EFFECTIVENESS OF MONETARY POLICY INTERVENTION ON EXCHANGE RATE VOLATILITY IN KENYA

Ndagara, M.M., Mugendi L.K., and Galo, N.M.
Department of Social Sciences, Chuka University, P. O. Box 109-60400, Chuka
Department of Management Science, Chuka University, P. O. Box 109-60400, Chuka, Kenya
Email: ndagaramaureen@gmail.com, lmaugu@chuka.ac.ke, maugukana@yahoo.com, galon@chuka.ac.ke

ABSTRACT
Despite the monetary policy intervention in foreign exchange markets by Central bank of Kenya to stabilize the exchange rate and to reverse the growth in the country's trade deficit through increased competition, Kenya has been facing wide fluctuations in US dollar to Kenya shilling exchange rates since the adoption of a floating exchange rate system in 1993 resulting to increased exchange rate risk. Other than the high volatility of exchange rate, there has been a continuous depreciation of Kenya shilling to US dollar. Depreciation of home currency decreases return on investment when investing internationally. This study aimed at evaluating the effectiveness of monetary policy on exchange rate volatility in Kenya using GARCH (1, 1) model. The specific objectives of the study were; to determine the effectiveness of net foreign exchange intervention, 91-day Treasury bill rate, Central bank rate and inflation on exchange rate volatility in Kenya. A descriptive longitudinal time series research design was used. Monetary policy intervention was found to be effective in reducing exchange rate volatility by use of foreign exchange intervention and Treasury bill rate. A unit decrease in 91-day Treasury bill rate decreases the exchange rate volatility by 2.5790 units while a unit increase in foreign exchange intervention decreases the volatility by 0.3042 units. Central bank rate has no effect on volatility. The finding of this study is of great significance to monetary policy makers and society at large. Since non-sterilized intervention was found to result into monetary policy dilemma, policy makers should strive for a policy mix that will ensure stable exchange rates by stemming out any excessive volatility in the exchange rate to avoid further depreciation and fluctuation on exchange rate. A combination of a stable exchange rate environment and a competitive currency will attract investment, increase aggregate output and expand country's economic prosperities.
Keywords: Foreign Exchange Rate, Foreign Exchange Intervention, Central Bank Rate, 91day Treasury Bill rate.

INTRODUCTION

Background of the Study

Exchange rate is an important indicator of economic growth of a country and its volatility has significant impact on international trade. Unpredictable changes in exchange rate may reduce international trade by increasing the risks of importing and exporting. Equally, by increasing the risk of investing in foreign assets, exchange rate volatility may retard the flow of capital between the countries. Central Bank's principal object is formulation and implementation of monetary policy directed to achieving and maintaining stability in the general level of prices, that is, low inflation and to sustain the value of the Kenya shilling (CBK, 2015). Monetary policy is defined as any conscious action undertaken by the monetary authorities to change the quantity, availability or cost of money (Shaw, 1973).

Monetary policy implementation focuses on instruments, operating targets, and goals. The instruments are manipulated to achieve preferred values of an operating target. Instruments are the variables directly controlled by the Central Bank. Intermediate target variables fall between operating targets and goals in the sequence of links that run from policy instruments to real economic activity and inflation (Walsh, 2010). According to CBK (2015), the main target variables for monetary policy are inflation and output. After the breakdown of the Bretton Woods system of fixed exchange rates in 1973, the Articles of the International Monetary Fund (IMF) were amended to provide that members would collaborate with the Fund and other members to assure orderly exchange arrangements and to promote a stable system of exchange rates (Neely, 2005). Monetary policy through Central Bank directs intervention to counter disorderly market conditions, which has been interpreted differently at different times. Often, excessive exchange rate volatility or deviations from long-run equilibrium exchange rates have incited intervention (Calvo and Reinhart, 2002; Kathryn, 1993).

The liberalization of capital flows in the last two decades and the enormous increase in the scale of cross-border financial transactions which was developed by General Agreement on Tariffs and Trade (GATT), have increased exchange rate movements (Clark *et al*., 2004). Currency crises in emerging developing countries and market economies are special examples of high exchange rate volatility for instance

the Zimbabwe's 2008 hyperinflation (Ellyne and Daly, 2013). In addition, the transition to a market-based system in Central and Eastern Europe often involves major adjustments in the international value of these economies' currencies. According to Kinyua (2001), Central Bank of Kenya pursued a somewhat passive monetary policy since it was created in 1966 to 1970. One of the reason being that the bank had not then acquired sufficient experience in the management of monetary policy and the Kenyan economy had no severe macroeconomic problems to resist during this period. During 1970-1980 Kenya faced major difficulties in the form of 1973 oil crisis and the coffee boom of 1977/78 that threatened her ability to sustain the commendable 6-8 percent annual economic growth rate as it used to enjoy in the 1960's. The country had to confront emerging and severe constraints on the balance of payments. This was due to the collapse of the Bretton woods system of fixed exchange rates in 1971-1975, thus the balance of payments and domestic prices came under increasing pressure.

In mid- 1992 there was liberalization of the economy where interest rate controls were removed and exchange rate made flexible, ushering in a new era in monetary policy where open market operations (OMO) was the main tool and minimal reliance on reserve requirement(Gichuki, Oduor and Kosimbei, 2012; Moki, 2014). After liberalization, there was almost no intervention by CBK in the foreign exchange market. As result, Kenya was categorized among developed countries as a free floater (Corazon, 2014). The control of inflation became a major focus of monetary policy to reign in consequences of relaxation of monetary policy that followed the run up to Kenya's first multiparty election and increase in international oil prices occasioned by the first Gulf war.

A new institutional framework for conducting monetary policy was formalized with the amendment of the CBK Act in 1996 which targeted more on monetary base. The principal objective of the CBK was stipulated as formulation and implementation of monetary policy directed to achieving and maintaining stability in the general level of prices (Rotich, Kathanje and Maana, 2008). The behavior of monetary policy focused on conduct of the broad monetary aggregate, M2, defined as currency in circulation and term and non-term domestic currency deposits with banks. In 1998, the Bank had shifted to a much broader monetary aggregate, M3, defined as M2 plus foreign currency deposits held by residents, as its intermediate target.

The stated exchange rate policy of the CBK has been and continues to pursue a market determined exchange rate, only intervening in smoothening out erratic movement, servicing external obligations and achieving targeted level of foreign exchange reserves. Nevertheless, there have been instances where strong lobbying from non-traditional exporters for a depreciated exchange rate put pressure on the CBK to influence the market exchange rate in the short run. There were also occurrences where depreciation pressures coming from speculative tendencies occasioned by fragile donor relations and large food importation to mitigate adverse effects of drought could have led CBK to intervene in the foreign exchange market to reduce pressures on domestic inflation (Rotich *et al.,* 2008). Annual changes in monetary aggregates, since early 1990s, decelerated to low levels and were sustained through 2000 before picking up slightly in the run up to the 2002 elections which has kept increasing up to 2015.

