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The Causal Relationship between Exchange Rates and Stock Prices in Kenya

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Abstract
This study examined the causal relationship between foreign exchange rates and stock prices in Kenya from November 1993 to May 1999. The data set consisted of monthly observations of the NSE stock price index and the nominal Kenya shillings per US dollar exchange rates. The objective was to establish the causal linkages between leading prices in the foreign exchange market and the Nairobi Securities Exchange (NSE). The empirical results show that foreign exchange rates and stock prices are nonstationary both in first differences and level forms, and the two variables are integrated of order one, in Kenya. Secondly, we tested for cointegration between exchange rates and stock prices. The results show that the two variables are cointegrated. Thirdly, we used error-correction models instead of the classical Granger-causality tests since the two variables are cointegrated. The empirical results indicate that exchange rates Granger-causes stock prices in Kenya.
Keywords: Exchange rate, Stock prices, Causality, Unit root, Error-correction models, Kenya

1. Introduction

In the recent past, a number of developments have occurred in finance in emerging economies. Among the most notable developments have been the establishment and revitalization of stock markets in emerging economies; and the shift from fixed exchange rates towards independently floating exchange rates. This has been done with the help of International Finance Corporation (IFC, 1993). The creation of stock exchanges in less developed countries will mobilize savings for private sector investment (Hartman and Khambata, 1993). Murinde (1993) has argued that funds raised in the emerging markets enable firms to decrease their over-reliance on debt finance, and to increase overall efficiency, competitiveness and solvency. This is because equity capital is cheaper compared to debt capital.

Though some stock markets in emerging economies have been performing exceptionally well (IFC,. 1993), most of them tend to be very small in size, with very low volume of transactions. They lack high quality accounting data and other market information. Scown (1990) and Sifunjo (2011) contend that, they may be riskier than their counterparts in developed countries due to market inefficiency.

The rapid expansion in international trade and the adoption of floating exchange rates by countries in the developed and developing world was a harbinger of a new era of increased foreign exchange volatility. Jorion (1990) points out those exchange rates were four times as volatile as interest rates and ten times as volatile as inflation rates. For the investor, changes in exchange rate poses a foreign exchange risk. High fluctuations in exchange rates can lead to big losses in an investor’s portfolio of investments due to uncertainty of return on investments. This is due to the fact that movements in foreign exchange rates affect the prices of goods on the international markets and this in turn affects the profit margin of exporting and importing companies.

Murnde (1993) argued that, the exposure of firms to exchange rate risks has increased. Two different types of risks under an independently floating exchange rate regime are identified in the existing literature. First, transaction exposure, which arises due to gains or losses arising from settlement of investment transactions stated in foreign currency terms. Second, economic exposure, which arises from variation in the firm’s discounted cash flows when exchange rates fluctuate. Thus, the exchange rate risks affect the risks and returns and hence the value of the firm. Hence, theoretically changes in the exchange rates causes changes in stock prices.

1.1 Statement of the Problem

In 1993 the Kenya government changed its foreign exchange policy from a fixed exchange rate regime to a floating exchange rate regime. At the same time, the government embarked on a mission to develop the Nairobi Securities Exchange (NSE) to international standards. Whether such efforts have resulted into increased market efficiency is debatable. This study contributed to this debate by examining the predictability of exchange rates and stock prices in Kenya. Furthermore, the direction of causality between exchange rates and stock prices is both theoretically and empirically inconclusive (Granger, et al., 2000; Pan, et al., 2007; Stavarek, 2005; Wu, 2000; Muhammad and Rasheed, 2002; Issam and Murinde, 1997; Ozair, 2006; Vygodina, 2006). Therefore, there is need to establish the direction and magnitude of the interaction between exchange rates and stock prices at the Nairobi Stock Exchange. These linkages have implications for the ongoing attempts, by the government to develop the stock market while at the same time shifting to independently floating exchange rates. Therefore, the aim of this study is to investigate the causal relationship between exchange rates (represented by the Kenya shilling price of one U.S. dollar) and the stock prices (proxied by the NSE 20-share index). Studies elsewhere have established an interaction between activities in the foreign currency market and the stock market (Issam et. al., 1997; Smith, 1992).

