus we explore them in the following section.

2.2 Empirical literature

This section reviews studies by regional focus and begin with the rest of the world. Africa and finally Kenya.

A study by Soric (2007) analyzed the monetary transmission mechanism through the influence of exchange rate variability on Croatian export volumes. He employed both ARCH and the historical volatility measure based not only on future but also on past exchange rate values to estimate volatility. He also used Johansen's multivariate cointegration approach and error-correction model (ECM) in exploring the influence of exchange rate volatility and domestic income on export volume and found a negative relationship between the variables. However, the effect of volatility obtained by an ARCH model on export volume was negative, but rather small which would mean that Croatian exporters react to a rise in kuna volatility by a small export reduction. The use of two models in estimating volatility strengthens the study since their application represents a methodological innovation in exploring the relationship between exchange rate variability and export volumes in Croatia and the ultimate goal is the achievement of better statistical results in the estimation of the explained relationship.

The relationship between export performance and exchange rate volatility across different monetary policy regimes in Asia was examined by Boug & Fagereng (2007). Johansen's multivariate cointegration techniques and ECM were used to capture both the short run and long run dynamics in the study. They also worked within the cointegrated VAR framework using the implied conditional variance from a GARCH model as a measure of volatility. Even after treating the volatility measure as either a stationary or a non-stationary variable in the VAR, they were not able to find any evidence suggesting that export performance has been significantly affected by exchange rate uncertainty. However, this treatment of volatility as either stationary or non-stationary does not seem convincing since volatility is characterized by clustering of large shocks to conditional variance. This therefore would have biased their results.

The link between real exchange rate (RER) volatility and exports in the case of Argentina was also examined by Moccero & Winograd (2006) in view of the twofold dimension of trade relations i.e the impact of intra-regional (with Brazil) and extra-regional (with the rest of the world) RER volatility on intra and extra-regional exports. They employed ARCH in estimating exchange rate volatility while cointegration tests were performed using the Johansen and Joselius methodology. They found out that volatility matters for exports in Argentina such that reducing RER volatility (intra-region or extra-region) had a positive impact on exports to Brazil but a negative impact on sales to the rest of the world. This trade-off increases when the reduction in volatility falls on the intra-regional RER volatility. The strength of this study is depicted in the estimation for instance of the export equation to Brazil, not only the level and volatility of the bilateral RER was included, but also, the same measures for the rest of the world thus not only the absolute but also the relative volatility (the volatility with the other's country partners) was taken into account. This minimizes the omitted variables problem and hence unbiased estimated coefficients.

The investigations on the impact of short-run volatility of exchange rates on the volume of exports (Germany, Canada, France, UK, US) was carried out by Frey (2005) using the conditional variance of the nominal-effective-exchange rate as the measure of uncertainty (GARCH estimation). It is evident that the estimation differs from previous studies especially with respect to the identified properties of the data, e.g. the properties of the time series differ across the countries and the measures of competitiveness are integrated of order two i.e. need to be differenced twice to become stationary. In the regressions, significantly negative coefficients of the conditional variance term were found for three out of five countries. These findings can be explained by the size of international trade diversification of a country and the symmetrical or asymmetrical movements of the exchange rates to the trading partners.

The impact of exchange-rate volatility on the export flows of 10 developing countries (Burkina Faso, Colombia, Costa Rica, Jordan, Kenya, Korea, Myanmar, Pakistan, South Africa, and Venezuela) was also investigated by Arize et al (2003) using the quarterly data for the period 1973-1998 by employing a traditional specification of the long-run equilibrium export demand in the flexible exchange-rate environment. Their variables of interest included volume of a country's export goods, foreign economic activity, and relative prices (measured by the ratio of that country's export price in U.S. dollars to the world export price in U.S. dollars). Exchange-rate volatility proxy was constructed by the moving-sample standard deviation while econometric analysis exploited the theory of cointegration and estimates of the cointegrating relations were obtained using Johansen's multivariate procedure. The results indicated that increases in the exchange-rate volatility exert a significant negative effect upon export demand in most of the countries studied.

Investigations of the impact of exchange rate uncertainty on the disaggregated exports of the UK was done by Cheong et al. (2002) using a dynamic modeling framework on a set of monthly sectoral data. They included variables such as export volumes, relative export price levels, world income and exchange rate volatility. Various methods were used to measure exchange rate volatility including the absolute percentage change of the exchange rate, the moving average of the standard deviation of the growth rate of the exchange rate, the residuals from an autoregressive integrated moving average (ARIMA) model, and the measures generated by a GARCH model. VAR models were also formulated for each of the four major manufacturing export sectors of the UK including the sectors of Chemicals, Material manufactures, Machinery and transport equipment, and Miscellaneous finished manufactures The results indicated that, for the major manufacturing categories analyzed, exchange rate uncertainty depressed international trade. However, this study can be questioned on some of these approaches of measuring volatility which can potentially ignore information on the stochastic processes by which exchange rates are generated. It is also a fact that monthly data gives more precise results when compared to yearly data especially on exchange rate volatility and hence this study is accredited.

The impact of real exchange rate volatility on the export flows of Turkey to the United States and its three major trading partners in the European Union was determined by Vergil (2002) for the period 1990:1-2000:12. Variables used included real exports, real foreign economic activity. real exchange rate, and exchange rate volatility. Two separate versions of exchange rate volatility were computed: the standard deviation of the percentage change in the real exchange rate and the variance of the real exchange rate around its predicted trend. Having confirmed that both of the versions sufficiently measure the volatility of real exchange rates. the version of the standard deviation of the percentage change in the real exchange rate was employed as one of the independent variables that estimate real exports. Using both cointegration and error-correction techniques, the paper explicitly took into account the possibility of a lagged relationship and investigates the long-run relationship between exports and its determinants and also considers the short run dynamics by which exports converge on their long-run equilibrium values. The results provided evidence that the real exchange rate volatility had a significant negative effect on real exports.

A new empirical look at the longstanding question of the effect of exchange rate volatility on international trade flows was taken up by Wang & Barrett (2002) by studying Taiwan's exports to the United States from 1989-1998. In particular, they employed sectoral level, monthly data and a multivariate GARCH estimator. They found that real exchange rate risk has insignificant effects in most sectors, although agricultural trade volumes appear highly responsive to real exchange rate volatility. Unlike most of literature reviewed which uses GARCH modeling in a two-step process to identify the conditional variance of the (real) exchange rate series. their simultaneous estimation of exchange rate process with the trade volume equation using a multivariate GARCH estimator is noted.

A relationship between exports and real exchange-rate uncertainty for the developing economy of Korea was examined by Arize (1996) in a long-run equilibrium export demand function. He used a time varying measure of exchange rate volatility to proxy for exchange-rate uncertainty. This proxy was constructed by the moving sample standard deviation of the growth rate of the real effective exchange rate. He further employed multivariate cointegration and error-correction techniques in the study and the major result suggested that real exchange-rate uncertainty had a negative effect on exports.

However, the technique used in constructing the proxy for exchange-rate uncertainty is likely to suffer from the measurement error problem which can produce biased estimates. It can also ignore information on the stochastic processes by which exchange rates are generated.

An error correction model of the impact of real effective exchange rate volatility on the performance of non-traditional exports for Zambia between 1965 and 1999 was estimated by Musonda, (2008) and it assumes that demand for a country's exports depends on real foreign income and relative prices. The export supply depends on domestic relative prices and exchange rate volatility. The findings show that exchange rate volatility depresses exports. The study also used GARCH estimation for exchange rate volatility. This study remains relevant to our study since we will adopt this method of estimation.

Characteristics of short-term fluctuations/volatility of the South African exchange rate were determined by Todani & Munyama (2005) who also investigated whether this volatility affected the South Africa's exports. In particular they investigated the impact of exchange rate volatility on aggregate South African exports to the rest of the world, as well as on South African goods, services and gold exports. They also employed the ARDL bounds testing procedures developed by Pesaran et al. (2001) to test the existence of a level relationship between the dependent variable and the regressors. In measuring volatility, they used two models: Moving Sample Standard Deviation and the ARCH /GARCH models. The results suggested that depending on the measure of volatility used, there is either no statistically significant relationship between South African exports and exchange rate volatility or when a significant relationship exists, it is positive. However, the application of ARDL bounds testing approach which allows testing for the existence of cointegration irrespective of whether the underlying regressors are I(0), I(1) or mutually cointegrated is worth noting.

Similarly, Kihangire et al. (2002) examined the effects of exchange rate variability on Uganda's flowers exports during 1994 - 2001 by testing the central hypothesis that following the floating exchange rate regime, Uganda's exports of tropical flowers are negatively and significantly correlated with exchange rate variability. The absence of pure *I(0)* or *I(1)* in the data, and lack of endogeneity and simultaneous bias problems invited them to apply *ARDL* approach to cointegration and *OLS* . The results suggested that although Uganda's flower exports are negatively correlated with exchange rate variability, the measured effects are insignificant. However their use of yearly data is not convincing and could have altered the findings.

