



**DETERMINANTS OF EXCHANGE RATE VOLATILITY OF THE KENYAN
SHILLING AGAINST WORLD MAJOR CURRENCIES**

^{1*} **James Kibiy**

Jomo Kenyatta University of Agriculture and Technology
jkibiy@gmail.com

^{2**} **Dr. Tabitha Nasieku**

Jomo Kenyatta University of Agriculture and Technology
tabithanasieku@gmail.com

Abstract

In recent years, Kenya has experienced exchange rate fluctuations and volatility which have had an impact on the country's competitiveness, international trade, inflation and general economic growth. The study sought to analyze the determinants of exchange rate volatility of the Kenyan Shillings against world major currencies by examining interest rate, inflation, external public debt and money supply as the economic variables of interest. This was done through an evaluation of the standardized beta coefficients after performing a linear regression analysis. The study examined the global major currencies with a focus on the EURO, USD and YEN. The study employed monthly time series data for the period January, 2006 to December, 2015 sourced from the CBK and KNBS websites. The research utilized descriptive statistics in the evaluation of the study. Trend Analysis, Correlation Analysis and Regression Analysis was done using the SPSS statistical software. External public debt and money supply were both found to have an effect on the volatilities of the KES/EUR and KES/USD exchange rates while interest rates and inflation were found not to be statistically significant to their volatilities. Money supply had the most impact with a negative effect on the volatility of the two exchange rates while external public debt was found to have a lower contribution with a positive effect. Interest rates, inflation and money supply were found to have an effect to the KES/JPY (100) volatility while external public debt was found not to be statistically significant. Money supply was found to have the highest unique influence on the KES/JPY (100) exchange rate volatility followed by interest rates while inflation contributed the least. Both Interest rates and Inflation were found to have a positive effect on the KES/JPY (100) volatility while money supply had a negative effect. The study concludes that increasing the monetary supply in the country can be effective and efficient in restraining currency volatility. On the other hand, a decrease in external public debt, interest rates and inflation would likewise have the same desired effect in restraining exchange rate volatility. The study therefore recommends that the government sets up a monetary policy framework that would make monetary policy more efficient through the stabilization of money supply. The government should also reduce external public debts and seek alternative ways to raise its finances. A lower central bank rate should also be adopted in order to reduce the volatility of currency rates and hence improve the stability of exchange rates. The inflation rate should also be contained through sound policy measures.

Keywords: Exchange Rate Volatility, External Public Debt, Interest Rate, Inflation Rate, Money Supply

1.0 Introduction

The financial world has evolved to a liberal, dynamic and vibrant system due to increased globalization. One of the aspects of this evolution has been the swift growth and development of the international foreign exchange (FOREX) markets. The exchange rates have an important role in the realm of finance and the economy of a country as it influences the monetary system and other macroeconomic aspects. How they behave and move is an imperative pointer of how the economy is performing. As (Otieno, 2013) and (Danmola, 2013) posit, the real exchange rate in particular is of greater significance as it is an important relative price which signals inter-sectoral growth in the long run and acts as a measure of international competitiveness. When exchange rates (RER) is misaligned, it can lead to a distortion in price signals that affect the allocation of resources in the economy.

A company's profitability, the stability of prices and a country's constancy is affected by exchange rate variability caused by this misalignment. In developing countries, misalignment in the RER has often taken the form of overvaluation, which adversely affects the tradable goods sector or export sector. Overvaluation results in a real decline in the price of foreign goods relative to domestic goods. An exchange rate is said to be overvalued when it appreciates more than its equilibrium and undervalued when it depreciates more than its equilibrium (Ojebiyi & Wilson, 2011).

Exchange rate fluctuations has been a big concern to the government, investors, analysts and other stakeholders because it results to uncertainty of employment, trade, investment, cash flows, profits and economic growth (Musyoki, Pokhariyal, & Pundo, 2012) and (Canales-Kriljenko & Habermeier, 2004). (Petursson, 2009) states that large exchange rate swings can result to challenges on controlling inflation, real allocation problems and to general financial instability. These fluctuations have since been experienced after the abolishment of the Bretton Woods system of fixed exchange rates in 1971 and after taking up the floating rate system in 1973 where the demand and supply of the currencies determine the exchange rate price (Ojebiyi & Wilson, 2011).

Kenya has witnessed in recent years a continuous trend of unpredictable fluctuations of the Shillings. The currency fluctuations affect economic growth movement in the country by hindering firms from participating in investment, innovation and trade especially for exporting companies as compared to the domestic firms. The risk-averse investors involved in international trade may reduce their trading activities and investments in the event that the exchange rate fluctuations are not contained.

The exchange rate plays a vital role in the Kenyan economy since it participates in the stock market, foreign exchange market and also affects international trade i.e. export and import of goods and services. (Kirui, Wawire, & Onono, 2014) indicate that fluctuations affects the stock market depending on whether the currency appreciates or depreciates. The argument of (Kirui, Wawire, & Onono, 2014) is also supported by (Kiptoo, 2007) who states that the Kenyan financial market

has been affected by the exchange rate volatilities in his study on the effects of real exchange rate volatility and misalignment on trade and investment in Kenya. In the event of a rise in value of its currency, there will be a reduction in the competitiveness of a country like Kenya which is export oriented and hence having a negative impact on the stock market.

