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Policy Implication of Non-Sterilized and Sterilized Central Bank Intervention on Exchange Rate Volatility in Kenya

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Abstract

Central bank of Kenya through the monetary policy is required to choose a policy mix that would ensure stable exchange rates by stemming out any excessive volatility in the exchange rate since volatility introduces uncertainty that negatively affects business decisions and plans. The increase in exchange rate volatility has negative effects on international trade and capital flows, thus having an adverse impact on domestic economy. Unpredictable changes in exchange rates 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. There has been a dilemma in policy making whether to intervene direct in the foreign exchange market or not and whether to sterilize the intervention or not. This study aimed at evaluating the policy implication of non-sterilized and sterilized intervention on exchange rate volatility in Kenya using GARCH (1, 1) model. Data for analysis included monthly time series data on US Dollar-Kenya shilling bilateral exchange rate, net foreign exchange intervention by central Bank, 91-day Treasury bill rates and inflation rate. The data for all the variables was purposively selected from January 1997 to June 2016 which makes a total of 233 months. The data was extracted from the Monthly Economic Reviews and surveys of the Central Bank of Kenya and Kenya National bureau of Statistics and also from database on their websites and analyzed using Eviews software. Non-sterilized intervention was found to be effective in reducing exchange rate volatility by individually using foreign exchange intervention and 91-day Treasury bill rate. However, Non- sterilized monetary policy intervention in the foreign exchange market was found to interfere with one or more of monetary policy other goals. The dilemma in non-sterilized central bank intervention results in central bank 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. Therefore, 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.

Key Words: Non-sterilized intervention, sterilized intervention, exchange rate volatility

INTRODUCTION

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 & 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 & 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 from 1966 when it was created to 1970. One of the reason being that the bank had not then acquired sufficient experience in the management of monetary policy and also the Kenyan economy had no severe macroeconomic problems to resist during this period. 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 & Maana, 2008). Kenya works under the policies of floating exchange rate but its foreign exchange market is inefficient (Muhoro, 2003 & 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. There has been a dilemma in policy making whether to intervene direct in the foreign exchange market or not and whether to sterilize the intervention or not. This study aimed at evaluating the policy implication of non-sterilized and sterilized intervention on exchange rate volatility in Kenya using GARCH (1, 1) model.

Central banks can affect the exchange rate using direct or indirect method. The indirect method is to change the domestic money supply while the direct method is to intervene directly in the foreign exchange market by buying or selling currency which is called foreign exchange intervention. An indirect method the central bank can use to raise or lower the exchange rate is through domestic money supply and interest rate changes. Increase in the domestic money supply will cause an increase in Kenya shilling to US dollar exchange rate, that is, a Kenya shilling depreciation. Similarly, a decrease in the money supply will cause a shilling appreciation. Central bank intervenes indirect through open market operation. The direct way for central banks to intervene and affect the exchange rate is to enter the private foreign exchange (FOREX) market directly by buying or selling domestic currency.

STERILIZED AND NON-STERILIZED INTERVENTION

Non-sterilized intervention is an intervention which affects the monetary base that is, the central bank does not adopt any countermeasures to prevent its intervention from affecting the size of its balance sheet. The relationship between exchange rates and monetary control mostly comes from the balance sheets of central bank. On the liabilities side, there is base money which comprises reserves, currency and the central bank's net worth while the assets side consist of net foreign assets (NFA) and net domestic assets (NDA). Any intervention in the foreign exchange market will change NFA (Simatele, 2004). Sterilized foreign exchange intervention occurs when a central bank counters direct intervention in the FOREX with a simultaneous offsetting transaction in the domestic bond market. Non-sterilized intervention is generally assumed to have a significant influence on the exchange rate (Simwaka & Mkandawire, 2011).

According to Archer (2005), Sterilized intervention can also affect exchange rate through three channels which include portfolio balance channel, signaling or expectation channels, and order flow or noise-trading channel. Portfolio balance channel postulates that foreign and domestic bonds are considered imperfect substitutes in investor portfolios. Viewed from the perspective of a representative investor in an international portfolio of assets, a change in relative scarcity of domestic versus foreign currency assets will cause a portfolio reallocation that changes relative prices in the process and one type of the relative price changes might be exchange rates. It emphasizes that sterilizing intervention through typical open market operations will change the currency composition of government securities held by the public (Humpage, 2003). For example, a sterilized purchase of foreign exchange by central bank increases the amount of domestic bonds held by the public relative to foreign bonds, resulting in a depreciation of the local currency. It is predicted that changes in relative supply of foreign and domestic assets under sterilized intervention will require a change in expected relative returns (Dominguez & Frankel, 2003). Unluckily, many empirical studies do not find evidence in favor of this channel and those that do suggest that it is weak. The reason offered for the lack of a portfolio effect is that the typical intervention transaction is minor relative to the stock of outstanding assets. Dominguez and Frankel (1993) were the first to find some evidence in favor of this channel but their results remained questionable as they found either a wrong sign or insignificant coefficient for the relative asset supplies. Likewise, Bhaumik and Mukhopadhyay (2000) in the Indian context arrived at the same inclusive result.

