# THE RELATIONSHIP BETWEEN EXCHANGE RATE VOLATILITY

# AND VOLUME OF TEA EXPORTS IN KENYA

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# DECLARATION

I declare that this Research project is my original work and that it has not been submitted in any University for any degree award

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# DEDICATION

This research project is dedicated to my mother, Mrs. Bernadette Atieno (M*in Ray*)

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# ABBREVIATIONS

GDP            Gross Domestic Product

OECD           Organisation for Economic Co-operation and Development

CBK            Central Bank of Kenya

KES            Kenya Shilling

USD            United States Dollar

AFA            Agriculture and Food Authority

EATTA          East African Tea Trade Association

GOK            Government of Kenya

KNBS           Kenya National Bureau of Statistics

FDI            Foreign Direct Investment

KTDA           Kenya Tea Development Authority

LDC            Least Developed Country

FDI            Foreign Direct Investment

# ABSTRACT

The Agricultural economy accounted for 26% of the Kenyan GDP in 2016 and as such was a major contributor towards the economic performance of export trade in Kenya. Agricultural produce is fundamental to Kenya's export sector with tea and horticultural produce being the key export products. Kenya exports her tea to United Kingdom, Netherlands, Pakistan, United States of America, Uganda and Tanzania. Approximately 90% of the tea produced in Kenya is exported. The currency adopted for the auction of tea in international markets is the USD. Kenya has adopted the floating exchange rate system where an exchange rate is determined by market forces of demand and supply for foreign currencies implying the value of the local currency is never constant. This research study sought to study the relationship between exchange rate volatility and the volume of tea exports in Kenya. The descriptive research design was used to conduct this assessment. Data used was collected from the Central Bank of Kenya, the Kenya National Bureau of Statistics and the Agriculture & Food Authority, Tea Directorate. Data was presented using tables. A multiple regression model was applied to establish the relationship between the dependent, the independent and the control variables. Correlation analysis and coefficient of determination were used to determine the significance of the model adopted. The results of the regression analysis established the relationship between the variables. The coefficients that corresponded to inflation rate, tea prices and tea production were positive implying that there was a positive relationship with the volume of tea exported in Kenya while exchange rate volatility was negative implying a negative relationship with tea exports in Kenya. The research concluded that exchange rate volatility had a weak negative relationship with the volume of tea exports in Kenya. The research recommended that policies that encourage export trade be formulated and adopted as they would boost export trade.

# CHAPTER ONE : INTRODUCTION

## 1.1 Background to the study

The Bretton Woods fixed exchange rate system was abolished in 1971, resulting in exchange rate volatility being a major concern for stakeholders in the financial sector (El-Masry & Abdel-Salam, 2007). It was replaced by a floating rate system of exchange, which is prone to frequent changes thus currency fluctuations (Abor, 2005). Exchange rate exposure is the sensitivity associated with movements in the real value of domestic currency to the unforeseen movements in the rates of exchange.

In Kenya, the Vision 2030 is used as a fundamental benchmark in the measurement of the progress of Kenya's economic development. It's built upon three pillars i.e. the social, political and economic pillars. Manufacturing, financial services, wholesale and retail trade, tourism, IT enabled services and agriculture have been key drivers that have fuelled the growth of the Kenyan GDP in the 2016. The trade sub-sector contributes significantly to the GDP of Kenya through promotion of both domestic and international trade. Key programmes under this sub-sector are geared towards promoting enabling business environment, spearheading regional integration initiatives and promoting internationally recognised fair trade practices. The provision of affordable business credits is a core poverty elimination programme implemented by the trade sub sector to reduce poverty by offering trade finance, business entrepreneurial and advisory services to micro and small enterprises (Ministry of Planning, January 2012).

Baliamoune-Lutz & Ndikumana (2007) noted that African countries had implemented several economic reforms that included trade liberalization, and aimed at boosting the growth of the

economy. The theory behind the motivation for these reforms has been that trade liberalization is expected to raise trade, which in turn leads to an increase in the rate of growth in the economy.

### 1.1.1 Tea exports

Exports are defined as goods and services, which reduce from the stock of material resources of a country by leaving its economic territory (OECD, 2017). Exports consist of commodities transferred from residents to foreigners.

Agricultural produce is fundamental to Kenya's export sector with tea and horticultural produce being the key export products. Kenya's other export products are tobacco, cement, petroleum products, coffee, textiles, and steel products. Kenya exports her commodities to United Kingdom, Netherlands, Pakistan, United States of America, Uganda and Tanzania (Trading Economics, 2017). Approximately 90% of the tea produced in Kenya is exported. The quantities exported are measured in million kilogrammes.

### 1.1.2 Exchange rate volatility

The term exchange rate is used to imply the price at which a domestic currency may be converted into a foreign currency. Rate of exchange is the price of one country's currency in relation to another (Wise Geek, 2017). Exchange rates can either be a market rate or an official rate. Market rate describes the exchange rate determined largely because of market forces. On the other hand, an official rate describes the exchange rate determined by a regulator, usually a country's central bank, CBK in the Kenyan context.

Exchange rate volatility is the predisposition of a foreign currency to increase or decrease in value and as such leading to movements in the profitability of foreign exchange trades (Wise Geek, 2017). Volatility of the rate of exchange is therefore a quantifier of the level of these movements and their frequencies. Volatility is often used concurrently with the stocks, although foreign exchanges will also be volatile. This therefore implies that volatility will affect any business transaction that involves two different countries.

### 1.1.3 Exchange rate volatility and tea exports

Exchange rate and trade flows has been widely studied both on theoretical and empirical grounds. It should be noted that movements in the rates of exchange have a permanent effect on international trade. Chirchir, Mmbayiza & Jagongo (2017) noted that theoretical and empirical studies since the adoption of a floating system of exchange rates in 1973 based their subjects on how volatility in exchange rates affected volumes of international trade. The volatility and uncertainty associated with movements in exchange rates have led policy makers and researchers investigate the impact such movements had on trade volumes (Ozturk, 2006).

Exchange rates remains to be a controversial area both theoretically, empirically and international finance. He notes further that despite recent empirical studies neglecting potential existence of long run relation in exchange rates and fundamentals of economics, structural models have been used in the study of exchange rates (Yutaka, 2012). The management of exchange rates is still a major concern to economists from developing countries even though there exists a lot of literature in this area; notably because an exchange rate regardless of how it is conceptualised, is a signal of competitiveness of a country's currency against the rest of the world (Aliyu, 2008). However, she notes that the determination of equilibrium exchange rate has

no simple answer because estimation equilibrium exchange rates and their degree of misalignment is still a challenging empirical problem in open economy macroeconomics.

Sauer & Bohara, (2001) in their research say that arguments have been put forward that volatility in exchange rates as adverse effects on international trade because the importers averse to risk face a higher risk and uncertainty about profits from their foreign trades and consequently lower their activities abroad. In theory though, the direct effect is uncertain and is dependent on factors like risk aversion, currency in which contracts are denominated, hedging opportunities available and the existence of other risks in the business implying that the relation between exchange rate uncertainties and trade is eventually empirical.

### 1.1.4 Tea industry in Kenya

In Kenya, the tea sector operates under the Ministry of Agriculture for guidance on policy and technical issues. It is well structured, with the Tea Directorate as regulator, the Tea Research Foundation of Kenya deals with research related to tea production in Kenya and KTDA for the management of small scale tea producers and factories (Tea Directorate, 2017). According to Deloitte Kenya Economic Outlook (2017), the agricultural economy accounts for 26% of the Kenyan Gross Domestic Product (GDP) and employs approximately three quarters of the her citizens and accounts for 50% of earnings from exports.

In Africa, Kenya is the biggest producer of tea and currently prides herself as one of the world's major producer of black tea. To begin with, Kenyan tea is pests and disease free implying that the tea is produced without use of any agrochemicals. Only fertilizer, is used when growing tea so as to replenish nutrients in the soil. This has resulted in Kenyan tea being relished in the wake

of a world population that is more aware of their health. Tea farming in Kenya is practiced along the equator and as such gets maximum sunlight all through the year. The tea is grown in high altitude areas of over 1500 metres above sea level where they receive an average of about 1300 millimetres of rainfall per year. This is spread out throughout the year thus ensuring a constant supply both in terms of quantity and quality. Lastly, it should be noted, that Kenya has several varieties of tea which are constantly being advanced to match the regions where tea I grown in the country. Research is constantly being conducted, ensuring that all new varieties developed have enhanced properties (AFA, 2017).

The Export Auction System is used for the sale of tea meant for exportation in Kenya. It was adopted in Nairobi in 1956 but was later relocated to Mombasa in 1969 and operates under the management of EATTA. This is the body tasked with promotion of the best interest of tea traders in the African continent. The USD is used as the approved mode of trade. The Mombasa tea auction started international when it conducted a successful USD auction as per GoK policies on exchange rates control circular number 5/92/13 of October 1992. Sales are done in accordance with rules and regulations of EATTA ensuring fair play. Trade usually occurs between members and are numbered annually beginning with sale number 1on the first Monday in January and closing with either 50 or 51 at the end of the year in December (EATTA, 2017).

## 1.2 Research problem

Rutto & Ondiek (2014) in their study of the impact of exchange rate volatility on Kenya's tea exports that was aimed at finding out the relationship that existed between exchange rate fluctuations and tea exports' performance in Kenya found that there existed a significant negative impact between exchange rate volatility and the performance of Kenya's tea exports. A

study that was based on the fact that the Kenyan tea market was experiencing a stint of relatively poor performance in the international markets and seasonal fluctuations in exchange rates and inflation rates.