Exchange rate volatility has received considerable attention in literature because it has a significant impact on the main keys of macroeconomic variables. Excess real exchange rate volatility reduces the level of international competitiveness, trade, and economic growth. It also restricts the international flow of capital by reducing both direct investment in foreign operating facilities, and financial portfolio investment (Musyoki, Pokhariyal, & Pundo, 2012) and (Kiptoo, 2007). Exchange rate volatility also has real economic costs as it affects price stability, corporate's profitability and the general economic and financial stability (Benita & Lauterbach, 2007).

Volatility of exchange rates is attributed to overshooting, a phenomenon which occurs when the immediate response of the exchange rate due to a change is greater than its long-run response (Krugman & Obstfeld, 2006). The volatility of the exchange rates is normally a feature of the flexible exchange rate regime and real shocks are identified as the dominant source of exchange rate volatility (Chipili, 2012).

1.2 Statement of the problem

Exchange rate stability is one of the main factors that promote total investment, price stability and stable economic growth (Samara, 2009). Volatility of the exchange rates could have a negative effect on trade and investment hence a country's international competitiveness will deteriorate. The exchange rates in Kenya have been fluctuating with the shilling depreciating between 2007-2011 (Kirui, Wawire, & Onono, 2014). There has been a continuous trend of exchange rate fluctuations in the country and this has translated into a high degree of uncertainty for the two main monetary policy objectives that policymakers often seek to achieve; price stability and economic growth.

Evaluating the determinant factors of exchange rate volatility has been a vital research agenda for both scholars and policy makers (Otuori, 2013) and (Boykorayev, 2008). The empirical studies relating to the effects and contribution the factors have on exchange rate volatility are although not conclusive. (Twarowska & Kąkol, 2014) established inflation rate as one of the most important determinant factors while market interest rate was one of the least factors affecting the EUR/PLN exchange rate level. (Canales-Kriljenko & Habermeier, 2004) found nominal factors to explain about 70% of volatility with interest rates and inflation having higher impact on the volatility with other factors being insignificant in 85 developing and transition economies in 2001. (Grydaki & Fountas, 2010) on the other hand, ascertained that inflation and money supply contribute majorly to the volatility of exchange rates in Latin American countries. (Okoth, 2013) established inflation rate and interest rate to affect the KES/USD exchange rate the most while other unexplained factors impacted the least between the years 2007 to 2012.

There is conflicting evidence and mixed views of the various studies on the contribution and strength of effect the determinant factors have on the exchange rate volatility over different time horizons and in different countries. Moreover, (Okoth, 2013) suggested that more studies to be carried out on the relationship between the exchange rates and other factors in addition to interest rates and inflation rates. This is because there was limited literature available to indicate the relationship between them. Further research along these lines is therefore necessary in order to ascertain more comprehensively the effects of each determinant factor on the exchange rate volatility in Kenya.

1.3 General Objective

The main objective of this study is to analyze the determinants of exchange rate volatility of the Kenyan shillings against world major currencies.

1.3.1 Specific Objectives

1. To determine the effect of interest rate on the exchange rate volatility of the Kenyan Shilling against world major currencies.
2. To establish the effect of inflation on the exchange rate volatility of the Kenyan Shilling against world major currencies.
3. To find out the effect of external public debt on the exchange rate volatility of the Kenyan Shilling against world major currencies.
4. To ascertain the effect of money supply on exchange rate volatility of the Kenyan Shilling against world major currencies.

2.0 Research gaps

Despite ample studies having been done and with existing literature on exchange rate volatility in Kenya, not much has been done on the examination of the various determinants of exchange rate volatility by analyzing the effects and extent to which each one of them impacts the exchange rate volatility. Researches that have been conducted in Kenya on exchange rates have mainly focused on explaining exchange rate behavior, with emphasis on the role of macroeconomic variables such as monetary policy shocks in the country (Musyoki, Pokhariyal, & Pundo, 2012).

For instance (Ambunya, 2012) examined the relationship between exchange rate movement and stock market returns volatility at the Nairobi securities exchange. (Gachua, 2011) did a study on the effect of foreign exchange exposure on financial performance of listed companies in Kenya. (Kiptoo, 2007) researched on the effects of real exchange rate volatility and misalignment on trade and investment in Kenya. (Kirui, Wawire, & Onono, 2014) evaluated the relationship of macroeconomic variables, volatility and stock market returns of companies listed at the Nairobi securities exchange in Kenya. (Mbogo, 2015) recently did a case study on the effect of currency depreciation on financial performance of manufacturing and allied companies listed on the Nairobi securities exchange.

The above are some of the studies carried out on exchange rates in the country but in light of these, we can conclude that the study on evaluation of exchange rate determinants remains ambiguous. None has focused on evaluating the strength of effects the factors have on exchange rate volatility of the Kenyan shillings against global major currencies. This research project tends to fill this research gap by establishing the contribution and the extent to which each factor impacts volatility of the foreign exchange rates in Kenya with a focus on the G3 world major currencies.

3.0 Research Methodology

The research applied descriptive statistics and the empirical model used is set to estimate the strength of effect of each determinant factor on exchange rate volatility. The descriptive research design is suitable for evaluating in depth the correlation of exchange rate determinants on exchange rate volatility.

A study population comprises all the subjects that comply with some standard set of specifications and comprises of entire group that is of interest to the researcher (Yount, 2006). In the current study, the target population comprises of all the world major global currencies. These include; the United States Dollar (USD), the European Euro (EUR), the Great Britain Pound (GBP), the Japanese Yen (JPY), the Swiss Franc (CHF), the Canadian Dollar (CAD), the Australian Dollar (AUD) and the New Zealand Dollar (NZD).