The impact of real exchange rate volatility on Kenya's exports of horticulture and tea in an export demand framework was investigated by Kiptui (2008) who postulated a long-run relationship between exports, foreign economic activity, relative prices and exchange rate volatility. He used the Moving Average Standard Deviation (MASD) as a measure of the exchange rate volatility. Cointegration techniques and error correction modeling was applied to Kenyan monthly data over the period 1997:10 to 2007:6 for the case of horticulture and the period 2002:1 to 2007:9 for tea. His results show that exchange rate volatility has significant negative effects on Kenya's real exports of tea and horticulture. Existence of long-run relationships between variables was also indicated by respective elasticities from the cointegrating equations. Foreign income and relative price variables were found to be highly significant too. However, the main concerns of this study stems mainly from failing to focus on the specific export destinations of influence for the respective crops leading to a general rather than specific conclusion. The GARCH method which is more efficient in measuring RER volatility will also be used in this study in place of MASD that he adopted.

2.3 Overview of the literature

From the literature reviewed, it is clear that the use of error correction techniques together with more disaggregated data tend to give statistically significant relationships between trade and exchange rate volatility. The ambiguity that was depicted from the earlier studies is slowly fading away by the fact that most recent studies find negative relationship between exchange rate volatility and exports. It is also evident that the period of study for most studies is at least ten years. Various methods were adopted in estimating exchange rate volatility and depending on these methods, the results were compared. GARCH based measures of volatility have increasingly been preferred because they are likely to produce consistent estimates of parameters of interest and also allow the capturing of non-constant time varying conditional variance, and thus are very useful in describing volatility clustering.

This paper drew much relevance from studies for instance; Arize (1996), Musonda (2008), Todani & Munyama (2005), and Kiptui (2008) among others on the use of cointegration techniques and also the GARCH as a measure of RER volatility. These methods were thus adopted in this study.

The study aims to provide further evidence on the impact of real exchange rate volatility on the tea exports while trying to take account of some of the unresolved issues related to previous studies for instance: which exchange rate volatility measure to use, which data frequency and aggregation level to employ and which estimation method to apply. As pointed out by McKenzie (1999), each of these issues and how they are handled may be part of the explanations for the inconclusive findings in the literature so far. Our study focuses on post liberalization period (1993:7 – 2008:12) and investigates the impact of the real exchange rate volatility on Kenyan tea exports to its three major tea importers (Pakistan, Egypt and UK) using monthly data. GARCH estimation of the exchange rate volatility will be adopted because of its efficiency in describing volatility clustering.

CHAPTER THREE

METHODOLOGY

This chapter presents a theoretical framework to be used in the study. We then specify the model for the study and the hypothesis to be tested. Lastly, the variables to be used in the study are discussed.

3.1 Theoretical framework

The standard export demand function relates the rest of the world demand for a country's exports to the world income positively, and to the relative price of a country's export price over world export prices, negatively. This paper extends the standard specification of the demand for exports by further incorporating exchange rate variability. Some studies for instance, Bahmani-Oskooee and Kara (2003) included the nominal exchange rate as a potential determinant of export demand such that if a currency depreciation is to stimulate exports, a negative sign of its estimated parameter is expected, and vice versa

There are situations in which the exchange rate variability could have negative or positive effects on exports. These effects are analyzed in terms of risk or uncertainty. Exporters are either very risk-averse or less risk-averse and therefore would react differently to changes in exchange rates. Most of the earlier work is on models with risk-averse firms and spot exchange rate changes representing the only source of risk for the economy. Hooper and Kohlhagen (1978) postulate that if agents are risk-averse. an increase in exchange rate variability induces them to reduce the volume of trade and reallocate production towards domestic markets and vice versa i.e if agents are less risk averse. De Grauwe (1988). however, argues that the effect of an increase in the exchange rate will depend upon the convexity of the utility function, which in turn depends on the degree of risk aversion. If agents are sufficiently risk-averse. an increase in risk associated with higher exchange rate volatility raises the expected utility of export revenue and induces exporters to export more to avoid a possibility of a reduction in their revenues. This is known as the income effect of exchange rate volatility. More real exchange rate volatility could also prompt exporters to reduce exports and divert resources to other sectors. This is the substitution effect. Ultimately, the effect of real exchange rate volatility on exports is ambiguous.

3.2 Model specification

On the basis of the conceptual framework of exchange rate variability discussed above, and following the studies of Arize et al. (2003) and Vergil (2002) among others, the tea export demand equation can be written in the following form:

$$X_{tea} = \beta_0 + \beta_1 Y_t + \beta_2 P_t + \beta_3 P_c + \beta_4 V_t + \mu_t$$

where

X_{tea} : Tea export volume;

Y_t : Foreign incomes

P_t : Domestic Tea prices

P_c : Domestic coffee prices

V_t : Real Exchange rate volatility

β_0 : Constant

β_1, β_2, β_3 and β_4 : Coefficients to be estimated

μ_t : Error term

The equation above indicates that demand for Kenyan tea exports depend on the income of its importers, domestic tea prices, domestic coffee prices and the uncertainty/risk associated with exchange rate fluctuations.

It is expected that higher foreign incomes would create more demand for the country's exports. On the other hand, declines in domestic tea prices reflect increased competitiveness and hence higher demand for the Kenyan tea exports and vice versa. This is because lower tea prices in Kenya make Kenyan tea competitive (as it makes it cheaper for the tea importing countries) relative to the other tea exporting nations. The expected coefficient signs are therefore positive for foreign incomes i.e β_1 and negative for domestic tea prices i.e β_2. Domestic coffee prices are expected to have a positive effect on the tea exports since coffee is a substitute to tea and in the event that its price is higher domestically, then there is a shift to tea and hence the positive link, therefore β_3 is expected to have a positive sign. However, the effect of exchange rate volatility on trade is not known, it depends on traders' attitude to risk. Less risk averse traders view exchange rate uncertainty as an additional opportunity to increase profits because they would export more[4] no matter the level of risk thereby boosting overall trade flows, Franke (1991), and Sercu (1992). On the other hand, risk-averse traders view the risk associated with exchange rate uncertainty as an additional cost, which will tend to depress overall trade volumes, Ethier (1973), and Gagnon (1993). In this context, the impact of exchange rate volatility on trade is not known.

The study hypothesizes that increased exchange rate volatility has a significant negative impact on tea export volume performance.
Following floating exchange rate regime in 1993, Kenya's exports of tea would be negatively and significantly correlated with exchange rate variability. The traditional belief is that the increased volatility of exchange rates has a negative impact on an economy. One key argument has been that exchange rate volatility could have negative effects on international trade, both directly through uncertainty and adjustments costs, and indirectly through its effect on the allocation of resources and government policies (Chit, Judge 2008).

3.3 Definition of Variables

The variables used in this study are defined in this section.

Export volume (X_t)

This is the total export volumes of Kenya's tea to its three major trading partners (Pakistan, Egypt and UK) for the period between 1993:07 and 2008:12, in Metric tons. This is because Kenya adopted more liberal policies for the domestic economy in the second half of 1993. Volume is used rather than value because price effects may distort the value figures[5]. for instance in times of inflation the value of tea may be overstated reflecting more tea exported while in reality the volume of tea exported maybe less due to loss of competitiveness of the domestic product in the world market. In times of low tea

[4] The assumption is that the more tea exported, the more the profits gained from it and the higher the trade flows, *ceteris paribus*.
[5] Value of tea is equal to the volume multiplied by the price per unit.

prices, the value figures may be understated hence low volume stated yet in actual fact tea producers might have exported more to remain in the same income curve. Infact, Learner and Stern (1970) suggested that it is more appropriate to measure trade by volume than by value.

Foreign income (Yt)

This refers to the income of Kenya's major tea importers (Pakistan, Egypt and UK). Economic theory suggests that income in an importing country is a major determinant of a nation's exports. GDP of the countries will therefore be used.

Tea Prices (P_t)

Tea export volume exported is expected to increase with a fall in tea prices domestically. This is because lower tea prices makes the Kenyan tea gain competitiveness in the market since it becomes cheaper relative to the foreign prices and so the tea importing countries increase their demand for tea and hence an increase in tea volume exported from Kenya.

Coffee Prices (P_c)

Coffee is a tea substitute and thus the tea volume exported is expected to increase with a rise in coffee prices. This is because when coffee prices increases domestically, consumers loose their demand for the commodity as they opt for the substitute (tea). As the demand for tea increases, the producers shift resources away from coffee production to tea and by so doing the exported tea volumes increases given that 95% of tea produced in Kenya is exported as earlier stated.

Real exchange rate volatility (V_t)

Real exchange rate in our case between Kenya and its major tea trading partners (UK, Pakistan and Egypt) is also the relative prices and it measures competitiveness.