Akwabi (2015), in her study the impact of foreign exchange rate volatility on Kenyan export trade which aimed at finding out how foreign exchange rate fluctuations affected export trade in Kenya, she found a positive relationship between the fluctuations in exchange rate and export trade in Kenya. The study observed the effect of foreign exchange rate fluctuations on export trade in Kenya using the monthly time series data from 2011 to 2015. In her study she found out that the independent variables (exchange rates, inflation and FDI), were statistically significant factors in Kenya's export trade. This led her in concluding that the exchange rate was a major factor in determining the levels of export trade in Kenya.

Muthamia & Muturi (2015), in their study were investigating in abroad aspect the determinants of tea export earnings in Kenya. In their study, they found out that there exists a positive relationship between incomes from tea and rate of exchange, exportation of services and food, prices of tea, and value addition of agriculture. On the contrary, an indirect relationship was found to exist between incomes from tea exports and income of main players in the tea market traded with. All the variables that were regressed were significant except for the inflation. They note that tea export earnings and the real rate of exchange have a positive relationship in the short run implying that an increase in real rate of exchange triggered by depreciation of the Kenyan shilling against the USD would result in higher earnings from tea exports. On the other hand depreciation of the USD against the Kenyan shilling occasioned the fall in the real rate of exchange led to a decline in the earnings received from tea exports.

According to Hasan, Muktadir-Al-Mukit, & Islam (2015), export income is a function of the prices of export and the quantity of goods, and the rate of exchange of the local currency to the international currency. They further cite studies which suggest that export quantities is based on export price, which is reasonably stable, and the fluctuations that arise in the rate of exchange. Both positive and negative fluctuations, influence export by either raising exports when depreciation occurs or reducing exports when exchange rate appreciations occur on the contrary.

Although extensive research has already been carried in this field about the exchange rate dynamics, a lot still remains to be examined to give investors, specifically import and export traders, a better understanding of the market. The relationship that exists between exchange rate volatility has not yet been fully understood due to the differing conclusions that have been arrived at by researchers. Ozturk (2006), for instance found that findings of different studies were not easy to compare since periods of study, specified models, country and risk vary widely. In most cases, he states that long run measures are adopted which may be better to study trends in exchange rates rather than volatility, leading him to conclude that most studies appear to favour the assumption that trade levels are depressed by volatility of exchange rates.

## 1.3 Research Question

The research study will seek to answer the research question; what is the relationship between exchange rate volatility and tea exports in Kenya?

## 1.4 Research Objective

The objective of this study is to determine the relationship between exchange rate volatility and the tea exports in Kenya.

## 1.5 Value of the study

This study will be useful for future researchers and academicians as it will increase resources to the already available body of knowledge. They will be able to refer to the findings of this research. In addition, policy makers may also be able to consider some the outcomes of this research paper in coming up with sectoral legislation relating to exportation of tea and other agricultural produce knowing very well that Kenya is a largely an agricultural economy. This is true because bulk of Kenya's wealth consists agricultural products e.g. tea, coffee, sugar, cut flower etc.

In addition stakeholders in the tea export sector will be able to apply some of the recommendations that will come out from the research study to improve their business operations and have a better understanding of their processes. Finally, this research study will enable the researcher to be awarded a degree of Master of Science once it is satisfactorily completed and the findings submitted.

# CHAPTER TWO: LITERATURE REVIEW

## 2.1 Introduction

This chapter seeks to provide a review of literature on the effect of exchange rate volatility on volumes of tea exported by Kenya. It also analyses some of the previous studies that have been carried out the world over. Finally, it highlights the gaps discovered in the analysis and summarises them indicating how the study hopes to fill the specific gap.

## 2.2 Theoretical Literature Review

This section examines the different theories that have been adopted by different researchers in carrying out studies relating to volatility in exchange rates and trade.

### 2.2.1 Theory of a firm under uncertainty

Côté (1994), notes that the producer theory a firm under uncertainty is used to analyse the effects of exchange rate volatility on trade. She observes that the traditional uncertainty trade models study how undiversified business entities behave yet their profitability is explicitly related to changes in a bilateral rate of exchange. The inconsistency of that rate of exchange assumes a risk measure to the firm in taking the trade. Many studies use time series despite theory indicating that how exchange rate volatility behaves is dependent on the nature of the firm and usually based to a large extent on aggregate data.

**2.2.2 Gravity model**

Fogarasi (2008), in his research concentrates on the relationship between volatility of exchange rate and agriculture trade in Romania, by use of a gravity model based on panel data. Over the last one and a half decade, he notes that internationally trade with agricultural products and macroeconomic environments had undergone massive changes making it important in transition economies. This short-run and long-run effects of monetary policy were important on agriculture sector, because of a lack of credible farm policy in which farm incomes were influenced by international trade in agriculture sub-sector.

**2.2.3 Inflation rate differential / Purchasing power parity theory**

This theory tries to measure the relationship of inflation and exchange rate. The theory was developed by Gustav Cassel in 1918. This theory is rooted on the law of one price which postulates, if transaction costs do not exist, goods that are identical should have the same price in different markets. The PPP formula is expressed as the rate of inflation in the home market less the rate of inflation in the foreign market divided by the inflation rate in the foreign market plus one and this is expressed as percentage (Madura, 2007)

**2.2.4 International Fisher Effect**

The theory was proposed by Irving Fisher in the year 1930. In this theory interest rates as opposed to inflation rate differentials is used to explain the changes in exchange rate over a period of time. This theory takes into account the different inflations in countries and argues that the nominal interest rates will differ due to this factor. It is the use of the fisher effect in two countries to come up with the expected change in the rate of exchange. The difference in the

nominal rate of two countries is caused by the change in exchange rates among the two countries if the real interest rate is the same in the two countries in. The theory suggests that differentials in interest rate can only exist if the exchange rate was to be altered in a manner that the loss occasioned by foreign exchange rate transactions is offset by the higher interest rate advantage. This theory suggests that where a currency has a high interest rate it is probable that it shall consequently have a high level of inflation. Investors in the home country will not therefore be interested in investing in interest bearing instruments in foreign countries as the effect of the rate of exchange could offset the advantage presented by the interest rates (Madura, 2007).

Even if the differential in nominal interest rates accurately reflects the differential in expected inflation rates, an exchange rate is influenced by other factors and not just inflation. The IFE formula is explained as the interest rate in the home market less the rate of interest in the foreign market expressed as a percentage divided by the interest rate in the foreign market plus one.

## 2.3 Determinants of volumes of tea exports in Kenya

This section will briefly discuss some of the factors that will usually tend to determine the volumes of tea exports in Kenya.

### 2.3.1 Exchange rate volatility

Exchange rate refers to the price of domestic currency in relation to the foreign currency. Exchange rate volatility therefore refers to the uncertainty in the prevailing currency prices in relation to another currency. It is therefore a key determinant of a country's exports. Appreciation of the home country's currency makes their exports less competitive since they will

be expensive thus less attractive to foreign buyers. Generally, a lower rate of exchange rate will be expected to impact negatively on the quantities of tea exported.

The uncertainties that come about due to exchange rate volatility especially with both importers and exporters have a negative effect on the volumes of tea exported. This is due to the fact that importers of tea will not be in a position to tell what prices they will pay for the tea and exporters on the other hand will not be able to tell the tea volumes they will be able to sell.

### 2.3.2 Inflation rate

Inflation is the general increase in the prices of commodities in an economy and as such leading to a decrease in the purchasing power of currency. Inflation makes exports to appear more expensive in foreign country. Increased inflation therefore results to a decrease in volume of exports. This is due to the fact that the importer will now be only able to fetch a decreased volume of the tea compared to what he had paid previously as a result of inflation. Generally, a rise in inflation rate is will impact negatively on the quantity of tea exports.

On the contrary, if the rate of inflation is decreasing, tea prices are likely to fall and such making imports cheaper. This will have a positive effect on the volumes of tea exported since importers will now be able to purchase more tea leading to an increase in the volume of tea exported.

### 2.3.3 Price of tea

Price is an important determinant of the quantity supplied. In economic theory, lower or reduced prices result to higher quantity demanded for normal goods. Thus if prices of tea are low, then

there will be an increased demand for Kenyan tea thus increasing the country's volume of tea exports.

The contrary assertion will also be true. An increase in the price of tea or rather higher tea prices will have a negative effect on the volume of tea that will be exported since the commodity will be expensive to acquire thus leading to a decrease in the volume of tea exported.

### 2.3.4 Tea production

The volume of tea production refers to the quantity of tea that is produced and made available for both local consumption and export markets. It then implies that the quantity of tea produced will determine how much will be available for both exportation and domestic consumption purpose. For instance, if the volumes produced of tea produced is high, then it means there will be a huge quantity available for exportation. On the contrary, if the volume of tea production is low, this will have a negative effect on the volumes of tea exported since there will be low quantities available for exportation.

### 2.4 Empirical Literature Review

Studies in the past that have employed panel data found out that there exists an inverse relationship between exchange rate volatility and trade. Ozturk (2006), provided a wide literature survey of exchange rate volatility and trade. He examined both theory and empirical studies that existed since the late 70's. He found out that results from different studies were not easy to compare. This he attributed to the fact that long run measures that were adopted were good for analysing changes in trends for rates of exchange and not volatility. In conclusion he says that

majority of studies appear to agree to the conventional assumption that volatility in rates of exchange will lead reduction in the levels of trade.

According to Arize, Malindretos, & Krishna (2003), most studies that are empirical treated volatility due to exchange rate as a risk. It is due to this treatment that risk averse traders would shy from foreign trades as more risk meant higher costs for them. This can be attributed to the rate of exchange being agreed in advance when the contract is entered into, and payments are made at a future date. If the behavior of rates of exchange end up to be random, profits to be realized stop being certain thus reducing the advantages of international trade. For LDCs, risk arising from exchange rates are usually not hedged because of inaccessibility or in some cases not existent at all for all traders. Even if its assumed that hedging were possible, limitations and certain costs would arise e.g. large nature of forward contracts, a relatively short maturity and difficulty in planning and timing international transactions in the forward markets.