Two main sampling techniques applied to get a suitable sample size for the study are probability sampling and non-probability sampling techniques. The purposive technique was utilized for the study because based on judgment, the G3 currencies the EURO, USD and YEN are appropriate representation of the world major currencies because the EU, US and Japan are world's three leading economic blocs across the three major markets of the world i.e. Europe, North America and Asia (Erdemlioglu, Laurent, & Neely, 2012).

This study used secondary data sourced from the Central Bank of Kenya and Kenya National Bureau of Statistics websites. Monthly time series data from January 2006 to December 2015 was employed for this study. The data collected included exchange rates of KES against the G3 currencies, interest rates, inflation rates, external public debt and money supply.

Regression analysis, Correlation analysis and Trend analysis was performed during the evaluation using the Microsoft Excel Spreadsheet tool and the Statistical Package for Social Sciences (SPSS). Linear Regression Model was the empirical model used to analyze the contribution and strength of effect of each of the determinants on exchange rate volatility by regressing exchange rate volatility against changes in the determinants. Evaluation of the relationship between exchange rate volatility and the determinant factors was done through correlation analysis and then the regression will be done using Ordinary Least Square (OLS).

The OLS regression equation is as shown below:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

4.0 Research Findings and Discussion

4.1 Descriptive statistics

The table 4.1 shows the descriptive statistics of the monthly exchange rate of the Kenyan Shilling against the European Euro, US Dollar and the Japanese Yen respectively for the period between January, 2006 to December, 2015.

From the descriptive statistics table 4.1 below which shows the characteristics of the full sample data set, the Exchange rate of the Kenyan Shilling against the Euro is found to have a minimum of €85.84 and a maximum of €138.74 for the 120 months between January, 2006 to December, 2015. The average exchange rate of the Kenyan Shilling against the Euro was found to be €106.88. The exchange rate value of the Kenyan Shilling against the US Dollar on the other hand registered a minimum value of \$61.90 and a maximum of \$105.28 during the same period while its mean was \$81.08. On the other hand, the Kenyan shilling versus the Japanese Yen exchange rate minimum value is ¥54.27 and has a maximum of ¥131.97 during the same period. The mean exchange rate was found to be ¥83.03.

All the three exchange rates were found to be positively skewed. The exchange rate between the KES against the JPY (100) being mostly positively skewed with a value of 0.274 while that of the KES against the EUR being the least positively skewed with a value of 0.148.

Table 4.1: Descriptive Statistics of the exchange rates

		EUR	USD	JPY(100)	Valid N (listwise)
N	Statistic	120	120	120	120
Minimum	Statistic	85.84	61.90	54.27	
Maximum	Statistic	138.74	105.28	131.97	
Mean	Statistic	106.8775	81.0758	83.0258	
Std. Deviation	Statistic	10.79164	9.90278	17.57809	
Variance	Statistic	116.460	98.065	308.989	
Skewness	Statistic	.148	.194	.274	
	Std. Error	.221	.221	.221	
Kurtosis	Statistic	-.007	-.359	-.383	
	Std. Error	.438	.438	.438	

The table 4.2 below shows the descriptive statistics of the monthly currency volatilities of the Kenyan Shilling against the European Euro, US Dollar and the Japanese Yen respectively for the period between January, 2006 to December, 2015.

The mean monthly volatility of the currencies were as follows; the European Euro 9.176, the US Dollar 8.780, and the Japanese Yen 13.743. The minimum monthly deviation from the sample mean were 2.172 for the European Euro, 0.615 for the US Dollar and 1.650 for the Japanese Yen. Maximum mean deviation from the sample mean was 29.440 for the European Euro, 23.982 for

the US Dollar and 46.552 for the Japanese Yen. All the currencies volatility exhibited positive skewness with that of the European Euro being the highest with 0.89 and that of the Japanese Yen having the lowest positive skewness of 0.45. This means the probability distribution of the volatilities was asymmetrical towards the right. All the currencies volatility were not heavy tailed since they did not exhibit positive kurtosis of more normal distribution kurtosis.

Table 4.2: Descriptive Statistics of the currencies volatility

	Euro Volatility	US dollar Volatility	Japanese Yen Volatility
Grand mean	9.176	8.780	13.743
Minimum	2.172	0.615	1.650
Maximum	29.440	23.982	46.552
N	120	120	120
Kurtosis	-0.19	-1.00	-0.72
Skewness	0.89	0.48	0.45

The table 4.3 below shows the descriptive statistics of the monthly independent variables for the period between January, 2006 to December, 2015.

The mean interest rate for this period was 9.3833 with minimum rate being 5.75 and maximum rate being 18.00. Standard deviation was 2.896. The mean inflation rate was 8.3062 having a minimum rate of 1.85 and maximum rate of 19.72 while the standard deviation was 4.811. Mean external debt was 713,726.221 million KES with the highest external debt being 1,615,184.2 million KES and a minimum external debt of 396,563.999 million KES. The mean money supply in the country for the ten-year period was 1,385,655.23 million KES with a minimum money supply of 560,504 million KES and a maximum of 2,650,182 million KES.

Table 4.3: Descriptive Statistics of the independent variables

	N	Minimum	Maximum	Mean	Std. Deviation
Interest Rate	120	5.75	18.00	9.3833	2.89612
Inflation	120	1.85	19.72	8.3062	4.81070
External Debt	120	396563.9985	1615184.2000	713726.221128	313521.0644672
Money Supply	120	560504	2650182	1385655.23	616350.716

4.3 Trend analysis

The graph shown below in figure 4.1 depicts the trend of the Kenyan Shilling exchange rate against the European Euro, the US Dollar and the Japanese Yen for the 120-month period between January, 2006 up to December 2015.