2. The Relationship between Exchange Rates and Stock Prices

There is need to examine the economic relationship between stock prices and foreign currency exchange rates first before looking at the causal relationship. The following paragraphs demonstrate that the relationship between these two financial price variables is direct

There are at least two theoretical approaches to the causal relations between stock prices and exchange rates (Granger, 2000). The first one is the traditional approach. For a multinational firm, volatility in exchange rates causes changes the value of that firm's foreign operation. This can either lead to a profit or a loss on its balance sheet. The profit or loss will change the firm's stock price. In this approach, exchange rate change is expected to lead to a change in stock price. According to this argument, devaluation could either raise or lower a firm's stock price depending on whether that firm is an exporting firm or it is a heavy user of imported inputs. Moreover, Adler and Dumas (1984) showed that even firms whose entire operations are domestic in nature may be affected by exchange rates, if the movements in currency influence their input and output prices, hence the demand for their goods and services.

The second theoretical basis is the portfolio approach. In this approach, changes in stock prices may influence movements in exchange rates via portfolio adjustments (Tabak, 2006). A drop in stock prices causes a reduction in the wealth of domestic investors, which in turn leads to a lower demand for money with ensuing lower interest rates. The lower interest rates encourage capital outflows ceteris paribus, which in turn cause local currency depreciation. In this case, stock price is expected to lead exchange rate with a negative correlation.

2.3 Non-stationarity, Cointegration and Granger Causality

At the least complicated level of economic theory lies the belief that certain pairs of economic variables should not diverge from each other by too great an extent, at least in the long-run. Thus, such variables may drift apart in the short-run or according to seasonal factors, but then economic forces, such as market mechanism or government intervention, will begin to bring them together again (Granger, 1969). Such variables are interest rates on assets with different maturities, prices of a commodity in different parts of the country; income and expenditure by local government, and the value of sales and production costs of an industry, money supply and prices, and spot and futures prices of a commodity.

In some cases, economic theory involving equilibrium concepts might suggest close relations in the long-run, possibly with addition of other variables (Smith l992). However, the correctness of the beliefs about long-term relatedness is an empirical question. The idea underlying cointegration allows specification of models that capture part of such beliefs about long-term relatedness. Since the concept such as the long-run is a dynamic one, the natural area for these ideas is that of time series theory and analysis.

A logical starting point in a study such as this one is, therefore, to address the time series properties of exchange rates and stock prices. This is because any empirical analysis from which valid inferences can be drawn must ensure that all time series are of the same order of integration in order to avoid the problem of spurious relationships and erroneous conclusions (Olowoye, 1995). Empirical studies indicate that most macroeconomic time series data follow random walks. Phillips and Durlauf (1986) and Ohania (1988), among others have demonstrated that if time series variables are non-stationary, all regression results with non-stationary series will differ from the classical theory of regression with stationary series. This means that regression coefficients with non-stationary series will be misleading. To avoid spurious relationships and misleading results with respect to exchange rates and stock prices, this study employs the co-integration and error correction models by Engle and Granger (1987).

The application of the classical Granger causality tests is a common practice in empirical research (Olowoye, 1995). In the classical Granger causality test, a variable X causes Y in Granger's sense, if the lagged values of X help improve the forecast of Y. One of the problems of the classical Granger-causality tests which Miller and Russek (1990) and Miller (1991) pointed out is that it is possible to find no causal relationship between two variables that share a common trend. This is so because a variable that exhibits non-stationarity will show no tendency to return to the long-term equilibrium level in the event of a random disturbance. Therefore, the classical Granger causality test may lead to misleading results.

The most significant aspect of co-integration analysis over the classical Granger causality test is that if two variables are integrated of order one, 1(1), and co-integrated, there must be Granger causality in at least one direction because one variable can help predict the other.