The signaling channel refers to the signals sent by the central bank to the market. This model assumes asymmetric information between market participants and the central bank. Sterilized intervention functions through the signalling channel by causing private agents to alter their exchange rate expectations (Mussa, 1981). With this channel, intervention influences the exchange rate because it changes perceptions of market participant about the future. Perception can be about future relative scarcities, future income streams, risks, and can change price levels without a single transaction taking place (Archer, 2005). Edison (1993) argues that intervention is effective and occurs through both the portfolio balance and signalling channels. This could happen if investors are not sure whether the central bank is sterilizing its interventions. Knowing that sterilization is occurring would require a careful observation of several markets unless the central bank announces its policy. However, rather than announcing a sterilized intervention, a central bank that wants to affect expectations should announce the FOREX intervention while hiding its offsetting open market operation. In this way investors may be fooled into thinking that the FOREX intervention will lower the future Kenya shilling value and thus may adjust their expectations. If investors are fooled, they will raise Kenya shilling to US dollar exchange rate in anticipation of the future Kenya shilling depreciation. The increase in Kenya shilling to US dollar exchange rate will result in an increase in GNP and a depreciation of the shilling. In this way, sterilized

interventions may have a more lasting effect upon the exchange rate. However, the magnitude of the exchange rate change in this case, if it occurs, will certainly be less than that achieved with a non-sterilized intervention.

The Noise-trading channel can operate even when intervention is carried out unnoticeably and hence does not provide a signal to market participants. A central bank can use sterilized interventions to induce noise traders to buy or sell currency. The principle underlying this channel is that a central bank can manipulate the exchange rate by entering in a relatively thin market and, on a minute-by minute basis; the exchange rate is determined by marginal demand and supply flow in the foreign exchange market (Goodhart & Hesse, 1993; Hung, 1997).

METHODOLOGY

The research used a descriptive longitudinal time series research design. A longitudinal study follows the same sample over time and makes repeated observations. The study used monthly data on Kenya shilling to US dollar exchange rate returns (ERT), net FOREX intervention (INV), 91-day Treasury bill rate (TB) and Inflation rate (INF). Logarithmic returns are the most frequently used because they have more suitable statistical properties than rates. The percentage logarithmic returns are calculated as follows:

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

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

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-Kenya shilling exchange rate since US dollar is the most commonly used currency to settle international transactions. The main sources of the data included: The Statistical Bulletins and the Monthly Economic Reviews of the CBK and the Economic Surveys of the Kenya national bureau of statistics. Some data was also extracted from CBK and KNBS database on their websites. The data was then saved in Excel spreadsheet which was then imported to Eviews.

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 some times 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. To measure the impact of monetary policy intervention on the volatility of the Kenya shilling to US dollar exchange rate, generalized autoregressiveconditional heteroscedasticity (GARCH) model was used with net FOREX intervention data, central bank rate, 91-day treasury bill rate and inflation rate in both the conditional mean and variance equations as proposed by Engle (1982) and Baillie and Bollerslev (1986). GARCH is designed to model and forecast conditional variances. The variance of the dependent variable is modeled as a function of past values of the dependent variable and independent or exogenous variables. The significance of parameters in GARCH (1,1) and the overall significance of the model were tested using p-values and diagnostic checks respectively. Statistical hypothesis were estimated at 5% level of significance.

The model is as follows;

$ERT_t = a_0 + a_1 lnINV_t + a_2 \Delta lnTB_t + a_3 \Delta lnINF_t + \varepsilon_t$.. ……conditional mean equation (1)
Where,
$\varepsilon_t|\Omega_{t-1} \sim N(0, h_t)$.

$h_t = b_0 + b_1 INV_t + b_2 \Delta lnTB_t + b_3 \Delta lnINF_t + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}$……conditional variance equation .(2)
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), 91-day Treasury bill rate (TB) and inflation (INF). 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} 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 should be negative. The coefficient of inflation rate a_3, is expected to be positive that Kenya shilling depreciates against Us Dollar with increase in inflation rate thus increasing the exchange rate mean return.