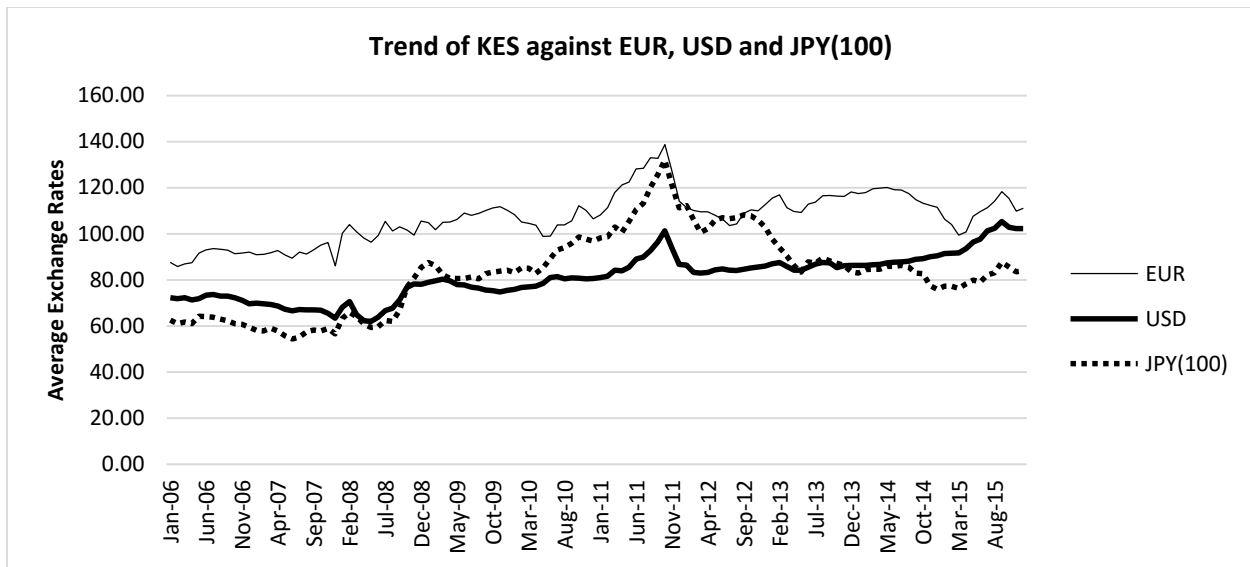


Figure 4.1: Trend of the KES exchange rate (graph of time series chart)

Results of the trend analysis for the exchange rates of the big three major currencies showed that while there were fluctuations for all the three exchange rates, an overall pattern in the long run was observable for the exchange rates. All the big three currencies' exchange rate have an increasing trend between January, 2006 up to October, 2011 where the exchange rate prices were at the peak. A decreasing trend is then observable for the three afterwards with the KES/JPY decreasing the most for the period after October, 2011 to March, 2015 after which the exchange rates for the three currencies started to rise again.

From the graph, it can be observed that in the years 2008 and 2011, there was high fluctuations of the Kenyan shilling versus the Euro, US Dollar and Japanese Yen exchange rates. The 2008 fluctuations can be attributed to the global financial crisis which began in 2007 and peaked in 2008 as a result of the bursting of the United States housing bubble. The exchange rate fluctuations experienced in the year 2011 can be explained by the August 2011 stock markets fall as a result of the price drop of stock prices in the stock exchanges across the major world markets in North America i.e. the USA, Europe, and Asia.

4.4 Correlation analysis of the variables

The KES/EUR exchange rate

There is statistical significant association between the Euro volatility and both the external debt and money supply. Money supply and external debt have a negative linear relation with volatility with money supply being more negatively correlated with a value of -0.442 as compared to that of the external debt which has a value of -0.363. On the contrary, both the interest rates and inflation are not significantly correlated with Euro volatility. This is shown in Table 4.4 below.

Table 4.4: Correlations of the KES/EUR volatility and the independent variables

		EUR volatility	Interest rate	Inflation	External debt	Money supply
EUR volatility	Pearson	1	-.002	.141	-.363**	-.442**
	Correlation					
	Sig. (2-tailed)		.982	.124	.000	.000
	N	120	120	120	120	120
Interest rate	Pearson	-.002	1	.267**	.139	.147
	Correlation					
	Sig. (2-tailed)	.982		.003	.129	.109
	N	120	120	120	120	120
Inflation	Pearson	.141	.267**	1	-.133	-.119
	Correlation					
	Sig. (2-tailed)	.124	.003		.148	.195
	N	120	120	120	120	120
External debt	Pearson	-.363**	.139	-.133	1	.966**
	Correlation					
	Sig. (2-tailed)	.000	.129	.148		.000
	N	120	120	120	120	120
Money supply	Pearson	-.442**	.147	-.119	.966**	1
	Correlation					
	Sig. (2-tailed)	.000	.109	.195	.000	
	N	120	120	120	120	120

** . Correlation is significant at the 0.01 level (2-tailed).

The KES/USD exchange rate

There is a significant relationship between the US Dollar volatility and both the external debt and money supply. External debt and money supply have a negative correlation of -0.396 and -0.554 respectively with the US Dollar volatility. However, interest rates and inflation are not significantly correlated with the US Dollar volatility. This is shown in Table 4.5 below.