2.4 Empirical Literature

Previous researches conducted to study the causal relationship between stock prices and exchange rates have approached this issue from either a microeconomic or macroeconomic perspective (Issam and Murinde, 1997; Jorion, 1990; Smith, 1992a; Solnik, 1987; Nyamute, 1998; Loudon, 1993). Empirical studies at the microeconomic level suggest that there is generally weak evidence of exposure of firm's share price to exchange rate risks. However, it has been found that resource stocks (gold, other metals and oil industries) and industrial stocks respond differently to fluctuation in exchange rates. When currency appreciates, industrial stocks tend to perform well than when currency depreciates (Loudon, 1993). This study will not examine the microeconomic relationships.

Issam and Murinde (1997) studied the causal relationship between exchange rates and stock prices in India, Korea, Pakistan and Philippines. This was based on the bivariate vector autoregressive model. They first tested for stationarity and the order of integration of the time series data used. They found that all the variables were nonstationary in level forms and stationary after they have been differenced once. Thus, they concluded that the variables were nonstationay. Next, they tested for cointegration between exchange rates and stock price index. They found that the two variables were cointegrated in the Philippines and India, only. Hence, they applied Granger-causality tests in Korea and Pakistan where exchange rates and stock prices were not cointegrated and error-correction model in the Philippines and India where the two variables were cointegrated. Among the findings of interest were that exchange rates Granger-cause stock prices in Korea, Pakistan, and India, whereas stock prices Granger-cause exchange rates in the Philippines.

Nyamute (1998) studied the relationship between stock prices and other financial variables like money supply, interest rates, inflation rates and exchange rates in Kenya. The findings were that, a positive relationship exists between stock prices and exchange rates. There are, however, fundamental methodological flaws in Nyamute (1998) study which render the findings of questionable validity. First, he performed regression analysis on non-stationary series. This violates the classical theory of regression analysis with stationary time series (Olowoye, 1995; Granger, 1986; Phillips, 1986; Ohania, 1988). Consequently, these will lead to spurious relations that induce serial correlation that violate the basic assumptions for estimating the regression equation. Due to this violation we will have a misleading result characterized by a high value of the coefficient of determination associated with a low value of Durbin-Watson statistic. Secondly, since the order of integration of the time series used in the study is not known, the regression coefficients will be meaningless (Granger, 1986). Thirdly, no test of structural break in the model was done, even when it was obvious that the data set selected spread across two economic structures: the fixed exchange regime and the floating exchange rate regime (Chow, 1960). Moreover, the assumptions made in Nyamute (1998) study are too rigorous and restrictive. These assumptions are normal distribution of the residuals, homoscedaticity, and no autocorellation. This study relaxes these assumptions, tests for stationary and the order of integration of the time series, and also tests for structural break. The current study also epIicit1y examines the direction of causality between exchange rates and stock prices

Baharom, Royfaizal and Habibullah (2008) examined the causal relationships between stock prices and exchange rates in Malaysia. In this study, the data set consists of monthly real effective exchange rates (REER) and stock prices index (SP) for Malaysia covering the period from January 1988 to December 2006. In the analysis, the period of study was divided into two sample periods. The first is the pre-crisis period starting from January 1988 to June 1997. The second is the post-crisis period starting from July 1998 to December 2006. Johansen (1991) cointegration method was used and the period was divided into two sub periods, crisis and post crisis. They only found short term relationships but no long run relationships between the two variables.

Adam and Tweneboah (2008) studied the impact of macroeconomic variables on stock prices. They used the Databank stock index to represent the stock market and inward foreign direct investments, the treasury bill rate (as a measure of interest rates), the consumer price index (as a measure of inflation), average crude oil prices , and the exchange rate as macroeconomic variables. They analyzed quarterly data for the above variables from 1991 to 2007 using cointegration test, vector error correction models (VECM). These tests examined both long-run and short-run dynamic relationships between the stock market index and the economic variables. This study found that there is cointegration between macroeconomic variables and stock prices in Ghana indicating long run relationship. The VECM analyses showed that the lagged values of interest rate and inflation had a significant influence on the stock market. The inward foreign direct investments, the oil prices, and the exchange rate showed weak influence on price changes

