Migration Letters

Volume: 21, No: S9 (2024), pp. 1040-1072

ISSN: 1741-8984 (Print) ISSN: 1741-8992 (Online)

www.migrationletters.com

Relationship Between Exchange Rates And Kenya Stock Index Within The Context Of A Fluctuating Growth Rate And Political Environment

Anthony Njuguna[1], Phouthakannha Nantharath*[2], and Eungoo Kang[3]

Abstract

This study investigates the impact of fluctuating growth rates and politics on the relationship between exchange rates and the Kenya Stock Index. By utilizing historical data from 2008 to 2017, the research employs quantitative methods and statistical techniques such as the Bai Perron procedure, correlation, and granger causality. The results demonstrate significant correlation and causality during the global recession, while local events have a lesser impact. The political environment, including elections and regional politics, also influences this relationship. The findings emphasize the need for comprehensive under- standing and awareness of these dynamics to guide informed decision-making in investments, risk management, and monetary policy.

Keywords: *Exchange rates, stock index, structural breaks, correlation, granger causality.*

INTRODUCTION

In today's globalized financial landscape, understanding the intricate relationship between exchange rates and stock market indices remains a central concern. This study aims to provide unique insights into this relationship, with a particular focus on the Kenyan market. While Ke[1]nya's market may be relatively small compared to global giants, its specific characteristics and experiences offer valuable lessons that can be of interest and relevance to a broader audience. The significance of this paper lies in its exploration of a developing economy's financial dynamics, where fluctuating growth rates and political events exert a distinct impact on the exchange rates and the stock market. Unlike studies in well-established markets, our research delves into the nuances of Kenya's unique market conditions. This paper differentiates itself by integrating structural breaks analysis, identifying critical economic events that marked distinct periods. This methodology allows us to precisely capture how relationships between exchange rates and stock market in- dices evolve during these pivotal moments, offering a granular understanding of these dynamic interactions.

Recognizing the importance of incorporating structural breaks in studies, this re- search aligns with the imperative of ensuring that models faithfully mirror the evolving nature of economic and financial systems. Such an approach not only fortifies the robustness of analyses but also contributes to enhanced forecasting accuracy. Be- yond academic circles, these insights hold substantial value for decision-makers across diverse fields, providing them with valuable tools to navigate the complexities of eco- nomic dynamics. In essence, the integration of structural breaks analysis stands as a crucial pillar in refining our comprehension of economic phenomena and empowering informed decision-making. Although Kenya's market may be relatively small, the lessons learned here have the potential to resonate globally. As economies worldwide grapple with fluctuating growth, political uncertainty, and their effects on financial markets, Kenya's experiences can provide valuable insights and strategies that can be applied in various contexts. The focus

[1]Saint Mary's University of Minnesota, Minneapolis MN, USA
[2,3]Becamex Business School, Eastern International University, Binh Duong Province, Vietnam.

on Kenya underscores the increasing importance of frontier markets in the global economy. As these markets become more interconnected and influential, understanding their dynamics is not only interesting but essential for a comprehensive view of the international financial landscape.

While Kenya's market may be smaller than some of the global giants, it is a significant player in Africa, with a total market capitalization of approximately $25 billion. Its economic and financial activities influence the region and have implications for broader international economic trends. As a developing economy, Kenya's financial market has faced a unique set of challenges and opportunities. This makes it an instructive case study for understanding how frontier markets respond to fluctuating growth and political changes. The dynamics at play in Kenya's market can offer valuable lessons for investors, policymakers, and financial experts around the world. In an interconnected global economy, insights from Kenya can inform decision-making and risk management in various international settings. By unraveling the intricate relationship between exchange rates, the Kenya Stock Index, fluctuating growth rates, and political events, this study aims to provide valuable insights that can inform decision-making in the financial arena. Through a com- prehensive analysis, we will contribute to a deeper understanding of the dynamics that shape financial markets, ultimately benefiting those who seek to navigate the complexities of investing in Kenya.

To thoroughly examine the correlation and causality between exchange rates and account of the methodology employed, including data collection and analysis techniques. Subsequently, we will delve into two prominent theories—the flow model and the stock model—that elucidate the relationship between stock indices and exchange rates in both developing and developed countries. Furthermore, we will extensively review existing literature to evaluate the degree of support for these theories. Finally, based on our findings, we will draw meaningful conclusions and discuss the implications they hold for investors, policymakers, and the field of finance.

