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MODERATING EFFECT OF INFLATION RATES ON THE RELATIONSHIP BETWEEN FOREIGN EXCHANGE RATES AND STOCK PRICES IN THE KENYAN CAPITAL MARKET

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Abstract:
There has been a downward trend in the equities market with NSE 25, NASI, and NSE 20 declining by 9.9%, 3.5%, and 5.7% respectively from 2012 to 2015 and 2017. Ever since the Shilling was allowed to float freely, the unpredictability of Nairobi's exchange market has been largely observed and in 2006 February, the index in NSE 20-Share rose to 4057, 2007 January it went further to 5774, but in February 2009 it hit a low of 2475. The drop went further in 2011 by 27%. This brought about losses to investors for example in 2009 when brokerage firms collapsed. This has led to a loss of confidence in investors in the Nairobi Securities; and for this reason, researchers have to come in and work together to find ways of stabilizing our stock market. This research seeks to add value to the literature by analyzing whether the regulation of the interaction of inflation rates with exchange rates on stock prices will stabilize the undesirable situation. Stock market plays an important role of intermediation in the economy and enhancing investors' confidence in the market can have a positive impact on resource allocation hence economic growth. Reviewed literature has found the effects both in the short-run and the long-run. The disparity of their results might be attributed to different countries that are being analyzed on different capital mobilities, economic links, trade volumes, and methodologies among others. This study established the moderating effect of inflation rates on the relationship between foreign exchange rates and stock prices. The study is built on the theory of stock prices. The research adopted a correlational research design. Time series monthly secondary data was collected from January 1998 to December 2018. Multivariate analysis was employed. The 2-step hierarchical regression which resulted in an R^2 change of 3% was fairly a good increase in the predictive capacity for stock price changes. The study therefore concluded that Inflation Rates moderate the relationship between stock prices

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and exchange rates and recommends that the Central Bank of Kenya as the regulator and Capital Markets Authority (CMA) should consider formulating favorable policies to manage Inflation rates as it is an investment driver in the economy.

JEL: E31; D53; E44

Keywords: inflation, exchange rates, capital markets, stock markets

1. Introduction

The Kenya currency is the trading symbol embraced by most of East Africa to gauge the foreign exchange market. It is the most reliably stable regional currency, despite the consistent depreciation relative to the U.S. dollar which has brought about adverse effects to our economy and has been the backbone of several researches in the past few years. From mid-2011 to date Kenya's exchange rate has shown a dramatic shift from an average of 83 shillings per U.S. dollar to a historical all-time high of 106.80 in October 2011. Kenyan Central Bank in initiated response measures aimed at tightening liquidity, raising interest rates, and tightening operations within the money market. This was a bid to keep the shilling stable and ensure investors keep coming into the country and also stabilize inflation rates, this is according to (KNBS, 2010). As of 2016, the Kenyan shilling exchange for the U.S. dollar has been soaring around the 100 mark growing concerns about the public debt value over the years.

Changes in stock prices have always been keenly monitored in the securities exchange market because they determine the stock market's stability so that investors and managers can be able to devise strategies that companies and investments going forward. The resultant effect is an upsurge in interest rates, consequently capital inflows and appreciation of the domestic money. Clear from Pan (2012) is that stock price fluctuations will have an effect on the flow of capital in and out of an economy, that will lead to a change in the domestic currency exchange rate. Analysis of market indices can provide investors with relevant information that will enable them to draw forecasts of future market trends (Zhang, 2009).

2. Literature Review

2.1 Theory of Stock Prices

The school of thought by Fama (1970) introduced the theory of Efficient Capital Market Theory, which gained prominence compared to other approaches to stock behavior. The theory has been cited with the efforts of trying to explain the stock price behavior using statistical time series models. This efficient capital market is a market that assumes the prices represent the entire firm's value. This theory is very important in the modern finance world since it deals with a fundamental issue in finance – how stock prices change in the securities exchange and also why they occur. The implications to financial managers and investors on why and how these changes in stock prices take place are some of the practical problem solutions for this study. The EMH, also known as the Random Walk theory now gives a proposition to which the available information by the firm through the wrap-up of the stock price representation of the firm in the efficient capital market helps to avoid earning excess profits, more than what the total market earns. The main pillar that guides this theory is the arrival of new information, which does not affect the pricing of securities.