Generally, trade between two countries depends upon, among other things, exchange rates and the relative price level of the two partners (Todani, Munyama 2005). We define it as follows:

$$RP_t = ER_t * \frac{PX_f}{PX_d}$$

Where ER_t is the nominal exchange rate over time

PX_f is the foreign tea prices

PX_d is the domestic tea prices

Exchange rate volatility being a measure that captures the uncertainty faced by exporters due to unpredictable fluctuations in the exchange rates also considers the currency movement effect through uncertainty on trade decisions.

De Grauwe, 1988, argue that volatility based on the real exchange rate is the more relevant measure because the effects of uncertainty on a firm's profit that arise from fluctuations in the nominal exchange rate are likely to be offset in large part by movements in costs and prices. So like Kenen and Rodrik (1986), we will work with volatility in the real exchange rate.

The literature is not unanimous as to which measure is the most appropriate for exchange rate volatility. Various methods have been used to measure exchange rate volatility. These include the absolute percentage change of the exchange rate employed by Bailey et al (1986), the MASD of growth rate of the exchange rate used by Chowdhury (1993) and others, the residuals from an autoregressive integrated moving average (ARIMA) model in Asseery and Peel (1991), and the measures generated by a GARCH-type model in Kroner &Lastrapes (1993) and Holly (1995) among others. However, recent literature has increasingly adopted the use of Bollerslev's (1986) GARCH models because of its ability to capture non-constant time varying conditional variance and describe volatility clustering. Our study will therefore use GARCH model to estimate the real exchange rate volatility.

CHAPTER FOUR

DATA AND DATA SOURCES

4.1 Data types and sources

Most of the data used was obtained from various issues of the Kenya National Bureau of Statistics. Specifically, monthly tea export volumes and values were obtained from the Kenya Revenue Authority (KRA) and CBKMERs, Foreign exchange rates from KNBS LEIs. Total Exports from the customs department, foreign GDP from IMF's *International Financial Statistics,* OECD reports and the *World Bank's African Development Indicators.* Domestic tea and coffee prices were obtained from the Tea Board and Coffee Board of Kenya respectively.

4.2 Descriptive statistics

From the data, descriptive statistics give a fair view of the statistical properties of a series (see Table 1 below). Using time series graphs in the context of macro economic variables enables us to detect time dependence of a variable (see appendix A: i). In discerning normality we examine kurtosis and skewness. Jarque- Bera statistic is vital in testing normality. In this test a null of normal distribution is tested i.e skewness of zero and kurtosis of three Gujarati (2007). Most of the variables are normal according to this criteria (see Appendix D).

Table 1 : Descriptive statistics

	TEAVOLUME	GDP	TEAPRICES	COFFEEPRICES	RERVOLATILITY
Mean	13604.85	4.99E+11	124.6422	171.1593	72.91501
Std. Dev.	3625.394	5.11E+11	26.99512	52.21450	9.257978
Observations	185	185	185	185	185

The mean values of the variables above reflect their average values such that 13604.85 .4.99E+11, 124.6422, 171.1593 and 72.91501 are the average values of ; the volume of tea exported in metric tones, Foreign income in billions of Kenyan shillings, Price of tea in Kenya shillings per kilogram, Price of coffee in Kenya shillings per kilogram, and

RER volatility index. The standard deviation value shows how big the deviation of the tea volume exported value is from the regression line, the smaller the better.

The observations are 185. Any loss of an observation reduces the degrees of freedom and therefore distorts the results.

The coefficients of correlation in the table below also show that the degree of linear association between the dependent and independent variables is small, that is 0.41, 0.3, 0.2 and 0.06 between the volume of tea exported and the foreign income, tea prices, Coffee prices and RER volatility respectively.

Table 2: Correlation matrix

	TEAVOLUME	GDP	TEAPRICES	COFFEEPRICES	RERVOLATILITY
TEAVOLUME	1.000000	0.413766	0.298569	0.191499	0.060187
GDP	0.413766	1.000000	0.393350	0.340951	0.034263
TEAPRICES	0.298569	0.393350	1.000000	0.114510	0.393410
COFFEEPRICES	0.191499	0.340951	0.114510	1.000000	-0.300315
RERVOLTILITY	0.060187	0.034263	0.393410	-0.300315	1.000000

We can also see that the independent variables are not strongly correlated from the fact that none of the correlation coefficient is above 0.5. For instance, GDP has a correlation coefficient of 0.39, 0.34, and 0.03 with tea prices, coffee prices and RER volatility respectively. This avoids the problem of multicollinearlity where the independent variables are correlated.

CHAPTER FIVE

EMPIRICAL RESULTS.

5.1 Regression results

	Coefficient	Std.Error	t-value	t-prob	Part.R^2
Tea volume (MT)_1	0.316756	0.09023	3.51	0.001	0.0924
Constant	-110.820	3708	-2.16	0.032	0.0000
GDP_4	-5.78506e-009	3.514e-009	-1.65	0.102	0.0219
Tea prices (Ksh.)_3	34.9769	20.92	1.67	0.097	0.0226
Coffee prices (ksh)_3	-11.3570	11.31	-1.00	0.317	0.0083
RER volatility_2	60.8235	41.97	1.45	0.150	0.0171

sigma	2639.53	RSS	843020691
R^2	0.603477	F(52,121) =	3.541 [0.000]**
log-likelihood	-1586.13	DW	2.03
mean (Tea volume)	13911.1	var(Tea volume (MT))	1.22186e+007

This can further be explained in an equation below:

$$X_{tea} = 110.820 + 5.78506\text{e-}009 Y_t - 34.9769\, P_t + 11.3570\, P_c - 60.8235\, V_t + \mu_t$$

$$t = (-2.16) \quad (-1.65) \quad (1.67) \quad (-1.00) \quad (1.45)$$

Each point on the regression line gives an estimate of the expected value of the dependent variable corresponding to the each independent variable. The constant in the equation shows that if the values of the independent variables were all zero then the average volume of tea exported would be 110.820 metric tonnes. A unit increase in foreign income, on average would increase the volume of tea exported by 5.78506e-009 metric tones. Similarly, if coffee prices (tea substitute) increased by one unit, on average, then the volume of tea exported would increase by 11.3570 metric tonnes. However, if the tea prices increased by a unit, on average then the total volume of tea exported decreases by 34.9769 metric tones. A unit increase in RER volatility on the other hand, on average would decrease the volume of tea exported by 60.8235 metric tonnes. It is evident that RER volatility has a bigger negative effect on the volume of tea exported for every unit change in the volatility of the RER.

The R^2 value of about 0.60 means that 60% of the variations in the volume of tea exported is explained by the explanatory variables in this model (Foreign income, tea prices, Coffee Prices and the RER volatility) i.e the explanatory variables explain upto 60% of the variations in the volume of tea exported. Most of the variables have the signs that were expected, that is, foreign income and coffee prices are positively related to the volume of tea exported while the tea prices and RER volatility are negatively related to the dependent variable. However, Foreign income, tea prices and RER volatility are relatively significant with t values of (-1.65) , (1.67), (1.45) respectively which are all closer to the standard t value of 2. Their probability values are 0.102, 0.097 and 0.150 respectively which are not far from the value of 0. All these show relative significance of these independent variables in the model (see Appendix C: i)

Error correction model

	Coefficient	Std.Error	t-value	t-prob	Part.R^2
DTea volume (MT)_1	0.535755	0.3373	1.59	0.115	0.0218
Constant	78.2211	225.5	0.347	0.729	0.0011
DGDP_1	-3.83001e-009	2.305e-009	-1.66	0.099	0.0238
DTea prices (Ksh.)_5	33.4569	22.95	1.46	0.148	0.0185
DCoffee prices (ksh)_3	-10.6201	9.250	-1.15	0.253	0.0115
DRER volatility_2	61.0196	55.65	1.10	0.275	0.0105
residuals_1	-1.25079	0.3534	-3.54	0.001	0.0998

sigma	2638.92	RSS	786917933
R^2	0.49862	F(55,113) =	2.043 [0.001]**
log-likelihood	-1537.19	DW	2.06
mean(DTea volume	58.2227	var (DTea volume	9.287e+006

Chi^2(7) = 12.115 [0.0968] and F-form F(7,106) = 1.1694 [0.3266]
ARCH 1-7 test: F(7,99) = 0.16080 [0.9921]

Testing for heteroscedasticity using squares

Chi^2(11)= 33.132 [0.0005] and F-form F(11,101)= 2.2391 [0.0177]

RESET test: F(1,112) = 0.33285 [0.5651]

This can be put as follows:

X_{tea} =78.22+3.83001e-009Y_t - 33.46 P_t + 10.62P_c - 61.02V_t - 1.25 $ECM + \mu_t$

t = (0.347) (-1.66) (1.46) (-1.15) (1.10) (-3.54)

The constant in the equation shows that if the values of the independent variables were all zero then the average volume of tea exported would be 78.22 metric tonnes. A unit increase in foreign income, on average would increase the volume of tea exported by 3.83001e-009 metric tones. Similarly, if coffee prices (tea substitute) increased by one unit, on average, the volume of tea exported would increase by 10.62 metric tonnes. However, if the tea prices increased by a unit, on average then the total volume of tea exported decreases by 33.46 metric tones. A unit increase in RER volatility on the other hand, on average would decrease the volume of tea exported by 61.02 metric tonnes.