2. Materials and Methods

To methodically unravel the complexities surrounding our research questions, a strategic selection of econometric techniques was employed. The methodology adopted for this study encompasses the use of the Bai-Perron procedure, Granger causality analysis, and Correlation analysis. These specific methodologies were chosen for their inherent strengths in offering profound insights into the intricate relationship between exchange rates and the stock index. Furthermore, their applicability extends to accom- modating the multifaceted influences of fluctuating growth rates and political factors within the unique context of Kenya. In this section, we delineate the systematic ap- plication of these econometric tools, elucidating their individual roles in providing a robust framework for our investigation.

The Bai-Perron procedure was utilized to identify structural breaks in the data. Given Kenya's fluctuating growth and political environment, it was essential to account for any significant shifts or changes in the relationship between the variables over time. This test allowed us to identify these structural breaks, providing a more accurate understanding of the changing patterns in the relationship between exchange rates and the stock index during different periods.

Granger causality and correlation analysis were employed to establish the causal and associative relationships between exchange rates and the stock index, considering the volatile growth and political implications for these relationships. These techniques enabled us to examine whether changes in exchange rates can be used to predict changes in the stock index, and vice versa, over various periods defined by structural changes. By

evaluating Granger causality and correlation, we aimed to uncover the dynamic interactions and dependencies between these variables, shedding light on their interplay and the potential impact of fluctuating growth and political factors. This approach allowed us to identify data patterns that stakeholders could utilize, provid- ing valuable insights into the implications of volatile growth and political dynamics on the relationship between

exchange rates and the stock index. To ensure the reliability of the analysis, the augmented Dickey-Fuller test was utilized to check the station- arity of the data. This step was crucial as it verified whether the time series data exhibited a stable behavior over time, allowing us to make valid inferences from the statistical analysis. Additionally, the Johansen method was applied to evaluate co- integration, which helped determine whether the stock index and exchange rate data were inherently linked. If co-integration was established, a Vector Error Correction Model (VECM) was applied. Otherwise, a Vector Autoregressive (VAR) model was used.

Normalization techniques such as logarithmic transformations, lagging, and differ- encing were employed to prevent spurious relationships and ensure accurate analysis of the data. The integration order of the time series data was also examined to determine if further co-integration tests were necessary.

These selected test methods have been widely used in previous studies, providing a robust foundation for rigorous analysis. By employing these techniques, we aimed to generate valuable insights into the causation and correlation between different ex- change rates and stock returns, considering the unique challenges posed by Kenya's fluctuating growth and political environment. Ultimately, these methods will con- tribute to enhancing the understanding of relationships and offer valuable benefits to stakeholders, including investors, policymakers, and researchers in the field.

2.1. Research Design

The relationship between the exchange rates and stock returns in the Kenyan econ- omy was determined using the Bai-Perron procedure, Granger Causality, and Pearson Correlation. The Bai-Perron procedure determined the structural breaks influenced by the fluctuating growth and politics that led to six periods in the 10-year sample.Pearson Correlation and Granger Causality determined how fluctuating growth and politics affected the relationships in the six periods.

2.2. Pearson Correlation

It investigated how exchanges correlate with the Kenyan market's stock index and the strength of the relationship. Pearson r shows the linear relationship between the test variables, denoted by y and x, in the generally straight-line equation form of $Y = bX + a$. The Pearson coefficient r ranges between -1 and 1. If the value of r is 0, the variables x and y are not dependent on each other [11].

The variables must be homoscedastic, normally distributed, and linear in calcu- lating the Pearson correlation. Linearity assumes that variables depict a straight-line relationship, and homoscedasticity means that data is normally distributed about the regression line. The exchange rates and stock returns were normalized through log, lag, and differencing. The Augmented Dickey-Fuller test was used to test for unit root before running the Pearson correlation.

