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ECONOMICS

NATURE OF CAUSALITY BETWEEN EXCHANGE RATE AND STOCK PRICES IN KENYA

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ABSTRACT

Purpose of the study: The objective of the study was to examine the nature of causality between exchange rate and stock prices in Kenya.

Statement of the problem: In Kenya, there has been volatility in exchange rates that have been deemed to have an adverse effect on the share prices. Over the last five years, in the aftermath of 2008 post-election violence, both economy and the shilling suffered a serious decline. The foreign exchange rate has been fluctuating hitting an all-time high of Kshs/USD107 in the year 2011 from KShs/USD 87 in the year 2010. Nairobi All Share Index (NASI) plunged 30.45 percent to 68.08 points in 2011 down from the 97.82.

Methodology: The target population consisted of monthly observations of the Nairobi All Share Index (NASI) and the nominal Kenya shillings per US dollar exchange rates from the year 2008 to 2015. Secondary data was collected from Central Bank and Nairobi Securities Exchange. The research employed a Vector Auto-Regression (VAR) model. Granger causality approach was employed to infer information about the directions of causality between foreign exchange rates and stock prices.

Findings: The study found out that exchange rate Granger causes stock prices in Kenya.

Recommendations: The study recommends that causation should be vital tool of designing exchange rate policies. The investment banks should consider the linkage between stock market and exchange rate in risk management process. Besides, investors can consider this linkage in hedging against open exposure caused by foreign exchange volatility. The central bank should effectively strive to maintain a stable exchange rate through use of monitory policy tools since exchange rate volatility poses a financial risk to the country.

Keywords: *Causality, Exchange Rate, Stock Prices, Kenya*

BACKGROUND OF THE STUDY

Stock prices can be influenced by volatility of the market, the prevailing economic conditions, and reputation of the company. Other than demand and supply, other macroeconomic variables such as exchange rate, interest rates, Gross Domestic Product, current account, employment, inflation, and money supply determine the demand and supply of shares, thus influencing share prices (Kurihara, 2006). According to Lu, Metin, and Argac (2001) volatility of stock prices in stock market are linked with macroeconomic behavior in developed countries. The stock market is a critical institution in an economy which significantly indicates the performance of an economy. Stock market return is one of the most pertinent parameter for the shareholders and management of the organizations (Lu, Metin, & Argac, 2001).

In a global context, various financial crisis has been associated with different factors. However, major crisis; Argentina 1994, East Asia 1997, Turkey 2001, Latin America 1994, and global financial crisis of 2007/2008 have one homogeneous characteristic; the simultaneous effect on stock prices and currencies. To a larger extent, this simultaneous effect has raised an alarm on which variable is the leading cause of the other (Abbas, 2010). Theoretically, a lack of agreement exists on the nature of causality between exchange rate and stock prices movement. Recent global context statistics provide mixed results. However, information about the relationship present in separate financial markets has established three theories which are, asset approach, traditional approach as well as the portfolio approach (Aima & Zaheer, 2015).

In Kenya, the history of exchange rates has been volatile since 2007. The USD/KES spot exchange rate has depreciated by 0.20 percent during the last ten years. From 1993 until 2013, the USD/KES

averaged 75.99, reaching an all-time high of 105.75 in October 2011 and recorded low of 36.23 in January of 1993 (Obura, Mukras, & Oima, 2013). The depreciation of exchange rate resulted to macroeconomic problems such as worsening of the balance of payment (BOP), high inflation rates, an increase in the cost of imports, a decrease in stock prices, and a decrease in exports (KPMG, 2012). Fundamentally, the volatility of foreign exchange rate has an influence on a firm's value because the future of a company's income changes with foreign exchange rates fluctuations. For instance, appreciation of exchange rate shrinks the sales and profits of exporters since there will be a loss of competitiveness by exporters in the global market. Conversely, importers will increase their competitiveness in the domestic market raising the profit and hence stock price (Agrawal et al., 2010).

Changes in exchange rates have an influence on domestic firms upon exporting outputs and importing part of their inputs. For instance, when a currency is devaluated, exported goods become cheaper while imported inputs become expensive (Tabak, 2006). According to Aggarwal (1981), devaluation positively affect exporting firms because it increases firms' profit margins, which in turn boost average stock prices (Aggarwal, 1981). Some fundamentalist investors such as Phylaktis, Kate, and Ravazzolo (2005), have studied these relationships in the quest to predict the future trends for each other with no conclusive results. Thus, clear knowledge of the causality between exchange rate and stock prices will help domestic as well as the international investors to plan for risk management through hedging (Ravazzolo & Phylaktis, 2005).