Rahman and Uddin (2009) investigated the interactions between stock prices and exchange rates in three emerging countries of South Asia namely, Bangladesh, India and Pakistan. There data were the average monthly nominal exchange rates of US dollar in terms of Bangladeshi Taka, Indian Rupee and Pakistani Rupee and monthly values of Dhaka Stock Exchange General Index, Bombay Stock Exchange Index and Karachi Stock Exchange All Share Price Index for period of January 2003 to June 2008. They found that exchange rates and stock prices data series are non stationary and integrated of order one. Thus, they applied Johansen procedure to test for the possibility of a cointegrating relationship. Their results shows that there is no cointegrating relationship between stock prices and exchange rates. Finally, they applied the Granger causality test to study any causal relationship between stock prices and exchange rates. Evidence provided indicated that there is no causal relationship between stock prices and exchange rates in the countries.

Bonga-Bonga and Hoveni (2009) assessed the extent of volatility spillovers between the equity market and the foreign exchange market in South Africa. They applied a multi-step family of GARCH whereby volatility shocks obtained from the mean equation estimation in each market are included in the conditional volatility of the other market, respectively. The appropriate volatility models for each market were selected using several criteria such as covariance stationarity, persistence in variance and leverage effects. The results show that there is a unidirectional relationship in terms of volatility spillovers, from the equity market to the foreign exchange market.

Agrwal, Srivastav and Srivastava (2010) analyzed the relationship between Nifty returns and Indian rupee-US Dollar Exchange Rates. They applied several statistical tests in order to study the behavior and dynamics of both the series. They also investigated the impact of both the time series on each other. The sample period for their study was from October, 2007 to March, 2009 using daily closing indices. They found that Nifty returns as well as exchange rates were non-normally distributed. Further investigation into the causal relationship between the two variables using Granger Causality test highlighted unidirectional relationship between Nifty returns and Exchange Rates, running from the returns towards the exchange rates.

Kös, Doqanay, and Karabacak (2010) investigated the existence and direction of relationship between stock prices and exchange rates for Turkish financial market. Granger (1969) causality testing methodology was employed to reveal the nature of relationship between the two variables. The data used included five currencies: US dollar, Euro, Japanese Yen, Pound Sterling, Swiss Franc and two baskets of currencies of Undersecretariat of Foreign Trade of Turkey. Their results show that there is a uni-directional causality running from stock prices to exchange rates using the daily observations for the sample period, which runs from February 23, 2001 to November 4, 2009.

In summary, therefore, there is no empirical consensus on the causal relationship between exchange rates and stock prices. Specifically, the causal direction between the two financial price variables is not resolved. Moreover, none of. the previous studies investigated this issue with respect to the Kenyan context. This research intends to draw on the recent developments in econometrics to set up a framework for testing this issue in the light of our local experience. An integrated statistical framework using the bivariate vector auto-regressive (BVAR) model is used to test the research hypotheses. This specification is given by Equations 6 and 7, below.

3. Research Methodology

The main line of inquiry will be limited to the aggregate stock prices (whose proxy variable is the NSE 20-share index) and the floating value of the exchange rate (represented by the Kenya shilling price of one U.S. dollar). The main hypothesis is that a negative relationship exists between the strength of the Kenya shilling relative to the U.S. dollar and the NSE index. And the causal direction will be from the exchange rates to stock prices.

3.1 Bivariate VAR Model

To study the relationship between exchange rates and stock prices, there is need to establish whether changes in stock prices causally affect exchange rates or vice versa. First the prototype model of Granger (1969) is used because it is not only the simplest and most straight forward, but also the existence of causal ordering in Granger's sense points to a low causation and implies predictability and exogeneity.

The Granger's four definitions of causality are considered using the following BVAR model.

$$Ex_t = \sum_{j=1}^{m} \alpha_j EX_{t-j} + \sum_{j=1}^{n} \beta_j SP_{t-j} + \varepsilon_i \qquad (1)$$

$$SP_t = \sum_{j=1}^{m} c_j EX_{t-j} + \sum_{j=1}^{n} d_j SP_{t-k} + \mu_i \qquad (2)$$

Where EX is the exchange rate; SPis the stock price index ; αj, βj are coefficients of the exchange rate equation; c_j, d = are the coefficients of the stock price equation; and ε_t, $u_t$are the white noise error terms.