2.3. Granger Causality

Each of the variables alternates between being an independent or dependent vari- able. Thus, the test was used to establish whether the variables arise from the other. According to Granger [17], causality is the predictability of one time series using a different time series, which can be depicted using Xt, and Yt, respectively. The lat- ter causes the former if Yt has past information essential in predicting Xt, and that information is not found in another series used in the predictor.

$$X_t = \sum_{j=1}^{m} a_j X_{t-j} + \sum_{j=1}^{m} b_j Y_{t-j} + \varepsilon_t$$

$$Y_t = \sum_{j=1}^{m} c_j X_{t-j} + \sum_{j=1}^{m} d_j Y_{t-j} + \eta_t$$

According to Granger [17], ε_t, and η_t denote uncorrelated white noise series. The equation shows that the variable Y_t causes X_t when b_j is nonzero and vice versa. When the two events occur between Y_t and X_t, the feedback relationship occurs if c_j and b_j are nonzero. The causality process used in this study is illustrated in the figure below. The exchange rates and the stock index time series were differenced to ensure they were stationary. This is because the stationary time series possess a constant variance and mean. The stationarity of the differenced data was confirmed using the Augmented Dickey-Fuller test. For any time series that failed to meet the conditions for the Johansen method, the researcher used the vector autoregressive (VAR). Besides, for the time series integrated in a similar order, further testing was done using the Johansen method for the co-integration. Ogaki et al. [34] posited that the Johansen method was preferred because it tests more than a single co-integration relationship. None co-integrated time series were tested for short-run relationships utilizing vector auto regression (VAR), while the co-integrated ones were tested using the vector error correction method (VECM).

2.4. Research Questions and Hypothesis

The study sought to answer and explore the following research questions.

1. Do Kenyan stocks correlate with the Kshs per pound, Kshs per dollar, or Kshs per euro?

2. Is there causality from Kenyan stocks to Kshs per euro, Kshs per pound, or Kshs per dollar?

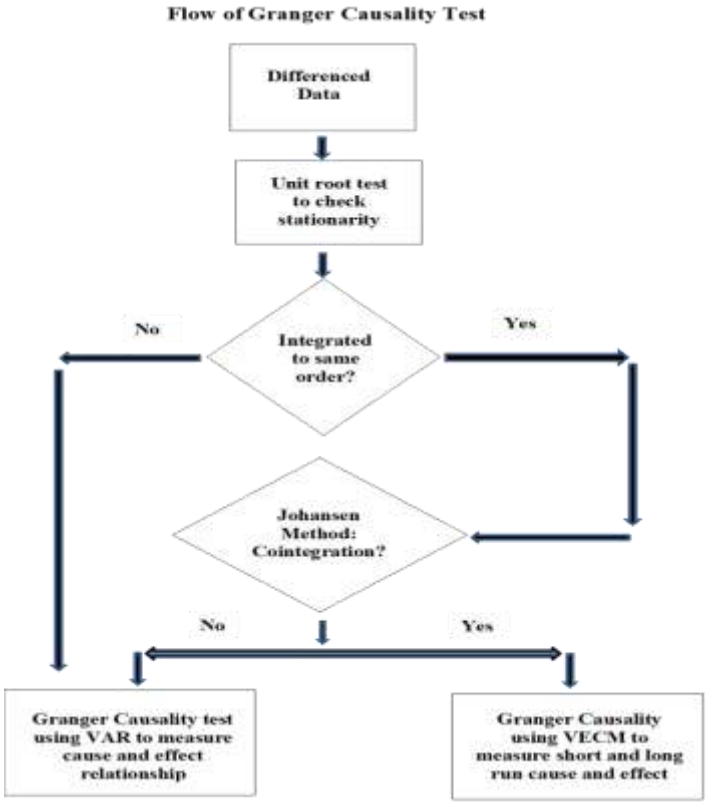


Figure 1: Flow of Granger causality test

3. Is there causality from Kshs per euro, Kshs per pound, or Kshs per dollar to Kenyan stocks?
4. Is a relationship between Kenyan stocks and Kshs per euro, Kshs per pound, or Kshs per dollar impacted by fluctuating growth and politics?

2.5. Variables and Measurement

Variables used in this study include the Kenya stock (NSE 20 share index) and exchange rates of Kshs per pound, Kshs per dollar, or Kshs per euro. The three exchange rate values were used to measure the value of the Kenya shilling. When each of the values increases, the shilling depreciates and vice-versa.