The term "efficient market" was first introduced by E. F. Fama in 1965 in a paper where he proposed that securities valuation be known because of the new information, and the reflection will instantly be reflected on the actual stock prices. The EMH suggests that to profit from the changes in stock prices in the market is very hard and sometimes unlikely. New information from prices is reflected on securities prices at any given time. The inconsistencies of prices make the securities adjust quickly and often even before investors can trade and profit from them through the acquired new information. The reason why the efficient market exists is because of the fluctuation in stock prices due to new information and investors competing to profit from it.

Investors and investment managers are potentially known for being risk averse and they are always on the run to identify securities doing well. They use various statistical forecasting methods to help them in predicting and making great investment decisions. According to Clarke, J., Jandik, T. and Mandelker, G. (2014), any edge that an investor gets is a potential translatable profit for them.

Efficient markets are necessary if the moderator desires that the high-valued projects or firms should be allocated more funds. The possibility is only when the pricing of stocks is correct and they reflect the exact future discounted cash flows. The efficiency of a capital market is when companies can be able to raise capital and value for themselves since the process of price discovery is performed by the market itself. The efficiency helps firms quantify the price at which stock traders can exchange claims for future cash flows of a firm. According to Hameed & Hammad (2006), when prices actually reflect the kind of information exhibited in the market, participation costs will be reduced and the market will have productive projects. From the perspective of a policy, the efficiency of the capital market plays a great mandate in the markets. This theory of stock prices is very relevant to this study because of the role it plays in the capital markets. The research assessed how foreign exchange rates affect stock prices, using inflation as a moderator effect, and therefore considering these macroeconomic forces affecting stock prices, the effects of the efficient capital market theory will not be ignored.

2.2 Empirical Literature on Inflation Rates, Foreign Exchange Rates and Stock Prices

Mohammed, Njoroge, and Mwenda (2015), in their investigation on "Granger Causal Association amid Macroeconomic Variables and Kenya Stock Prices showed that, with the negligible values of effects obtained from the relationship of macroeconomic variables and stock prices, while some variables like inflation rates have huge impacts, all the variables significantly explain stock prices.

Engle and Rangel (2005) made very clear discoveries from their analysis stock market's volatility positively, even though inflation will depend on the extent. Further into the study of inflation, they note that the inflationary effects only had high predictive power in the growing markets and not the already established markets like Canada and other developed countries. They estimated the Spline-GARCH model's coefficients and concluded that the predictive power of inflation on annual volatility was insignificant or rather weak since the annual realized volatility had many drawbacks.

Nyaga (2014) conducted a study through an event study methodology to investigate the response of stock price in relation to exchange rate movement in the commercial and services segment of firms listed at the NSE from 2009 to 2013. From the results of the Pearson product-moment correlation, a negative relationship between exchange rate volatility and share prices was witnessed.

Liang, Lin, and Hsu (2013) studied five Asian countries; Singapore, Philippines, Thailand, Malaysia, and Indonesia on their stock prices and exchange rates data. Using periodic monthly gathered data between August 2008 to June 2011, and analyzed on panel unit-root-test. From the analysis, the result showed an inverse relationship denoting the negative effect of exchange rates on stock prices in both long and short-run causal relationships.

Over the past twelve months, NSE performance has remained unpredictable and led to both actual and fair-value investor losses. However, literature links NSE performance with volatility in exchange rates and interest fluctuation (Obura & Anyango, 2016). Modeling exchange rate exposure has been a growing area of research in the last decade. This reviewed literature by Obura & Anyango, 2016 led to an additional contribution to research by this study to further understand to what extent the interaction between exchange rate fluctuation and inflation rate affects stock prices.

EGARCH model was used by (Nor et al., 2005) to analyze the stochastic disparity in the volatility dynamics of financial stocks and he chose Inflation rates in the country of Malaysia that captured the periods from August 1980 to December 2004. The study reported a positive and significant value of the β coefficient which implied that a rise in inflation level affects in inflation improbability.

There have been quite inconclusive results from the literature on the association between exchange rates and inflation rates on stock prices as both the negative and the positive effects have their fair share of support. This leads the researcher to introduce inflation rates as a moderating variable to see how their effects are so prominent in the economic changes when exchange rates shift and the stock market is shaken.