Granger (1969) offered four definitions of causality which comprise unidirectional causality from SP to EX; unidirectional causality from EX to SP; feedback causality between EX and SP; and independence between EX and SP. Those definitions imply that for SP to Granger-cause EX, the coefficient $\beta_j \neq O$ in equation (2), whereas c_j=0 in equation (3). And for EX to Granger-cause SP, cj≠0 whereas β_j=0. If we allow for the possibility of j=0 in the summation symbol of equation (1) and (2), the relationship between the two time series is said to be instantaneous. This implies that, instantaneous causality is established when the inclusion of the present values of the independent variable improves the prediction or goodness of fit (or R-square) of both equations.

3.2 Unit Root and Co-integration Tests

There are two steps in the co-integration test. The first step is to test whether exchange rates and stock prices are integrated of order zero, I(0), that is whether exchange rates and stock prices are stationary. Performing the Dickey-Fuller (DF) and the Augmented Dickey-Fuller (ADF) tests accomplish this. The ADF test is based on the following
regression equations:

$$\Delta SP_t = \alpha_0 + \beta_1 T + \lambda_1 SP_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta SP_{t-1} + \varepsilon_{1t} \qquad (3)$$

$$\Delta EX_t = \alpha_0 + \beta_2 T + \lambda_2 EX_{t-1} + \sum_{i=1}^{P} \theta_i EX_{t-1} + \varepsilon_{2t} \qquad (4)$$

Where, Δ is the First difference operator; $\Delta SP_t = SP_t - SP_{t-1;}$ $\Delta EX_t = EX_t - EXt_{t-1;}$ θ_i is the coefficients of the differenced lagged variables of the exchange rates; α_0 is the constant term; $\alpha_1$is the coefficient of the differenced values of SP; $\beta_1\beta_2$ are the coefficients of the time trend; λ_1, λ_2 are the coefficients of the lagged variables of SP and EX , respectively; T is the time trend; ε_{It}, ε_{2t} are white noise error terms

The difference between the DF test and the ADF test is that in the former, $\sum\alpha_1=\sum\theta_1=0$; in the ADF test *n* and *p* are chosen so that ε_{1t}, and ε_{2t}, respectively are white noise. The null hypothesis, H0, is that SP and EX have unit roots, i.e., H_0: $\lambda_1 = \lambda_2 = 1$. The alternative hypothesis is that both variables are integrated of order zero, I (0). We reject the null hypothesis if λ_1 and λ_2 are significantly negative and the *t*-statistics are less than (or greater in absolute values) than the critical values in Fuller (1976). As a matter of procedure, we performed this test both in first differences and level forms. The ADF test was performed with different autoregressive orders until we obtained individual series for SP_t and EX_t that were consistent with the white noise error terms.

The second step is to determine whether the stochastic trends in EX and SP that contained unit roots have long-run relationship. This is accomplished by estimating the co-integration equation with EX and SP in level forms and testing whether the residuals of the co-integration regressions are stationary. The co-integration equations are of the form:

$$SPt = \alpha EX + \mu_1 \qquad (5)$$

$$EXt = \tau\, SPt + \eta_t \qquad (6)$$

where μ_t and η_t are residuals to be tested for stationarity. If the computed ADF is greater than the critical values,
we reject the null hypothesis of co-integration between exchange rates and stock prices. Otherwise, we accept the null hypothesis of no cointegration between the two variables.