Thus, the study examined the nature of causality between exchange rate and stock prices in Kenya, drawing insights from various empirical studies that have explored the dynamic interaction between stock markets and currency markets across different countries and economic contexts. Notably, studies like Kisaka and Mwasaru (2012) specifically addressed the Kenyan market, finding that exchange rates Granger-cause changes in stock prices, which is directly relevant to the objective of this research. Other studies, such as Aggarwal (1981), Bahmani-Oskooee and Sohrabian (1992), and Ajayi and Mougoue (1996), provided a broader perspective by examining advanced economies and revealing both unidirectional and bidirectional causality between these variables. This rich body of empirical evidence, despite presenting mixed results, underscores the complexity of the relationship between exchange rates and stock prices and highlights the

importance of considering both global and local economic conditions in understanding this interplay within the Kenyan context.

STATEMENT OF THE PROBLEM

The performance of a security market reflects the economic situation of a country. In a globalized world, security prices are affected by both the country's domestic economy activities and foreign economic events (Obura et al., 2013). In the aftermath of 2007-2008 post-election violence in Kenya, both the stock prices and the currency declined.The foreign exchange rate hit an all-time high of Kshs/USD107 in the year 2011 from KSh/USD 87 in the year 2010. Nairobi All Share Index (NASI) plunged 30.45 percent to 68.08 points in 2011 down from the 97.82 (KPMG, 2012). The volatility of exchange rates and fluctuations of stock prices led to big losses in investors' portfolios due to uncertainty and inefficiency of financial markets (Odoyo, Muasya, & Kipyego, 2014). Due to this, various research have been carried out to investigate the dynamic issue of the inter-temporal causality between stock returns and exchange rates, but the results are inconclusive. In addition the empirical findings provide four strings of evidence that differs sharply.

The first string of empirical studies found out that exchange rate Granger-cause changes in stock prices (Issam & Murinde, 1997; Ajayi et al., 1998). The second string found out that stock prices Granger-cause changes in the exchange rate (Tabak, 2006; Bonga-Bonga & Hoveni, 2011). The third string of evidence found a bidirectional causality (Bahmani-Oskooee & Sohrabian, 2011; Pan, et al., 2000). Conversely, the fourth string of empirical studies found no sign of a causality (Ajayi, 1998). Besides, a study conducted in Kenya by Kisaka and Mwasaru (2012), found out that exchange rate Granger-cause stock prices. However, the study used Nairobi 20 Share Index; which does not reflect real market performance. In addition the study was conducted for the period between May 1993 to May 1999, which does not reveal the trend in last eight years when Kenya faced the extreme volatility of exchange rate (Kisaka & Mwasaru, 2012; Ramasamy & Yeung, 2001; Agrawal et al., 2010)

Besides, the review of existing empirical studies lacks a high level of evidence to provide a conclusive link between exchange rate and stock prices which remain a vital research issue. Thus, this study seeks to examine the nature of causality between exchange rate and stock prices in Kenya. This research aims to shed light on how exchange rate fluctuations influence stock market

performance in an emerging market setting, taking into account local economic policies, market maturity, and external economic forces. The outcome of this study could provide valuable insights for investors, policymakers, and scholars, offering a clearer understanding of the interplay between currency valuations and equity markets in emerging economies and contributing to the broader discourse on financial market dynamics.

RESEARCH OBJECTIVE

To examine the nature of causality between exchange rate and stock prices in Kenya.

LITERATURE REVIEW

Theoretical Literature

The Good Market Theory, often referred to as the Flow Oriented Model or Traditional Approach, posits that exchange rate fluctuations have a direct impact on stock price movements. According to Donbursh and Fisher (1980), this model emphasizes the importance of a country's current account balance as a key determinant of its currency's exchange rate. The theory suggests that changes in the exchange rate, influenced by trade balances and financial flows, can affect company valuations, particularly for those engaged in international trade. The theory proposes a one-way causality from exchange rates to stock prices, highlighting the concept that stock prices reflect the present discounted value of a firm's expected future cash flows. Therefore, any factor that affects a company's cash flow would be reflected in its stock price, assuming the market is efficient (Rahman & Uddin, 2009; Tian, Gary, Ma, 2010; Sims,1980a).

In contrast, the Portfolio Balance Theory, also known as the Stock-Oriented Model, argues that causality flows from stock prices to exchange rates. This approach, detailed by Branson, Halttunen, and Masson (1977), contends that stock prices directly influence exchange rates through the performance of the capital account. The theory asserts that a thriving stock market attracts foreign investment, leading to capital inflows that bolster the local currency. This model underscores the connection between stock prices and exchange rates via capital account transactions, suggesting that stock price variations can lead to corresponding changes in exchange rates. The theory also accounts for the impacts of market liquidity and segmentation on trading ease and foreign investment levels, respectively (Aima & Zaheer, 2015; Cushman, 2003).