The R^2 value of about 0.5 means that 50% of the variations in the volume of tea exported is explained by the explanatory variables in this model (Foreign income, tea prices, Coffee Prices and the RER volatility) i.e the explanatory variables explain upto 50% of the variations in the volume of tea exported (see appendix C: iii). Most of the variables have the signs that were expected, that is, foreign income and coffee prices are positively related to the volume of tea exported while the tea prices and RER volatility are negatively related to the dependent variable. However, all variables; Foreign income, tea prices, coffee prices and RER volatility are relatively significant with t values of (-1.66), (1.46), (-1.15) and (1.10) respectively. The adjustment term is very significant implying that there is a rapid adjustment towards the long run steady state i.e the long-run equilibrium relationships are confirmed by the significant negative coefficient of the ECM (which is the residual from the cointegrating equation). In other words, the coefficient of the error correction term is -1.25 implying faster adjustment of about 125% towards equilibrium. The DW statistic of 2.06 depicts the absence of autocorrelation while the F test being significant at 1% shows the overall fitness of the model with the independent variables explaining much of the variations in the dependent variable.

However, before we obtained the results, some econometric issues were tackled starting with the unit root tests as explained in the next section.

5.2 Unit root tests

To avoid the pitfall of wrong inferences from the non-stationary regressions, the time series data should be stationary. Regressing a non-stationary variable on another non-stationary variable might result in very attractive outcome which might be characterized by high R^2 and a low DW statistic whilst in actual fact they are spurious (Lutkepohl. 1993). So Ordinary Least Squares (OLS) may lead to inconsistent and less efficient parameters as they may show that there is a strong relationship whilst in actual fact there is no relationship at all and hence the results obtained from such regressions will not have a meaningful economic interpretation. Given that stationarity is of paramount importance, it is imperative to first carry out the unit root tests, to test for stationarity before running a regression.

We employ both Augmented Dicky-Fuller (ADF) and Phillips-Peron tests to determine the existence of a unit root (See appendix B). By incorporating the autoregressive process of order p, the ADF becomes superior to DF. Basically ADF test has been chosen for its consistency, accuracy and resourcefulness. Phillips-Peron test is even more superior since it has generalized the ADF test to the case where the disturbance terms are serially correlated by introducing a correction term to the test statistics of ADF test. The null hypothesis of ADF is $\delta=0$ against alternative hypothesis that $\delta<0$. Where $\delta=\gamma-1$. A rejection of this hypothesis means that the time series is stationary or it does not contain a unit root while not rejecting means that the time series is non-stationary (Enders, 1995). An $I(0)$ time series is integrated of order zero and means that it is stationary in levels while some series needs to be differenced several times before becoming stationary. This implies that the number of times a series needs to be differenced before becoming stationary is the order of integration. So a $I(d)$ series means that it has to be differenced d times before the series become stationary.

From the behavior of the variables at levels (see appendix A: i) which show that the variables may not be stationary, we proceed to test for the presence of unit roots in each of the variables. We begin with the Augmented Dickey Fuller (ADF) unit root tests (See Appendix B: i) of Tea volume, GDP, Tea prices, coffee prices and finally RER volatility. This is then followed by the Philip Peron tests (see appendix B: ii).
The summary of the unit root test results were then summarized in the table below:

Table 3: Summary results of Unit Root tests

	Series				
ADF Test:	**Teavolume**	**GDP**	**Teaprices**	**Coffeeprices**	**RERvolatility**
Levels	-0.12	0.15	0.55	-0.70	-0.22
1st diff	-14.70	-10.06	-13.90	-14.95	-16.69
PP Test : Level	-0.10	0.53	0.38	-0.40	-0.11
1st diff	-43.91	-10.05	-18.39	-15.56	-36.89

Notes: Mackinnon critical values at 5% level of significance is -1.94 and -2.57 at 1% level

From the results above, we notice that the values of all the variables at levels (that is -0.12, 0.15, 0.55, -0.70 and -0.22 for the ADF test. -0.10, 0.53, 0.38, -0.40 and -0.11 for PP test, all in absolute values) are less than the critical values (in absolute terms) both at 5% and 1% level of significance and therefore we may not reject the null hypothesis of the presence of unit roots, this applies to both ADF and PP tests (See appendix B). The conclusion is therefore that all the variables are not stationary at levels, they have a unit root. However, the presence of a unit root in the variables at levels could lead to the problem of spurious regression and so by differencing all the variables once we solved the nonstationary problem as can be seen from the smooth trending behavior of the variables at first difference (in appendix A:ii). From the unit root analysis above, all our variables are intergrated of order 1 as shown by both ADF and Phillips Perron tests. This is from the fact that the values of all the variables at first difference (that is -14.7, -10.06, -13.9, -14.95,-16.69 for the ADF test and -43.91, -10.05, -18.39, -15,56, -36.89 for the PP test, all in absolute value) are greater than both the 5% and 1% critical values hence we reject the null hypothesis of the presence of a unit root and thus our variables became stationary at their first difference. However, by doing so we would loose the long-run information in the data which is important in the model. We therefore need to employ a mechanism that tackles the problem of spurious regression and have the long-run information as well. This basically requires combining the short-run (differenced) equation with the long-run (level-based) equation in one model. This can be done provided we find a vector that renders a linear combination of the level variables that is stationary. Such a vector is referred to as the cointegrating vector, and the method of using it to generate a stationary linear combination is the cointegration analysis.

We then use the Engel-Granger two step procedure in this analysis.

5.3 Engel-Granger (EG) two step approach

Having noted that our variables of interest follow an $I(1)$ process, then in the first stage, we estimate the long-run equilibrium equation (using OLS) and the result is as shown in table 4 below:

Table 4: Long run equilibrium equation for tea (OLS)

Variable	Tea Equation (1993:07-2008:12)
C	110.82(2.16)
X_{t-1}	0.32 (3.51)
Y_{t-4}	5.79e-009 (-1.65)
P_{t-3}	-34.98 (1.67)
P_{c-3}	11.36 (-1.00)
V_{t-2}	-60.82 (1.45)

$R^2 = 0.60$, DW = 2.03

As earlier stated, the results above show that 60% of the variations in tea volume exported is determined by the four variables (Foreign income, tea prices, Coffee Prices and the RER volatility). Most of the variables have the signs that were expected. Foreign income, tea prices and RER volatility are relatively significant. A unit increase in foreign income and coffee prices (tea substitute) on average, increases the tea exported by 5.78506e-009 and 11.36 metric tons respectively, while a unit increase in the tea prices on average, decreases the tea volume exported by 34.98 metric tonnes. RER volatility on the other hand has a bigger negative effect of 60.82 metric tonnes of the volume of tea exported for every unit increase in the volatility of the RER (appendix C: i). Generally we note that RER volatility has a relatively negative significant effect on the volume of tea exported.

After the long run relationship is established, we then save the residual and test it for stationarity as shown below. The ADF test on the residual of the long-run equation is equal to the linear combination of the variables of interest and this test is conducted to determine if the variables in question are cointegrated- i.e whether the error term follows a stationary process (see appendix C: ii)

Unit-root test of the residual

ADF Test:	Residual
Levels	-5.114

Notes: Mackinnon critical values at 5% level of significance is -1.94 and -2.57 at 1%

The above unit root results show that the residual series is stationary in levels (since the ADF calculated value of 5.114 is greater than ADF critical values of 1.94 and 2.57 at 5% and 1% levels of significance respectively both in absolute terms) and hence there exists a cointegrating vector that ties the variables in the regression equation (the variables are co-integrated). Having noted that, then in the second stage we combine the error term with the differenced variables to estimate the final model which is an Error Correction Model (ECM). In addition, by noting the Granger representation theorem that states that a cointegrating system has an error-correction representation and vice versa, we can formulate an ECM and the results are as follows:

Table 5: Regression result - Error Correction Model

Variable	Tea Equation (1993:07-2008:12)
C	78.2211 (0.347)
ΔX_{t-1}	-0.535755 (1.59)
ΔY_{t-1}	3.83001e-009 (-1.66)
ΔP_{t-5}	-33.4569 (1.46)
ΔP_{c-3}	10.6201 (-1.15)
ΔV_{t-2}	-61.0196 (1.10)
ECM	-1.25079 (-3.54)

Summary Statistics
$R^2 = 0.50$,
DW = 2.06
Normality, Jarque-Bera = 20.0918 [0.0000]
Heteroskedasticity, F=2.2391 [0.0177]

The estimated model passes the diagnostic tests in the sense that none of the classical assumptions are violated in statistical terms. The normality test is also significant.The adjustment term is significant implying that there is a rapid adjustment towards the long run steady state i.e the long-run equilibrium relationships are confirmed by the significant negative coefficient of the ECM (which is the residual from the cointegrating equation). The coefficient of the error correction term is -1.25 and this implies a faster adjustment of up to 125% towards equilibrium (See Appendix C: iii).