According to Ndungu (2000), exchange rate policy in Kenya moved slowly between two major regimes namely; fixed exchange rate from 1974 to 1992 and from 1993 Kenya has fully adopted flexible exchange rate with a continuous depreciation of Kenya shilling to US dollar. Since the adoption of a floating exchange rate system in 1993, no available evidence has been achieved in realizing the objective for which the foreign exchange market was liberalized. Large volatilities in exchange rates have since characterized Kenya financial market (Kiptoo, 2007). From 1993 until 2015, the US dollar to Kenya shilling averaged 74.56 reaching an all-time high of 106.80 in October 2011 followed by 106.7 in September 2015 and a low of 35.9 in January of 1993 (World Bank data, 2015).

The depreciation of 2011 was attributed to the debt crisis in the euro zone, pressures from Kenya's balance of payment and due to arbitrage in the local money market (Corazon, 2014). According to republic of Kenya (2015), the depreciation of 2015 was attributed to various factors which include; US strengthening the dollar, high demand for dollar for financing development projects where payment is made in dollars which makes its price to increase, increased external borrowing by the government, distortion of the current account due to insecurity in the country and increased government expenditure which in turn increases GNP resulting to inflation and BOP deficits.

Kenya works under the policies of floating exchange rate but its foreign exchange market is inefficient (Muhoro, 2003 and Kimani, 2013). Its economy face increasing openness and globalization day by day and market forces of demand and supply are unable to adjust into a stable exchange rate thus making the exchange rate of her currency volatile. This provokes the Central Bank of Kenya to intervene in the foreign

exchange market through a monetary policy. The main question of interest is whether monetary intervention achieves its objectives of reducing volatility and sustaining the value of the Kenya shilling.

Statement of the Problem

A stable foreign exchange rate is necessary in reducing the exchange rate risk for short-term payment flows, maintaining competitiveness of domestic (export) industry and protecting balance sheets of domestic firms and enterprises against depreciation (Chmelarova and Schnabl, 2006). Like many developing countries, Kenya is vulnerable to inflationary pressures, currency instability and balance of payments crises. Therefore, one of the policy objectives of monetary policy is to stabilize the price level including the foreign exchange rate which is the price of a currency and to maintain a sound market-based financial system (Kinyua, 2001). However, regardless of CBK use of various monetary policy transmission mechanisms like net FOREX intervention, central bank rate (CBR) and open market operations to bring about exchange rate stability, Kenya has been facing wide fluctuations of US dollar to Kenya shilling exchange rates from the average long run equilibrium exchange rate since the adoption of a floating exchange rate system in 1993 (Kiptoo, 2007). Other than the high volatility, the other major problem is continuous depreciation of Kenya shilling to US dollar reaching an all-time high of 106.8 in October 2011 and 106.7 in September 2015.

If exchange rate fluctuations are not predictable, increasing exchange rate volatility could lead to risk-averse agents to cut down their international trading activities (Chit et al., 2010) due to increased risks of importing and exporting and retard the flow of capital between the countries due to increased risk of investing in foreign assets. Again, sharp movements of the nominal exchange rate in the short-term can impact inflation via the import prices pass-through effects (CBK, 2015). In addition, exchange rate volatility has frequently been associated with economic crisis and may be a signal of lack of policy credibility (Calvo and Reinhart, 2002). Most available studies in Kenya have concentrated on the effectiveness of monetary policy on inflation and economic growth which are the major targets of the monetary policy using vector auto-regression (VAR) models leaving a gap on monetary policy effect on exchange rate volatility. Exchange rate volatility influences inflation and economic growth and thus should be incorporated in the monetary policy (CBK, 2015).

This study therefore, seeks to evaluate the effectiveness of monetary policy against its policy goal of stabilizing the exchange rate using a longer time series data by applying generalised autoregressive conditional heteroscedasticity (GARCH) model which has been largely unexplored by the literature.

Objective of the Study

The general objective of the present study was to examine the effectiveness of monetary policy intervention on exchange rate volatility in Kenya.

Specific Objectives

The study was based on the following specific objectives: Determination of the effectiveness of net foreign exchange intervention on exchange rate volatility in Kenya. Establishment of the effectiveness of Central bank rate on exchange rate volatility in Kenya. Establishment of the effectiveness of 91-day Treasury bill rate on exchange rate volatility in Kenya. Determination of the moderating effect of inflation rate on effectiveness of monetary policy on exchange rate volatility in Kenya.

Research Hypotheses

The hypotheses tested were"

H_{01}: Net Foreign exchange intervention has no significant effect on exchange rate volatility in Kenya.

H_{02}: Central bank rate have no significant effect on exchange rate volatility in Kenya

H_{03}: 91-day Treasury bill rate have no significant on exchange rate volatility in Kenya.

H_{04}: Inflation rate has no significant moderating effect on exchange rate volatility in Kenya.

Significance of the Study

High fluctuation of exchange rate in Kenya is noticeably making economic activity more risky as uncertainty rises. This is not good for the economy. The study result are highly relevant in the formulation and implementation of an effective monetary policy that promotes exchange rate stability and improves the welfare of the people. Therefore, the study is of great significant to investors, government, policy makers, business people, future scholars and society at large. Investors can use the findings as a tool in portfolio allocation, risk management and as an input in derivative asset pricing in short term risk management. Government can use the study as a benchmark for comparison of past years monetary policies and review them basing on results found in the study thus enabling them formulate and implement an optimal monetary policy to reduce exchange rate volatility and inflation. Business people, like entrepreneurs, bankers, international financial institutions and markets can use the findings from this research to aid them in implementing their organizational management duties. The study is significant to policy makers since it sheds some new light on the appropriate monetary policy to

be undertaken and their impact on exchange rate. The study is also important to FOREX dealers, private sector and the public as a whole, to understand the degree of responsiveness of exchange rate to changes in different monetary policy tools. Future scholars will be able to use the findings for further research either to develop themes or for literature review.

Scope of the Study

The study used monthly data on US Dollar-Kenya shilling exchange rate, net foreign exchange intervention data by Central bank, central bank rate (CBR) and 91-day Treasury bill rates and analyse it using GARCH (1,1) model. All data ran over the period January 1997 to June 2016. The data ran from January 1997 which is the period after a new institutional framework for conducting monetary policy was formalized with the amendment of the CBK Act in 1996 to target more on monetary base with the principal objective of the monetary policy directed to achieving and maintaining stability in the general level of prices. It ended in June 2016 for convenience on the availability of updated data. The study focused on the US dollar to the Kenya shilling exchange rate since the US dollar is the currency most commonly used in settling international transactions.

LITERATURE REVIEW

Foreign Exchange Intervention and Exchange Rate Volatility

Dominguez and Frankel (1993) examine the effect of intervention by regression estimation. Their work takes the independent variable to be the differentials in expected rates of the return between domestic and foreign assets and uses ex post changes in exchange rate to measure investors' expectation. By assuming that investors choose their portfolio allocation to optimize a function of mean and variance of ending period wealth, their findings generally support the effectiveness of intervention through portfolio balance and expectation channels. Kim, Kortian and Sheen (2000) analyzed intervention by the Reserve Bank of Australia on foreign exchange markets from 1983 to 1997. They included control variables in mean and variance equations which were different measures of foreign exchange intervention, plus day of week and holiday dummies. Using exponential GARCH models, large interventions have a stabilizing influence in the foreign exchange market direction and volatility.