Arize, Malindretos, & Krishna (2003) however found counter arguments that showed a positive relationship. A study they cite, showed that where income effects dominated, a positive effect on trade could arise from exchange rate volatility. This was supported by the fact that risk averse exporters will be persuaded to raise exports if the marginal utility of returns they expected from international trade was raised due to volatility of the exchange rate. The study stated that the degree of risk averse an exporter is would guide the effect of exchange rate uncertainty on exportation. A risk averse exporter concerned with a fall in incomes may raise his exports when the apparent risk is more, whereas the not so risk averse one would not be moved by the uncertainty considering that income expectations from exports are not attractive thus settling on having less imports during times of higher risk.

In their paper, Sercu & Uppal (1998), examine the assumption that volatility in rates of exchange results to a fall in the levels of trade. This they do using a stochastic general equilibrium model. Notably in their model, the rate of exchange is determined endogenously unlike existing works on trade and exchange rate volatility. They argue that both trade and exchange rate volatility are endogenous in their nature and thus it would be inappropriate to compare them to one another as if they were exogenous in nature. They demonstrate that either a positive or a negative relation could exist between exchange rate volatility and trade; scenarios that are a possibility based on the origin of the rise in volatility of exchange rate. In the instance where the origin of the rise of rate of volatility is caused by a rise in volatility of the endowment processes leading to increased trade levels and in the instance where there is an increase in the level of differentiation of commodity markets leading to a decrease in the levels of trade. They reckon that since both scenarios occur in the real world, there model is an explanation for empirical studies that did not find a strong inverse relation between rate of exchange volatility and volume of international trade.

Côté (1994), found out that evidence on the effects of exchange rate volatility on the total volumes of exports from industrial nations was mixed. She noted theory, especially microeconomic, was not helpful in formulating any strong decision as to the effects that exchange rate volatility had on international trade. For instance, if one was to reach the conclusion that volatility in exchange rates reduced trade levels, would mean they depend on a rather strict set of guidelines. Recent studies that focussed on the trade flows of Canada that she cited, and estimated Canada –US trade flows regressions based five broad sectors were not able to find any strong effects of exchange risk. Thus they concluded they concluded recent theory

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and empirical studies did not prove any strong relationship between exchange rate volatility and trade.

Jebitok (2010), in her research paper, notes that several studies concluded that a rise in exchange rate volatility caused the levels of trade to decrease. She goes further to state this was supported by literature that stated higher exchange rate risk caused incomes from exportation to fall and therefore doesn't encourage one to export. This by extension affects the subsequent production of these exports in the same way. She goes further to note that 95% of tea produced in Kenya is exported (KNBS 2009); thus tea exportation is directly determined by its production which is dependent on the price levels. Considering the existence of a firm's option to hedging opportunities against contractual exposure, she cited a study that showed exchange rate volatility did not impact on the volumes of trade if the firms were having hedging contracts. Viaene & de Vries (1992), used that analysis to allow forward rates to be determined independently meaning exchange rate volatility had a negative effect on international trade.

Rutto & Ondiek (2014) in their study of the impact of exchange rate volatility on Kenya's tea exports that was aimed at finding out the relationship that existed between exchange rate fluctuations and tea exports' performance in Kenya found that there existed a significant negative impact between exchange rate volatility and the performance of Kenya's tea exports. This was depicted by the results of the regression analysis which showed that a 1% rise in foreign exchange volatility led to a reduction of 63% in the level of tea exports. Their study was premised on the fact that, at that time the Kenyan tea export market was having a relatively poor performance in the international market and the seasonal fluctuations in the exchange rates and inflation rates. As a result, they therefore made recommendations and policy intervention

measures to be adopted as regards exchange rate volatility. They however observed that tea export trends which indicated Kenya's share of the global tea trade had been fluctuating over time and having many countries implementing steps that were aimed at liberalising business, economic and market environments to reduce barriers to foreign trade, the quantities of tea exports were expected to rise.

Akwabi (2015), in her study the impact of foreign exchange rate volatility on Kenyan export trade which aimed at finding out how foreign exchange rate fluctuations affected export trade in Kenya, she found a positive relationship between the fluctuations in exchange rate and export trade in Kenya. The study observed the effect of foreign exchange rate fluctuations on export trade in Kenya using the monthly time series data from 2011 to 2015. In her study she found out that the independent variables (exchange rates, inflation and FDI), were statistically significant factors in Kenya's export trade. She noted that political instability, under-developed infrastructure and poor macro-economic environments were factors that had continued to slow export trade performance and this in effect reduced export earnings. This led her in concluding that the exchange rate was a major factor in determining the levels of export trade in Kenya. She recommends that GOK should consider adopting policies that support export trade. If implemented, she says notes that these measures will lead to creation of more job opportunities whose effect will be increased levels of production brought about by the creation of jobs and job security. Also, she notes that the performance of the economy fully relies on the political stability of a country. She reiterates that export performance is no exception and the government must ensure that a conducive political environment exists to support export trade.

Kiptui, (2007) in his research study which sought out to examine the role played by real exchange rate in influencing the demand for exports from Kenya in an export demand framework found out that in the long-run there was no relationship in the case for manufactured goods but a relationship existed for the other export categories i.e. tea, coffee and horticulture. The results indicated the existence of positive effects in the short-run for real exchange rates which were found to be statistically insignificant. He also notes that the results could be an indication of the existence of threshold levels where exchange rate fluctuations harm exports growth. He concludes that the argument about appreciation in the real rate of exchange affected exports negatively and did not support his analysis where a rise in international economic activity dominated the factor that explained growth.

Cherop & Changwony (2014), in their research sought to understand how smallholder producers of tea earnings were affected by fluctuation in exchange rates in Kenya and how they mitigated themselves against these fluctuation exposures through KTDA Limited. The study found out that there was a positive relationship existing between movements in exchange rate and the corresponding movements in the net income for tea sold. A scenario they reckon is strange considering that income accruing from exports were expected to be reducing when the local currency was on an appreciating trend. Although, on further analysis they note that this scenario was reversed when the quantities that were exported increased. In conclusion, they state that their study was not able to determine whether trading in USD affected smallholder tea factories either in the positive or in the negative conclusively. There was a positive correlation between changes in exchange rates, volumes sold, level of incomes and the selling prices as they validated by use of the Spearman's coefficient computation. They recommended that further studies look at

exchange rate fluctuations on a monthly basis which this study will adopt. They reckon that there were fluctuations in the exchange rates which were quite substantial but that information was lost in averaging of rates and being used as annual averages.

Muthamia & Muturi (2015), in their study were investigating in abroad aspect the determinants of tea export earnings in Kenya. They adopted a longitudinal research time series approach. In their study, they found out that there exists a positive relationship between incomes from tea and rate of exchange, exportation of services and food, prices of tea, and value addition of agriculture. On the contrary, an indirect relationship was found to exist between incomes from tea exports and income of main players in the tea market traded with. All the variables that were regressed were significant except for the inflation. They note that tea export earnings and the real rate of exchange have a positive relationship in the short run implying that an increase in real rate of exchange triggered by depreciation of the Kenyan shilling against the USD would result in higher earnings from tea exports. On the other hand depreciation of the USD against the Kenyan shilling occasioned the fall in the real rate of exchange led to a decline in the earnings received from tea exports. However, they found out that the prices of tea at the tea auction in Mombasa were substantial whether the period under consideration was the short run or the long run.

There findings suggested the existence of a relationship in the negative both in the short and long runs between exports of tea and foreign income, which implied that if foreign earning is on the rise, the earnings from tea exports were on a decline. Tea export earnings and the domestic rate of inflation displayed a direct relationship in the short run; and an inverse relationship was observed in the long run. They note that rising inflation would result in a higher cost of

production because the prices of inputs would increase. Also, they state that since tea fertilizer was imported, gains that arose from export earnings would be equally offset leading to a decline in earnings from tea exports. The models they used showed that inflation was an insignificant variable as far as tea earnings from exports were involved.

In their study aimed at establishing the effect of volatility in exchange rates and selected macroeconomic variables on the performance of tea exports of firms managed by the KTDA so as to contribute to the development of a vibrant and competitive tea sector, Chirchir, Mmbayiza & Jagongo (2017), used a simple autoregressive conditionally heteroscedastic (ARCH) approach. Their study found out that an increase in the shilling rate of exchange of volatility led to a more proportionate decrease in the demand for tea exports from Kenya to the 5 main importers because an increase in rate of exchange volatility increased uncertainty in the behaviour of future rates of exchange. This goes to show that Kenyan tea exporters are averse to risk, a trend supported by the reduction in tea exports in the wake of increased exchange rate volatilities. This helped them to reduce their exposures to risk occasioned by the fluctuations. They concluded that aggregate demand and supply of any nation will be affected by the volatility in exchange rates although the degree of how effective and consequences thereof were dependent on the economic conditions that were prevailing. The findings of their study showed that the rate of exchange volatility and the selected micro-economic variables influenced tea export performance in Kenya to the 5 main importers of Kenyan tea in the world. In conditions oh high rates of exchange volatility which caused uncertainties in exporters' profits, they reduced production or sold to domestic markets thus negatively affecting exports.

## 2.5 Summary of Empirical Review

The literature reviewed clearly shows that no conclusive finding has been reached at to explain how exchange rate volatility and trade relate. All theories discussed seem to be based on some underlying assumptions. These assumptions include the period of data under review, whether the exporter is risk averse or not, the availability of hedging opportunities in the market and so forth. Whereas some researcher's ultimate conclusion is that an increase in exchange rate volatility will have a negative effect on the export performance of a country, and the economy at large; the researcher is not able to draw a definitive from the theoretical and empirical models studied. An overview examination of the data on tea exports in Kenya and exchange rate movements seem to show a different trend.