Our particular interest being the RER risk variable in the study is found to have a negative coefficient of 61.02 as expected though not very significant. This means that a one unit increase in the RER volatility on average, leads to a decline in the tea volume exported by 61.02 metric tones.

Foreign income on the other hand is found to positively influence the tea volume exported by 3.83001e-009 metric tones for every one unit increase in the foreign income. However, an increase in tea prices by one Kenyan shilling decreases the tea volume exported by 33.46 metric tons. A price of coffee as a tea substitute on the other hand has a positive impact of 10.62 metric tons of tea exported per shilling increase in a kilogram of coffee. This is because as the price of coffee increases, its market decreases domestically hence a shift of resources to the tea sector and thus an increase in the tea exports.

CHAPTER SIX

CONCLUSION, POLICY IMPLICATIONS AND RECOMMENDATIONS

6.1 Conclusion

Motivated by the increasing exchange rate volatility observed in Kenya in recent years and the concerns that this volatility has raised among policymakers and tea exporters, this paper has investigated whether there is evidence that exchange rate volatility has a negative or positive impact on tea exports. Using time series analysis, we find negative and relatively significant evidence on the impact of RER volatility on tea exports. The study covers the post-liberalization period (1993:7-2008:12) and examines the effects of RER exchange rate volatility on Kenya's tea exports using cointegration approach. The results show that exchange rate volatility has a relatively significant negative short and long-run effect on Kenya's tea export volume.

6.2 Policy Implications and Recommendations

From the results obtained, we argue that there is need to look at exchange rate volatility deeply and to adopt appropriate monetary and fiscal policies to ensure stability in exchange rates since it impacts on the country's tea exports.

Pursuing appropriate fiscal and monetary policies for instance the government can cover the tea exporters to avoid the effects of volatility of exchange rate on their tea exports.

In the long-run, there is need to develop forward and futures markets to enable exporters hedge against exchange rate risk.

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APPENDICES

A: (i) Graphs of Variables at Levels

Figure 2: Trends of Tea volume against period (months)

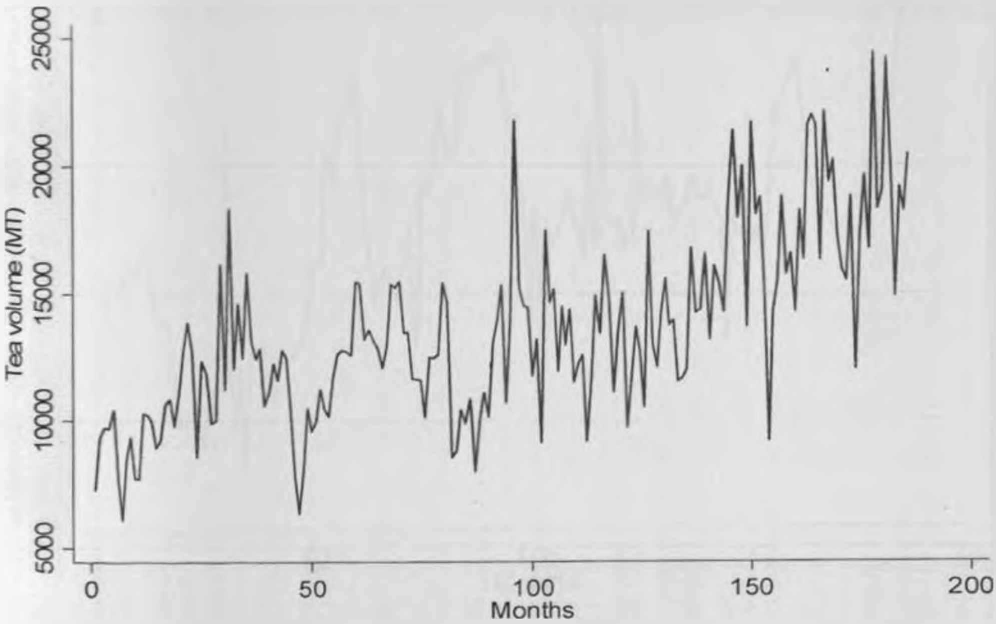


Figure 3: Trends in GDP against period (months)

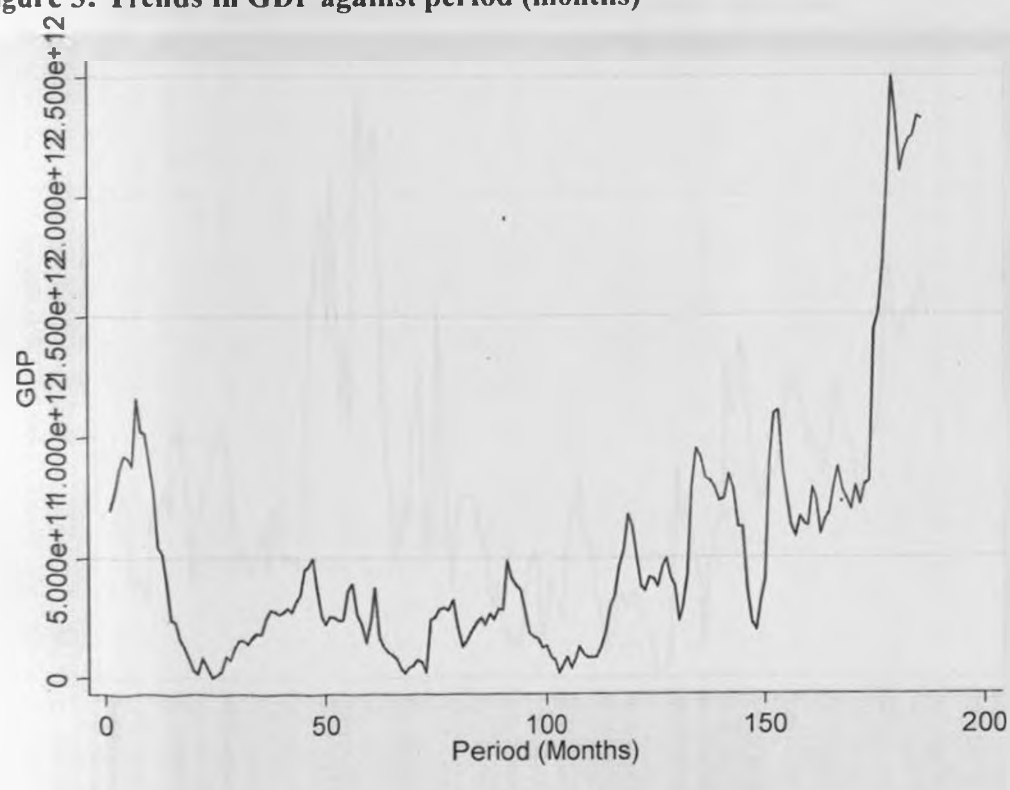


Figure 4 :Tea Prices against period (months)

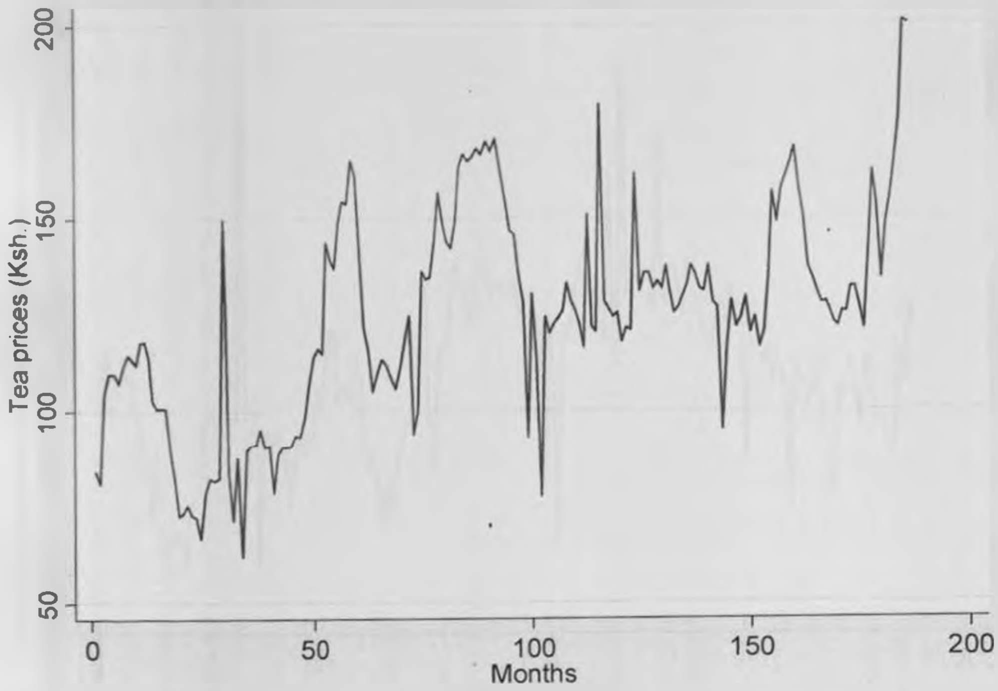


Figure 5 : Coffee (Tea substitute) Prices against period (months)