Moreover, Fatum and Hutchison (2002)'s and Fatum and Hutchison (2003)'s reports on the effectiveness of intervention, using daily data from Bundes Bank, the Bank of Japan, the European Central Bank, and the Federal Reserve, find official intervention to be effective when used selectively and directed toward short-term objectives. Similarly, Simatete (2004) examines the effect of central bank intervention on the Zambian kwacha and used a GARCH (1, 1) model to estimate effect of intervention on mean and variance. She found that central bank intervention in the foreign exchange market increases the mean but reduces the volatility of the Zambian kwacha. This finding supports the 'speculative bandwagon' and a 'leaning against the wind' strategy. These studies however have no harmony on which channel of intervention works although they have discussed on sterilised intervention mostly signalling and portfolio balance channels.

To add on that, Behera, Narasimhan and Murty (2005) explored the relationship between exchange rate volatility and central bank intervention in India. The study uses monthly data on Rupee-Us Dollar bilateral exchange rate and RBI intervention in Indian foreign exchange market plus other control variables which included; net foreign institutional investment inflows, interest rate and inflation differentials of India and US over the post-reform period, June 1995 through December 2005 and a dummy variable. The study used GARCH(1,1). It found that the intervention of RBI is effective in reducing volatility in the Indian foreign market. However, the result is not supporting the theoretical positive association between exchange rate return and RBI intervention. Thus the reserve bank intervention has been reducing the extent of fluctuations of exchange rate rather than changing the direction of the rupee movement against the US dollar.

Correspondingly, Simwaka and Mkandawire (2006) studied the effectiveness of foreign exchange market interventions carried out by the Reserve Bank of Malawi. They used monthly data of net sales of foreign exchange and exchange rate data over a four year period. The results confirm that net sales of dollars depreciate, rather than appreciate the Malawian currency (kwacha). The study also finds that the Reserve Bank of Malawi intervention reduces the volatility of the kwacha. This infers that the Reserve Bank of Malawi actually achieves its objective of control fluctuations of the kwacha. Kihangire (2011) support this view using data from 1993 to 2010 and analyzing it based on a structural vector auto-regression (VAR) model that Bank of Uganda's (BOU) direct intervention in the IFEM reduces exchange rate volatility. However, this method has a problem of omitted variable bias.

Also, Kembe (2013) supports that intervention reduces exchange rate volatility in Kenya. He carried out an event study although not specified, on the impact of central bank intervention on the volatility of the US Dollar, Euros, and Sterling Pounds against Kenya

Shilling over the period 2009 to 2011. Net intervention was defined as the net purchases of the US dollars by the CBK. The study used analysis of variance where CBK intervened and where CBK did not intervene and it was found to be effective. However, due to the tendency for foreign exchange rate data to be skewed in terms of distributions or volatility clusters, the use of simple descriptive statistics such as the standard deviation method has been found not effective as a measure of its volatility (Bollerslev, 2002).

However, Baillie and Osterberg (1997) using GARCH research found little evidence that the different types of foreign exchange intervention have had much effect on the conditional mean of exchange rate returns in the spot US exchange rates and some evidence that intervention is associated with slight increases in the volatility of exchange rate returns from 1985 to 1990. Chang and Taylor (1998) used high frequency data on exchange rates and interventions for their analysis and conclude that intervention has a very little effect on volatility. Aguilar and Nydahl (2000) examined impact of intervention on level and volatility of Swedish Krona (krona-dollar and krona-mark rates) from January 1993 to November 1996. They used a bivariate GARCH model and implied volatility approach from currency options. They found no significant effect for exchange rate level and only weak evidence for reduction in volatility for the whole period.

When Fatum and King (2004) used high frequency data set to test the effectiveness of intervention on exchange rate during 1995 and 1998 but control for currency co-movements of CAD/USD exchange rate against the US dollar, they found no significant. However, Fatum and King (2005) find intervention to have a systematic impact on exchange rate volatility when aggregating intervention operations at the daily level. There is evidence that intervention was associated with changes in direction and smoothing of exchange rate. However, the effects are weakened when controlling for currency co-movements, against the USD, thus suggesting that controlling for currency co-movements is important in assessing the effectiveness of intervention.

The above findings differ from the findings of Brandner *et al.* (2001) who investigated the effectiveness of intervention in the European Monetary System by using daily data of intervention activity of six European Central banks, covering period from August 1993 to April 1998. They used exponential GARCH and Markov Switching ARCH in testing for intervention. The results revealed that even in the same institutional framework, intervention does not seem to affect the means and variances in a consistent and predictable manner. Hutchison (2003) found intervention supported by Central Bank interest rate change and intervention coordination to have greater impact but does on comment on the direction of influence. Egert and Lang (2005) investigated the impact of daily official foreign exchange interventions on the exchange rates of two EU candidate countries, namely Croatia and Turkey for the periods from 1996 to 2004 and from 2001 to 2004, respectively. Using a variety of GARCH models, the results reveal that both the Croatian and the Turkish central bank's interventions influence to some extent, the level of the exchange rate during the period studied. Moreno *et al.* (2013) find that foreign exchange intervention can affect exchange rate returns and volatility, although the effects may be short-lived. Echavarría *et al.* (2013) found that, in Colombia, the exchange rate responds differently to intervention following preannounced rules. Dominguez (1998) analyzed a long time series of daily data in the context of various GARCH "generalized autoregressive conditional heteroskedasticity" specifications. She used the event study to test the relationship between exchange rate returns and intervention and macro announcements which were represented by dummies. She found that secret interventions generally increase volatility.

Moreover, Morana and Beltvatti (2000) support this argument by concluding that the intervention is not particularly effective, with the spot rate only changing in the intended direction for 50 % of the time and that usually intervention is associated with increases in volatility. Similarly, Doroodian and Caporale (2001) analysed the effectiveness and the impact of Federal Reserve intervention on US exchange rates, using daily measure of exchange rate intervention in the yen/dollar and mark/dollar exchange market for the period 1985 to 1997. By using GARCH model, they found that intervention is linked with a significant increase in the intraday conditional variance at both exchange rates.

In summary there is no harmony among empirical studies on the effect of FOREX intervention on the exchange rates. In addition, findings vary by time period, data source and even estimation method used. Thus, this study seeks to determine the effectiveness of FOREX intervention against the monetary policy goal of stabilizing the exchange rate using a time series study by applying GARCH (1,1) model in measuring volatility, a longer monthly time series data and control variables to avoid overestimation.