3. Methodology

The study utilized a correlational design and time-series secondary on foreign exchange rates, inflation rates, and stock prices from document review for 21 years spanning from

January 1998 to December 2018. The validity of the assumptions of the hierarchical regression was first checked here in consideration of the assumptions of the Classical Linear Regression Model (CLRM). The diagnostic tests that were used to ensure the model chosen is statistically significant are as follows; Breusch-Pagan test of heteroskedasticity to check if the variables are normally distributed with a constant variance, Durbin Watson test to check for serial autocorrelation, Multicollinearity Variance Inflation Factors (VIF) to test for multicollinearity and the Chow test to test for model stability.

3.1 Model Specification

The following moderation model was specified and estimated:

$$Y_t = \beta_0 + \beta_1 EXR_t + \acute{\varepsilon}_t \quad (1)$$

$$Y_t = \beta_0 + \beta_1 IF_t + \acute{\varepsilon}_t \quad (2)$$

$$Y_t = \beta_0 + \beta_1 EXR_t + \beta_2 IF_t + \beta_3 EXRIF_t + \acute{\varepsilon}_t \quad (3)$$

Where:
Y_t = Stock Price at month t
EXR_t = Average Foreign Exchange Rate between two exchange rates in Kenya i.e. USD & EURO) at month t
IF_t = Inflation Rates at month t
EXRIF = Interaction between foreign exchange rates and inflation rates at month t
β_0 = constant
β_1, β_2, β_3 = Stock price sensitivity to foreign exchange rates, inflation rates, and the moderating effect
$\acute{\varepsilon}_t$ = Error term at time $_t$

Transforming equation 3 into natural logs, we obtain:

$$ln\ Y_t = \theta + \beta_1\ ln\ EXR_t + \beta_2\ ln\ IF_t + \beta_3\ ln\ EXRIF_t + \mu_t \quad (4)$$

Where:
$ln EXR_t$, $ln IF_t$, $ln EXRIF_t$ = The log transforms for exchange rates, inflation, and the interaction variable.
μ_t = The natural log of the Error term at time t

3.1 Heteroskedasticity Test

Table 1 below shows the heteroskedasticity test using the Breusch Pagan test. the null hypothesis states that the data set is homoscedastic or has no presence of heteroskedasticity, meaning they all have zero means and constant variances while the

Alternative hypothesis reveals the presence of heteroskedasticity. Rejecting the null hypothesis of no heteroskedasticity (homoskedasticity), the p-value must be less than the significance value of 0.05 ($p < 0.05$).

Table 1: Summary of Breusch-Pagan's Heteroskedasticity Test Results

Test of Heteroskedasticity			
F-statistic	1.687964	F Prob (3,236)	0.1703
Obs*R-squared	5.041543	Chi-Square Prob (3)	0.1688
Scaled explained SS	4.866742	Chi-Square Prob (3)	0.1818

Source: Researcher 2020, Summarized from data set (1998-2018).

From Table 1, the probability value of Chi-square is 0.1688, which means that the probability value is significant. This means the test statistic value $\mathbf{n\chi^2}$ is higher than 0.05 which is the significance level, therefore we do not reject the null hypothesis of No heteroskedasticity in the data which we can refer to as homoscedastic. The conclusion therefore was that the data followed assumptions of the CLRM and that the disturbance terms in the regression function had a constant variance and are best linear unbiased estimators (BLUE).

3.2 Durbin Watson Test

The range of the Durbin-Watson statistics results is 0 to 4. If DW=2, then there is no autocorrelation, in the case where DW<2, it shows positive autocorrelation, and in the case where DW>2, shows negative autocorrelation. All the variables were converted into the first difference to remove any form of serial correlation. The variables were transformed to D(SP), D(USD), D(EURO), and D(IF). The initial hypothesis states that the residuals are not autocorrelated or not serially correlated while the Alternative hypothesis is that the residuals are autocorrelated. To reject the null hypothesis, the p-value of the test statistic must be less than the probability significance value of 0.05.