In conclusion, a great percentage of the studies previously conducted arrived at the conclusion that exchange rate volatility reduces the level of trade despite the effect being relatively small. Also, most of the literature reviewed showed a predominance previous of studies being conducted in the developed countries. Those conducted in developing countries, for instance, Akwabi (2015), covered a period of 5 years. This, some scholars stated that was especially because of a missing empirical data in most of the world's developing countries. The results cannot be therefore credibly extrapolated onto developing countries hence this is the rationale of the study. This study will therefore seek to find out the implications of exchange rate volatility on tea export trade in Kenya.

## 2.6 Conceptual Framework

A conceptual framework shows the perceived relation between the independent variable and the dependent variable. As shown in below, the independent variable is exchange rate volatility, while the quantity of tea exports is the dependent variable. The control variables for the study were inflation rate, tea prices and quantity of tea produced. It was hypothesized that the independent variable was going to have an effect on the quantity of tea exported.

Independent variable                                              Dependent variable

| Exchange rate volatility |  →  | Quantity of tea export |

| Inflation rate |
| Tea prices |
| Volume of tea production |

Control variables
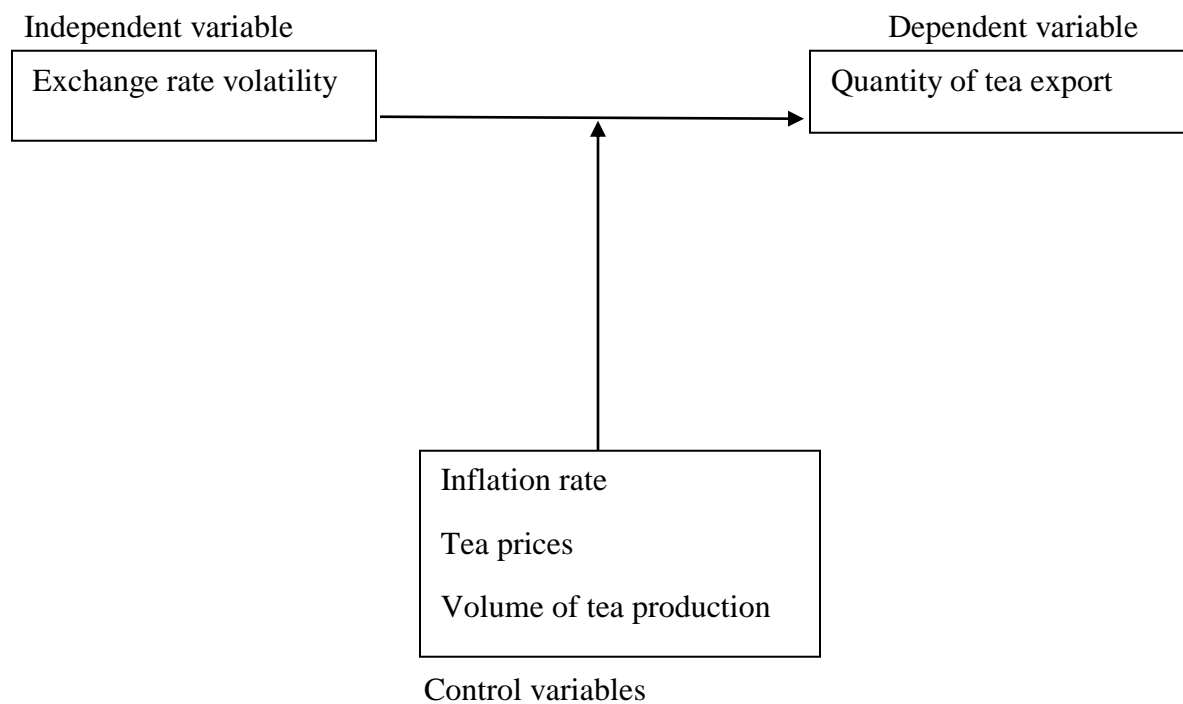
# CHAPTER THREE : RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter indicated how the study was carried out. It included the design, sample and population, data collection and finally the analysis and presentation of the data collected.

## 3.2 Research Design

This research study used descriptive research design. This design used description as a tool to organise the data collected into patterns that emerged during analysis and presentation. It also has visual aids in the form of tables to aid in the presentation of the findings.

## 3.3 Population and sample

Ogula (2005), defines population as any group of institutions, people or objects that have similar characteristics. The unit of analysis for this study was Kenya. A sample refers to a smaller group or sub-group obtained from a population (Mugenda & Mugenda, 2003). This subgroup is cautiously selected so as to be representative of the whole population with the relevant characteristics. The sample used in this study was the aggregate data on quantity of tea exported from 2007 to 2016. The study utilized aggregate monthly data. See appendices 1 to 5 attached.

## 3.4 Data Collection

This research study used secondary data. The research data sources was the statistic of the monthly average US dollar exchange rates against the Kenyan shilling available from the Central Bank of Kenya website. This is because the CBK is the regulatory body of financial institutions

and as such quotes the official exchange rate. It is also worthy to note that the USD is the currency of trade used by the EATTA at the tea auctions in Mombasa. The researcher also used the aggregate monthly statistics showing the volumes of tea exported from Kenya available on the Agriculture and Food Authority website.

## 3.5 Data analysis and Presentation

Quantitative research approach was used to arrive at the finding of the research study. Multiple linear regression models was used to analyse data collected. Tables were used to present the data collected.

Generally, a simple linear regression equation will take the form;

$y = f(x)$

The multiple linear regression model for the study took the form;

$y = a + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + \varepsilon$

Where;

$y$ = volume of tea exports

$x_1$ = exchange rate volatility

$x_2$ = inflation rate

$x_3$ = price of tea

$x_4$ = volume of tea production

$\varepsilon$ = error term

### 3.5.1 Operationalization of variables

| Variable | Name | Measurement |
|---|---|---|
| y | Volume of tea exports | Natural log of aggregate tea exports |
| $x_1$ | Exchange rate | Standard deviation |
| $x_2$ | Inflation rate | Inflation rate |
| $x_3$ | Price of tea | Natural log of prevailing tea auction price |
| $x_4$ | Volume of tea production | Natural log of aggregate tea production |

### 3.5.2 Test of significance

This study used tests of significance. In particular, the t-statistic, the co-efficient of determination $(r^2)$ and the co-efficient of correlation(r) was generated to have an in-depth understanding of the relationship which existed between the variables under study. Tests of significance was carried out for all variables using t-test at 95% level of confidence. Pearson correlation coefficients was calculated to help in examining the relationship among study variables. These coefficients were used to indicate the bearing and strength of linear relationships between variables of this study i.e. exchange rate volatility, tea exports, tea prices and inflation rate. The $(r^2)$ was calculated to help illustrate how the regression model fitted the data in the study. A high $(r^2)$ was to imply a higher reliability of the model results.

# CHAPTER FOUR: DATA ANALYSIS AND INTERPRETATION

## 4.1 Introduction

The findings from analysis of data are presented in this chapter. The results from the descriptive statistics and the regression analysis are also presented in this chapter. The summary of the findings, the results of the model and the interpretations are also presented here.

## 4.2. Descriptive Statistics

It presents the mean of the variables and the standard deviations in this study.

**Table 1: Descriptive statistics**

|  | Tea exports | Exchange rate volatility | Inflation rate | Tea price | Tea produced |
|---|---|---|---|---|---|
| Mean | 1.544445522 | 0.566561859 | 0.082969167 | 0.404943008 | 1.501781782 |
| Standard Deviation | 0.084169876 | 0.628787071 | 0.047864089 | 0.083711841 | 0.107891199 |
| Minimum | 1.252853031 | 0.041277123 | 0.0185 | 0.217483944 | 1.195899652 |
| Maximum | 1.762678564 | 2.92948563 | 0.1972 | 0.534026106 | 1.701567985 |
| Count | 120 | 120 | 120 | 120 | 120 |

Table 1: Descriptive statistics, above, is a summary of the study using descriptive statistics. The results were obtained using Excel 2013 data analysis tool run from January 2007 through to December 2016. A ten year period, using the monthly aggregate data. The data used is presented in appendices 1 to 5. The mean for tea exports was 1.5444 and the standard deviation was 0.8412. The exchange rate volatility had a mean of 0.5666 and a standard deviation of 0.6288. The rate of inflation had a mean of 0.0830 and a standard deviation of 0.0479. The price of tea had a mean of 0.4049 and a standard deviation of 0.0837. Tea production had a mean of 1.5018

and a standard deviation of 0.1079. In summary, the tea exports had a higher mean compared to the other variables used in the study while exchange volatility was the most volatile at 62.88%.

## 4.3 Coefficients of correlation and Regression analysis

### 4.3.1 Coefficient of correlation

The study used the coefficient of correlation to analyse the relationship between exchange rate volatility on tea exports in Kenya. The Pearson correlation coefficient was used to help establish whether there existed a linear relation between the dependent variable, the independent variable and the control variables as assumed by the regression model applied.

**Table 2: Correlation matrix**

|  | Tea exports | Exchange rate volatility | Inflation rate | Tea price | Tea produced |
|---|---|---|---|---|---|
| Tea exports | 1 |  |  |  |  |
| Exchange rate volatility | -0.182996509 | 1 |  |  |  |
| Inflation rate | -0.131917399 | 0.561778044 | 1 |  |  |
| Tea price | 0.130993114 | 0.099158859 | 0.125561392 | 1 |  |
| Tea produced | 0.320235434 | -0.093298163 | -0.266859699 | -0.003136125 | 1 |

Table 2: Correlation matrix, above, shows that there is a correlation between the dependent variable, the independent variable and the control variables. The coefficient of correlation between the exchange rate volatility and tea exports was -0.1830. Inflation rate and tea exports had a correlation coefficient of -0.1319, tea prices and tea exports on the other hand was at 0.1310, and tea production and tea exports was at 0.3202.