The Arbitrage Pricing Theory (APT), formulated by Ross in 1979, offers a broader approach by associating stock prices with various macroeconomic factors through a multi-factor model. The APT posits that stock returns are influenced by multiple macroeconomic risks and non-market factors, based on the principle of arbitrage. This theory asserts that in an efficient market, two similar assets with identical risks and returns should be priced equally. The APT extends the analysis of stock market behavior to include a wider array of macroeconomic variables, moving beyond the direct interplay between stock prices and exchange rates (Ross, 1979). The Arbitrage Pricing Theory (APT) that assumes that the rate of return on any security is a linear function of k factors (Ross, 1976). The model is formulated as;

$$R_i = \lambda_0 + \beta_{i1}\lambda_1 + \beta_{i2}\lambda_2 + \ldots\ldots + \beta_{ik}\lambda_k + \varepsilon_i \qquad i=1, 2\ldots, n$$

The APT model shows that the rate of return (R_i) is a linear function of k macroeconomics factors (λ_k) with ƙ sensitivities (β_k).

Empirical Review

The study by Aggarwal (1981) found a direct correlation between exchange rate movements and stock prices in the US, suggesting that changes in exchange rates could impact a company's financial outcomes and, consequently, its stock prices. Bahmani-Oskooee and Sohrabian (1992) applied Granger causality tests to investigate the US market and found a short-term bidirectional causality between share prices and exchange rates, without a long-term relationship. Similarly, Ajayi and Mougoue (1996) explored the dynamics in advanced economies and discovered short-term effects where stock price increases led to currency depreciation in the US and UK. Ajayi, Friedman, and Mehdian (1998) compared developing nations with developed ones and found consistent patterns in developed economies that align with the portfolio model, indicating different causality directions across countries. Pan, Fok, and Liu (2000) noticed increased interactions between exchange rates and stock prices during the 1997 Asian financial crisis, while Ravazzolo and Phylaktis (2005) observed a positive relation between stock and foreign exchange markets over an 18-year period in Pacific Basin countries, influenced by the US stock market.

Osei (2006) discovered a long-term relationship between selected macroeconomic variables and the Ghana stock market, while Adam and Tweneboah (2008) found cointegration between macroeconomic factors and stock prices in Ghana, with significant impacts from inflation. Bonga and Hoveni (2011) revealed a unidirectional volatility spillover from the equity market to the

foreign exchange market in South Africa. Agrawal, Srivastav, and Srivastava (2010) examined the relationship between Nifty returns and USD-INR exchange rates, finding a unidirectional correlation from Nifty returns to exchange rates. Lastly, Kisaka and Mwasaru (2012) focused on Kenya, where they found that exchange rates Granger-caused changes in stock prices, reflecting the unique dynamics and challenges within the Kenyan market.

RESEARCH METHODOLOGY

The methodology is presented in sections.

Research Design

The study used a non-experimental research design, since there was no control of the variables. The non-experimental research design is a research design in which variables used in the research are not manipulated nor is the environment controlled (Belli, 2008). The main objective of the study was to investigate dynamics of rates of exchange and prices of stock in NSE. The study used Granger causality and Vector Auto regression (VAR) method.

Theoretical Model

The study adopted Asset Pricing Theory (APT) in the development of the empirical model. The Asset Pricing Theory (APT) is a multifactor model has the assumption that the function of the rate of return on any stock is linear with k factors (Ross, 1976). The model is given by equation 3.1 below;

$$R_{it} = \lambda_0 + \beta_{1t}\lambda_{1t} + \beta_{2t}\lambda_{2t} + \beta_{3t}\lambda_{3t} + \cdots + \beta_{kt}\lambda_{kt} + \varepsilon_i \quad i = 1, 2, 3\ldots, k \ldots\ldots\ldots 3.1$$

Where; R_i is the return of asset, β_k is the coefficients of λ_k factor, λ_k are the factors, and ε_i is the random noise term.

The above equation shows that the function for rate of return (R_{it}) is a linear with k macroeconomics factors (λ_k) with k coefficients (β_k). The model shows a linear relationship between the prices of stock and the macroeconomic variables. If there are k macroeconomics factors i.e $\lambda_1, \lambda_2, \ldots\lambda_k$ with each stock having k sensitivities ($\beta_1, \beta_2, \ldots,\beta_k$). The theoretical model can be expressed as;

$$SP_{it} = \lambda_0 + \beta_{it}\lambda_{it} + \ldots + \beta_{kt}\lambda_{kt} + \varepsilon_i \qquad i = 1, 2 \ldots k \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.2$$

Where; SP_{it} is the stock price, β_{it} is the coefficients of λ_{it} factor, λ_i are the factors, and ε_i is the random noise term.