2.6. Population and Sample

The population used was the stock index data obtained from the Nairobi Securities Exchange. The other includes the Kshs per pound, Kshs per dollar, and Kshs per euro obtained from the Central Bank of Kenya. The data covered 10 years between 1st January 2008 and 31st December 2017. The researcher matched the foreign exchange rate and the trading days of the stock index. Any day only available in one time series was excluded since the unmatching could lead to parameter inaccuracies [22].

2.7. Data Collection

Secondary data was collected from databases of the two sample populations, NSE and CBK. The data for about 10 years consisted of the daily stock market index and the daily exchange rates of the three exchange rates. Data over the ten years enabled the identification of the changes in the causation and correlation over time as influenced by the fluctuating political and growth environment.

2.8. Validity and Reliability

Secondary data have limitations that limit the validity and reliability of the study findings. The researcher did not have control over stock index calculation. Besides, if companies included in the index and its calculation were inaccurately selected, it would limit the study. The researcher did not control the historical data accuracy for exchange rates and stock indexes. If there is a misrepresentation of the historical data, there is the possibility of making an erroneous conclusion.

2.9. Data Analysis Process

The data analysis process involved performing statistical tests, as shown below.

2.9.1. Bei-Perron Multiple Structural Breaks

The Bei-Perron multiple structural breaks was used to determine the changes within the 10 years' time series. It was expected that several breaks would occur at unknown dates during the 10 years that the study covered. The following model defined by Bai and Perron [3] was used as shown below.

$$y_t = x_t'\beta + z_t'\delta_j + \mu_t \qquad (t = T_{j-1} + 1, \ldots, T_j),$$

According to the model, y_t represent the observed independent variable at time t, while z_t(q x 1) and x_t(p x 1) are vectors of the co-variates. The β and δ_j , where j can take values from 1 to m+1, represent the corresponding vectors of coefficients. The (T1, . . . , Tm) represent the breakpoints that are treated as unknowns.

2.9.2. Selection of Structural Break Method

A suitable test was developed by evaluating the tests of structural changes inherent in the EViews software used in the study. The most efficient method for this study was the multiple Break Point test since it allows the identification of multiple unknown breakpoints [3]. Figure 2a - d below show the three exchange rates and the stock index.

Figure 2: Figure 2a, 2b, 2c and 2d

Figure 2a

Figure 2b

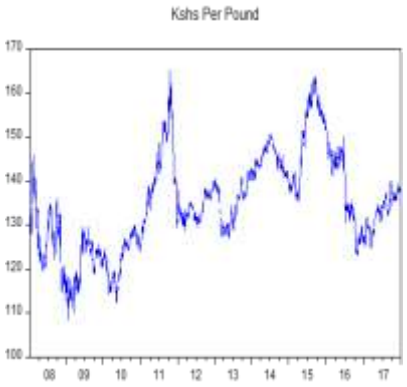


Figure 2c

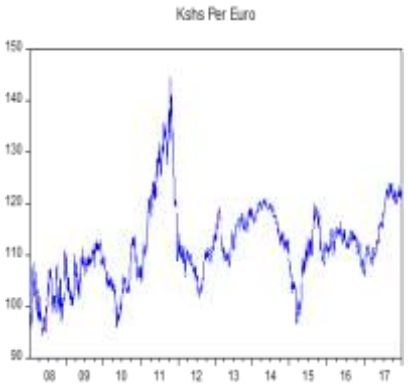


Figure 2d

The graphs above change their direction at multiple points, demonstrating the possibility of finding many breakpoints. The EViews has five breakpoints' tests cate- gorized into sequential, global maximizers, and hybrid tests. Hybrid is a conglomerate of sequential and global maximizers tests. Identifying several breaks reduces the sum- of-squared residuals in all the probable sets of break partitions [3]. Bai Perron tests have a weakness because all produce different breaks, so Bai and Perron [4] came up with a procedure called Bai Perron Procedure, which, if applied, results in the most accurate outcome. The procedure applies both global maximizer (UDMax and WDMax tests) and sequential test (Sequential L+1 breaks vs. L).