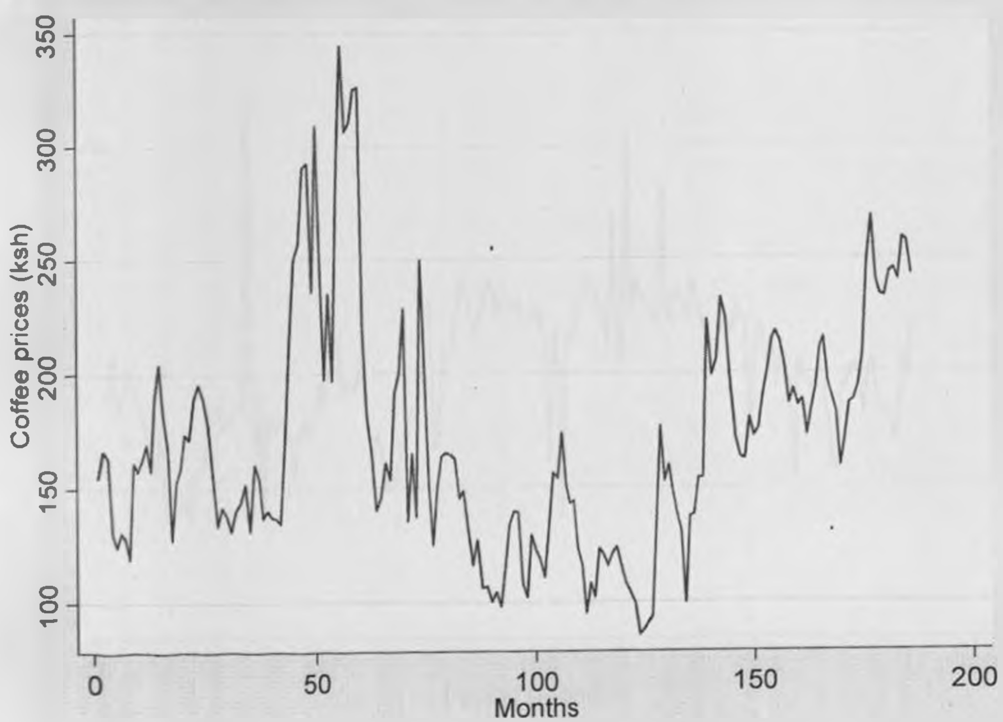


Figure 6 : Trends in Relative prices against

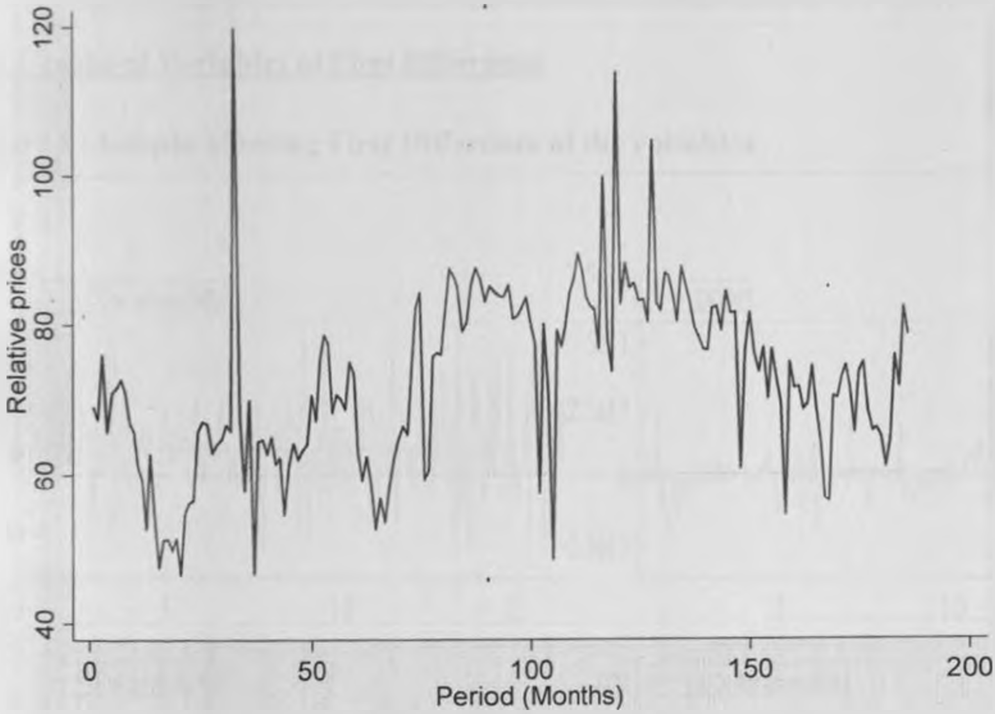
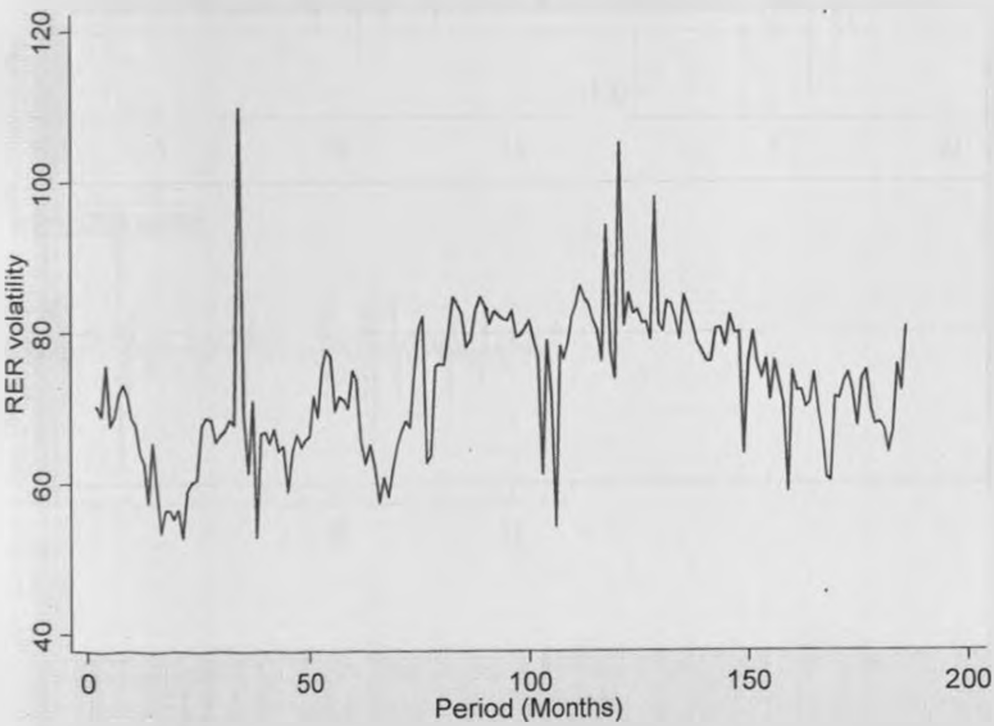
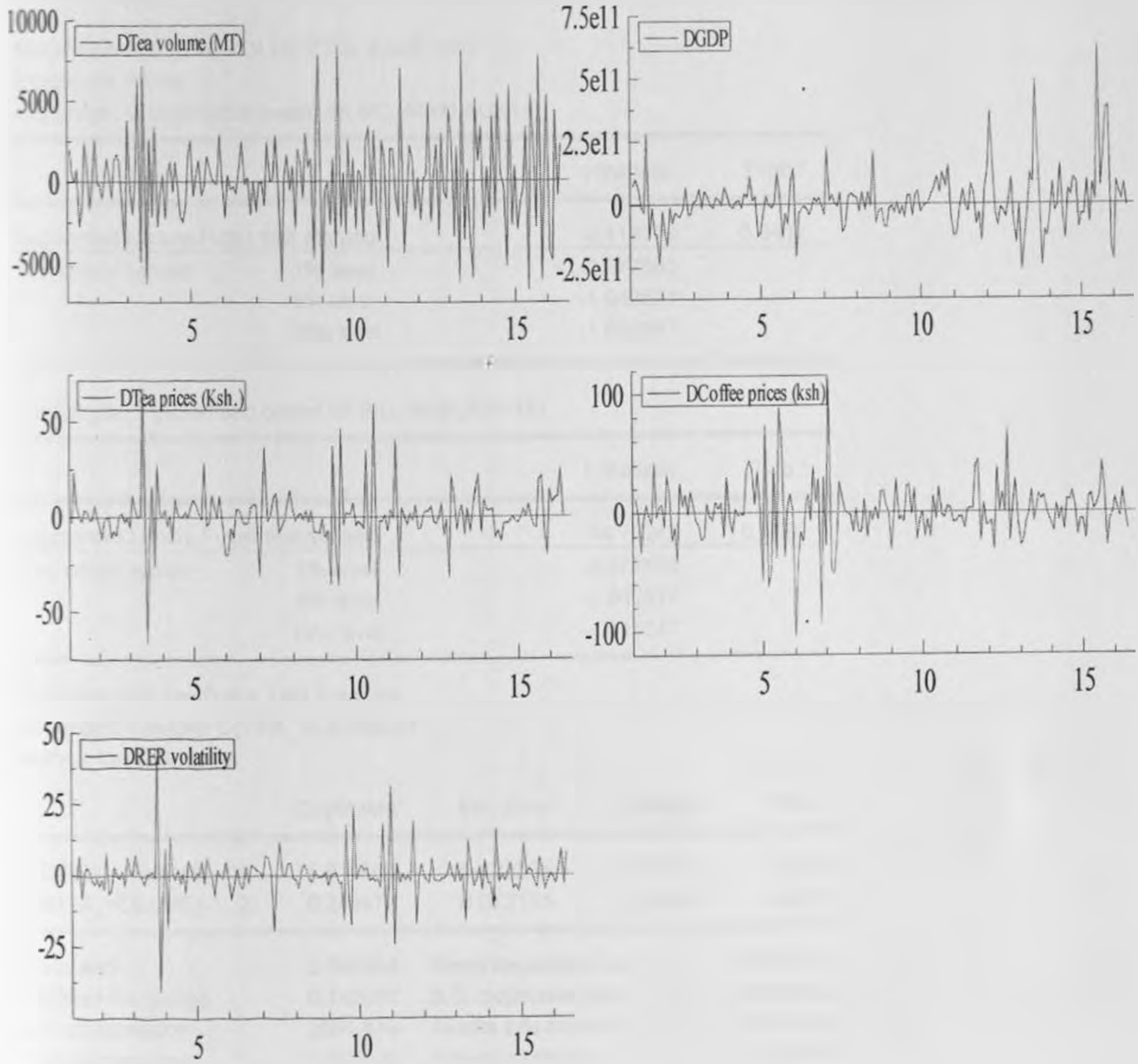