Central Bank Rate and Exchange Rate Volatility

Gichuki et al. (2012) wanted to determine the optimal monetary instruments between interest rates and reserve money in influencing the conduct of monetary

policy for Kenya, employing stochastic IS-LM model using a quarterly data covering the period 1994 to 2010. Variables used in the model include gross domestic product, M3, and CBK overdraft interest rate. The study established that the interest rate (CBR) is a superior policy instrument over reserve money in meeting Kenya's monetary policy objectives. In addition, Corazon (2014) wanted to establish the effect of monetary policy on economic growth and exchange rate in Kenya using VAR model covering the period 1997 to 2013. The study used credit to the private sector, Central Bank Rate, treasury bills, short-term interest rate (INBK), lending rate and nominal effective exchange rate (NEER) as measures of monetary policy shocks. The study noted that the interest rate channel followed by the credit channel to be the most effective channels in influencing economic growth.

Obondi (2013) examined relationship between foreign exchange rate and CBR for the period from June 2006 to August 2013 using a regression model. From the findings, the study concluded that central bank rates has no significant effect on nominal exchange rate since they have a weak positive relationship to the foreign exchange rate and thus cannot be used to predict the movement of the foreign exchange rate.

The 91-Day Treasury Bill Rate and Exchange Rate Volatility

Zettelmeyer (2004) examine the impact of monetary policy on exchange rate; evidence from three small open market economies which were Australia, Canada and Zealand during 1990s. The three countries have a high degree of openness both in terms of trade and capital flows; floating exchange regime in the sense that no particular level of exchange rate was targeted by policy makers and they use formal inflation targets. The study used three month Treasury bill rate as a measure of policy shocks. The study established that a contractionary shock will appreciate exchange rate. Also, Cheng (2006) uses VAR techniques to analyze the monetary transmission mechanism in Kenya. The study examined how variations in the short-term interest rate (Treasury bill rates and interbank rates) account for fluctuations in output, prices, and the nominal effective exchange rate. The study used monthly data for 1997 to 2005 and found that variations in short-term interest rate account for significant fluctuations in nominal exchange rate and prices, while accounting little for output fluctuations.

Kathanje *et al.* (2007) in their analysis of the monetary policy function for Kenya during the period 1997 to 2006 used monthly data on REPO rate, Interbank rate and Treasury bill rate as a measure for monetary policy shocks. The study established that CBK has been successful in controlling inflation for the greater period in the sample. Moreover, Tobias (2011) used GARCH model to test the effect of short term interest rate on the volatility of the foreign exchange rate using Treasury bill rates from August 1991 to December 2007.

The findings revealed that there exists a link between short term interest rates and the volatility of foreign exchange rate in Kenya. Another study by Cheruiyot (2012) examining the effect of monetary policy tools in countering inflation in Kenya for the period between 2006 and 2011 using a multivariate model used 91-day Treasury bill rate, exchange rate, money supply (M3) and REPO rate as measures of monetary policy effect. The study concludes that 91-day Treasury bill rate, exchange rate and money supply are effective in controlling inflation whereas REPO rate has little effect on the level of prevailing retail prices in an economy.

Gichuki and Moyi (2013) examined the monetary condition index for Kenya using a quarterly time series data from 2000 to 2011. The study employed a simple aggregate demand function for the computation of monetary condition index. They used 91-day Treasury bill rate, credit to private sector, and real exchange rate as measures for monetary policy transmission. The study concluded that the three variables are the main channels of monetary transmission in Kenya. Moki (2014) also used Treasury bill as a measure of monetary policy shock to determine the effect of monetary policy in controlling inflation in Kenya. Maina (2014) sought to investigate the impact of interest rate channel of monetary transmission mechanism in executing monetary policies in Kenya. The study used monthly data for 1993 to 2013. VAR model was used in analysis. Treasury bill rates and REPO rate were used as the measure for monetary policy shocks. The study found that there exists significant influence of interest rate channel of monetary transmission shock to GDP c and CPI (inflation). The study that REPO rates had a significant influence on nominal effective exchange rate.

Moderating Effect of Inflation on Effectiveness of Monetary intervention

Kenya’s monetary policy operates under inflation targeting monetary frame work. Therefore, other than monetary tools effect on exchange rate, the level of inflation will also affect the exchange rate volatility. Ndung'u (1999) measured whether the exchange rate is affected by monetary policy in Kenya. The study employed co-integration analysis on quarterly time series data from 1970 to 1995. The study further assessed whether the monetary effects are permanent or transitory. The study established that excess money supply fed into the cyclical movements of the real

exchange rate, implying that monetary shocks affect the real exchange rate. In addition, the study revealed that growth in money supply and inflation depreciates nominal exchange rate. Further analysis established that the nominal exchange rate is determined by the real income growth, rate of inflation, money supply growth, and cycles in the real exchange rate movements, the co-integrating factors and shocks.

In addition, Sundavist (2002) claimed that the differences in anticipated inflation that are embedded in the nominal interest rates affect the future spot rate of exchange. Moreover, Utami and Inanga (2009) examined the influence of inflation rate and interest rate differentials on exchange rate changes based on the international Fisher effect theory in Indonesia using quarterly and yearly data for the interest, inflation differentials and changes in exchange rate over a five year period from 2003 to 2008 using four foreign countries; namely: the USA, Japan, Singapore, the UK and Indonesia as the home country. The result revealed that interest rate differentials have positive but no significant influence on changes in exchange rate for USA, Singapore and UK, relative to that of Indonesia. Inflation rate differentials have negative significant influence on changes in exchange rate for Japan.

Mahmood and Bashir (2015) also investigated the impact of interest rate, inflation rate and money supply on exchange rate volatility in Japan. The results revealed that both short run and long run relationships exist between inflation and exchange rate volatility. High money supply and increase in interest rate raises the price level (inflation) which leads to increase in exchange rate volatility. Equally, Ebiringa and Anyaogu, (2014), using historical data on Nigeria from 1971 to 2010 established a significant short-run and long run positive relationship between inflation and exchange rate. Moreover, they displayed that interest rate exhibited a negative relationship with exchange rate. Concerted effort of all monetary authorities is therefore required to ensure that periodic variation in inflation is kept at the barest minimum for stability in exchange rate regime to be achieved.

Most of the available studies have investigated the effect of monetary policy on inflation and economic growth where in measuring monetary policy shocks they included 91-day treasury bill rates together with REPO rate and/or interbank rates. However, the present study used 91-day treasury bill rate and CBR since they forms the basis for setting commercial bank lending and other market rates, respectively (Cheruiyot, 2012; Ndiarangu *et al*., 2013) and also included Net FOREX intervention as one of monetary tools. Most researchers have used VAR model in their estimation; however, the present study used GARCH model in analysis.

Theoretical Literature Review

Monetarist and Keynesian Theories on Monetary Policy Transmission

In the monetarists' theory, the monetary transmission mechanisms influence the economy through the wealth channel and financial asset prices (Meltzer, 1995). A contraction of monetary policies leads to decline in stock prices through reduced demand resulting to overall decrease in individual wealth since there are limited capital gains from stocks. This will lead to a fall in aggregate demand. An expansionary monetary policy will result to an increase in demand for financial assets which in turn will lead to an increase in individual wealth, thus increasing expenditure and aggregate demand. With a contractionary monetary policy, consumers demand will fall and therefore will reduce spending in stock markets which will lead to a fall in stock prices (Patinkin 1965; Walsh, 2010).