2.9.3. Selection of Trimming

Trimming is done to establish the maximum number of breaks the data possess. The Bai Perron tests possess predetermined maximum breaks linked with the size of the predetermined trimming. The trimming of 0.05, 0.10, 0.15, 0.20, 0.25 have maximum breaks of 18, 8, 5, 3, 2 respectively. The too large and too small trimmings have inadequate confidence intervals, and as a result, the majority lack the true value. According to Bai and Perron [4], the small trimming size leads to distortion of the size estimates since they are based on very few observations.

2.9.4. Correlation Analysis

A correlation was performed using daily data from stock indexes and three ex- change rates. The Bai-Perron test determined structural changes that define the various periods individually tested for correlation. Correlation over various periods defined by structural changes helped determine volatile growth and political implica- tions for relationships and identify data patterns that stakeholders could use. Before the correlation is determined, the time series data is differenced, logged, or lagged, and Augmented Dickey Fuller (ADF) is applied to ensure that both time series are stationary for improved accuracy.

2.9.5. Granger Causality Test

Granger causality was determined using daily data from the stock index and three exchange rates. The Bai-Perron test identified structural changes that defined differ- ent periods of individually tested causality to determine volatile growth and political impact on relationships and identify data patterns that stakeholders could use. The time-series data was differenced before the Granger causality was determined. We then applied a unit root test using Augmented Dickey-Fuller (ADF) to determine if both time series were stationary. Augmented-Dickey-Fuller tests start with data at level to tests the three equations. If the p-value of the ADF test statistic is less than 5% in all three equations, you can reject the null hypothesis and accept the alternative hypothesis. This means that the variable is stationary at the level. If not stationary at level, the time series data is first differenced, and the three equations tested again to see whether the differenced variables have become stationary. Cointegration is as- sumed if the two data sets become stationary after first difference. If not integrated granger causality using VAR is applied to determine causality.

2.9.6. Hypothesis for Cointegration

H:0 there is no long run relationship between stock index and exchange rates
H:a there is a long run relationship between stock index and exchange rates

The null hypothesis is rejected in favor of the alternative hypothesis if the p- value of the trace statistic or eigenvalue statistic is less than 5%, indicating that the variables are co-integrated or have a long-run relationship. If co-integration is indicated, the short-run and long-run associations are established using the vector error correction approach (VECM). Error correction mechanisms occur when a proportion of disequilibrium from one period is corrected in the next period [14]. Short run cause and effect between stock index and exchange rates under vector error correction method (VECM) were determined using Wald test on Error correction terms.

2.9.7. Hypothesis for Short Run Causality

H:0 There is no short run causality
H:a There is short run causality

The null hypothesis is rejected in favor of the alternative hypothesis if the p-value of Chi-square is less than 5%, indicating that there is short-run causation between the variables. If there is no co-integration, a granger causality test is used in a vector autoregression (VAR) environment to determine the link.