Model Specification

An empirical counterpart of equation (3.2) can be achieved by introducing exchange rate into APT model as part of the significant explanatory variable. As mentioned earlier, research by Osei (2006) found out a significant long-run relationship between exchange rate and stock price in Ghana. Following the theoretical model equation (3.2), the empirical model for this study expresses stock prices as a linear function of inflation, money supply, interest rates, and the exchange rate with each factor having β_k coefficient. The relationship between stock return and macroeconomics variables may be expressed in general form as follows;

SP= f (INF, EXR, TBR, MS) ……..…….... 3.3

Where SP is monthly stock price, INF is inflation rate, TRB is Treasury bill rate, and MS is the money supply and EXR is the exchange rate.

The Linear equation becomes

$SP_t = \lambda_0 + \beta_1 INF_t + \beta_2 EXR_t + \beta_3 MS_t + \beta_4 TBR_t + \varepsilon_t$ ……..…….3.4

Where SP_t is the stock market price at time t, λ_0 is the intercept, β is the coefficient of each macroeconomic variable, INF is inflation, EXR is the exchange rate, TBR is 91-day treasury bill rate (a proxy for interest rates), and MS is the broad money supply (M3).

Testing for Stationarity (Unit Root Test)

Unit root is a fundamental test performed to ensure that time series data has a constant mean and variance to avoid spurious results. Unit roots test was carried out to avoid the problem of the non-stationarity series that may lead to spurious results due to trend in the data series. The study employed Augmented Dickey-Fuller test and Kwiatkowski Phillips Schmidt-Shin (KPSS) unit root test to establish the stationarity of the time series and to determine the order of integration of variables. Using the ADF unit root tests the following equation is estimated:

$$\Delta Y_t = \alpha + \beta_t + \rho Y_{t-1} + \sum_{i=1}^{k} \delta_i \Delta Y_{t-1} + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.5$$

The null and alternative hypotheses tested in the study were that H_0: $\rho = 0$ and H_1: $\rho < 0$.
If the computed t-statistics is greater than the asymptotic critical values in absolute values, the null hypothesis (series contained unit root), was rejected and concluding that the series was stationary (Gujarati, 2004). The major weakness of ADF is that it has a lower power and hence it tends to give biased conclusion. To remedy this, the study employs KPSS to eliminates the low power which occurs in Augmented Dickey Fuller (ADF) test (Green, 2008) For the KPSS criterion, the hypothesis tests for the series was:

$$x_t = \beta y_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.6$$

The hypotheses test for the model:

$H_o: \sigma_e^2 = 0 \mapsto x_t \ \ I(0)$ Stationary

$H_1: \sigma_e^2 \neq 0 \mapsto x_t \ \ I(0)$ Non-stationary

If t-calculated statistics is greater than the asymptotic critical values, the null hypothesis for stationarity is rejected, concluding that the series is non-stationary.

Vector Autoregressive Model

The study employed Vector Auto regression (VAR) model. The compact form of a VAR model that links stock prices and selected macroeconomic variables in equation (3.3) is represented as:

$$X_t = A_0 + A_1 X_{t-1} + A_2 X_{t-2} + \cdots + A_p X_{t-p} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.7$$

Where A_0 is n × 1 vector of constant terms, $A_1, A_2, .., A_p$ are n × n matrices of coefficients, X_t is a n×1 vector of endogenous variables: X_t = (NASI, INF, EXR, TBR, MS) and εt is a vector of serially uncorrelated disturbance terms with a constant variance and Zero means. To estimate VAR model (3.7) a system of equation for stock prices and exchange rate was developed; where the Granger causality of the exchange rate and stock price was examined (Enders & Granger, 1998).

Granger Causality Test

X is said to Granger-cause Y, if Y can be better predicted using the histories of both X and Y than it can by using the history of Y alone. Granger causality is employed in situations where there is some relationship between two variables, but it is not known which variable causes the other to move. In this case, Granger causality test was employed to test the association between stock price and exchange rates (Giles, 2015). Granger causality test was done through estimation of two regression equation expressed as follows:

$SPt=\alpha+\beta_{11}SP_{t-1}+\ldots+\beta_{1p}SP_{t-P}+\beta_{11}EXR_{t-1}+\ldots+\beta_{1q}EX_{t-q}+\beta_{11}INF_{t-1}+\ldots+\beta_{1p}INF_{t-R}+\beta_{11}TBR_{t-1}+\ldots+\beta_{1p}TBR_{t-S}+\beta_{11}MS_{t-1}+\ldots+\beta_{1p}MS_{t-U}\ \varepsilon_t$ ………..…………………..… 3.8

$EXR_t=\alpha+\beta_{22}EXR_{t-1+\ldots+}\beta_{2p}EXP_{t-P}+\beta_{22}SP_{t-1}+\ldots+\beta_{2q}SP_{t-q}+\beta_{22}INF_{t-1}+\ldots+\beta_{2p}INF_{t-R}+\beta_{22}TBR_{t-1}+\ldots+\beta_{2p}TBR_{t-S}+\beta_{22}MS_{t-1}+\ldots+\beta_{2p}MS_{t-U}+\varepsilon_t$ ……….. ……………... 3.9