In equation (2), the conditional volatility depends on the same set of determinants as that of the mean equation (i) 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. Besides, 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, 91-day Treasury bill rate and Inflation will be effective if decreasing them lowers the volatility of the monthly Kenya shilling to US dollar returns. Therefore, the expected sign for b_2 and b_3 is positive.

RESULTS AND DISCUSSIONS

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 the return series justifies the 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 some times 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

After the confirmation of the arch effect GARCH model was estimated. It is expected that estimating GARCH$(1,1)$ specification to be sufficient to eliminate ARCH -effects from the residuals. Again for a well specified GARCH (1,1) model, the Wald test should show that the sum of ARCH coefficient α , and GARCH coefficient β to be less than one for the overall model to be stationary. The ARCH-LM test F-probability was

0.640451 which is greater than 0.05 and that of Ljung-Box Q-statistic for squared residuals was 0.403 which is also greater than 0.05. Therefore, the null hypothesis of no further ARCH effect in the estimated GARCH model was accepted.

To assess the degree of volatility persistence, the Wald test was used. The null hypothesis for this test is that the sum of ARCH coefficient (α) and GARCH coefficient (β) is equal to one; that is, H_0: $\alpha + \beta = 1$, to mean that the error variance is integrated or non-stationary against the alternative H_1: $\alpha + \beta < 1$, that is, error variance is stationary. This means that volatility will not take long time to revert to mean as $\alpha + \beta < 1$. Again the constant term in variance equation, ARCH and GARCH term should be greater than zero and significant. From table 10, it is seen in that the coefficient of the ARCH term (α) is 0.5733, coefficient for GARCH term (β) is 0.2566 and constant term for the variance equation is 0.2566. These coefficients are all positive and significant as required since their Z probabilities are less than 0.05. The sum of ARCH and GARCH coefficients, $\alpha + \beta = 0.8299$, which is lower than unity. The null hypothesis of non stationarity was rejected. This confirms the stationarity of the variance to display that volatility will not take long time to revert to mean.

The GARCH (1,1) model is shown in Table 1.

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
ΔLNTB	0.2464	0.6074	-2.5842	0.0098
ΔLNINF	0.2565	0.3294	0.7479	0.4545
AR		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	0.027
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**	

The conditional mean equation and variance equation are thus specified as follows:

$ERT_t = -0.9863\ INV_t - 1.5696\ TB_t + 0.256546AR(1) + \varepsilon_t$ ……Mean equation

$h_t = 4.3853 - 0.3042INV_t + 2.5790\ TB_t + 1.2159INF_t\ + 0.5732\varepsilon_{t-1}^2 + 0.2566h_{t-1}$……Variance equation

PARAMETER ESTIMATES

From conditional mean equation, 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. Simwaka and Mkandawire (2011) also support that non-sterilized sale of foreign exchange would be expected, other things being equal, to appreciate the exchange rate through contraction of money supply and therefore interest rates. 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.

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.

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 intervention is non-sterilized. The 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.

Again, a non-sterilized intervention through 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. Another problem with indirect method is that to affect the exchange rate the central bank must change the domestic interest rate. Most of the time, central banks use interest rates to maintain stability in domestic markets. If the domestic economy is growing rapidly and inflation is beginning to rise, the central bank may lower the money supply to raise interest rates and help slow down the economy. If the economy is growing too slowly, the central bank may raise the money supply to lower interest rates and help spur domestic expansion. Thus, to change the exchange rate using the indirect method, the central bank may need to change interest rates away from what it views as appropriate for domestic concerns at the moment.

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. Therefore, 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, CBK can sterilize the intervention if it does not want its intervention to have any effect on the money supply and domestic interest rates by removing the liquidity which it injected into the market through purchase of dollars by selling domestic securities in exchange for liquid funds through a decrease in Treasury bill rate. What changes is the composition of the banking system's portfolio of domestic and foreign assets that is, net foreign assets increases while net domestic asset decreases by the same amount. 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 AND RECOMMANDATION

This study aimed at evaluating the policy implication of non-sterilized and sterilized intervention on exchange rate volatility in Kenya using GARCH (1, 1) model. iIt used monthly time series data from January 1997 to June 2016.The results from GARCH model confirmed that INV can influence exchange rate in the short run without affecting domestic money supply while TB directly affect domestic money supply and interest rate. Changing the money supply will affect the average interest rate in the short-run and the 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 to non-sterilized intervention which may not be the best for the country. This dilemma of monetary policy results in CBK choosing to sterilize its interventions by countering the effect of foreign exchange intervention 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. Therefore, 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.

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