### 4.3.2 Goodness of fit statistics

**Table 3: Regression results**

| Regression Statistics | |
|---|---|
| Multiple R | 0.386218558 |
| R Square | 0.149164774 |
| Adjusted R Square | 0.119570506 |
| Standard Error | 0.078977608 |
| Observations | 120 |

The goodness of fit test statistics in the Table 3: Regression results, above, were used to show the level of the relationship that existed between the dependent variable (tea exports), the independent variable (exchange rate volatility) and the control variables (inflation rate, price of tea and tea produced). The coefficient of correlation R was 0.3862. A coefficient of correlation of 38.62% indicated that there was a medium relationship between the dependent and independent variables. An R square of 0.1492 was obtained whereas the adjusted R square was 0.1196. An adjusted R square of 11.96% means that there are other variables which are not included in this study which account for 88.04% variation in the volume of tea exports. The standard error estimate was 0.0790.

### 4.3.3 Analysis of Variance (ANOVA)

ANOVA statistics were computed in this research paper to help determine the significance of the regression model in predicting the relationship between the dependent and the independent variables.

**Table 4: Analysis of Variance (ANOVA)**

ANOVA

| | Df | SS | MS | F | Significance F |
|---|---|---|---|---|---|
| Regression | 4 | 0.12575539 | 0.031438847 | 5.040326412 | 0.000885814 |
| Residual | 115 | 0.717308198 | 0.006237463 | | |
| Total | 119 | 0.843063588 | | | |

The F critical value is 2.45 while the F calculated is 5.04.The F calculated was greater than the F critical value hence the model selected was significant in explaining the relationship between the dependent, independent and control variables. The significance F was 0.00089 which is less than the level of significance of 0.05. This means that the relationship that existed between the dependent, the independent and the control variables was therefore significant.

### 4.3.4 Regression Model

A multiple linear regression model was used in this research paper to measure the statistical significance that existed the dependent variable, the independent variable and the control variables. The model helped to examine the effect of exchange rate volatility on tea exports in Kenya. The model for the equation used is as below:

$y = a + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + \varepsilon$

**Table 5: Regression Model Coefficients**

|  | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% |
|---|---|---|---|---|---|---|
| Intercept | 1.12600031 | 0.113522404 | 9.918749707 | 3.96398E-17 | 0.901134277 | 1.350866344 |
| Exch. rate volatility | -0.025587872 | 0.013960486 | -1.832878337 | 0.069407457 | -0.053240907 | 0.002065164 |
| Inflation rate | 0.071914053 | 0.190131513 | 0.378233211 | 0.705954642 | -0.304699883 | 0.448527988 |
| Tea prices | 0.146594596 | 0.087266209 | 1.679855207 | 0.095700207 | -0.026262969 | 0.31945216 |
| Tea produced | 0.24478471 | 0.069834819 | 3.505195732 | 0.00065136 | 0.106455374 | 0.383114046 |

The results above can be represented in an equation as shown below;

$y = 1.1260 - 0.0256\, x_1 + 0.0719\, x_2 + 0.1466\, x_3 + 0.2448\, x_4 + \varepsilon$

Each point in the model equation represents an estimate of the expected value of the dependent variable that will correspond to the independent variables. The equation above shows that the volume of tea exports was 1.1260, if all the independent variables were to be at a constant of zero i.e. exchange rate ($x_1$), inflation rate ($x_2$), tea price ($x_3$) and tea produced($x_4$). A unit increase in the exchange rate volatility will lead to a decrease of –0.0256 in the volume of tea exports. On the other hand, a unit increase in the inflation rate, tea prices and tea production would lead to 0.0719, 0.1466 and 0.2448 increase respectively in the volume of tea exports.

At the 1.96 level of significance for the t statistic, only the intercept and tea produced had significant values of 9.9187 and 3.5052 respectively. As per the model, the P-value of the tea produced was less than 0.05 which signifies that it is individually statistically significant in predicting the volume of tea exported. The P-values of exchange rate volatility, inflation rate and tea prices were greater that 0.05 hence were individually statistically insignificant in predicting the volume of tea exported in Kenya.

## 4.4 Summary and Interpretation of Findings

This research study was carried to find out the relationship between exchange rate volatility and the volume of tea exports in Kenya. Secondary data collected from the Central Bank of Kenya, Agriculture and Food Authority and Kenya National Bureau of Statistics was used in carrying out the research study. The research study found out that a relationship actually exists between exchange rate volatility and volumes of tea exported in Kenya. Table 1: Regression statistics, shows that exchange rate volatility had a correlation coefficient of -18.3% against the volume of tea exports. Inflation rate had a correlation coefficient of -13.2%, tea auction prices was at 13.1% and tea production was 32.02%. The above results show that the exchange rate volatility and tea produced have a negative and medium correlation against the volumes of tea exported. Inflation rate also a negative and weak correlation against the volumes of tea exported while tea auction price has a positive and weak correlation against the volumes of tea exported. Tea produced had a positive and medium correlation against the volume of tea exports.

The findings of the research show that tea produced was the greatest predictor of the tea volumes Kenya exported at 0.2447 with a t statistic of 3.5052, followed by tea prices at 0.1466 with a t statistic of 1.6799. The inflation rate was at 0.0719 with a t statistic of 0.3782 and exchange rate volatility was at -0.0256 with a t statistic of -1.8328. All factors constant, a unit change in exchange rate volatility would have the effect of changing the volumes of tea exports by 0.0256 units.

The model had a correlation coefficient, R, of 38.62%, signifying that the variables had a medium positive relationship. The coefficient of determination, $R^2$, was at 14.92% while the adjusted $R^2$ was at 11.96%. This implies that the variables explained 11.96% of the changes that

occurred in regards to the dependent variable i.e. volumes of tea exported from Kenya at a confidence level of 95% while 88.04% of the changes were by factors not considered in this regression model.

The results from the regression show that when all the dependent variables are at zero i.e. exchange rate volatility, inflation rate, tea prices and tea produced then the volume of tea exported will be constant at 1.1260. Suppose exchange rate volatility increased by a unit, then export trade would decrease by 0.0256. If inflation rate increased by a unit, the volume of tea exported would rise by 0.0719. A unit increase in the price of tea exports would lead to an increase of 0.1466 in the volume of tea exported. If the quantity of tea produced increased by a unit, then the volume of tea exported would rise by 0.2448. This research study finding is consistent with Chirchir, Mmbayiza & Jagongo (2017), Rutto & Ondiek (2014) and Jebitok (2010), who all concluded that there existed a negative relationship between exchange rate volatility and the levels of export goods, in this case volume of tea exported from Kenya. This study also concluded that exchange rate volatility is a not significant determinant in the volume of tea exported from Kenya.

# CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

## 5.1 Summary

This chapter is a summary of the research study findings, conclusion and recommendations as per the study.

The study was conducted with the main objective of determining if there exists a relationship between exchange rate volatility and the volume of tea exported in Kenya. The study adopted a descriptive research design and applied a multiple regression model on the secondary data collected for monthly periods between 2007 and 2016. The data was collected from the Central Bank of Kenya, Kenya National Bureau of Statistics and the Agriculture and Food Authority websites. This is presented in appendices 1 – 5. Excel spreadsheets 2013 was used for the data analysis. Data was presented using tables.

The dependent variable, the volume of tea exported from Kenya was measured using its natural logarithm. The independent variable, exchange rate volatility was measured using standard deviation. The control variables selected for the study were inflation, tea prices and tea produced and were measured using the inflation rate, natural logarithm of tea prices and natural logarithm of tea produced respectively.

Exchange rate volatility was found to have a negative relationship with the volume of tea exported from Kenya. The control variables i.e. inflation, tea prices and tea produced were all found to have a positive relationship with the volume of tea exported from Kenya. The most

significant correlation was between the volumes of tea exported and that of tea produced at a significance level of 0.05.

The results of the regression analysis established the relationship between the variables. The coefficient of correlation R was 0.3862. A coefficient of correlation of 38.62% indicated that there was a medium relationship between the dependent and independent variables. An R square of 0.1492 was obtained whereas the adjusted R square was 0.1196. An adjusted R square of 11.96% means that there are other variables which are not included in this study which account for 88.04% variation in the volume of tea exports. The F calculated in the ANOVA statistics was found to be 5.04 and was greater than the F critical value of 2.45. The *p*- value of tea produced was less than 0.05 while exchange rate volatility, inflation and tea prices had *p*- values greater than 0.05. The regression model obtained therefore was;

$$y = 1.1260 - 0.0256 \, x_1 + 0.0719 \, x_2 + 0.1466 \, x_3 + 0.2448 \, x_4 + \varepsilon$$

The coefficients that corresponded to inflation rate, tea prices and tea produced were positive implying that they had a positive relationship with the volume of tea exported. The coefficient of exchange rate volatility was negative signifying a negative relationship with the volume of tea exported from Kenya. Tea produced had the highest correlation coefficient at 0.2448. Tea prices, inflation rate and exchange rate volatility had coefficients of 0.1466, 0.0719 and 0.0256 respectively. In summary, tea produced had the greatest effect, while exchange rate volatility had the lowest.

## 5.2 Conclusions

The objective of the study was to establish the relationship between exchange rate volatility and the volumes of tea exported in Kenya. The findings indicated that the objective of the study was achieved. The coefficient that corresponded to exchange rate volatility was negative implying that there exists a negative relationship between exchange rate volatility and volumes of tea exported in Kenya.