Where; ε_t is the noise error term, t-i is the time lag. Equation (3.8) postulates that current stock price (SP) is related to past values of Exchange rate (EX) as well as past values of SP. Similarly, equation (3.9) stipulates that EX is related to past values of EX as well past values of SP. Following equation 3.8 and 3.9, the following hypothesis was be tested. The hypothesis test of equation (3.8):

H_0; EX do not Granger cause SP

H_1; EX Granger cause SP

Similarly, the hypothesis test for equation (3.9):

H_0; SP do not Granger cause EX

H_1; SP Granger cause EX

The four possible expectations are; [1] presence of unidirectional causality SP to EX, [2] presence of unidirectional causality from EX to SP, [3] SP and EX Granger cause each other, i.e., bilateral causality and [4] EX, and SP are independent of each other.

The Dynamics Response

Studies have found out that estimated coefficients of the VAR model have no economic interpretation because they are equal to reduced form equations. Sims (1980) came up with a method of estimating VAR coefficients to trace the dynamics path of a specific variable in a system, given a certain effect of innovation or a shock brought about by a change in a variable. The dynamic response is estimated through Variance decomposition and the Impulse Response functions (IRF). VAR model can be written in the form of Vector Moving Average (VMA) where variables may be expressed as a function of the past and current values of the error terms. The VMA representation traces out the time path of shocks on the variables in VAR (Sims, 1980b)

The Impulse Response Functions

The impulse responses functions was be delivered from Vector Moving Average. They link the future values of the variables to the current values of error term (Enders & Granger, 1998)

Data Type, Source and Analysis.

The study utilized secondary data for the period 2008-2015. The sources of data included; Central Bank of Kenya, Nairobi Securities Exchange, and Capital Market Authority (CMA). The NASI share index was be obtained from NSE databases and Capital Market Authority. The exchange rate, money supply, 91-Day Treasury Rate, and inflation rate was obtained from the Central Bank statistics. The objective was achieved by carrying out Granger causality test between SP and EX.

FINDINGS AND DISCUSSIONS

The empirical findings and discussions are presented in sections.

Data Characteristics

The study used monthly time series data for the period 2008-2015. The sources of data included Nairobi Securities Exchange, Capital Market Authority and central bank of Kenya. Data was collected for the variables including Exchange rate (EX), Nairobi All Securities Exchange (NASI), Inflation rate (INFL), Treasury Bill rates (T-Bills), and Money Supply (M3).

Descriptive Statistics for Variables

Table 1: Descriptive Statistics for Macroeconomic Variables Data Set

	NASI	EXCHANGE RATES	91 DAY TBILL	INFLATION	M3
Mean	106.33	84.08	8.64	9.04	1575201.0
Median	97.09	84.61	8.39	7.08	1513656.0
Maximum	172.93	105.28	21.65	19.72	2650182.0
Minimum	58.42	61.10	1.60	3.18	810206.0
Std. Dev.	33.36	8.84	3.88	5.05	552743.6
Skewness	0.52	-0.04	0.98	0.84	552743.6
Kurtosis	1.97	3.51	5.10	2.32	0.342390
Jarque-Bera	8.37	1.05	32.74	12.93	6.354379
Probability	0.015	0.59	0.00	0.00	0.041703

Source: Author (2016)

Descriptive statistics give summaries about the sample and they form a fundamental basis for every quantitative data analysis. The summary of the statistical characteristic of all the variables are shown in Table 1. Sample mean, standard deviation, skewness and kurtosis, the Jacque- Bera statistics and the P- value, have been reported. The high standard deviation of stock returns (SR) implies that there was high volatility at the stock market. The actual data and refined data for estimation is attached as Appendix 1.

Stationarity Test

The study employed Augmented Dickey-Fuller test and Kwiatkowski Phillips Schmidt-Shin (KPSS) unit root test to establish the stationary of the time series and to determine the order of integration of variables. Tables 2 show results for unit root tests.

Table 2: ADF Unit Root Test Results

Variable	Form of test	Test Statistic	ADF Asymptotic Critical Value			Conclusion
			1% level	5% level	10% level	
Exchange Rates	Intercept only	-1.162061	-3.503879	-2.893589	-2.583931	Non-Stationary
	Trend and intercept	-2.871588	-4.062040	-3.459950	-3.156109	
NASI	Intercept only	-0.997677	-3.503879	-2.893589	-2.583931	Non-Stationary
	Trend and intercept	-2.781080	-4.062040	-3.459950	-3.156109	
Inflation rate	Intercept only	-4.319833***	-3.503879	-2.893589	-2.583931	
	Trend and intercept	-4.062695***	-4.062040	-3.459950	-3.156109	Stationary
Interest Rates	Intercept only	-2.277793	-3.503879	-2.893589	-2.583931	Non-Stationary
	Trend and intercept	-2.421911	-4.062040	-3.459950	-3.156109	
Money Supply	Intercept only	2.978019	-3.503879	-2.893589	-2.583931	Non- Stationary
	Trend and intercept	-1.455593	-4.062040	-3.459950	-3.156109	

Source: Author (2016)

Note: ***stationary at 1%; ** stationary at 5%; * stationary at 10% levels of significance.