3.3 Error Correction Model and Granger-causality

Engle and Granger (1987), among others, have shown that if variables such as SP and EX are integrated of order one, I(1), and η_t = $EX_t - \pi\, SP_t$ and μ_t $SP_t - \alpha\, EX_t$ are both I(0), that is, if long-run relationships exist between these two variables, then SP_t and EX_t are said to be co-integrated. The Granger representation theorem states that in this case, SP_t and EX_t may be considered to be generated by error-correction models of the form:

$$\Delta SP_t = \alpha_0 + \sum_{1=1}^{n} \beta_{1i} \Delta EX_{t-1} + \sum_{i=1}^{q} \beta_{2i} \Delta SP_{t-i} + \delta\eta_{t-1} + \varepsilon_{1t} \qquad (7)$$

$$\Delta EX_t = \alpha_0 + \sum_{i=1}^{n} \beta_{1i} \Delta SP_{t-1} + \sum_{i=1}^{q} \beta_{2i} EX_{t-i} + \lambda\mu_{t-1} + \varepsilon_{2t} \qquad (8)$$

Where, $\alpha_0$is the constant terms; β_i are the coefficients of the lagged variables of SP and EX; δ, λ = coefficients of the error-correction term; η, μ = error-correction terms. The error correction coefficients, δ and λ, are expected to capture the adjustment of ΔSP_t and ΔEX_t towards long-run equilibrium, while ΔSP_{t-i} and ΔEx_{t-i} are expected to capture the short-run dynamics of the model.

The error-correction models given by equations 7 and 8 are used to test causal relationship between exchange rates and stock prices in Kenya. The inclusion of the error-correction terms in Equations 7 and 8 introduces additional channels through which causality could emerge and equilibrium could be re-established in the event of shocks to the foreign exchange market or to the stock exchange. In Equation 7 and 8 the focus is mainly on the statistical significance of the error-correction coefficients, δ and λ. (the t-statistics are used to measure the significance of the error-correction coefficients).

3.4 Diagnostic Tests

The model specified by equations 7 and 8 are subjected to three key econometric testing procedures namely: autocorrelation, heteroscedasticity and structural break. We first carried out diagnostic tests on the ECMs in order to determine the efficiency, unbiasedness and consistency of the specifications.

3.4.1 Auto-correlation test using the LaGrange Multiplier-test

This test is performed to find out if there is mutual statistical independence for the different disturbance terms. If the residuals do not fulfill this condition, then linear dependencies exist between the residuals and hence, they are said to be auto-correlated. The presence of autocorrelation makes ordinary least squares estimators (OLS) less efficient. Because the variance of the estimator is affected, the estimate of the confidence interval also becomes less reliable.

3.4.2 Heteroscedasticity test using the F-test

Heteroscedasticity occurs when the assumption of constant variance of the disturbances is violated. When the variances of the disturbances tend to increase or decrease with the increasing values of the regressors, the disturbance are said to be heteroscedastic. They may be heteroscedastic when they are in some way dependent on the regressors appearing in the specified equation or when the equation fails to include all relevant regressors.

The presence of heteroscedasticity makes the OLS estimators inefficient in that the property of least variance no longer applies to these estimates. However, they continue to be unbiased and generally consistent. Since heteroscedasticity affects the variance of the parameters, significance tests of the parameters are unreliable

3.4.3 Structural Break Test using the Chows Test (Chow, 1960)

In economic research sample observations over time or across individual units are collected for testing a given model. Suppose that time series observations X and Y are collected over 20 years. It may appear advantageous to maximize degrees of freedom by lengthening the series. But over this stretch of time, the basic structure that the model seeks to explain may have undergone important changes. Even over a shorter period such structural changes may take place for one reason or another, for instance, a war.

The data may obviously belong to two different economic structures. The problem is how to test the existence of such structural influences. That is, we want to determine whether or not a particular sample belongs to one structure or two or more. In the latter case true regression coefficients for the different structures are likely to be different, and the coefficients estimated from the unified sample will not be reliable. This is achieved by applying Chow's test (which will not be described here) to the given set of observations.

3.5 Data and Sample

The data set consists of monthly observations of the closing price index and Ksh/USD foreign exchange rates in the two markets. Monthly data on the Nairobi Stock Exchange Index (1964=100) were obtained from the Nairobi Stock Exchange. Monthly data on the nominal foreign exchange rate were obtained from the Central Bank of Kenya.

The sample period started from November 1993 to May 1999. The starting date was dictated by the time when the government shifted its foreign exchange policy from fixed exchange rates to independently floating exchange rates.