According to Keynes, interest rate channel is the main channel for monetary policy transmission. A contractionary monetary policy will result to an increase in interest rates leading to crowding out of local investments. This increases unemployment and lowers aggregate demand due to low consumption levels (Mishkin, 1996). Keynes also supports monetary policy transmission through exchange rate channel with adoption of expansionary monetary policy interest rates fall this leads to capital outflows since domestic interest rates are lower than foreign interest rates thus causing a depreciation of the local currency (Walsh, 2010). The depreciation makes local goods competitive in the world market since they become cheaper and thus an appreciation of the exchange rate.

Purchasing Power Parity and Mundell-Fleming Model

PPP is based on the concept of "law of one price (LOOP)". LOOP indicates that identical good/services should sell for the same price in two separate markets when there are no transportation costs and no differential tax rates in the two markets. Purchasing Power Parity (PPP) by Cassel (1918) indicates that exchange rate between one currency and another is in equilibrium when their domestic purchasing powers at that rate of exchange rate are equivalent hence the exchange rate tends to be established at the point of equality between the purchasing powers of the two currencies. In absolute term PPP indicates that exchange rate between two countries should equal to the price ratio of similar goods and services in both countries. This implies that exchange rate must change to adjust to the change in the prices of goods in the two

countries (Ebiringa *et al* (2014)). Therefore, when one country's inflation rate rises relative to that of another country it results to decreased exports and increase in imports thus depressing the country's currency. The theory attempts to confirm inflation and exchange rate relationship by asserting that changes in exchange rate are caused by inflation rate differentials (Kara and Nelson, 2002). For example, if a country experiences a hyperinflation it will experience at the same time a corresponding external depreciation of its currency. Therefore, domestic inflation will rise with real exchange rate depreciation.

According to Mankiw (2006) and Blanchard (2006), Mundell-Fleming model is an economic model first set forth by Robert Mundell and Marcus Fleming. The model is an extension of the IS-LM model. In the IS-LM, interest rate is the key component in making both the money market and the good market in equilibrium. Under the Mundell-Fleming framework of small economy, interest rate is fixed and equilibrium in both markets can only be achieved by a change of nominal exchange rate. Mundell (1968) and Fleming (1962) argue that the exchange rate enters the macroeconomic framework of interest and output determination because changes in exchange rates affect competitiveness. Under a system of floating exchange rates, the exchange rate is set by market forces and is allowed to fluctuate in response to changing economic conditions. An increase in money supply shifts the LM curve downward. This directly reduces the local interest rate and in turn forces the local interest rate lower than the global interest rate (DeGrauwe, 2000). This depreciates the exchange rate of local currency through capital outflow. (Hot money flows out to take advantage of higher interest rate abroad and hence currency depreciates.)

The depreciation of the currency follows from the interest rate parity condition. The depreciation makes local goods cheaper compared to foreign goods and increases export and decreases import. Hence, net export is increased. Low interest rate also leads to increase in investment. Increased net export and investment leads to the shifting of the IS curve to the right resulting to increase in equilibrium income. This shift continues to the right until the local interest rate becomes as high as the global rate.

At the same time, the BOP is supposed to shift too, as to reflect depreciation of home currency and an increase in current account or in other word, the increase in net export. These increase the overall income in the local economy. A decrease in money supply causes the exact opposite of the process (Young and William, 2004). To conclude, these theories support a relationship between exchange rate, interest rate differentials and inflation differentials. This again, justifies why they should be included in the analysis model. Mundell- Fleming model also supports the influence of exchange rate through unsterilized intervention, that is, monetary policy channel.

Conceptual Framework

The conceptual framework in Figure 1 displays the relationships of variables used in the study.

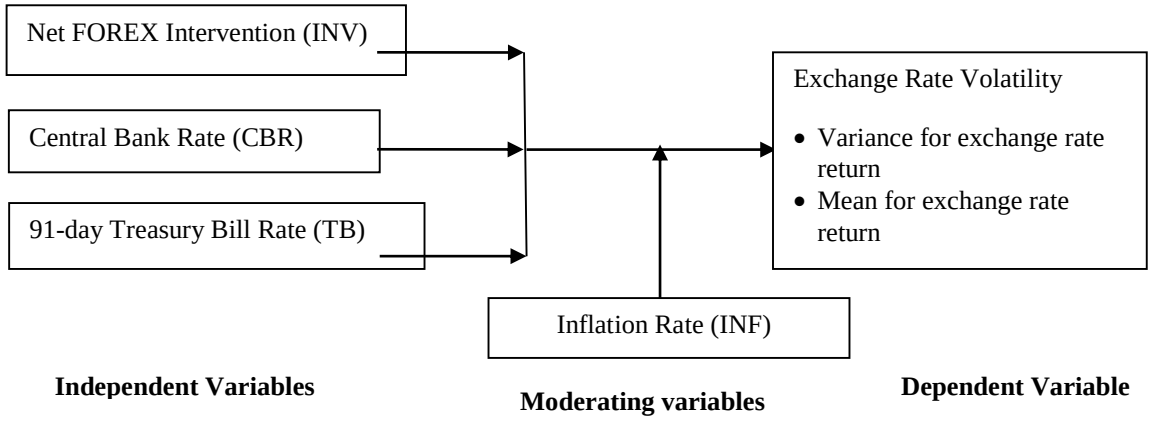

Figure 1. Diagrammatic conceptual framework

METHODOLOGY

The research used a descriptive longitudinal time series research design. A longitudinal study follows the same sample over time and makes repeated observations. Sampling design used was non- probabilistic purposive sampling since it allows a study to use cases that have some specific characteristics with respect to the objective (Kombo and Tromp, 2006. The variables used in this study were: Kenya shilling to US dollar exchange rate returns (ERT), net FOREX intervention (INV), central bank rate (CBR), 91-day Treasury bill rate (TB) and Inflation rate (INF). It has been observed by researchers like Cheng (2006), Ndirangu *et al.*,(2013), Gichuki *et al.*, (2013), Maina and Moki (2014) that monetary policy transmission in Kenya can be measured by the above variables. Logarithmic returns are the most frequently used because they have more suitable statistical properties than rates. The percentage logarithmic returns are calculated as follows:

$$Return_t(ERT) = (lnEr_t - lnEr_{t-1})100 = ln\left(\frac{Er_t}{Er_{t-1}}\right)100. \quad 1$$

Where, Er_t is exchange rate (Ksh/US dollar) in time t and Er_{t-1} is the exchange rate at time t-1.