From the ADF criterion, all the variables (NASI, EX, MS, IR) except inflation rate were found to contain unit roots (non-stationary). Under the ADF test the null hypothesis for the presence of a unit root was not rejected at 5 per cent level of significance for stock prices, exchange rates, money supply and interest rate. However, the presence of a unit root was rejected at 5 per cent level of significance for inflation, meaning inflation was stationary. However, all the variables except money supply that were not stationary as per ADF tests were all found to be stationary by KPSS test which is a superior test for stationarity (Gujarati, 2004). The findings of the test are shown in Table 3.

Table 3: KPSS Stationarity Tests Results

Variable	Form of test	Test Statistic	KPSS Asymptotic Critical Value			Conclusion
			1% level	5% level	10% level	
Exchange Rates	Intercept only	1.043243	0.7390	0.4630	0.3470	Stationary
	Trend and intercept	0.114640***	0.2160	0.1460	0.1190	
NASI	Intercept only	0.903606	0.7390	0.4630	0.3470	Stationary
	Trend and intercept	0.204774*	0.2160	0.1460	0.1190	
Inflation rate	Intercept only	0.297011***	0.7390	0.4630	0.3470	
	Trend and intercept	0.065395***	0.2160	0.1460	0.1190	Stationary
Interest Rates	Intercept only	0.298815***	0.7390	0.4630	0.3470	Stationary
	Trend and intercept	0.066681***	0.2160	0.1460	0.1190	
Money Supply	Intercept only	1.283437	0.7390	0.4630	0.3470	Non-Stationary
	Trend and intercept	0.291941	0.2160	0.1460	0.1190	

Source: Author (2016)

Note: ***stationary at 1%; ** stationary at 5%; * stationary at 10% levels of significance.

In the KPSS criterion, all variables except money supply were stationary at levels since the computed LM test statistics were less than the asymptotic critical values for rejection of the null hypothesis at 1 per cent, 5 per cent or 10 per cent level of significance (Judge, Hill, Griffiths, & Lee, 1985). First difference was done on money supply to make the series stationary.

Table 4: 1st Difference using ADF and KPSS Stationarity Tests Results

Variable	Form of test	ADF	KPSS	conclusion
Money Supply 1st Difference	Intercept only	-9.086610***	0.409378***	Stationary
	Trend and Intercept	-9.030787***	0.435435	Stationary

Source: Author (2016)

After 1st differencing of money supply, all the variables were stationary. The analysis of ADF and KPSS reveals that exchange rate, Nairobi all securities index, inflation rate, and interest rate are stationary at level, thus are intergrated of order I(0). Money supply became stationary after 1st

difference; thus it is intergrated of order I (1). Because all the variables except money supply were stationary at levels as shown by KPSS tests, it was concluded that there was no need to carry out cointegration analysis of the variables.

Test for Multicollinearity

According to Gujarati (2004), multicollinearity between regressors leads to inaccurate estimates since the presence of multicollinearity inflates coefficients of standard errors thereby affecting the predictors. To avoid having inaccurate estimates, correlation between regressors was done to test for multicollinearity. To affirm the absence of multicollinearity, the correlation coefficient between variables should be less than 0.8. The results of the correlation coefficients was represented by correlation matrix in Table 5.

Table 5: Present Pearson's Bivariate Correlation Results

		Exchange Rates	NASI	Inflation	Interest rates	dM3
Exchange Rates	Pearson Correlation	1.000				
	Sig. (2-tailed)					
NASI	Pearson Correlation	.501**	1.000			
	Sig. (2-tailed)	.000				
Inflation	Pearson Correlation	-.220*	-.399**	1.000		
	Sig. (2-tailed)	.031	.000			
Interest rates	Pearson Correlation	.423**	.036	.396**	1.000	
	Sig. (2-tailed)	.000	.728	.000		
dM3	Pearson Correlation	.206*	.285**	-.227*	-.001	1.000
	Sig. (2-tailed)	.046	.005	.027	.992	

Source: Author (2016)

From the results in Table 5, it could be seen that the exchange rate, Nairobi all securities exchange, inflation rate, interest rates, and money supply were not highly correlated to any other variable. Nairobi All Securities Exchange was found to be moderately correlated to the exchange rate (0.50). Inflation rate was negatively correlated to exchange rate (-0.22) and Nairobi All Securities Exchange (-0.4). Interest rates was positively related to exchange rates (0.42), Nairobi All

Securities Exchange (0.04), and inflation rates (0.40). Money supply was positively correlated to exchange rates (0.21), Nairobi All Securities Exchange (0.29) whereas it was negatively related inflation (-0.23) and interest rate (-0.001). Multicollinearity results indicate that the correlation coefficients between independent variables were less than 0.8 proving there was no serious multicollinearity among the variables.