4. Results

The stationarity test was performed in first level forms and first differences for the stock price index and the exchange rate. In particular, we tested whether stock prices and exchange rates are integrated of order zero, 1(0), that is whether, SP_t and EX_t are stationary. We performed the ADF test based on the standard regression and a time trend - equations 8 and 9. The results show that all variables are not stationary in level forms; Both the Dickey-Fuller (DF) and the augmented Dickey-Fuller (ADF) reject the null hypothesis at the 5% and 1% levels of significance after the variables have been first differenced. Thus the variables are integrated of order one, 1(1) and therefore the classical Granger-causality test is inappropriate in this case. The results of the unit root test are reported in Table 1.

The computed t-statistic (-3.730) is greater than the critical value (-3.45) at 5% level of significance. On the basis of these results, we rejected the null hypothesis of no cointegration between exchange rates and stock prices. These results indicate that we use an error correction model (ECM) to proceed instead of the classical Granger-causality test since the two variables are co-integrated. Miller and Russek (1990) have shown that, Granger causality tests are misspecified if they are applied to standard vector autoregressive form to differenced data for co-integrated variables. The results of this test are reported in Table 2. The problem of multicollinearity is not severe, this is evident from a low ratio of 22 the estimated beta to its variance (0.0006) and a low coefficient of determination (R-square = 0.14) which does not vary with the number of parameters in the model.

Table 3 shows the results of the error correction model using both the stock price and exchange rate equations. The residual was lagged once. On the basis of these equations we applied the F-test and reported the results in Table 4. The best error correction estimates are based on the stock price equation and it includes the residual lagged once. When the F-test was applied based on this equation, the results suggest that we reject the null hypothesis that exchange rates do not Granger-cause stock prices. Miller and Russek (1990), pointed out that, the null hypothesis is not only rejected if the coefficients of EX are jointly significant but also if the error-correction term coefficients (6 and) are significant. The significant F-statistics of the error correction term given in Table 4, indicate that exchange rates Granger-causes stock prices in Kenya.

5. Discussion and Conclusions

5.1 Discussion of Results

The direction of Granger-causality from exchange rates to stock prices has a number of implications for individual investors, corporate investors, financial regulators and market intermediaries. Sharp fluctuations in the stock prices arising from fluctuations in foreign exchange rates can cause panic among portfolio managers. This will induce them to liquidate portions of their equity portfolios to hedge against currency losses. The net impact will be a slump in the NSE Index, an indicator of poor trading condition on the stock market. High volatility in the stock market makes it difficult for investors in the foreign exchange-market and the stock market to protect their investment against an adverse turn in market developments. The cost of risk management is high given that currently we do not have derivative instruments that can help investor to efficiently and effectively allocate risk in this situation. Greater volatility in the currency market and hence the stock market will cause problems in maintaining pricing efficiency. This can lead to greater uncertainty and an increase in diverse views on the nature and extent of the market shock. This issue is very important because efficient dissemination of information and the provision of greater access to liquidity remain the main reasons for organized markets. If volatility persists for a long time, there will be a disruption in the price discovery process in the market. A perceived increase in risk with respect to the foreign exchange market, and hence the stock market, will lead to higher cost of capital. This will lead to reduction in the sources of supply. This arises not only from the falling investor confidence in these two markets but also the financing capacity of investors may decline.

Listed companies on the Nairobi Securities Exchange also face similar problems, especially those with high exposure to foreign exchange risk. This will translate into higher operating and financing costs as well as bad debt. Publicly owned companies that heavily rely on imports will suffer from depreciation in the Kenyan currency, this ultimately affects their earnings due to the reliance on imports for their activities. Corporate profitability is also affected. This will be evidenced by contraction in EPS. High volatility in the foreign exchange market and hence in the stock market will have a great impact on the development of the Nairobi Securities Exchange. If the government through the Central Bank of Kenya cannot intervene in the foreign exchange market, this may lead to disruption in market development. There is also greater need for introduction of derivatives in the market to help investors manage risk cost-effectively. Instruments like options and futures should be introduced in the local financial market.