Figure 7 :RER volatility against period (months)



(ii) Graphs of Variables at First Difference

Figure 8 : Graphs showing First Difference of the variables



B: Unit root tests

(i) ADF tests

a. Tea volume

Null Hypothesis: TEA_VOLUME has a unit root
Exogenous: None
Lag Length: 2 (Automatic based on SIC, MAXLAG=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.119739	0.6412
Test critical values:	1% level	-2.577660	
	5% level	-1.942574	
	10% level	-1.615547	

Lag Length: 1 (Automatic based on SIC, MAXLAG=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-14.70242	0.0000
Test critical values:	1% level	-2.577660	
	5% level	-1.942574	
	10% level	-1.615547	

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TEA_VOLUME,2)
Method: Least Squares

	Coefficient	Std. Error	t-Statistic	Prob.
D(TEA_VOLUME(-1))	-1.811860	0.123235	-14.70242	0.0000
D(TEA_VOLUME(-1),2)	0.240472	0.072115	3.334563	0.0010

R-squared	0.745394	Mean dependent var	9.697213
Adjusted R-squared	0.743987	S.D. dependent var	5062.382
S.E. of regression	2561.449	Akaike info criterion	18.54540
Sum squared resid	1.19E+09	Schwarz criterion	18.58048
Log likelihood	-1694.904	Hannan-Quinn criter.	18.55962
Durbin-Watson stat	2.067973		

b. Foreign GDP

Null Hypothesis: GDP has a unit root
Exogenous: None
Lag Length: 1 (Automatic based on SIC, MAXLAG=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.145630	0.7271
Test critical values:	1% level	-2.577590	
	5% level	-1.942564	
	10% level	-1.615553	

Lag Length: 0 (Automatic based on SIC, MAXLAG=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.06161	0.0000
Test critical values:	1% level	-2.577590	
	5% level	-1.942564	
	10% level	-1.615553	

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares

	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-0.711323	0.070697	-10.06161	0.0000

R-squared	0.356163	Mean dependent var	-4.24E+08
Adjusted R-squared	0.356163	S.D. dependent var	1.36E+11
S.E. of regression	1.09E+11	Akaike info criterion	53.67920
Sum squared resid	2.19E+24	Schwarz criterion	53.69667
Log likelihood	-4937.486	Hannan-Quinn criter.	53.68628
Durbin-Watson stat	2.013436		

c. Tea prices

Null Hypothesis: TEAPRICES has a unit root
Exogenous: None
Lag Length: 2 (Automatic based on SIC, MAXLAG=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.545285	0.8330
Test critical values:	1% level	-2.577660	
	5% level	-1.942574	
	10% level	-1.615547	

Lag Length: 1 (Automatic based on SIC, MAXLAG=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.90475	0.0000
Test critical values:	1% level	-2.577660	
	5% level	-1.942574	
	10% level	-1.615547	

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TEAPRICES,2)
Method: Least Squares

	Coefficient	Std. Error	t-Statistic	Prob.
D(TEAPRICES(-1))	-1.612261	0.115950	-13.90475	0.0000
D(TEAPRICES(-1),2)	0.243937	0.072192	3.378992	0.0009

R-squared	0.671895	Mean dependent var	-0.130298
Adjusted R-squared	0.670082	S.D. dependent var	24.20238
S.E. of regression	13.90148	Akaike info criterion	8.112737
Sum squared resid	34978.47	Schwarz criterion	8.147813
Log likelihood	-740.3154	Hannan-Quinn criter.	8.126955
Durbin-Watson stat	1.949037		

d. Coffee prices

Null Hypothesis: COFFEEPRICES has a unit root
Exogenous: None
Lag Length: 0 (Automatic based on SIC, MAXLAG=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.703601	0.4109
Test critical values:	1% level	-2.577522	
	5% level	-1 942555	
	10% level	-1.615559	

Lag Length: 0 (Automatic based on SIC, MAXLAG=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-14.94910	0.0000
Test critical values:	1% level	-2.577590	
	5% level	-1.942564	
	10% level	-1.615553	

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(COFFEEPRICES,2)
Method: Least Squares

	Coefficient	Std. Error	t-Statistic	Prob.
D(COFFEEPRICES(-1))	-1.099903	0.073576	-14.94910	0.0000

R-squared	0.549782	Mean dependent var	-0.141983
Adjusted R-squared	0.549782	S.D. dependent var	38.41864
S.E. of regression	25.77824	Akaike info criterion	9.342358
Sum squared resid	121606.7	Schwarz criterion	9.359831
Log likelihood	-858.4970	Hannan-Quinn criter.	9.349440
Durbin-Watson stat	1.998937		

e. RER Volatility

Null Hypothesis: RER_VOLATILITY has a unit root
Exogenous: None
Lag Length: 2 (Automatic based on SIC, MAXLAG=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.216202	0.6072
Test critical values:	1% level	-2.577730	
	5% level	-1.942584	
	10% level	-1.615541	

Lag Length: 1 (Automatic based on SIC, MAXLAG=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-16.69112	0.0000
Test critical values:	1% level	-2.577730	
	5% level	-1.942584	
	10% level	-1.615541	

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RER_VOLATILITY,2)
Method: Least Squares

	Coefficient	Std. Error	t-Statistic	Prob.
D(RER_VOLATILITY(-1))	-1.947531	0.116681	-16.69112	0.0000
D(RER_VOLATILITY(-1),2)	0.371464	0.069276	5.362079	0.0000

R-squared	0.749704	Mean dependent var	0.008737
Adjusted R-squared	0.748314	S.D. dependent var	13.44563
S.E. of regression	6.745451	Akaike info criterion	6.666542
Sum squared resid	8190.200	Schwarz criterion	6.701751
Log likelihood	-604.6553	Hannan-Quinn criter.	6.680815
Durbin-Watson stat	1.998073		

(ii) Philip Peron Tests

The nonstationary series was further confirmed by the Philip Peron's test of all the variables as follows:

a.Tea volume

Null Hypothesis: TEA_VOLUME has a unit root
Exogenous: None
Bandwidth: 14 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.103729	0.6467
Test critical values:	1% level	-2.577522	
	5% level	-1.942555	
	10% level	-1.615559	

Bandwidth: 24 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-43.90698	0.0001
Test critical values:	1% level	-2.577590	
	5% level	-1.942564	
	10% level	-1.615553	

Residual variance (no correction)	6860417.
HAC corrected variance (Bartlett kernel)	1040993.