Residual Tests Results

The classical linear regression requires that the regression error term must be normally distributed with zero mean and constant variance (Green, 2008). After running the specified regression model; the test for normality, heteroskedasticity and autocorrelation were conducted on the residual to ensure all the OLS assumptions are not violated before making any conclusions and checking whether the estimated models could be used for forecasting. A series of diagnostic results were carried out to ascertain the statistical soundness of the models (Gujarati, 2004). The following sections report results of the residual-based tests, model specification, and the stability tests.

Normality Test - Histogram-Normality Test

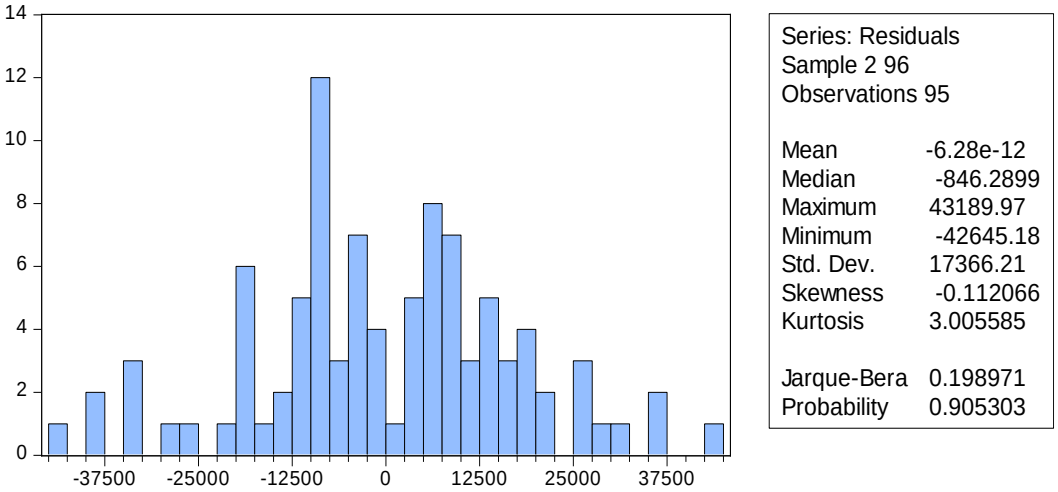

Figure 1: Jarque-Bera Test for Normality

Source: Author (2016)

One of the basic assumption of good regression model is that the error term of the regression model should be normally distributed. To affirm the normality test, the probability of the Jarque Bera should be more than the 0.05. The null hypothesis was that the error term was normally distributed. The Jarque Bera Statistics was found to be 0.1990 with probability value 0.9053 (90.53 percent)

which was greater than p-value of 0.005 (5 percent). Thus, the null hypothesis was not rejected meaning that the residual was normally distributed as shown in Figure 1.

Autocorrelation Test- Breusch-Godfrey Langrage Multiplier Test

Serial correlation is present if residuals of one period are related to the residuals of the previous period. Breusch-Godfrey Serial Correlation LM to test was employed on the study to test for the presence of serial correlation. The null hypothesis for serial correlation test was stated as, H_0: There is no serial correlation. If the probability value (p-value) is greater than 5%, the null hypothesis is not rejected. The results on Breusch-Godfrey Serial Correlation LM Test are presented in Table 6

Table 6: Serial Correlation Tests Results

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	12.07	Prob. F(4,89)	0.0000
Obs*R-squared	0.35173	Prob. Chi-Square(2)	0.00452

Source: Author (2016)

Since the probability value is less than 5 percent, the null hypothesis of no serial correlation is rejected, concluding there is presence of serial correlation. Thus, to correct for presence of serial correlation, the study employed HAC (Newey-West) standard errors to correct for serial correlation.

Heteroskedasticity Test- Breusch-pagan Langrage Multiplier Test

Heteroscedasticity transpires when the variance of the residuals in a model is not constant. Breusch-Pegan-Godfrey test was employed to test for the presence of Heteroscedasticity. The null hypothesis for the test, H_0: Variance is constant (homoscedasticity). If the probability value (p-value) is greater than 5 percent, the null hypothesis is not rejected. The results are presented in Table 7

Table 7: Heteroskedasticity Test Results

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.761849	Prob. F(4,90)	0.1435
Obs*R-squared	6.898719	Prob. Chi-Square(4)	0.1413
Scaled explained SS	3.498268	Prob. Chi-Square(4)	0.4781

Source: Author (2016)

Since the probability value is greater than 5 %, the null hypothesis of variance is constant is not rejected, concluding there is no problem of heteroskedasticity.