Model Specification

The basic version of Ordinary Least squares estimation required that research on time varying volatility to remove volatility estimates from asset return data before specifying a parametric time series model for volatility by assuming that volatility is constant over some interval of time. However, according to Engle (2001), it is expected that there will be heteroscedasticity in financial time series data since in financial data some periods are riskier than others, that is, the expected value of error terms at sometimes is greater than others. Moreover, these risky times are not scattered randomly across quarterly or annual data. Instead there is a degree of autocorrelation in the riskiness of financial returns. Engle (1982) proposed the class of Autoregressive Conditional Heteroscedastic (ARCH) models that capture the serial correlation of volatility.

This led to the Generalized ARCH model (GARCH) introduced by Bollerslev (1986). GARCH is an efficient way to model volatility in high frequency econometric time series. More importantly, GARCH models of exchange rate volatility allow the empirical testing of the effectiveness of intervention on both level and volatility of exchange rate to be carried out simultaneously on both the mean and conditional volatility of exchange rate returns (Edison and Liang, 1999). Therefore, the model becomes:

$$ERT_t = a_0 + a_1 lnINV_t + a_2 \Delta lnCBR_t + a_3 \Delta lnTB_t + a_4 \Delta lnINF_t + \varepsilon_t. \quad 2$$

Where:

$\varepsilon_t | \Omega_{t-1} \sim N(0, h_t)$.

$$h_t = b_0 + b_1 INV_t + b_2 \Delta lnCBR_t + b_3 \Delta lnTB_t + b_4 \Delta lnINF_t + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1}. \quad 3$$

Where,

$b_o, \alpha, \beta > 0 \; and \; \alpha + \beta < 1.$

Equation (1) represents the mean equation in which the dependent variable is rate of logarithmic return on nominal exchange rate ($RETURN_t$) during a month. It is assumed that the average return depends on net intervention (INV), central bank rate (CBR) and 91-day Treasury bill rate (TB). Further, it is also assumed that the random disturbance term in the mean equation (ε_t) has a conditional normal distribution with mean zero and variance (h_t) and are modeled as normally distributed conditional on the information set Ω_{t-1} available at time t-1. Here, Ω_{t-1}Ÿ indicates all the (lagged) information available to the participants in the foreign exchange market at time t. The monetary policy is expected to reduce the extent of fluctuations of the exchange rate and change direction of shilling movement against the US dollar.

According to theory, the intervention of a central bank is said to be effective if the coefficient a_1 is positive and significant. Thus, Kenya shilling depreciates against the US Dollar as the net US dollar purchases increase. That is, the purchase (or sale) of the US dollar results in depreciation (or appreciation) of the Kenya shilling. Also a decrease in interest rate should decrease the mean exchange rate return. Thus, Kenya shilling depreciates against the US Dollar as interest rate decreases. Therefore, coefficients a_2 and a_3 should be negative. The coefficient of inflation rate a_4 is expected to be positive that Kenya shilling depreciates against Us Dollar with increase in inflation rate thus increasing exchange rate mean return.

In equation (2), conditional volatility depends on same set of determinants as that of the mean equation (1) plus two more determinants; past disturbance $\alpha \varepsilon_{t-1}^2$ and the lagged variance, βh_{t-1}. According to Dominguez (1998), foreign exchange intervention is regarded as successful if intervention significantly reduces the volatility of the exchange rate. Schwartz (1996) stated that unsuccessful foreign exchange intervention is likely to increase exchange rate volatility. CBK intervention is said to be effective if an increase in net purchases of dollars lowers the volatility of the monthly Kenya shilling to US dollar returns. Hence, the expected sign for b_1 is negative. Also, CBR and 91-day Treasury bill rate will be effective if

decreasing them lowers volatility of the monthly Kenya shilling to US dollar returns. Thus, the expected sign for b_2 and b_3 is positive. Inflation is also expected to increase volatility hence b_4 is expected to be positive.

RESULTS AND DISCUSSION

Unit Root and Normality Test

The presence of unit roots for all the variables in the mean equation were tested by applying Augmented Dickey Fuller (ADF) and Philips Perron (PP) tests. All variables were found to be stationary at 5% level of significance after taking the second difference. The use of standard ARCH/GARCH model requires testing the distribution of the dependent variable. If the series is not normally distributed then GARCH model is found to be applicable in analyzing the data. Histogram-stat test for normality was applied where descriptive statistics of the exchange rate return including skewness and kurtosis measures were computed. The exchange rate return series was found to be positively skewed. This shows the presence of volatility in the return series implying that depreciation in the exchange rate occurs more often than appreciation. The probability of JB statistic was 0.000<0.05; thus, the null hypothesis that the series is normally distributed was rejected. The non-normality of return series justifies use of ARCH and GARCH model.

ARCH Effects and Volatility Clustering Test

Before estimating ARCH and GARCH model it is necessary to test for the residuals of the mean equation to check whether they disagree with the assumptions of the OLS. ARMA equation was estimated by an econometric model which was built by applying OLS technique after which the estimated residuals are obtained. The assumptions underlying the GARCH model are that the time series under consideration must exhibit heteroscedasticity as well as autocorrelation. It is expected that there will be heteroscedasticity in financial time series data since in financial data some periods are riskier than others, that is, the expected value of error terms at sometimes is greater than others (arch effect). Moreover, these risky times are not scattered randomly across quarterly or annual data but riskier periods may be followed by other riskier one and less risk period followed other less risk periods (Volatility Clustering). Ljung-Pierce Q-statistic of the squared deviations (Q^2) and Lagrange Multiplier ARCH test (ARCH-LM test) were employed.

The Ljung-Box Q-statistic for squared residuals as well as the ARCH-LM test confirms the presence of ARCH effect since their F-probabilities (0.00) are less than 0.05; hence the null hypothesis of zero ARCH effect in the residuals is rejected. Again, a line graph for exchange rate return residual was plotted to verify the presence of volatility clustering. Both the test revealed that there is heteroscedasticity, autocorrelation and volatility clustering in the exchange rate return series and that it follows a non-normal distribution. Once ARCH has been found in the investigated data, it justifies the use of GARCH models. The inverted AR root for mean equation was 0.24 which is inside the unit circle, that is, between -1 and 1. Therefore, the mean equation is well defined.

Estimated GARCH (1, 1) Model

To measure the effect of monetary policy intervention on both the level and volatility of the US Dollar-Kenya shilling exchange rate a GARCH model with exogenous monetary policy intervention data in both the conditional mean and variance equations as proposed by Engle (1982), Bollerslev (1986), and Baillie and Bollerslev (1989) was used. The effect for monetary policy intervention on the exchange rate level is captured by the mean equation of GARCH model while on volatility is captured by variance equation as shown in Table 1. As a result of exchange rate risk that an investor encounters when investing internationally, it is observable that the volatility of exchange rate affects the expected returns of an investment. Depreciation is supposed to increase exchange rate return because it makes local goods cheaper compared to foreign goods thereby increasing export and decreasing import. In other word it makes local goods to be more competitive (Mundell, 1968 and Fleming, 1962). Therefore, an increase in exchange rate return could be interpreted to mean that the currency has depreciated and a decrease in returns means an appreciation of the local currency. Therefore, the variance equation measures the degree of volatility (fluctuation) while mean exchange rate return equation gives the direction of movement of fluctuations. GARCH (1, 1) model is shown in Table 1.