Table 2 demonstrates the probabilities of the test results, as shown below:

Table 2: Summary of Durbin Watson Serial Correlation Test

Serial Correlation LM Test:			
Dependent Variable: D(SP)			
F-statistic	1.382227	F Prob(2,233)	0.2531
R-squared*Obs	2.802392	Chi-Square Prob(2)	0.2463
Durbin Watson Stat			**2.030102**

Source: Researcher 2020, Summarized from data set (1998-2018).

From Table 2, the Durbin-Watson statistics value of 2.030102 suggests No autocorrelation in the residual considering the corresponding DW limits. The probability Chi-square value of 0.2463 also concurs with the findings as the χ^2 P-value is greater than the significance value of 0.05 therefore we reject the null hypothesis of no autocorrelation.

The conclusion therefore confirms that the Durbin-Watson test results confirm that the assumptions of autocorrelation were not violated i.e. the data will now not give any chance for any spurious regression, inflated R^2 and the regression will be the best linear unbiased estimator (BLUE).

3.3 Testing for Multicollinearity

Multicollinearity in this study was tested using the VIF test. When the VIF value is more than 5, then it demonstrates the presence of high multicollinearity in the independent variables.

Below are the results of multicollinearity using the variance inflation factors by Cuthbert Daniel:

Table 1: Summary of Multicollinearity Test Using VIF

	Coefficient	**Uncentered**	**Centered**
Variable	Variance	VIF	VIF
C	156847.9	60.73606	NA
USD	37.65443	101.2422	1.828191
EURO	16.60028	65.51125	1.897056
IF	149.6136	4.689237	1.107131

Source: Researcher 2020, Summarized from data set (1998-2018).

From Table 4, all the centered VIF values for the independent variables were 1.8281, 1.8970, and 1.1071, all between 1 and 5. Values greater than 5 represent multicollinearity at its critical levels. The conclusion therefore suggests that "there is moderate correlation but not severe enough to warrant corrective measures."

3.4 Model Stability Test

The Chow test was used for measuring stability. The test is used in time series analysis if within your sample you believe that at some few moments in the sample, a real-world event may have affected the trend. The data was split into two parts to try and see if we can actually get more accurate regression results. The test's Null hypothesis is that there are no breaks at specified break points while the alternative hypothesis demonstrates that we actually need to split this data into two parts to better maximize the regression output. In rejecting the null, the F-statistic that is calculated must be greater than the F-critical value. Table 5 shows a summary of the Chow test results:

Table 2: Summary of Chow's Breakpoint Stability Test

Chow Breakpoint Test: 2007M01			
Null Hypothesis: No breaks at specified breakpoints			
Varying regressors: All equation variables			
F-statistic	1.339198	F Prob(4,231)	0.2562
Ration of Log likelihood	5.479024	Chi-Square Prob(4)	0.2416
Wald Statistic	5.356792	Chi-Square Prob(4)	0.2526

Source: Researcher 2020, Summarized from data set (1998-2018).

From Table 5 above, the F-statistic value is 1.339198, and the F-critical value is obtained by reading from the F-table using the degrees of freedom F(k, n-2k). The F-critical value is hence 2.26. We therefore agree that there are no breaks at specific break points by not rejecting the null hypothesis. We conclude that since the coefficients of the split data are equal, they can be pooled, therefore the data can be represented with a single regression line.

3.5 Unit Root Test

Stationarity in our data was tested using the Augmented Dickey-Fuller test (unit root test) to avoid a regression that is spurious. For example, an Autoregressive (AR) series of the form $Y_t = \beta_0 + \beta_1 Y_t(-1) + \acute{\varepsilon}$ if the value of β is greater than 1 then the series will be explosive, if β is less than 1 then the series will be stationary meaning the shocks of the relationship between the current and the lag values will gradually die away, and if β=1 then the series will be unit root (non-stationary) and the shocks will be consistent, meaning every lag value will be reflected in the current value. A Unit root series is the null of the ADF test hypothesis, otherwise the alternative hypothesis is a stationary series.