The ANOVA statistics indicated that the F calculated value was 5.04 while the F critical value is 2.45. The F calculated was greater than the F critical value hence the model selected was significant in explaining the relationship between the dependent, independent and control variables. The significance F was 0.00089 which is less than the level of significance of 0.05. This means that the relationship that existed between the dependent, the independent and the control variables was therefore statistically significant.

The regression model obtained was:

$y = 1.1260 - 0.0256\, x_1 + 0.0719\, x_2 + 0.1466\, x_3 + 0.2448\, x_4 + \varepsilon$

At the 1.96 level of significance for the t statistic, as shown in Table 5: Regression Model Coefficients, only the intercept and tea produced had significant values of 9.9187 and 3.5052 respectively. As per the model, the P-value of the tea produced was less than 0.05 which signifies that it is individually statistically significant in predicting the volume of tea exported. The P-values of exchange rate volatility, inflation rate and tea prices were greater that 0.05 hence were individually statistically insignificant in predicting the volume of tea exported in Kenya.

The dependent variable used for this study was the volume of tea exported from Kenya. The independent variable used was exchange rate volatility and the control variables used were tea price, inflation rate and tea produced. The study looked at the effect of exchange rate volatility on the volumes of tea that were exported from Kenya using monthly time series data from 2007 – 2016. The study found out that exchange rate volatility had a weak negative relationship with the volume of tea exports from Kenya.

## 5.3 Recommendations of the Study

Kenya is mainly an agricultural economy. The GOK should therefore consider coming up with measures that will support export trade since it is a major earner of foreign currency for the country. For instance, the government should reduce the amount of documentation that has to be completed when exporting products from Kenya. Some taxes could also be reduced to encourage exportation. If these measures are effectively implemented, it could lead to creation of more job opportunities as a result of the increased production levels. This would help tackle the high levels of unemployment currently being witnessed in the country.

Kenya is an exporter of primary products like tea, coffee and horticulture. The policy makers should now look at ways of encouraging the setting up of industries in Kenya to process the primary products so that the country now exports secondary products. This is because primary export products are more affected by external shocks in the international markets as compared to secondary products. This can be done by offering incentives and subsidies for companies incorporated in Kenya to process the primary products. The incentives could include tax breaks, lower tax bands, and free public land in the country. This would go a long way in boosting export trade in the country.

Policy makers should also aim at creating and maintaining business environments that will be able to withstand fluctuations brought about by volatility in the foreign exchange market considering that export trade is conducted using foreign currency. The CBK in collaboration with other key players in the foreign exchange market should come up with policies that will mitigate the export traders from adverse effects of the sometimes very volatile movements that would discourage export trade.

Political stability of the country also determines the level of confidence of investors in the market. If the country is experiencing an unstable political environment, export traders will be discouraged from trading since they know that the safety of their products is not guaranteed and as such will shy away from the trade thus a fall in the level of export trade. This will have a negative effect on the volume of exports from the country. The government should therefore work towards ensuring the existence of stable political environment, which will boost the investor confidence in the market leading to increased export trade in the country.

## 5.4 Limitations of the Study

In carrying out the study, the researcher encountered several limitations. The time allocated for the research study for instance was quite limited. If the period for the research was a bit longer, more tests and analyses would have been performed to find out if similar results would have been achieved, given for instance that more variables had been considered in the research. The time period considered was also shorter considering that there have been previous research studies that covered longer time periods, some up to 60 years.

Data collection was also a challenge. Kenya being an emerging economy, the data available only covered a period of 10 years. Periods prior to 2007, had no data records, and as such were not

available to be used in the research study. The study was not able to consider all factors that affected volumes of tea exported from because no data could be collected since they could not be easily accessed or quantified e.g. the cost of production, rainfall, value addition etc.

The study also did not consider periods of economic significance, like booms and troughs that might have been experienced during the period of research being considered. For instance, the effect of the 2008 financial crisis was not considered in this research. If the research had considered the same, may be the research would have had a different finding.

## 5.6 Suggestions for further Research

This research study considered one independent variable i.e. exchange rates volatility and three control variables i.e. rate of inflation, tea prices and tea production. The researcher recommends that future research should consider increasing the number of variables that affect the volumes of tea export in Kenya e.g. cost of production, foreign direct investment, transport costs among other factors should be included to examine the relationship between such factors and tea exports in Kenya.

This research study only considered tea exports from Kenya. In future, researchers should consider doing a comparison of a variety of export goods e.g. coffee and horticultural products. This will give them the chance to relate the performance of the different export commodities that Kenya exports and the value the country gets from such activity. A study could be conducted on the effect of exchange rate volatility on the export trade considering tea, coffee and horticulture as the export products.

The study was carried out on tea export trade in Kenya. Further research could be carried out on the East African region for the same or even consider other major tea exporting economies

outside Africa but in the same league as Kenya. This will help get a deeper insight into the operations of tea exporting economies in comparison to Kenya. A study could be conducted on the effect of exchange rate volatility on tea export trade in East Africa or even the effect of exchange rate volatility on the tea export trade among major tea producing economies of the world.

This research study considered a time period of 10 years. Future research could doing the research based on a longer period of time to ascertain whether different results would be arrived at in that case. Significant events that happen during the period of research could also be factored in the research to ensure that they are not entirely assumed.

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# APPENDICES

## Appendix 1: Figures

**Figure 1: Volumes of tea exported from Kenya in Million Kgs.**

| Period | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|
| January | 35.0 | 30.4 | 34.9 | 39.2 | 33.6 | 37.9 | 39.8 | 41.5 | 43.7 | 40.2 |
| February | 31.9 | 27.9 | 25.1 | 37.6 | 32.2 | 44.7 | 42.9 | 42.0 | 40.4 | 45.7 |
| March | 33.4 | 23.9 | 33.8 | 40.2 | 41.5 | 35.4 | 36.1 | 41.9 | 35.1 | 42.3 |
| April | 29.8 | 35.2 | 24.8 | 31.8 | 32.1 | 29.4 | 40.1 | 40.7 | 28.0 | 42.1 |
| May | 33.8 | 28.8 | 22.4 | 31.0 | 34.4 | 29.9 | 45.4 | 40.9 | 26.2 | 43.4 |
| June | 32.0 | 33.0 | 26.9 | 36.8 | 37.7 | 30.1 | 42.3 | 42.8 | 36.7 | 57.9 |
| July | 24.7 | 31.6 | 32.4 | 38.3 | 37.4 | 33.2 | 46.1 | 46.8 | 37.5 | 42.6 |
| August | 28.3 | 40.2 | 25.6 | 37.7 | 37.2 | 37.2 | 43.7 | 44.9 | 30.7 | 37.0 |
| September | 21.2 | 36.6 | 30.9 | 43.8 | 28.8 | 35.7 | 38.7 | 35.3 | 40.7 | 35.9 |
| October | 21.4 | 34.1 | 27.1 | 27.8 | 30.2 | 38.6 | 38.7 | 41.5 | 42.0 | 27.9 |
| November | 36.4 | 32.6 | 30.3 | 41.5 | 39.3 | 44.0 | 40.2 | 39.6 | 38.5 | 30.7 |
| December | 17.9 | 29.1 | 28.3 | 34.9 | 36.2 | 33.5 | 40.5 | 41.1 | 43.4 | 34.7 |
| **Total** | **345.8** | **383.4** | **342.5** | **440.6** | **420.6** | **429.6** | **494.5** | **499.0** | **442.9** | **480.4** |

Courtesy: Agriculture and Food Authority / Tea Directorate

**Figure 2: Average exchange rate of the KES against the USD**

| Period | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|
| January | 69.89 | 68.08 | 78.95 | 75.79 | 81.03 | 86.34 | 86.90 | 86.21 | 91.36 | 102.31 |
| February | 69.62 | 70.62 | 79.53 | 76.73 | 81.47 | 83.18 | 87.45 | 86.28 | 91.49 | 101.93 |
| March | 69.29 | 64.92 | 80.26 | 76.95 | 84.21 | 82.90 | 85.82 | 86.49 | 91.73 | 101.49 |
| April | 68.58 | 62.26 | 79.63 | 77.25 | 83.89 | 83.19 | 84.19 | 86.72 | 93.44 | 101.23 |
| May | 67.19 | 61.90 | 77.86 | 78.54 | 85.43 | 84.38 | 84.15 | 87.41 | 96.39 | 100.73 |
| June | 66.58 | 63.78 | 77.85 | 81.02 | 89.05 | 84.79 | 85.49 | 87.61 | 97.71 | 101.15 |
| July | 67.07 | 66.70 | 76.75 | 81.43 | 89.90 | 84.14 | 86.86 | 87.77 | 101.20 | 101.33 |
| August | 66.95 | 67.68 | 76.37 | 80.44 | 92.79 | 84.08 | 87.49 | 88.11 | 102.43 | 101.41 |
| September | 67.02 | 71.41 | 75.61 | 80.91 | 96.36 | 84.61 | 87.41 | 88.84 | 105.28 | 101.27 |
| October | 66.85 | 76.66 | 75.24 | 80.71 | 101.27 | 85.11 | 85.31 | 89.23 | 102.78 | 101.32 |
| November | 65.49 | 78.18 | 74.74 | 80.46 | 93.68 | 85.63 | 86.10 | 89.96 | 102.17 | 101.75 |
| December | 63.30 | 78.04 | 75.43 | 80.57 | 86.66 | 85.99 | 86.31 | 90.44 | 102.20 | 102.13 |