Table 10 shows parameters of the variables in the mean and variance equation together with the p-values of Z – statistics. The coefficient of LNINV, ΔLCBR, ΔLNTB and ΔLNINF in mean equation are -0.9863, 0.0715, -1.5696 and 0.2464 respectively while for equation variance are -0.3042, 1.3515, 2.5790 and 1.2159 respectively. The constant of the mean equation is 1.5315 with a p-value of 0.2293 > 0.05 therefore, not significant. The coefficient of autoregressive term is 3.7265 with the p – value of 0.0011< 0.05. This implies that the mean of exchange rate return is influenced by previous information available in the market. Exchange rate level is affected by this information.

The constant term in variance equation is 4.3853 with a p-value of 0.0113< 0.05. This shows that it's positive and significant to mean there some unconditional

volatility which is not dependent on any factor equal to 4.3853. The coefficient for ARCH term is 0.5733 with a p- value of 0.0000 < 0.05 and that of GARCH term is 0.2566 with a p- value of 0.0006 < 0.05. The ARCH term measures volatility from previous period measured as a lag of the squared residual from the mean equation and the GARCH term measures the last period's forecast variance. The volatility characteristic of financial time series was therefore successfully captured by the GARCH (1, 1) model. The estimated results for the GARCH model reveal that the null hypotheses of no present of ARCH effect and of no present of GARCH effect were rejected since the coefficients of lagged squared residuals and lagged conditional variance have positive signs as expected and significant. These results show that monetary policy intervention leads to an increase in exchange rate volatility and uncertainty. This means that, past disturbances and information available to participants in foreign exchange market in previous period highly increases exchange rate volatility and uncertainty because intervention gives the market participants more concern about the stability of the market and the persistence of the intervention policies.

Table 1. Conditional mean and variance for monetary policy intervention

Variable	Coefficient	Std. Error	Z- Statistics	P-Value
		Mean Equation		
C	1.5315	1.2739	1.2022	0.2293
LNINV	-0.9863	0.5006	-1.9702	0.0488
ΔLCBR	0.0715	0.89023	0.0803	0.9360
ΔLNTB	-1.5696	0.6074	-2.5842	0.0098
ΔLNINF	0.2464	0.3294	0.7479	0.4545
AR	0.2565	0.0688	3.7265	0.0002
		Variance Equation		
C	4.3853	1.7319	2.5321	0.0113
ARCH(1)	0.5733	0.1081	5.3008	0.0000
GARCH(1)	0.2566	0.0744	3.4470	0.0006
LNINV	-0.3042	0.1379	-2.2060	0.0274
ΔLCBR	1.3515	2.2060	0.6126	0.5401
ΔLNTB	2.5790	1.2708	2.0300	0.0424
ΔLNINF	1.2159	0.3728	3.2620	0.0011
Wald stat = 0.8299		Inverted AR Roots = 0.24		

Therefore, lagged volatility has more significant effect on the current volatility. These findings support the theoretical arguments concerning the risk of exchange rate intervention according to Schwartz (1996). All these results confirm the adequacy of this GARCH model. The conditional mean equation and variance equation are thus specified as follows:

$$ERT_t = -0.9863\, INV_t - 1.5696\, TB_t + 0.256546 AR(1) + \varepsilon_t \quad 4$$

$$h_t = 4.3853 - 0.3042 INV_t + 2.5790\, TB_t + 1.2159 INF_t + 0.5732 \varepsilon_{t-1}^2 + 0.2566 h_{t-1} \quad 5$$

Effect of Net Foreign Exchange Intervention on Exchange Rate Volatility

From conditional mean equation in Table 10, the coefficient of FOREX intervention (INV) is - 0.9863 and the p-value is 0.0488 < 0.05. The result implies that holding other things equal, an increase in net foreign exchange intervention by one unit would lead to a decrease in mean return of foreign exchange rate by 0.9863 units. This shows that purchase (sale) of the US dollars would cause an appreciation (depreciation) of the Kenyan shilling. However, the result does not support the theoretical positive association between exchange rate return and FOREX intervention. In the variance equation, the FOREX intervention coefficient was - 0.3042 and significant as its p-value was 0.0274 < 0.05. This implies that an increase in net foreign exchange intervention by one unit would lead to a decrease in foreign exchange volatility by 0.3042 units holding other things equal. This shows that an increase in net purchases of US dollars by CBK in the foreign exchange market would result to a decline in the volatility of exchange rate. The mean and variance equation results could be interpreted that an increase in net purchases of US dollars reduces the levels of fluctuations of the exchange rate and appreciates the Kenya shilling against the US dollar. This result supports the description of CBK FOREX intervention as 'leaning against the wind'. Meaning it is acting to slow or correct excessive trends in the exchange rate.

This study is consistent with empirical studies such as Simatete (2004), Egert, Lang, Behera *et al*. (2005), and Kihangire (2011) which concluded that an increase in

FOREX intervention reduces the exchange rate volatility and changes the level of exchange rate. The result also supports the findings of Kembe (2013) that FOREX intervention reduces exchange rate volatility in Kenya. On contrary, other empirical studies such as Baillie and Osterberg (1997), Morana and Beltvatti (2000), and Doroodian and Caporale (2001) did not support the notion that FOREX intervention reduces the exchange rate volatility.

Therefore, holding other thing equal, a unit increase in net foreign exchange intervention would be effective in reducing volatility of exchange rate in Kenya by 0.3042 units and at the same time would decrease the exchange rate return against the expectations of the investors (leaning against the wind) by 0.9863 units thus leading to appreciation of Kenya shilling. This effect can be direct through the change in supply of Kenya shilling or US dollar thus affecting the demand of currency in the FOREX market or indirect through interest rate channel by changing the domestic money supply precisely the same way as when the CBK buys a treasury bill on the open market. Both direct and indirect effect act in the same direction. The only difference between the direct and indirect effects is the timing and sustainability (Stephen, 2005). The direct effect will occur immediately with central bank intervention since the CBK will be affecting today's supply of shillings or dollars on the FOREX market. The indirect effect, working through money supply and interest rates, may take several days or weeks.

Effect of Central Bank Rate on Exchange Rate Volatility

CBR coefficient in mean equation was positive (0.0715) against the expectation and insignificant since its P-value was 0.9360 > 0.05. Again the CBR coefficient in Variance equation is also positive (1.3515) and insignificant since its P-value was 0.5401 > 0.05. Therefore, CBR was found to be insignificant both in the mean and variance equations. Meaning that, CBR has no significant effect on the direction and volatility of exchange rate. The study in Kenya by Obondi (2013) also support that there is insignificant relationship between CBR and exchange rate.