Table 4.5: Correlations of the KES/USD volatility and the independent variables

		USD volatility	Interest rate	Inflation	External debt	Money supply
USD volatility	Pearson	1	-.029	.135	-.396**	-.554**
	Correlation					
	Sig. (2-tailed)		.756	.140	.000	.000
	N	120	120	120	120	120
Interest rate	Pearson	-.029	1	.267**	.139	.147
	Correlation					
	Sig. (2-tailed)	.756		.003	.129	.109
	N	120	120	120	120	120
Inflation	Pearson	.135	.267**	1	-.133	-.119
	Correlation					
	Sig. (2-tailed)	.140	.003		.148	.195

	N	120	120	120	120	120
External debt	Pearson	-.396**	.139	-.133	1	.966**
	Correlation					
	Sig. (2-tailed)	.000	.129	.148		.000
	N	120	120	120	120	120
Money supply	Pearson	-.554**	.147	-.119	.966**	1
	Correlation					
	Sig. (2-tailed)	.000	.109	.195	.000	
	N	120	120	120	120	120

** . Correlation is significant at the 0.01 level (2-tailed).

The KES/JPY (100) exchange rate

There is a statistical significant correlation between the Yen currency volatility and all the independent variables. Interest rates and inflation have a positive correlation with the volatility of the Japanese Yen. The interest rates have a stronger linear relation (0.383) than the inflation (0.323) with the Yen volatility. On the other hand, external debt and money supply have a negative correlation with the volatility the Yen. This is shown below in Table 4.6.

Table 4.6: Correlations of the KES/JPY (100) volatility and the independent variables

		JPY(100) volatility	Interest rate	Inflation	External debt	Money supply
JPY(100) volatility	Pearson	1	.383**	.323**	-.454**	-.478**
	Correlation					
	Sig. (2-tailed)		.000	.000	.000	.000
	N	120	120	120	120	120
Interest rate	Pearson	.383**	1	.267**	.139	.147
	Correlation					
	Sig. (2-tailed)	.000		.003	.129	.109
	N	120	120	120	120	120
Inflation	Pearson	.323**	.267**	1	-.133	-.119
	Correlation					
	Sig. (2-tailed)	.000	.003		.148	.195
	N	120	120	120	120	120
External debt	Pearson	-.454**	.139	-.133	1	.966**
	Correlation					
	Sig. (2-tailed)	.000	.129	.148		.000
	N	120	120	120	120	120
Money supply	Pearson	-.478**	.147	-.119	.966**	1
	Correlation					
	Sig. (2-tailed)	.000	.109	.195	.000	
	N	120	120	120	120	120

** . Correlation is significant at the 0.01 level (2-tailed).

Model 1: Regression Analysis model for the KES/EUR exchange rate

The general form of the equation to predict ERV_{EUR} from interest rates, inflation, external debt and money supply is:

$$ERV_{EUR} = 13.016 + 0.089R + 0.132I + 2.083 \cdot 10^{-5}EPD - 1.490 \cdot 10^{-5}M3$$

The constant variable (13.016) which is also known as the Y intercept represents the predicted value of the exchange rate volatility of the Euro when all the other variables are zero. The coefficient for interest rate (R) is 0.089 meaning that for every unit increase in interest rate, the Euro volatility increases by 0.089, holding all other variables constant. For every unit increase in inflation, we expect a 0.132 increase in the KES/EUR volatility, holding all other variables constant. The coefficient for external public debt is $2.083 \cdot 10^{-5}$, therefore for every unit increase in external debt, we expect an approximately $2.083 \cdot 10^{-5}$ point increase in the KES/EUR volatility, holding all other variables constant. Last but not least, for every unit increase in money supply, we expect a $1.490 \cdot 10^{-5}$ decrease in the KES/EUR volatility, holding all other variables constant.

Looking at the p-value of the t-test for each regressor variable, external debt and money supply make a significant unique prediction of the Euro volatility since the level of significance for both the external debt and money supply is less than 0.05. Interest rate and inflation did not contribute to the multiple regression model because their level of significance is greater than 0.05. This is probably due to overlap with other predictor variables in the model.

Therefore, by evaluating the two significant variables using the standardized beta coefficients which are used in comparing the strength of the effect of each regressor variable on the outcome variable, money supply has more impact on the Euro volatility with a beta value of -1.395. This means that money supply makes the strongest unique contribution to explaining the Euro volatility, when the variance explained by all other variables in the model is controlled for. The beta value for external debt is slightly lower having 0.992 showing it made a lower contribution. The summary for the coefficients of the regression analysis is shown in Table 4.7 below.

These findings conform to studies by (Canales-Kriljenko & Habermeier, 2004) who found out that nominal factors play a major role explaining up to 70 percent of the variance of NEER volatility and that of (Grydaki & Fountas, 2010) who also found out that nominal variability i.e. variability in money supply (measured by M3) explains volatility of exchange rates by a large scale. The findings though contrast that of (Twarowska & Kąkol, 2014) who establish that inflation rate is one of the most important determinant factors affecting the EUR/PLN exchange rate level. While the market interest rate came in as the third most important factor determining the level of Zloty exchange rate.