Courtesy: Central Bank of Kenya

**Figure 3: Inflation rate**

| Period | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|
| January | 4.6 | 9.4 | 13.2 | 6.0 | 5.4 | 18.3 | 3.7 | 7.2 | 5.5 | 7.8 |
| February | 3.0 | 10.6 | 14.7 | 5.2 | 6.5 | 16.7 | 4.5 | 6.9 | 5.6 | 7.1 |
| March | 2.2 | 11.9 | 14.6 | 4.0 | 9.2 | 15.6 | 4.1 | 6.3 | 6.3 | 6.5 |
| April | 1.9 | 16.1 | 12.4 | 3.7 | 12.1 | 13.1 | 4.1 | 6.4 | 7.1 | 5.3 |
| May | 2.0 | 18.6 | 9.6 | 3.9 | 13.0 | 12.2 | 4.1 | 7.3 | 6.9 | 5.0 |
| June | 4.1 | 17.9 | 8.6 | 3.5 | 14.5 | 10.1 | 4.9 | 7.4 | 7.0 | 5.8 |
| July | 5.5 | 17.1 | 8.4 | 3.6 | 15.5 | 7.7 | 6.0 | 7.7 | 6.6 | 6.4 |
| August | 5.3 | 18.3 | 7.4 | 3.2 | 16.7 | 6.1 | 6.7 | 8.4 | 5.8 | 6.3 |
| September | 5.5 | 18.7 | 6.7 | 3.2 | 17.3 | 5.3 | 8.3 | 6.6 | 6.0 | 6.3 |
| October | 5.4 | 18.7 | 6.6 | 3.2 | 18.9 | 4.1 | 7.8 | 6.4 | 6.7 | 6.5 |
| November | 6.1 | 19.5 | 5.0 | 3.8 | 19.7 | 3.3 | 7.4 | 6.1 | 7.3 | 6.7 |
| December | 5.7 | 17.8 | 5.3 | 4.5 | 18.9 | 3.2 | 7.2 | 6.0 | 8.0 | 6.4 |

**Courtesy: Central Bank of Kenya**

**Figure 4: Tea auction prices**

| Period | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|
| January | 1.80 | 2.28 | 2.30 | 3.00 | 3.16 | 2.91 | 3.28 | 2.74 | 2.32 | 2.72 |
| February | 1.75 | 2.42 | 2.27 | 3.13 | 3.07 | 2.95 | 3.09 | 2.35 | 2.42 | 2.48 |
| March | 1.70 | 2.21 | 2.32 | 3.01 | 2.89 | 3.03 | 2.81 | 2.16 | 2.72 | 2.30 |
| April | 1.65 | 2.31 | 2.43 | 2.82 | 2.87 | 3.08 | 2.50 | 2.16 | 2.77 | 2.11 |
| May | 1.65 | 2.28 | 2.49 | 2.53 | 2.88 | 3.14 | 2.56 | 2.06 | 3.09 | 2.21 |
| June | 1.75 | 2.43 | 2.70 | 2.37 | 2.97 | 3.29 | 2.44 | 2.03 | 3.27 | 2.40 |
| July | 1.74 | 2.55 | 2.90 | 2.35 | 3.16 | 3.42 | 2.44 | 2.28 | 3.39 | 2.43 |
| August | 1.75 | 2.77 | 3.06 | 2.78 | 3.18 | 3.42 | 2.38 | 2.17 | 3.21 | 2.31 |
| September | 1.87 | 2.81 | 3.18 | 2.80 | 3.05 | 3.31 | 2.19 | 2.01 | 3.10 | 2.33 |
| October | 1.87 | 2.29 | 2.78 | 2.77 | 2.89 | 3.20 | 2.05 | 2.02 | 3.24 | 2.39 |
| November | 1.80 | 1.88 | 3.05 | 2.79 | 2.85 | 3.24 | 2.17 | 2.02 | 3.06 | 2.66 |
| December | 1.85 | 1.89 | 3.21 | 2.94 | 2.86 | 3.27 | 2.45 | 2.01 | 3.03 | 2.67 |

Courtesy: Kenya National Bureau of Statistics

**Figure 5: Tea production in Kenya in million Kgs**

| Period | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|
| January | 41.6 | 29.7 | 25.5 | 37.7 | 35.9 | 36.2 | 45.3 | 44.9 | 41.7 | 50.3 |
| February | 34.8 | 24.1 | 21.5 | 34.8 | 26.7 | 18.4 | 38.5 | 33.7 | 24.3 | 43.9 |
| March | 32.2 | 16.9 | 18.8 | 39.2 | 22.4 | 17.8 | 33.3 | 33.3 | 15.7 | 45.3 |
| April | 30.7 | 27.4 | 18.3 | 35.9 | 31.4 | 18.1 | 38.2 | 39.9 | 23.8 | 37.6 |
| May | 32.1 | 36.4 | 29.8 | 35.6 | 32.8 | 37.3 | 39.6 | 41.1 | 37.5 | 36.6 |
| June | 27.3 | 22.8 | 25.3 | 29.8 | 28.9 | 30.2 | 30.5 | 31.9 | 32.2 | 35.9 |
| July | 22.7 | 24.2 | 21.5 | 24.4 | 26.3 | 24.3 | 26.2 | 30.8 | 30.9 | 29.3 |
| August | 22.7 | 24.5 | 21.2 | 23.1 | 24.4 | 31.9 | 26.3 | 26.8 | 28.4 | 29.5 |
| September | 28.9 | 32.0 | 27.4 | 28.8 | 30.5 | 33.5 | 32.8 | 33.3 | 36.8 | 36.8 |
| October | 35.2 | 35.3 | 32.8 | 34.1 | 39.9 | 40.2 | 44.3 | 45.4 | 41.3 | 41.3 |
| November | 32.3 | 34.4 | 35.9 | 37.0 | 36.8 | 39.9 | 35.5 | 38.6 | 40.4 | 39.9 |
| December | 28.8 | 37.9 | 36.1 | 38.3 | 41.3 | 41.4 | 41.7 | 45.1 | 46.4 | 45.1 |
| **Total** | **369.3** | **345.6** | **314.1** | **398.7** | **377.3** | **369.2** | **432.2** | **444.8** | **399.4** | **471.5** |

Courtesy: Agriculture and Food Authority / Tea Directorate

**Figure 6: Regression raw data**

| Period | Log tea exports **Kgs** | Exchange rate volatility **USD** | Inflation rate **%** | Log tea prices **USD** | Log tea produced **Kgs** |
|--------|--------|--------|--------|--------|--------|
| | y | $x_1$ | $x_2$ | $x_3$ | $x_4$ |
| Jan-07 | 1.5441 | 0.4010 | 0.04630 | 0.2553 | 1.61909 |
| Feb-07 | 1.5038 | 0.4697 | 0.03020 | 0.2430 | 1.54158 |
| Mar-07 | 1.5237 | 0.2905 | 0.02190 | 0.2304 | 1.50786 |
| Apr-07 | 1.4742 | 0.2581 | 0.01850 | 0.2175 | 1.48714 |
| May-07 | 1.5289 | 0.3389 | 0.01960 | 0.2175 | 1.50651 |
| Jun-07 | 1.5051 | 0.2523 | 0.04070 | 0.2430 | 1.43616 |
| Jul-07 | 1.3927 | 0.4377 | 0.05480 | 0.2405 | 1.35603 |
| Aug-07 | 1.4518 | 0.4238 | 0.05300 | 0.2430 | 1.35603 |
| Sep-07 | 1.3263 | 0.1250 | 0.05530 | 0.2718 | 1.46090 |
| Oct-07 | 1.3304 | 0.1821 | 0.05380 | 0.2718 | 1.54654 |
| Nov-07 | 1.5611 | 1.5052 | 0.06080 | 0.2553 | 1.50920 |
| Dec-07 | 1.2529 | 0.6335 | 0.05700 | 0.2672 | 1.45939 |
| Jan-08 | 1.4829 | 2.7753 | 0.09400 | 0.3579 | 1.47276 |
| Feb-08 | 1.4456 | 0.9250 | 0.10580 | 0.3838 | 1.38202 |
| Mar-08 | 1.3784 | 1.6121 | 0.11900 | 0.3444 | 1.22789 |
| Apr-08 | 1.5465 | 0.6178 | 0.16120 | 0.3636 | 1.43775 |
| May-08 | 1.4594 | 0.2459 | 0.18610 | 0.3579 | 1.56110 |
| Jun-08 | 1.5185 | 0.9741 | 0.17870 | 0.3856 | 1.35793 |
| Jul-08 | 1.4997 | 0.8451 | 0.17120 | 0.4065 | 1.38382 |
| Aug-08 | 1.6042 | 0.8409 | 0.18330 | 0.4425 | 1.38917 |
| Sep-08 | 1.5635 | 1.5855 | 0.18730 | 0.4487 | 1.50515 |
| Oct-08 | 1.5328 | 2.7105 | 0.18740 | 0.3598 | 1.54777 |
| Nov-08 | 1.5132 | 1.0341 | 0.19540 | 0.2742 | 1.53656 |
| Dec-08 | 1.4639 | 1.2068 | 0.17830 | 0.2765 | 1.57864 |
| Jan-09 | 1.5428 | 0.7508 | 0.13220 | 0.3617 | 1.40654 |
| Feb-09 | 1.3997 | 0.2157 | 0.14690 | 0.3560 | 1.33244 |
| Mar-09 | 1.5289 | 0.3148 | 0.14600 | 0.3655 | 1.27416 |
| Apr-09 | 1.3945 | 0.6007 | 0.12420 | 0.3856 | 1.26245 |
| May-09 | 1.3502 | 0.5703 | 0.09610 | 0.3962 | 1.47422 |
| Jun-09 | 1.4298 | 0.3542 | 0.08600 | 0.4314 | 1.40312 |
| Jul-09 | 1.5105 | 0.4067 | 0.08440 | 0.4624 | 1.33244 |
| Aug-09 | 1.4082 | 0.1226 | 0.07360 | 0.4857 | 1.32634 |
| Sep-09 | 1.4900 | 0.5989 | 0.06740 | 0.5024 | 1.43775 |

