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EFFECTIVENESS OF FOREIGN EXCHANGE INTERVENTION ON EXCHANGE RATE VOLATILITY IN KENYA

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ABSTRACT

Central Bank of Kenya carry out foreign exchange intervention in foreign markets to 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 ensures certainty, helping investors to make accurate planning and reduce operational risk. At the same time, competitive exchange rates help to ensure that the domestic goods remain competitive relative to foreign markets. A combination of a stable exchange rate environment and a competitive currency attracts investment, increase aggregate output and expand country's economic prosperities. This study aimed specifically at evaluating the effectiveness of foreign exchange intervention on exchange rate level and volatility. Data for analysis included monthly time series data on US Dollar-Kenya shilling bilateral exchange rate, net foreign exchange intervention by central Bank, central bank rate, 91-day Treasury bill rates and inflation rate from January 1997 to June 2016. Using GARCH (1, 1) model. It is found that foreign exchange intervention is effective in reducing the exchange rate volatility and appreciates the Kenya shilling against the US dollar. This result supports the description of CBK foreign exchange intervention as 'leaning against the wind'. Meaning it is acting to slow or correct excessive trends in the exchange rate.

KEYWORDS

Kenya, central bank**,** exchange rate, foreign exchange intervention, volatility.

JEL CODE

E50.

INTRODUCTION

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 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. 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).

Kenyan 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 directly in the foreign exchange market through buying and selling of foreign currency. The main question of interest is whether Kenya Central Bank direct intervention achieves its objectives of reducing volatility and sustaining the value of the Kenya shilling.

LITERATURE REVIEW

Many studies conducted in the past gives contradicting views regarding to the effectiveness of monetary intervention on exchange rate volatility. Some studies conclude that intervention reduces volatility of the exchange rate and changes exchange rate values, others argue that it increases the volatility and has no effect on direction of exchange rate, another group of scholars admit that intervention influences exchange rate volatility without giving a specific direction and still others have found that intervention is actually ineffective. Schwartz (1996) referred ineffective intervention to be "an exercise in futility" that at best can have short-term effect on exchange values and at worse; it brings uncertainty and volatility in foreign exchange markets and thus no need for central bank exercising it.

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 the mean and variance equations, which were the different measures of foreign exchange intervention, plus day of the week and holiday dummies. Using exponential GARCH models, they concluded that large interventions have a stabilizing influence in the foreign exchange market in terms of 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, Simatele (2004) examines the effect of central bank intervention on the Zambian kwacha. She used a GARCH (1, 1) model in order to estimate the effect of intervention on the 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 they have no harmony on which channel of intervention works although they have discussed on sterilised intervention mostly signalling and portfolio balance channels.

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 ANOVA to do its data analysis where variance analysis was used in the instances where CBK intervened in the market and in those days 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. Likewise, 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. To add on that Aguilar and Nydahl (2000) examine the impact of intervention on the level and volatility of the Swedish Krona (krona-dollar and krona-mark rates) from January 1993 to November 1996. They use a bivariate GARCH model and the implied volatility approach from currency options. They find no significant effect for the exchange rate level and only weak evidence for a reduction in volatility for the whole period. When Fatum and King (2004) use 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 U.S. dollar, the findings find 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.

On the other extreme, 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.

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 data period chosen for the empirical analysis is January 1997 to June 2016. 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.

The variables used in this study are Kenya shilling to US dollar exchange rate returns (ERT) and net FOREX intervention (INV). Control variables included in the model were; central bank rate (CBR), 91-day Treasury bill rate (TB) and Inflation rate (INF). INV is defined as the difference between central bank's purchase and sale of US dollar in the market in order to influence the exchange rate. 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.

MODEL SPECIFICATION

Foreign exchange intervention in the foreign exchange market affects exchange rate and its volatility by changing the market fundamentals, expectations of future fundamentals or policies, and speculative trends. This can be computed through a regression Model. In this study CBK foreign exchange intervention was related to exchange rate level and its volatility using GARCH (1,1) model.

The model is as follows;

$ERT_t = a_0 + a_1 lnINV_t + a_2\Delta lnCBR_t + a_3\Delta lnTB_t + a_4\Delta lnINF_t + \varepsilon_t$.. ……………………………………………………………conditional mean equation (1)

Where,

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

$h_t = b_0 + b_1 INV_t + b_2\Delta lnCBR_t + b_3\Delta lnTB_t + b_4\Delta lnINF_t + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}$. …………………………………………………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), central bank rate (CBR), 91-day Treasury bill rate (TB) and Inflation. 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. According to theory, the foreign exchange intervention 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.

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 foreign exchange 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.

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, $\mathrm{H}_0\colon \alpha + \beta = 1$, to mean that the error variance is integrated or non-stationary against the alternative $\mathrm{H}_1\colon \alpha + \beta < 1$, 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 1, 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 following Table.

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				

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

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

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

PARAMETER ESTIMATES

From conditional mean equation in Table 1, 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.

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. Therefore, exchange rate level is also 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 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 foreign exchange intervention leads to an increase in exchange rate volatility and uncertainty. This means that, past disturbances and information available to the participants in the 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. Hence, lagged volatility has more significant influence 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. Also, volatility appears to be affected significantly by both 91-day Treasury bill rate and inflation but central bank rate has no significant effect on both exchange rate level and volatility. Increasing 91-day Treasury bill rate reduces exchange rate volatility while inflation has a negative impact on exchange rate volatility. Therefore, 91-day Treasury bill rate and inflation have a significant policy implication in controlling exchange rate volatility.

SUMMARY AND CONCLUSIONS

It is generally agreed that a combination of a stable exchange rate environment and a competitive currency attracts investment, increase aggregate output and expand country's economic prosperities. To maintain the value of Kenya shilling and control exchange rate volatility, CBK intervenes directly in the foreign market with the goal of stabilizing the exchange rate. The GARCH model results for variance equation confirms that foreign exchange intervention reduces exchange rate volatility however, from the mean equation, FOREX intervention would decrease the exchange rate return against the expectations of the investors (leaning against the wind) leading to appreciation of Kenya shilling contrary to the theory. Thus CBK FOREX intervention has been reducing the extent of fluctuations of the exchange rate rather than changing the direction of the shilling movement against the US dollar. The 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.

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