Table 6 provides a summary of the results:

Table 3: Summary of Unit Root Test Results

Unit root as the Null hypothesis				
Series: LNSP, LNUSD, LNEURO, LNIF				
Exogenous variables: Individual effects, individual linear trends				
Automatic maximum lags selection				
Cross-sections included: 4				
Method			**Statistic**	**Prob.****
Level				
ADF - Fisher Chi-square			14.3452	0.0732
ADF - Choi Z-stat			-1.13443	0.1283
First Difference				
ADF - Fisher Chi-square			307.183	0.0000
ADF - Choi Z-stat			-16.3782	0.0000
Intermediate ADF test results D(CONSOLIDATED DATA)				
Series	**Prob.**	**Lag**	**Max Lag**	**Obs**
Diff(SP)	0.0000	1	2	249
Diff(USD)	0.0000	2	2	248
Diff(EURO)	0.0000	0	2	238
Diff(IF)	0.0000	1	2	249

Source: Researcher 2020, Summarized from data set (1998-2018).

From Table 6, all the variables of the study reported a unit root at level series I ~ (0) except for inflation rates. However, at the first difference I ~ (1) they all became stationary considering the p-value of the ADF statistic was less than the critical value of 0.05, therefore the null hypothesis of a unit root series was rejected.

After knowing that our data is stationary at the first difference, I ~ (1), we will want to ensure that our analysis does not suffer from non-normality autocorrelation, therefore we will run an order selection method called the Vector Auto Regression (VAR) for lagging.

3.6 VAR Lag Order Selection Criteria

Often, the Y variable responds to X within a lapse of time called a ***lag.*** When you have many lags the degrees of freedom are lost, misspecification of errors or serial correlation. Choosing the number of lags to use is basically an empirical decision. Though, the most appropriate way is to choose a criterion that gives the lowest values.

Table 7 gives results of the lag selections by the various criteria.

Table 4: Summary of VAR Lag order selection criteria

Endogenous variables: LNSP LNUSD LNEURO LNIF						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	48.20444	NA	8.01e-06	-0.382722	-0.323113	-0.358680
1	1461.760	2765.919	4.46e-11	-12.48277	-12.18473*	-12.36256
2	1489.735	53.76951*	4.02e-11*	-12.58645*	-12.04997	-12.37007*
3	1497.861	15.33810	4.30e-11	-12.51828	-11.74336	-12.20573
4	1512.044	26.27734	4.37e-11	-12.50254	-11.48919	-12.09382
5	1522.647	19.27783	4.59e-11	-12.45581	-11.20403	-11.95092
6	1530.460	13.93647	4.93e-11	-12.38494	-10.89471	-11.78388
7	1537.450	12.22466	5.34e-11	-12.30693	-10.57827	-11.60970
8	1551.444	23.98852	5.45e-11	-12.28955	-10.32246	-11.49616

Source: Researcher 2020, Summarized from data set (1998-2018).

From Table 7, the LR, the FPE, the AIC, and the HQ criteria all select a lag level of two except the Schwarz Information Criterion (SC) with a lag level of one. The study therefore chooses lag level 2 as the best to use for the model.

3.7 Results of Johansen's Cointegration Test

From the test in Table 8, the unrestricted rank trace statistics in the first row is 244.2362 which is more than 47.8561 on the critical value column. Also, the Max-Eigen statistics on the second row equals 88.6975 which is higher than the 27.5843 critical value at 5%. Both the probability values of the statistics are 0.000 ($p<0.05$), therefore study rejected the hypothesis that there is no cointegration. We conclude that the independent variables are sufficient to explain the dependent variable (stock prices) in the long run.

What the results simply mean is that, changes in inflation rates and foreign exchange rate values for a long period of time, lead to a resultant effect on stock prices. The change over time is what leads to the resultant change in stock prices and not spontaneous shocks in the economy. This result was contrary to studies of Benjamin (2006) and Masood and Sarwar (2015).

Table 8: Summary of Johansen Cointegration Test Results

Series: D(SP) D(USD) D(EURO) D(IF)				
Lags interval (in first differences): 1 to 2				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.313286	244.2362	47.85613	0.0001
At most 1 *	0.226593	155.5386	29.79707	0.0001
At most 2 *	0.197632	94.89852	15.49471	0.0000
At most 3 *	0.166336	42.93416	3.841466	0.0000
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.313286	88.69759	27.58434	0.0000
At most 1 *	0.226593	60.64004	21.13162	0.0000
At most 2 *	0.197632	51.96436	14.26460	0.0000
At most 3 *	0.166336	42.93416	3.841466	0.0000

Source: Researcher 2020, Summarized from data set (1998-2018).