For regulators, like the government, this study indicates that the market is prone to cross- asset volatility spillover, specifically, from the currency market to the stock market. This has implications for securities regulators. There is a need for expansion in the scope of their traditional responsibilities, particularly those that involve cross-asset effects. More important, however is for regulators to consider the adequacy, capacity and structure of the current regulatory environment to accommodate a wider and complex set of objectives.

Three areas are worth elaborating in the context of this study. Firstly, in assessing and managing risk, market authorities like the NSE and Capital Market Authority are likely to contend with a wide range of factors that can greatly influence the operational and informational efficiency of the financial markets. This also implies that regulators must be in a position to assess the nature of activity in the markets and the environment outside their traditional jurisdictions. Secondly, there is a gigantic task for the Nairobi Securities Exchange of having to develop locally and compete globally simultaneously, both for funds and provision of financial services. Regulators should oversee and facilitate development and growth of the securities market. This issue is very important with respect to financial globalization and integration. Thirdly, risk management is expected of all market participants. There is need to develop a risk management culture that permeates the corporations, financial intermediaries, investors and other market participants. This should address 'deeper issues like robust internal controls, incentives for senior management involvement, accountability structures and reporting guidelines for financial information. Education is likely to be an essential tool in this endeavor. Another implication of the findings of this study with respect to client asset-protection is to ensure investor protection, market discipline and integrity to minimize the risk of loss and insolvency of financial intermediaries like broker and dealers. Asset-protection may take the form of providing insurance schemes for small market investors; this helps to reduce information asymmetry among these investors regarding the financial health of the intermediaries.

5.2 Conclusion

The empirical evidence from this study shows that exchange rates Granger-causes stock prices in Kenya. There is unidirectional causality from exchange rates to stock prices. These findings have implications for investors, regulators, publicly owned companies, financial intermediaries and other market participants as discussed above.

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Table 1. Unit root test for the stock price index and nominal exchange rate Variable

Levels	**DF**	**ADF**	**Decision**
SPt	1.650	-7.039b	Accept Ho
Ext	2.794	-5.693b	Accept Ho
Differences	**DF**	**ADF**	**Decision**
ΔSPt	-3.260	-1.334a	Reject Ho
ΔExt	-4.053	0.329a	Reject Ho

Critical values for DF and ADF are as follows: at 1% -4.04, at 5% -3.45(Fuller 1976, p.373, Table 8.5.2). The variables were lagged once. Δ denotes the first difference operator; SP = stock price index; EX = nominal exchange rate. [a] statistical significance at 5% level. [b] statistical significance at 1% level

Table 2. Test results for Heteroscedasticity, Autocorrelation and Structural Break for ECMs

Test Type	Computed test statistic	Conclusion
T.l Heteroscedasticity	-5.364	Accept Ho
T.2 Autocorrelation	1st order = -7.105 2nd order = -11.823	Accept Ho Accept Ho
T.3 Structural Break	3.642	Accept Ho

T.1 has H_0: there is no heteroscedasticity; This relies on the F test whose critical values are as follows:(l,66) = 11.50 at 0.1% and 6.90 at 1%. T.2 has H_0: there is no autocorrelation; This relies on the LaGrange Multiplier test. The critical values are Chi-square at 5% and 1%, respectively. T.3 has H0: there is no structural break; This relies on F test whose critical values are (18,66) 3.99 at 5% and 7.04 at 1% levels of significance.

Table 3. Full Information Estimates of the Error-Correction Model

Equation	Exchange rates Granger- causes Stock prices	Stock prices Granger causes exchange rates
Dependent variable	ΔSP	ΔEX
Constant	15.46	-0.08
Error correction term	-0.5062 (-4.085)a	-0.0991 (-0.068)
ΔSPt-l	-0.1098 (-0.886)	0.0651 (0.486)
ΔEXt-1	0.0193 (0.182)	-0.4458 (-3.906)

Notes: t-statistics are in parentheses [s] significance at the 1% level.

Table 4. The results of Granger-causality test

Null hypothesis(H0)	F-statistic	Decision
SP does not Granger- cause EX.	0.486 F(3,66)	Accept H_0
EX, does not Granger- cause SP	-4.085 F(3,66)	Reject H_0