Table 4.7: Coefficients^a of the Regression Analysis model for KES/EUR exchange rate

Model	Unstandardized		Standardized	T	Sig.	95.0% Confidence	
	Coefficients					Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
1 (Constant)	13.016	2.126		6.121	.000	8.804	17.228
Interest rate	.089	.191	.039	.468	.641	-.290	.469

Inflation	.132	.115	.096	1.147	.254	-.096	.360
External debt	2.083E-005	.000	.992	3.202	.002	.000	.000
Money supply	-1.490E-005	.000	-1.395	-4.506	.000	.000	.000

a. Dependent Variable: EUR volatility

Goodness of fit of the model

The coefficient of determination is 0.270 which means there is a weak association between the Euro currency volatility and the independent variables. This means 27% of the variability of the Euro volatility is predictable from the independent variables. This is shown in Table 4.8 below.

Table 4.8: Model Summary of the Regression Analysis model for KES/EUR exchange rate

Model	R	Adjusted R Square	Std. Error of the Estimate	Change in R Square	F Change	df1	df2	Sig.	F
1	.520 ^a	.270	.245	5.7226302776944	10.629	4	115	.000	

a. Predictors: (Constant), Money supply, Inflation, Interest rate, External debt

Analysis of variance (ANOVA)

The p value is less than 0.05 level of significance thus we reject the null hypothesis i.e. the means of the independent variables are the same. Therefore, the independent variables are effective in determining Euro volatility. The multiple regression model thus statistically significantly predicts the volatility for the KES/EUR exchange rate. It is as shown in Table 4.9.

Table 4.9: ANOVA^a of the Regression Analysis model for KES/EUR exchange rate

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	1392.333	4	348.083	10.629	.000 ^b
	Residual	3766.077	115	32.748		
	Total	5158.410	119			

a. Dependent Variable: EUR volatility

b. Predictors: (Constant), Money supply, Inflation, Interest rate, External debt

Model 2: Regression Analysis model for the KES/USD exchange rate

The general form of the equation to predict ERV_{USD} from interest rates, inflation, external debt and money supply is:

$$ERV_{USD} = 13.687 + 0.072R + 0.139I + 4.508 \times 10^{-5}EPD - 2.808 \times 10^{-5}M3$$

The constant variable (13.687) shows the predicted value of the US dollar volatility when all the other variables are zero. The coefficient for interest rate is 0.072 meaning that for every unit increase in interest rate, the US dollar volatility increases by 0.072, holding all other variables

constant. For every unit increase in inflation, we expect a 0.139 increase in the KES/USD volatility, holding all other variables constant. The coefficient for external public debt is 4.508×10^{-5} therefore for every unit increase in external debt, we expect an approximately 4.508×10^{-5} point increase in the KES/USD volatility, holding other variables constant. Lastly, for every unit increase in money supply, we expect a 2.808×10^{-5} decrease in the KES/USD volatility, holding all other variables constant.

Looking at the p-value of the t-test for each predictor, since the level of significance for the external debt and money supply is less than 0.05, then the two predictor variables make a significant unique prediction of the US Dollar volatility. Interest rate and inflation did not contribute to the multiple regression model because their level of significance is greater than 0.05. This is probably due to overlap with the other independent variables in the model.

Therefore, by evaluating the two significant variables using the standardized beta coefficients which are used in showing the relative size of the influence of each regressor variable on the outcome variable, money supply has more impact on the US Dollar volatility with a beta value of -2.588. This means that the money supply makes the strongest unique contribution to explaining the volatility of the US Dollar when the variance explained by all other variables in the model is controlled for. The beta value for external debt is slightly lower having 2.113 showing it made a lower contribution. The summary of these is as shown in table 4.10 below.

The findings conform to the studies by (Canales-Kriljenko & Habermeier, 2004) and (Grydaki & Fountas, 2010) who found out that nominal factors and nominal variability i.e. variability in extended broad money play a major role and do explain volatility of exchange rates. The findings though contrast that of (Twarowska & Kałol, 2014) who establish that inflation rate as one of the most important determinant factors affecting the EUR/PLN exchange rate level. Market interest rate came in as the third most important factor determining the level of Zloty exchange rate.

Table 4.10: Coefficients^a of the Regression Analysis model for KES/USD exchange rate

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B	
	B	Std. Error				Lower Bound	Upper Bound
(Constant)	13.687	1.583		8.645	.000	10.551	16.824
Interest rate	.072	.142	.031	.508	.613	-.210	.355
Inflation	.139	.086	.100	1.624	.107	-.031	.309
1 External debt	4.508E-005	.000	2.113	9.304	.000	.000	.000
Money supply	-2.808E-005	.000	-2.588	-11.407	.000	.000	.000

a. Dependent Variable: USD volatility

Goodness of fit of the model

The coefficient of determination is 0.608 which means there is a strong association between the US Dollar volatility and the independent variables. This means 60.8% of the total variation in the USD volatility can be explained by the independent variables. Thus meaning the fit of the model is fairly good. The Table 4.11 below shows the coefficient of determination for the model.

Table 4.11: Model Summary of the Regression Analysis model for KES/USD exchange rate

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change in R Square	F Change	df1	df2	Sig. Change	F
1	.780 ^a	.608	.594	4.2611469523776	.608	44.564	4	115	.000	

a. Predictors: (Constant), Money supply, Inflation, Interest rate, External debt

Analysis of variance (ANOVA)

The p value is less than 0.05 level of significance thus we reject the null hypothesis i.e. the means of the independent variables are the same. The multiple regression model statistically significantly predicts the volatility for the KES/USD exchange rate. Therefore we conclude that the independent variables are effective in determining US Dollar volatility. Table 4.12 below shows the ANOVA results for the model.