3.8 Vector Error Correction Model

Table 9: Summary of the Vector Error Correction Model

Vector Error Correction Estimates				
Standard errors in ( ) & t-statistics in [ ]				
Cointegrating Eq:	CointEq1			
LNSP(-1)	1.000000			
LNUSD(-1)	3.902133			
	(1.87007)			
	[2.08662]			
LNEURO(-1)	-4.094496			
	(1.39268)			
	[-2.94002]			
LNIF(-1)	1.456800			
	(0.33858)			
	[4.30267]			
C	-9.287885			
Error Correction:	D(LNSP)	D(LNUSD)	D(LNEURO)	D(LNIF)
CointEq1	-0.003314	0.000250	-0.002887	-0.071612
	(0.00439)	(0.00142)	(0.00247)	(0.01690)
	[-0.75404]	[0.17586]	[-1.16710]	[-4.23785]
D(LNSP(-1))	0.155192	-0.059985	-0.049382	-0.002675
	(0.06723)	(0.02177)	(0.03784)	(0.25849)
	[2.30854]	[-2.75569]	[-1.30509]	[-0.01035]
D(LNUSD(-1))	-0.285142	0.211817	0.003906	0.369869
	(0.21879)	(0.07084)	(0.12315)	(0.84128)
	[-1.30325]	[2.98987]	[0.03172]	[0.43965]

D(LNEURO(-1))	-0.035937	0.074170	0.009559	-0.122436
	(0.13279)	(0.04300)	(0.07474)	(0.51059)
	[-0.27063]	[1.72501]	[0.12790]	[-0.23979]
D(LNIF(-1))	0.014914	5.29E-05	0.007197	0.255005
	(0.01605)	(0.00520)	(0.00903)	(0.06171)
	[0.92925]	[0.01019]	[0.79664]	[4.13211]
C	0.000662	0.001341	0.002094	0.000848
	(0.00367)	(0.00119)	(0.00207)	(0.01412)
	[0.18031]	[1.12751]	[1.01304]	[0.06008]

Source: Researcher 2020, Summarized from data set (1998-2018).

The dynamics of the short-run for stocks takes the following VECM framework:

$\Delta LNSPt=\mu 1+\gamma 1Zt-1+\Sigma\theta 1i\Delta LNSPt-ipi=1+\Sigma\delta 1i\Delta LNUSDt-ipi=1+\Sigma\tau 1i\Delta LNEUROt-1pi=1 +\Sigma\rho 1i\Delta LNIFt-ipi=1 + \varepsilon tLNSP$

Given:
yt = (SPt, USDt, EUROt, IFt),
*β1= (1.00, 3.9021, -4.0944, 1.4568).

From our cointegrating coefficients, we derive the Error Correction Term for long-run relationship:

$ECT_{t-1} = [Y_{t-1} – n_j X_{t-1} - \varepsilon_m R_{t-1}]$

This could be re-written as:

$ECT_{t-1} = [1.000LNSP_{t-1} + 3.9021LNUSD_{t-1} – 4.09449LNEURO_{t-1} + 1.4568LNIF_{t-1} – 9.2878]$

In the equation, there is a long-run relationship between inflation rates and US Dollar exchange rates on stock prices but negative relationship on Euro Exchange rate. The second row are coefficients of short-run and are also the representation of our vectors, given the models:

$$\Delta \ln Y_t = \alpha + \sum_{j=1}^{g} \alpha\ \Delta \ln USD_{t-j} + \sum_{j=1}^{g} \alpha\ \Delta \ln Y_{t-j} + \sum_{j=1}^{g} \alpha\ \Delta \ln EURO_{t-i} + \sum_{j=1}^{g} \alpha\ \Delta \ln IF_{t-j} + \lambda_i \mu_{t-1} + \varepsilon_t$$

$$\Delta \ln USD_t = \alpha + \sum_{j=1}^{g} \alpha\ \Delta \ln USD_{t-i} + \sum_{j=1}^{g} \alpha\ \Delta \ln Y_{t-j} + \sum_{j=1}^{g} \alpha\ \Delta \ln EURO_{t-j} + \sum_{j=1}^{g} \alpha\ \Delta \ln IF_{t-j} + \lambda_i \mu_{t-1} + \varepsilon_t$$