Regression Specification Error Test (RESET)

Ramsey (1969) proposed Regression Specification Error Test (RESET) to determine the departure from the classical linear regression assumptions. The model is used to detect specification errors in a model which could have been mis-specified but nonetheless give desired results. Ramsey and Alexander (1984), affirmed RESET as a test for correlation between independent variables and residuals, omitted variable problem and incorrect functional relationship in a model. In most cases the specification errors is due to measurement errors of the independent variables and expression of the independent variable as a function of lagged values in the model. The previous diagnostic test for normality, and heteroskedasticy proved that the estimated models satisfies all the OLS assumption hence desirable. Further, Ramsey RESET test was employed to examine the estimated equation and results are presented in the Table 8

Table 8: Ramsey RESET Tests Results

Dependent Variable	No. of terms	Test statistic		Conclusion
		F-statistic	Prob. (F-stat)	
Stock Price	1	3.204392	0.0768	No misspecification error evidence
	2	2.419326	0.0949	

Source: Author (2016)

The p-values of the F-statistic were both greater than 0.05. Therefore, the null hypothesis that the coefficients of the fitted values were all zero at 5 per cent level of significance for the models were

not rejected. Based on the results it was concluded that there was no possibilities of specification errors in the two models.

Granger Causality Test for Exchange rates and Stock prices

The objective was to examine the nature of causality between exchange rate and stock prices in Kenya. This objective was achieved by running Granger causality test. The null hypothesis for Granger causality tests is that stock price do not Granger cause exchange rate and exchange rate do not Granger cause stock prices. If the p-value is lower than the level of significance, then the null hypothesis is rejected. The estimation results are presented in Table 9

Table 9: Granger Causality Tests Results

VAR Granger Causality/Block Exogeneity Wald Tests			
Date: 05/20/16 Time: 15:28			
Sample: 1 96			
Included observations: 93			
Dependent variable: NASI			
Excluded	Chi-sq	df	Prob.
Exchange_rates	14.14582	2	0.0008
Interest_rates	0.165627	2	0.9205
Inflation	9.164867	2	0.0102
M3	7.666994	2	0.0216
All	46.33092	8	0.0000
Dependent variable: exchange rates			
Excluded	Chi-sq	df	Prob.
NASI	5.055646	2	0.0798
Interest rates	6.359179	2	0.0416
Inflation	4.473216	2	0.1068
M3	6.481919	2	0.0391
All	21.62525	8	0.0057

Source: Author (2016)

The Granger causality result for estimated equation (3.8) reveals that at 5 per cent level of significance, the p-value is (0.0008) which is less than the level of significance (0.005). Thus null hypothesis is reject (H_0; EX do not Granger cause SP) and alternative hypothesis is accepted (H_1; EX Granger cause SP), concluding that exchange rate Granger cause stock prices. On the other hand, the Granger causality result for estimated equation (3.9) reveals that at 5 per cent level of significance, the p-value is (0.0798) which is greater than the level of significance (0.05). Thus,

do not reject the null hypothesis (H_0; SP do not Granger cause EX) and conclude that stock prices do not Granger cause exchange rates.

CONCLUSION

The study concludes the causality test results indicate that exchange rates have a significant Granger causal effect on stock prices, as evidenced by a p-value of 0.0008, which is well below the 5 percent level of significance threshold. This finding supports the alternative hypothesis that exchange rates Granger cause stock prices, suggesting that fluctuations in exchange rates can predict changes in stock prices. Conversely, the relationship between stock prices and exchange rates does not exhibit a similar causality; the p-value of 0.0798 for this relationship exceeds the 5 percent significance level, leading to the retention of the null hypothesis that stock prices do not Granger cause exchange rates. This asymmetry in causality underscores the complexity of financial markets, where certain variables may influence others without reciprocal effects, highlighting the importance of understanding these dynamics for investors and policymakers in making informed decisions.

POLICY IMPLICATIONS

The study recommends that the investment banks should consider the linkage between stock market and exchange rate in risk management process. Besides, investors may consider this linkage in hedging against open exposure caused by foreign exchange volatility. The central bank should effectively strive to maintain a stable exchange rate through use of monitory policy tools since exchange rate volatility poses a financial risk to the country. Further, policies on exchange volatility management should be carefully designed in effort to avoid weakening interest rate since interest rate was the second variable that was found to have a negative effect on stock prices. The central Bank should ensure prudent measure are in place to maintain low inflation rate to keep interest rates stable and maintain stable stock prices in Nairobi Securities Exchange. In doing so, both domestic and foreign investor will invest in short term and long term portfolios, boosting the country economy.

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