Table 4.12: ANOVA^a of the Regression Analysis model for KES/USD exchange rate

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	3236.659	4	809.165	44.564	.000 ^b
1 Residual	2088.098	115	18.157		
Total	5324.757	119			

a. Dependent Variable: USD volatility
b. Predictors: (Constant), Money supply, Inflation, Interest rate, External debt

Model 3: Regression Analysis model for the KES/JPY (100) exchange rate

The general form of the equation to predict $ERV_{JPY(100)}$ from interest rates, inflation, external debt and money supply is:

$$ERV_{JPY(100)} = 8.738 + 1.550R + 0.336I + 6.106 \times 10^{-6}EPD - 1.205 \times 10^{-5}M3$$

The Y intercept (8.738) represents the predicted value of the exchange rate volatility of the Japanese Yen when all the other variables are zero. The coefficient for interest rate (R) is 1.550 meaning that for every unit increase in interest rate, the Yen volatility increases by 1.550, holding all other variables constant. For every unit increase in inflation, we expect a 0.336 increase in the KES/JPY (100) volatility, holding all other variables constant. The coefficient for external public debt is 6.106×10^{-6} therefore for every unit increase in external debt, we expect an approximately

6.106*10⁻⁶ point increase in the KES/JPY (100) volatility, holding all other variables constant. Lastly, for every unit increase in money supply, we expect a 1.205*10⁻⁵ decrease in the KES/JPY (100) volatility, holding all other variables constant.

Looking at the p-value of the t-test for each predictor, we can see that interest rate, inflation and money supply all make a significant unique prediction to the Yen volatility since their level of significance is less than 0.05. External debt did not contribute to the multiple regression model because its level of significance is greater than 0.05.

Therefore, by evaluating the three significant variables using the standardized beta coefficients which are used in comparing the strength of the effect of each regressor variable on the outcome variable, money supply has more impact on the Yen volatility with a beta value of -0.695. This means that money supply makes the strongest unique contribution to explaining the Yen volatility, when the variance explained by all other variables in the model is controlled for. The beta value for interest rate is lower having 0.420 showing it has a lower contribution to the KES/JPY (100) volatility while inflation has the lowest influence having a standardized beta value of 0.151. The summary of the regression analysis model is shown in Table 4.13 below.

The findings conform to a study by (Canales-Kriljenko & Habermeier, 2004) who found out that nominal factors play a major role explaining up to 70 percent of the variance of NEER volatility and that money market interest rates showed a strong relationship with NEER volatility. They analyzed detailed survey data based on a wide cross section of 85 developing and transition economies in 2001 using cross-section analysis of the regressions. The study also established that NEER volatility is higher in countries with higher inflation. (Grydaki & Fountas, 2010) also found out that variability in money supply and inflation do explain volatility of exchange rates.

In their study, (Twarowska & Kąkol, 2014) established that inflation rate was one of the most important determinant factors affecting the EUR/PLN exchange rate level. An increase in inflation rate had a negative effect and reduced the value of Polish currency. The market interest rate came in as the third most important factor determining the level of Zloty exchange rate volatility.

In Zambia, the research done by (Chipili, 2012) who modeled the exchange rate volatility in the country using GARCH also supports the findings and found that monetary factors are important for short-run exchange rate volatility with money supply and interest rates having a higher contribution to the Kwacha/Zim\$ exchange rate volatility than the other variables. Money supply had the largest positive effect on conditional volatility in terms of magnitude.

Table 4.13: Coefficients^a of Regression Analysis model for KES/JPY (100) exchange rate

Model	Unstandardized Coefficients B	Standardized Coefficients Beta	T	Sig.	95.0% Confidence Interval for B		
					Lower Bound	Upper Bound	
(Constant)	8.738	2.964	2.948	.004	2.866	14.609	
1 Interest rate	1.550	.267	.420	5.811	.000	1.022	2.079
Inflation	.336	.160	.151	2.097	.038	.019	.654

External debt	6.106E-006	.000	.179	.673	.502	.000	.000
Money supply	-1.205E-005	.000	-.695	-2.614	.010	.000	.000

a. Dependent Variable: JPY(100) volatility

Goodness of fit of the model

The coefficient of determination is 0.461, which means there is a weak association between the Japanese Yen volatility and the independent variables. Thus meaning 46.1% of the variability of the Yen volatility is predictable from the independent variables. Table 4.14 below shows the coefficient of determination for the model.

Table 4.14: Model Summary of Regression Analysis model for KES/JPY (100) exchange rate

Model	R	R Square	Adjusted R Square	R Std. Error of Estimate	Change in R Square	F Change	df1	df2	Sig.	F
1	.679 ^a	.461	.442	7.9779217817887	.461	24.583	4	115	.000	

a. Predictors: (Constant), Money supply, Inflation, Interest rate, External debt

Analysis of variance (ANOVA)

The p value is less than 0.05 level of significance thus we reject the null hypothesis i.e. the means of the independent variables are the same. The multiple regression model statistically significantly predicts the volatility for the KES/JPY (100) exchange rate. Therefore we conclude that the independent variables are effective in determining the volatility of Japanese Yen. The ANOVA results are shown in Table 4.15 below.