| | | | | | |
|---|---|---|---|---|---|
| Oct-09 | 1.4330 | 0.1630 | 0.06620 | 0.4440 | 1.51587 |
| Nov-09 | 1.4814 | 0.3074 | 0.05000 | 0.4843 | 1.55509 |
| Dec-09 | 1.4518 | 0.3516 | 0.05320 | 0.5065 | 1.55751 |
| Jan-10 | 1.5933 | 0.2889 | 0.05950 | 0.4771 | 1.57634 |
| Feb-10 | 1.5752 | 0.4087 | 0.05180 | 0.4955 | 1.54158 |
| Mar-10 | 1.6042 | 0.2345 | 0.03970 | 0.4786 | 1.59329 |
| Apr-10 | 1.5024 | 0.1227 | 0.03660 | 0.4502 | 1.55509 |
| May-10 | 1.4914 | 0.8629 | 0.03880 | 0.4031 | 1.55145 |
| Jun-10 | 1.5658 | 0.6481 | 0.03490 | 0.3747 | 1.47422 |
| Jul-10 | 1.5832 | 0.3986 | 0.03570 | 0.3711 | 1.38739 |
| Aug-10 | 1.5763 | 0.5708 | 0.03220 | 0.4440 | 1.36361 |
| Sep-10 | 1.6415 | 0.1721 | 0.03210 | 0.4472 | 1.45939 |
| Oct-10 | 1.4440 | 0.1064 | 0.03180 | 0.4425 | 1.53275 |
| Nov-10 | 1.6180 | 0.2411 | 0.03840 | 0.4456 | 1.56820 |
| Dec-10 | 1.5428 | 0.1146 | 0.04510 | 0.4683 | 1.58320 |
| Jan-11 | 1.5263 | 0.1223 | 0.05420 | 0.4997 | 1.55509 |
| Feb-11 | 1.5079 | 0.3522 | 0.06540 | 0.4871 | 1.42651 |
| Mar-11 | 1.6180 | 1.0752 | 0.09190 | 0.4609 | 1.35025 |
| Apr-11 | 1.5065 | 0.3620 | 0.12050 | 0.4579 | 1.49693 |
| May-11 | 1.5366 | 1.0448 | 0.12950 | 0.4594 | 1.51587 |
| Jun-11 | 1.5763 | 1.5516 | 0.14480 | 0.4728 | 1.46090 |
| Jul-11 | 1.5729 | 0.6469 | 0.15530 | 0.4997 | 1.41996 |
| Aug-11 | 1.5705 | 0.8166 | 0.16670 | 0.5024 | 1.38739 |
| Sep-11 | 1.4594 | 2.7651 | 0.17320 | 0.4843 | 1.48430 |
| Oct-11 | 1.4800 | 1.7367 | 0.18910 | 0.4609 | 1.60097 |
| Nov-11 | 1.5944 | 2.9295 | 0.19720 | 0.4548 | 1.56585 |
| Dec-11 | 1.5587 | 2.7384 | 0.18930 | 0.4564 | 1.61595 |
| Jan-12 | 1.5786 | 1.0273 | 0.18310 | 0.4639 | 1.55871 |
| Feb-12 | 1.6503 | 0.4188 | 0.16690 | 0.4698 | 1.26482 |
| Mar-12 | 1.5490 | 0.4502 | 0.15610 | 0.4814 | 1.25042 |
| Apr-12 | 1.4683 | 0.0739 | 0.13060 | 0.4886 | 1.25768 |
| May-12 | 1.4757 | 1.0352 | 0.12220 | 0.4969 | 1.57171 |
| Jun-12 | 1.4786 | 0.7039 | 0.10050 | 0.5172 | 1.48001 |
| Jul-12 | 1.5211 | 0.1308 | 0.07740 | 0.5340 | 1.38561 |
| Aug-12 | 1.5705 | 0.1123 | 0.06090 | 0.5340 | 1.50379 |
| Sep-12 | 1.5527 | 0.3474 | 0.05320 | 0.5198 | 1.52504 |
| Oct-12 | 1.5866 | 0.0986 | 0.04140 | 0.5051 | 1.60423 |
| Nov-12 | 1.6435 | 0.2115 | 0.03250 | 0.5105 | 1.60097 |
| Dec-12 | 1.5250 | 0.0607 | 0.03200 | 0.5145 | 1.61700 |
| Jan-13 | 1.5999 | 0.4722 | 0.03670 | 0.5159 | 1.65610 |

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|---|---|---|---|---|
| Feb-13 | 1.6325 | 0.2983 | 0.04450 | 0.4900 | 1.58546 |
| Mar-13 | 1.5575 | 0.2939 | 0.04110 | 0.4487 | 1.52244 |
| Apr-13 | 1.6031 | 0.4618 | 0.04140 | 0.3979 | 1.58206 |
| May-13 | 1.6571 | 0.4941 | 0.04050 | 0.4082 | 1.59770 |
| Jun-13 | 1.6263 | 0.3915 | 0.04910 | 0.3874 | 1.48430 |
| Jul-13 | 1.6637 | 0.4860 | 0.06030 | 0.3874 | 1.41830 |
| Aug-13 | 1.6405 | 0.0902 | 0.06670 | 0.3766 | 1.41996 |
| Sep-13 | 1.5877 | 0.2148 | 0.08290 | 0.3404 | 1.51587 |
| Oct-13 | 1.5877 | 0.6219 | 0.07760 | 0.3118 | 1.64640 |
| Nov-13 | 1.6042 | 0.5623 | 0.07360 | 0.3365 | 1.55023 |
| Dec-13 | 1.6075 | 0.3654 | 0.07150 | 0.3892 | 1.62014 |
| Jan-14 | 1.6180 | 0.4596 | 0.07210 | 0.4378 | 1.65225 |
| Feb-14 | 1.6232 | 0.1502 | 0.06860 | 0.3711 | 1.52763 |
| Mar-14 | 1.6222 | 0.0866 | 0.06270 | 0.3345 | 1.52244 |
| Apr-14 | 1.6096 | 0.1814 | 0.06410 | 0.3345 | 1.60097 |
| May-14 | 1.6117 | 0.3820 | 0.07300 | 0.3139 | 1.61384 |
| Jun-14 | 1.6314 | 0.1526 | 0.07390 | 0.3075 | 1.50379 |
| Jul-14 | 1.6702 | 0.0750 | 0.07670 | 0.3579 | 1.48855 |
| Aug-14 | 1.6522 | 0.2315 | 0.08360 | 0.3365 | 1.42813 |
| Sep-14 | 1.5478 | 0.2463 | 0.06600 | 0.3032 | 1.52244 |
| Oct-14 | 1.6180 | 0.1396 | 0.06430 | 0.3054 | 1.65706 |
| Nov-14 | 1.5977 | 0.2382 | 0.06090 | 0.3054 | 1.58659 |
| Dec-14 | 1.6138 | 0.1426 | 0.06020 | 0.3032 | 1.65418 |
| Jan-15 | 1.6405 | 0.3358 | 0.05530 | 0.3655 | 1.62014 |
| Feb-15 | 1.6064 | 0.1075 | 0.05610 | 0.3838 | 1.38561 |
| Mar-15 | 1.5453 | 0.3341 | 0.06310 | 0.4346 | 1.19590 |
| Apr-15 | 1.4472 | 2.5906 | 0.07080 | 0.4425 | 1.37658 |
| May-15 | 1.4183 | 1.0985 | 0.06870 | 0.4900 | 1.57403 |
| Jun-15 | 1.5647 | 0.7426 | 0.07030 | 0.5145 | 1.50786 |
| Jul-15 | 1.5737 | 1.0461 | 0.06620 | 0.5302 | 1.48996 |
| Aug-15 | 1.4870 | 1.1316 | 0.05840 | 0.5065 | 1.45332 |
| Sep-15 | 1.6096 | 0.4692 | 0.05970 | 0.4914 | 1.56585 |
| Oct-15 | 1.6237 | 0.8647 | 0.06720 | 0.5105 | 1.61595 |
| Nov-15 | 1.5855 | 0.1163 | 0.07320 | 0.4857 | 1.60638 |
| Dec-15 | 1.6370 | 0.1267 | 0.08010 | 0.4814 | 1.66652 |
| Jan-16 | 1.6042 | 0.0601 | 0.07780 | 0.4346 | 1.70157 |
| Feb-16 | 1.6599 | 0.2000 | 0.07090 | 0.3945 | 1.64246 |
| Mar-16 | 1.6263 | 0.0837 | 0.06450 | 0.3617 | 1.65610 |
| Apr-16 | 1.6243 | 0.1109 | 0.05270 | 0.3243 | 1.57519 |
| May-16 | 1.6375 | 0.1498 | 0.05000 | 0.3444 | 1.56348 |

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|---|---|---|---|---|
| Jun-16 | 1.7627 | 0.1128 | 0.05800 | 0.3802 | 1.55509 |
| Jul-16 | 1.6294 | 0.1587 | 0.06400 | 0.3856 | 1.46687 |
| Aug-16 | 1.5682 | 0.0443 | 0.06260 | 0.3636 | 1.46982 |
| Sep-16 | 1.5551 | 0.0413 | 0.06340 | 0.3674 | 1.56585 |
| Oct-16 | 1.4456 | 0.0677 | 0.06470 | 0.3784 | 1.61595 |
| Nov-16 | 1.4871 | 0.1252 | 0.06680 | 0.4249 | 1.60097 |
| Dec-16 | 1.5403 | 0.2027 | 0.06350 | 0.4265 | 1.65418 |