$$\Delta\, ln\, EURO_t = \alpha + \sum_{j=1}^{g} \alpha\, \Delta\, ln\, EURO_{t-j} + \sum_{j=1}^{g} \alpha\, \Delta\, ln\, IF_{t-i} + \sum_{j=1}^{g} \alpha\, \Delta\, ln\, Y_{t-j} + \sum_{j=1}^{g} \alpha\, \Delta\, ln\, USD_{t-j} + \lambda_i \mu_{t-1} + \varepsilon_t$$

$$\Delta\, ln\, IF_t = \alpha + \sum_{j=1}^{g} \alpha\, \Delta\, ln\, EURO_{t-j} + \sum_{j=1}^{g} \alpha\, \Delta\, ln\, IF_{t-j} + \sum_{j=1}^{g} \alpha\, \Delta\, ln\, USD_{t-j} + \sum_{j=1}^{g} \alpha\, \Delta\, ln\, Y_{t-j} + \lambda_i \mu_{t-1} + \varepsilon_t$$

Where:
g = lag length
μ_{t-1} = Error correction term (ECT), leads the variables of the study to equilibrium
LNSP as both a dependent and independent variable, the vectors can be re-written as:

$\Delta LNSP_t = -0.003314ECT_{t-1} + 0.15519\Delta LNSP_{t-1} - 0.2851\Delta LNUSD_{t-1} - 0.03593\Delta LNEURO_{t-1} + 0.014914\Delta LNIF_{t-1} + 0.000662$

$\Delta LNUSD_t = 0.000250ECT_{t-1} - 0.05998\Delta LNSP_{t-1} + 0.2118\Delta LNUSD_{t-1} + 0.07417\Delta LNEURO_{t-1} + 5.29E\text{-}05\Delta LNIF_{t-1} + 0.001341$

$\Delta LNEURO_t = -0.002887ECT_{t-1} - 0.04938\Delta LNSP_{t-1} + 0.0039\Delta LNUSD_{t-1} + 0.0095\Delta LNEURO_{t-1} + 0.00719\Delta LNIF_{t-1} + 0.00207$

$\Delta LNIF_t = -0.0716ECT_{t-1} - 0.002675\Delta LNSP_{t-1} + 0.3698\Delta LNUSD_{t-1} - 0.1224\Delta LNEURO_{t-1} + 0.255\Delta LNIF_{t-1} + 0.000848$

From the equation above of the vectors, the coefficient of the ECT is explained as, the previous periods deviations from long-run equilibrium corrected with the current period at an adjustment speed of 0.3%, also US Dollar exchange rate commands 28.5% of Stock prices negative change ceteris paribus in the short-run. For Euro exchange rate, a percentage change in euro is associated with 0.03593% decrease in Stock prices on average ceteris paribus in the short-run. Lastly, a percentage change in Inflation rate is associated with a 0.014914% increase in stock prices on average ceteris paribus in the short-run.

4. Results and Discussion

4.1 Multiple Regression Analysis

The researcher sought to test the interaction effect of exchange rates and inflation rates on stock prices via multiple regression. An interaction is observed when the nature of relationship of 2 variables changes as a function of a third variable – the moderator.

A 2-step hierarchical regression analysis for moderation was used. The change in R^2 from the model gave us the magnitude of the moderation. A significant change in the adjusted R^2 confirmed the moderation.

H_0: Inflation rates has no significant moderating effect on the relationship between foreign exchange rates and stock prices in the Kenyan capital market.

Table 10 below show the results of the moderation analysis. From the model summary in table 10, in the first case of model 1, when foreign exchange rates and inflation rates are regressed against stock prices, the R value is 0.474, an R^2 of 0.225, meaning 22.5% of the variability in stock prices is being accounted for by exchange rates and inflation rates. The Adjusted R^2 value is 21.8% which is indeed a small deviation. The p-value of 0.000 is < 5% significance, meaning the R^2 value of 0.225 is statistically significant.

Table 10: Summary of Model Results

Model Summary[c]										
	R	**R Square**	**Adjusted R Square**	**Estimate Std. Error**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**	**Durbin-Watson**
1	.474[a]	.225	.218	.3598178	.225	34.405	2	237	.000	
2	.505[b]	.255	.246	.3535114	.030	9.531	1	236	.002	1.540
a. Predictors: (Constant), Inflation Rates, Foreign Exchange Rate										
b. Predictors: (Constant), Inflation Rates, Foreign Exchange Rate, Interaction										
c. Dependent Variable: Stock Prices										

Source: Researcher 2020, Summarized from data set (1998-2018).