Table 4.15: ANOVA^a of the Regression Analysis model for KES/JPY (100) exchange rate

Model	Sum of Squares	Df	Mean Square	F	Sig.
1 Regression	6258.481	4	1564.620	24.583	.000 ^b
1 Residual	7319.432	115	63.647		
Total	13577.913	119			

a. Dependent Variable: JPY(100) volatility

b. Predictors: (Constant), Money supply, Inflation, Interest rate, External debt

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The objective of this study was to analyze the factors determining exchange rate volatility of the Kenyan shillings against world major currencies with a focus on the big three currencies i.e. the European Euro, the US Dollar and the Japanese Yen. The currency volatilities were the outcome

variables while interest rate, inflation, external public debt and money supply were the predictor variables. The study sought to establish the effect of each of these independent variables to the exchange rate volatility by determining and comparing the strength of their effects. This was done through an evaluation of the standardized beta coefficients after performing a linear regression analysis using the SPSS statistical software.

The volatility of the currencies were found to vary on the basis of period and currency based on the trend analysis. Results of the regression analysis for the exchange rates volatility for the period between January 2006 to December 2015 of the big three major currencies indicated that although not all the independent variables were statistically significant in determining each of the currency volatilities, overall, all of them contributed for all the three exchange rates volatility.

External public debt and money supply were both found to have an effect on the volatilities of the KES/EUR and KES/USD exchange rates while interest rates and inflation were found not to be statistically significant to the volatilities of the two currency rates. This may be due to an overlap with the other independent variables in the regression model. Money supply was found to have the most impact on the volatility of the two exchange rates in the ten-year research period while external public debt was found to have contributed lower on the currency volatility during the same period. Money supply had a negative effect on the KES/EUR volatility with a standardized beta value of -1.395 while external public debt had a positive effect with a beta value of 0.992. Money supply also had a negative effect on the KES/USD volatility with a standardized beta value of -2.588 while external public debt had a positive effect with a beta value of 2.113.

In the case of the KES/JPY (100) exchange rate volatility, three of the four independent variables were found to be statistically significant within the ten years of the scope of the study. Interest rates, inflation and money supply were found to have an effect to the Yen volatility while external public debt was found not to be statistically significant. Money supply was found to have the highest unique influence on the KES/JPY (100) exchange rate volatility followed by interest rates which was the second while inflation contributed the least to the Yen currency volatility. Interest rates was found to have a positive effect on the KES/JPY (100) volatility with a standardized beta value of 0.420. Inflation also had a positive effect to the KES/JPY (100) volatility with a standardized beta value of 0.151 while money supply exhibited a negative effect with a beta value of -0.695.

The study further found that for all the three exchange rate volatilities, money supply has a negative influence on them. For the both the KES/EUR and KES/USD exchange rate volatility, external debt has a positive effect. Interest rate and inflation also have a positive effect on the KES/JPY (100) exchange rate volatility. These findings conform to the findings of a study by (Benita & Lauterbach, 2007) which indicated that there are positive correlations between exchange rate volatility and interest rates. They found countries with relatively high exchange rate volatility maintaining higher real interest rates.

5.2 Conclusions

The research study analyzed the determinant factors affecting exchange rate volatility and the strength of effect each factor contributes to the volatility with a focus on the big three currencies i.e. the Euro, US dollar and the Yen from January 2006 to December 2015. The independent variables of interest were interest rate, inflation, external debt and money supply whose data were sourced from the CBK.

The study concluded that money supply contributes majorly on the volatilities of the three exchange rates and that an increase in the money supply by the central banks to the economy results to a reduction of the exchange rate volatility. This conforms to a study by (Chipili, 2012) in Zambia which showed that a steady money supply growth rate is recommended to reduce the volatility. A reduction on the monetary supply on the other hand results to an increase in currency volatilities. This was observed in all the three exchange rate volatilities. External debt had the second most influence and it positively impacted the KES/EUR and KES/USD exchange rate volatilities. Thus meaning an increase in external debts increases the volatilities of the two currencies while a decrease in external borrowing decreases their volatilities. Interest rates had the second most positive contribution to the KES/JPY (100) exchange rate volatility and its increase would increase the volatility while a reduction of the interest rates would result in a decline of the Yen Volatility. Inflation had the lowest positive influence on the Yen volatility meaning an increase in inflation would lead to an increase in volatility while a reduction in inflation in the country would lead to a fall in the Yen volatility.

Through the manipulation of the central bank rates and money supply, central banks exert influence over both inflation and subsequently the exchange rates and hence the volatilities. From the study, we can also come to a conclusion that increasing the monetary supply in the country can be effective and efficient in restraining currency volatility. On the other hand, a decrease in external public debt, central bank rates and inflation would likewise have the same desired effect in restraining exchange rate volatility.

5.3 Recommendations

Based on the study, there are various recommendations that will be beneficial to the government and all the stakeholders involved. These include:-

First, the government should come up and implement appropriate policy measures that will ensure the exchange rate is stabilized. This involves setting up appropriate policy instruments including a monetary policy framework that would make monetary policy more efficient and effective.

Secondly, since money supply has the highest effect on the volatility of exchange rates in terms of magnitude, this shows the significant role of monetary policy in exchange rate management. Stabilizing the monetary supply in the economy by the central bank should be the top priority in order to reduce the extent of exchange rate exposure to excess volatility.

Based on the findings, the study recommends that it is important that the government addresses the issue of external borrowing. The government should ensure that all public borrowing should be invested appropriately and in economic activities which can generate returns which will be used to subsequently refund the loans. The government should also seek to reduce external debt and seek alternative ways to raise its finances.

The study also recommends that the government should seek to minimize the variability on some of the variables such as interest rates which will ultimately reduce fluctuations on the exchange rates and their volatilities. A lower central bank rate should be adopted in order to reduce the volatility of currency rates and hence improve the stability of exchange rates. Inflation should also be controlled by use of sound and effective monetary policies.

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