Phillips-Perron Test Equation
Dependent Variable: D(TEA_VOLUME,2)
Method: Least Squares

	Coefficient	Std. Error	t-Statistic	Prob.
D(TEA_VOLUME(-1))	-1.459294	0.065687	-22.21570	0.0000

R-squared	0.729505	Mean dependent var	1.174728
Adjusted R-squared	0.729505	S.D. dependent var	5049.855
S.E. of regression	2626.386	Akaike info criterion	18.59003
Sum squared resid	1.26E+09	Schwarz criterion	18.60750
Log likelihood	-1709.282	Hannan-Quinn criter.	18.59711
Durbin-Watson stat	2.220171		

b.Foreign GDP

Null Hypothesis: GDP has a unit root
Exogenous: None

Bandwidth: 3 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.531068	0.8298
Test critical values:	1% level	-2.577522	
	5% level	-1.942555	
	10% level	-1.615559	

Bandwidth: 3 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-10.04998	0.0000
Test critical values:	1% level	-2.577590	
	5% level	-1.942564	
	10% level	-1.615553	

Phillips-Perron Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares

	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-0.711323	0.070697	-10.06161	0.0000

R-squared	0.356163	Mean dependent var	-4.24E+08
Adjusted R-squared	0.356163	S.D. dependent var	1.36E+11
S.E. of regression	1.09E+11	Akaike info criterion	53.67920
Sum squared resid	2.19E+24	Schwarz criterion	53.69667
Log likelihood	-4937.486	Hannan-Quinn criter.	53.68628
Durbin-Watson stat	2.013436		

c. Tea Prices

Null Hypothesis: TEAPRICES has a unit root
Exogenous: None
Bandwidth: 7 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.384310	0.7940
Test critical values:	1% level	-2.577522	
	5% level	-1.942555	
	10% level	-1.615559	

Bandwidth: 0 (Newey-West using Bartlett kernel)

	Adj. t-Stat	Prob.*

Phillips-Perron test statistic		-18.38691	0.0000
Test critical values:	1% level	-2.577590	
	5% level	-1.942564	
	10% level	-1.615553	

Phillips-Perron Test Equation
Dependent Variable: D(TEAPRICES,2)
Method: Least Squares

	Coefficient	Std. Error	t-Statistic	Prob.
D(TEAPRICES(-1))	-1.297497	0.070566	-18.38691	0.0000

R-squared	0.648805	Mean dependent var	0.013970
Adjusted R-squared	0.648805	S.D. dependent var	24.21537
S.E. of regression	14.35044	Akaike info criterion	8.170858
Sum squared resid	37686.10	Schwarz criterion	8.188330
Log likelihood	-750.7189	Hannan-Quinn criter.	8.177939
Durbin-Watson stat	2.124890		

d. Coffee prices

Null Hypothesis: COFFEEPRICES has a unit root
Exogenous: None
Bandwidth: 7 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.400250	0.5384
Test critical values:	1% level	-2.577522	
	5% level	-1.942555	
	10% level	-1.615559	

Bandwidth: 7 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-15.55920	0.0000
Test critical values:	1% level	-2.577590	
	5% level	-1.942564	
	10% level	-1.615553	

Phillips-Perron Test Equation
Dependent Variable: D(COFFEEPRICES,2)
Method: Least Squares

	Coefficient	Std. Error	t-Statistic	Prob.
D(COFFEEPRICES(-1))	-1.099903	0.073576	-14.94910	0.0000

R-squared	0.549782	Mean dependent var	-0.141983
Adjusted R-squared	0.549782	S.D. dependent var	38.41864
S.E. of regression	25.77824	Akaike info criterion	9.342358
Sum squared resid	121606.7	Schwarz criterion	9.359831
Log likelihood	-858.4970	Hannan-Quinn criter.	9.349440
Durbin-Watson stat	1.998937		

c. RER Volatility

Null Hypothesis: RER_VOLATILITY has a unit root
Exogenous: None
Bandwidth: 62 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.112705	0.6436
Test critical values:	1% level	-2.577590	
	5% level	-1.942564	
	10% level	-1.615553	

Bandwidth: 20 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-36.88638	0.0000
Test critical values:	1% level	-2.577660	
	5% level	-1.942574	
	10% level	-1.615547	

*MacKinnon (1996) one-sided p-values.
Phillips-Perron Test Equation
Dependent Variable: D(RER_VOLATILITY,2)
Method: Least Squares

	Coefficient	Std. Error	t-Statistic	Prob.
D(RER_VOLATILITY(-1))	-1.421183	0.067470	-21.06381	0.0000

R-squared	0.709114	Mean dependent var	0.052607
Adjusted R-squared	0.709114	S.D. dependent var	13.42177
S.E. of regression	7.238878	Akaike info criterion	6.802259
Sum squared resid	9537.047	Schwarz criterion	6.819797
Log likelihood	-621.4067	Hannan-Quinn criter.	6.809368
Durbin-Watson stat	2.300600		

C: Results

(i) Regression

	Coefficient	Std.Error	t-value	t-prob	Part.R^2
Tea volume (MT)_1	0.316756	0.09023	3.51	0.001	0.0924
Constant	-110.820	3708	-2.16	0.032	0.0000
GDP_4	-5.78506e-009	3.514e-009	-1.65	0.102	0.0219
Tea prices (Ksh.)_3	34.9769	20.92	1.67	0.097	0.0226
Coffee prices (ksh)_3	-11.3570	11.31	-1.00	0.317	0.0083
RER volatility_2	60.8235	41.97	1.45	0.150	0.0171

sigma	2639.53	RSS	843020691
R^2	0.603477	F(52,121) =	3.541 [0.000]**
log-likelihood	-1586.13	DW	2.03
mean (Tea volume)	13911.1	var(Tea volume (MT))	1.22186e+007

Normality test for Residuals

Mean	0.00000
Std.Devn.	2195.1
Skewness	0.0091707
Excess Kurtosis	1.8903
Minimum	-9028.8
Maximum	8192.1

Asymptotic test: Chi^2(2) = 26.057 [0.0000]
Normality test: Chi^2(2) = 22.985 [0.0000]

Testing for heteroscedasticity using squares
Chi^2(11)= 9.3754 [0.5873] and F-form F(11,110)= 0.56606 [0.8525]
RESET test: F(1,121) = 0.47661 [0.4913]

(ii) Unit-root tests for residual

Augmented Dickey-Fuller test for residuals; regression of Dresiduals on:

	Coefficient	Std.Error	t-value
residuals_1	-1.3343	0.26090	-5.1144
Dresiduals_1	0.31124	0.24239	1.2840
Dresiduals_2	0.26758	0.22275	1.2013
Dresiduals_3	0.21971	0.20401	1.0769
Dresiduals_4	0.21910	0.18642	1.1753
Dresiduals_5	0.25137	0.16556	1.5183
Dresiduals_6	0.17936	0.14107	1.2714
Dresiduals_7	0.10458	0.11435	0.91454
Dresiduals_8	0.097852	0.081022	1.2077

sigma = 2263.12 DW = 2.021 DW-residuals = 2.034 ADF-residuals = -5.114**

Critical values used in ADF test: 5%=-1.942, 1%=-2.578

RSS = 798987845.7

(iii) Error correction model

	Coefficient	Std.Error	t-value	t-prob	Part.R^2
DTea volume (MT)_1	0.535755	0.3373	1.59	0.115	0.0218
Constant	78.2211	225.5	0.347	0.729	0.0011
DGDP_1	-3.83001e-009	2.305e-009	-1.66	0.099	0.0238
DTea prices (Ksh.)_5	33.4569	22.95	1.46	0.148	0.0185
DCoffee prices (ksh)_3	-10.6201	9.250	-1.15	0.253	0.0115
DRER volatility_2	61.0196	55.65	1.10	0.275	0.0105
residuals_1	-1.25079	0.3534	-3.54	0.001	0.0998

sigma	2638.92	RSS	786917933
R^2	0.49862	F(55,113) =	2.043 [0.001]**
log-likelihood	-1537.19	DW	2.06
mean(DTea volume	58.2227	var (DTea volume	9.287e+006

Testing for error autocorrelation from lags 1 to 7
Chi^2(7) = 12.115 [0.0968] and F-form F(7,106) = 1.1694 [0.3266]

Testing for error ARCH from lags 1 to 7
ARCH 1-7 test: F(7,99) = 0.16080 [0.9921]

Normality test for Residuals

Mean	0.00000
Std.Devn.	2157.9
Skewness	0.025374
Excess Kurtosis	1.7827
Minimum	-8805.9
Maximum	7807.5

Asymptotic test: Chi^2(2) = 22.397 [0.0000]
Normality test: Chi^2(2) = 20.560 [0.0000]

Testing for heteroscedasticity using squares
Chi^2(11)= 33.132 [0.0005] and F-form F(11,101)= 2.2391 [0.0177]

RESET test: F(1,112) = 0.33285 [0.5651]

D: Normality Check

	TEAVOLUME	GDP	TEAPRICES	COFFEEPRICES	RERVOLATILITY
Skewness	0.613587	2.101526	-0.013702	0.929540	0.363085
Kurtosis	3.106766	7.662787	2.805119	3.728351	4.086450
Probability	0.002885	0.000000	0.861337	0.000000	0.001385
Observations	185	185	185	185	185