Model 2 takes into account that we have included an interaction effect as a predictor variable, and the R value has gone from 0.474 to 0.505. The R^2 value has also gone up from 22.5% to 25.5% which results to an R^2 change of 3% which is fairly a good increase in the predictive capacity. The F change of 0.000 which is ($p<0.05$) is also statistically significant.

Table 11: Summary of ANOVA Test Results

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	8.909	2	4.454	34.405	.000[b]
	Residual	30.684	237	.129		
	Total	39.593	239			
2	Regression	10.100	3	3.367	26.939	.000[c]
	Residual	29.493	236	.125		
	Total	39.593	239			
a. Dependent Variable: Stock Prices						
b. Predictors: (Constant), Inflation Rates, Foreign Exchange Rate						
c. Predictors: (Constant), Inflation Rates, Foreign Exchange Rate, Interaction						

Source: Researcher 2020, Summarized from data set (1998-2018).

Table 11 above gives us an ANOVA confirmation test as far as model 1 in Table 11 is concerned. From the table, the significance level of 0.000 less than the p-value of 0.05 ($p<0.05$) clearly depicts that the model is statistically significant in predicting foreign exchange rates and inflation rates variability on stock prices. Also, the F value of 26.939 corresponds to the R^2 value of 0.255 of the variances accounted for and its statistically significant.

At 95% confidence interval, a p-value < 0.05 is considered significant and an efficient predictor of the dependent variable. Statistical significance is therefore evident in all the variables estimated.

Table 12: Summary of Model Coefficients Results

Coefficients[a]						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	Std. Error	Beta		
1	(Constant)	5.107	.369		13.843	.000
	Foreign Exchange Rate	.141	.019	.443	7.596	.000
	Inflation Rates	.068	.038	.104	1.778	.077
2	(Constant)	1.829	1.122		1.630	.105
	Foreign Exchange Rate	.310	.058	.972	5.378	.000
	Inflation Rates	1.869	.585	2.848	3.197	.002
	Interaction	-.092	.030	-2.900	-3.087	.002
a. Dependent Variable: Stock Prices						

Source: Researcher 2020, Summarized from data set (1998-2018).

From the above results, in Table 12, the moderation effect was therefore tested and the Null hypothesis was rejected and the alternative was therefore adopted.

The model was therefore estimated as:

$$Y = 1.829 + 0.310\ EXR + 1.869\ IF - 0.092\ EXRIF + 1.122$$

Where:

Y(SP) = Monthly stock prices,
EXR = Average foreign exchange rate shifts (the average of two exchange rates in Kenya i.e. USD & EURO),
IF = Monthly inflation rates,
EXRIF = Interaction between foreign exchange rates and inflation rates.

From the model above, all factors at zero stock prices were 1.829. A unit increase in the combined foreign exchange rates (US Dollar and EURO) results to a small margin of increase of 0.310 on stock prices ceteris paribus. A unit increase in the interaction effect will result to a decrease of 0.092 in stock prices. A unit increase in Inflation rate will command a small increase in stock prices of 1.869. the findings support those of Mohammed, Njoroge and Mwenda (2015), Engle and Rangel (2005), Obura & Anyango, (2016) and Nor et al., (2005). However, the findings of the study contradicted those established by Nyaga (2014) and Liang, Lin, and Hsu (2013).

5. Recommendations

The study recommends that the CBK as the regulator and Capital Markets Authority (CMA) should consider formulating favorable policies to manage Inflation rates as it is an investment driver in the economy. The findings of the study have a significance on different stakeholders like investors and other players in the market.

6. Conclusion

The study concluded by rejecting the null hypothesis "inflation rates have no significant moderating effect on the relationship between foreign exchange rates and stock prices in the Kenyan capital market".

Conflict of Interest Statement

We the authors of the article titled "Moderating Effect of Inflation Rates on the Relationship between Foreign Exchange Rates and Stock Prices in the Kenyan Capital Market", do hereby declare that we do not have any conflict of interest in relation to the publication.

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