Effect of 91-Day Treasury Bill Rate on Exchange Rate Volatility

The coefficient for 91-day Treasury bill rate was -1.5696 and significant since its p-value is 0.0098 < 0.05. This implied that an increase in TB by one unit leads to a decrease in mean return of foreign exchange rate by 1.5696 units. Meaning that, a decrease in 91treasury bill rate by one unit increases the mean exchange rate return by 1.5696 holding other thing equal. This follows that a decrease (increase) in 91-day Treasury bill rate depreciates (appreciate) Kenya shilling against the US Dollar. The theory under Mundell- Fleming model and empirical result like (Yutaka, 2011) seems to support that a decrease in interest rate results to depreciation of domestic currency. Also, the TB coefficient in variance equation was 2.5790 with a P-value of 0.0424 < 0.05. Meaning that, increasing (decreasing) 91-day Treasury bill rate by one unit increases (lowers) the volatility of the monthly Kenya shilling to US dollar returns by 2.5790 holding other thing equal. This is in consisted with Zettelmeyer (2004) study about the relationship between exchange rate volatility and interest rate.

Therefore, holding other things equal, 91-day Treasury bill rate is seen to be more effective in reducing the exchange rate volatility since a unit change in 91-day Treasury bill rate influence the exchange rate volatility by 2.5790 units and at the same time change the level of exchange rate return by 1.5696 units while a unit change in INV influences the volatility and level of exchange rate by 0.3042 and 0.9863 units respectively. The 91-day Treasury bill rate affects the exchange rate through an indirect method. The indirect intervention traverses from open market operations to change the domestic money supply, to changes in domestic interest rates, to changes in exchange rates due to new rates of returns. The problem with this method is that it may take several weeks or more for the effect on exchange rates to be realized because the low interest rate has to increase investment and net export returns which will result to increased domestic money supply and hence depreciation of the Kenya shilling. A second problem with indirect method is that to affect the exchange rate the Central Bank may need to change interest rates away from what it views as appropriate for domestic concerns at the moment.

Moderating Effect of Inflation Rate on Effectiveness of Monetary Policy

Moreover, it is observed that the coefficient of inflation is 0.2464 in the mean but insignificant since its P-value is 0.4545 > 0.05. This could be because change in exchange rate return mostly affects the external market other than the internal market. Thus inflation does not affect the mean of exchange rate return. In the variance equation the coefficient for inflation is 1.2159 which is positive and significant since its P-value 0.0011 < 0.05. This implied that an increase (decrease) in inflation rate by one unit leads to an increase (decrease) of foreign exchange volatility by 1.2159 units holding other thing equal. This means that decreasing inflation rate lowers the volatility of the monthly Kenya shilling to US dollar returns, that is, it reduces exchange rate volatility. According to Keynesian theory, inflation rate and interest rate are

inversely related. This implies, reducing interest rate in order to reduce exchange rate volatility would increase inflation which will affect unemployment and GDP growth while reducing inflation in order to reduce exchange rate volatility will increase the interest rate.

In the model it is observed that a unit increase in inflation would result to an increase in volatility by 1.2129 units and a unit decrease in 91-day Treasury bill rate would reduce exchange rate volatility by 2.5790. Since CBK is entrusted to maintain domestic price stability, maintaining appropriate interest rates, a low unemployment rate and GDP growth, monetary policy intervention in the FOREX market will often interfere with one or more of its other goals. Inflation affect the effectiveness of monetary policy on exchange rate volatility since monetary actions for controlling exchange rate volatility negates inflation control. This dilemma of monetary policy results in CBK choosing to sterilize its interventions so as to cause a change in the exchange rate while at the same time leaving the money supply and hence interest rates unaffected.

A sterilized central bank intervention occurs when a CBK counters direct FOREX intervention with a simultaneous offsetting transaction in the domestic market through open market operations. Therefore, since INV and TB affect money supply in opposite direction, monetary policy makers can chose a policy mix that would ensure stable exchange rates by stemming out any excessive volatility in the exchange rate to avoid further depreciation and fluctuation on exchange rate and at the same time leave money supply and interest rates unaffected. Sterilizing intervention could have a short run and still a long run effect on exchange rate volatility.

A temporal effect would occur if CBK make a direct intervention in the FOREX market, over a short period of time, this will definitely change the supply or demand of currency and have an immediate effect on the exchange rate on those days. A more lasting impact would occur if the intervention could lead investors to change their expectations about the future. Therefore, if CBK wants to affect expectations should announce the FOREX intervention while hiding its offsetting open market operation. That is, it should not say whether it will sterilize intervention. Thus, investors may think that the FOREX intervention will lower the future dollar value and thus may adjust their expectations.

CONCLUSIONS

The main objective of this study was to evaluate the effectiveness of monetary policy against its policy goal of stabilizing the exchange rate. The results from GARCH model confirmed monetary policy intervention to be effective in reducing exchange rate volatility by use of FOREX intervention and 91-day Treasury bill rate. The results revealed that CBR has no significant effect on the mean and variance of exchange rate return, thus it is not an effective monetary policy for reducing the volatility of exchange rate in Kenya. It was found that inflation affect the effectiveness of monetary policy on exchange rate volatility since monetary actions for controlling volatility negates inflation control.

This study further confirmed the assumption that Kenya as a small open economy tends to have high and persistent exchange rate volatility as in the case in most open emerging countries. It was found that INV can influence exchange rate in the short run without affecting domestic money supply while treasury bonds directly affect domestic money supply and interest rate. Changing the money supply will cut the average interest rate in the short-run and price level, and hence inflation rate in the long-run. This interferes with other goals of monetary policy. Thus using each of the monetary tools individually will result in non-sterilised intervention which may not be the best for a country. This dilemma of monetary policy results in CBK choosing to sterilize its interventions by countering the effect of INV with that of 91-day treasury bill rate so as to cause a change in the exchange rate while at the same time leaving the money supply and hence interest rates unaffected.

RECOMMENDATIONS

In general, the research confirmed that monetary policy has been effective to some extend to control exchange rate volatility. Based on these findings the following recommendations are made:

Since both INV and treasury bonds affected the volatility of exchange rate in opposite direction and non-sterilized intervention results into monetary policy dilemma, policy makers should strive for a policy mix that will ensure stable exchange rates by stemming out any excessive volatility in the exchange rate to avoid further depreciation and fluctuation on exchange rate. This is recommended since stable exchange rates will ensure certainty, helping investors to make accurate planning and reduce operational risk. At the same time, competitive exchange rates will help to ensure that the goods remain competitive relative to foreign markets. A combination of stable exchange rate environment and a competitive currency will attract investment, increase aggregate output and expand a country's economic prosperities.

The present study reviewed that inflation has a significant effect on exchange rate volatility and thus

has been found to be having an important policy implication in controlling volatility of exchange rate in Kenya. Thus monetary policy should strive to target the level of inflation which reduces exchange rate volatility since by reducing inflation indirectly exchange rate volatility is reduced.

Central bank rate was found to be an ineffective monetary policy for controlling exchange rate volatility and the mean of exchange rate return. Therefore policy makers aiming at reducing the volatility should rely more on alternative policy rather than CBR.

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