Figure 3: Summary of Methodology

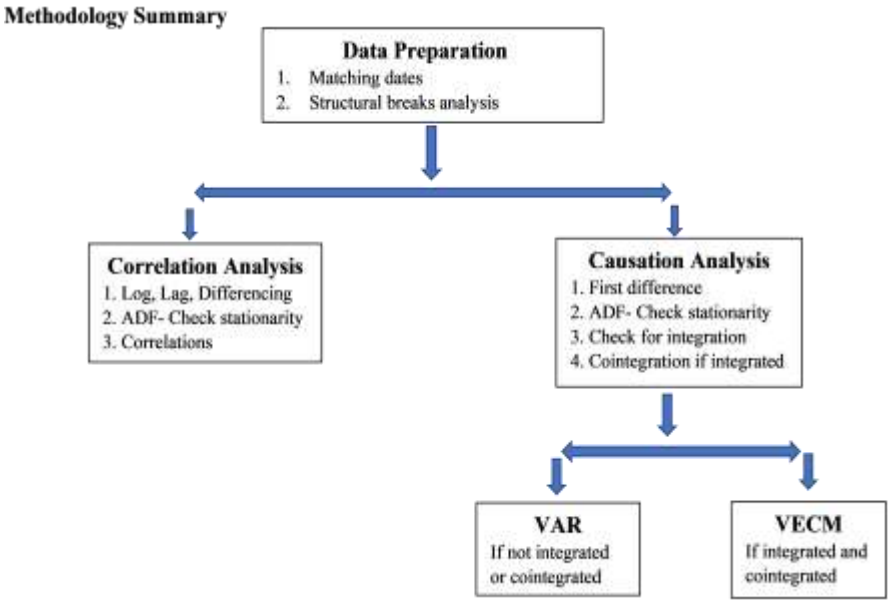


Figure 3 shows how we conducted data preparation, and analysis. As shown above, we matched the dates of each pair of stock indexes and the three exchange rates. The second step was to identify structural breaks. We conducted correlation analysis after data preparation, as shown in Figure 3. We first normalized the data using log, lag, and differencing, and we used Augmented Dickey-Fuller test to confirm stationarity. The second step was determining the correlations of each break period defined by structural breaks. The causation analysis was the final analysis completed. We normalized the data using first difference, and we applied Augmented Dickey-Fuller test to check for stationarity. Integration of stock index and exchanges was determined. Data that did not become stationary after first difference was assessed for causality using VAR. Data that became stationary after first difference was further assessed for cointegration. We applied VAR to data without cointegration, and VECM to data with cointegration.

3. Theory/Calculation

The literature review highlights two models explaining the relationship between exchange rates and stock returns. The flow model, proposed by Dornbusch and Fischer [12], highlights that exchange rate movements can have an impact on a company's international competitiveness. This, in turn, influences key factors like revenue, cost of funds, output, and ultimately the company's share price. The Flow model usually applies to developing countries, emphasizing that exchange rates play a significant role in influencing stock returns. Conversely, the stock model, proposed by [15], emphasizes the role of capital account transactions. According to this model, when stock returns rise, it attracts capital flows. As a result, there is an increased demand for the domestic currency, leading to the appreciation of the exchange rate. It is important to note that the stock model usually applies to developed countries.

3.1. Flow Model

Dornbusch and Fischer [12] posited that relative price of foreign goods influences demand for a country's products. Hence an increase in the relative price of overseas goods could shift demand to domestic items. A rise in demand of domestic goods enhances wealth and demand for home currency, resulting in a current account surplus

and currency appreciation. The rise in the value of the home currency will eventually result in lower exports and higher imports. Lower exports will decline stock price, a current

account deficit, and currency depreciation due to lower demand [12]. Since exchange rates determine competitiveness of an economy, causation is from exchange rates to stock returns.

3.1.1. Exchange Rates to Stock Returns – Flow Model

Moore and Wang [31] investigated the origin of the dynamic relationship between the stock return differentials and the exchange rates in Canada, Australia, the U.K., Japan, Singapore, Malaysia, Indonesia, Thailand, Philippines, and South Korea. Ac- cording to Moore and Wang [31], countries in Asia were linked to the current account and depicted a negative dynamic relationship between the real exchange rates and the relative stock prices. These countries linked to the current account represented a good representation of the flow-oriented model.

Sui and Sun [40] evaluated how the interest differential, stock returns and exchange rates relate in the short and long run. The focus was on the U.S. and the BRICS countries, including India, China, Russia, Brazil, and South Africa. The results of the daily exchange rates and the stock prices unraveled the reason for the direction from the foreign exchange rates to the stock returns in every BRICS country over the short run. The influence experienced on the stock returns in the BRICS countries was due to the high number of trading partners and the high investments. In that regard, the results show support for the flow-oriented model. Russia and Brazil depicted a bidirectional causality implying that the causality point both ways. However, South Africa, India and China demonstrated a unidirectional causality that only proceeds in a single direction.

Liang et al. [28] investigated the causal relationship that exists between currency markets and equity markets in Thailand, Singapore, Philippines, Malaysia, and In- donesia. The historical data on exchange rates and stock indices revealed that the ex- change rates and the stock returns are negatively related. Besides, the results depicted causality relationship from exchange rates to stock returns that support flow-oriented model in the five countries studied.

Kisaka and Mwasaru [25] explored the exchange rates and the stock prices' causal relationship in Kenya. The study utilized the nominal exchange rates and stock index for each month between November 1993 and May 1999. The data collected showed the existence of a unidirectional causality originating from the exchange rates to stock prices.

Zhao [45] studied the dynamic relationship between the stock price and the Ren- minbi (RMB) real effective exchange rates. The researcher used a model that consider the variance that varied with time series data. He relied on the real effective ex- change rate accounts for the currencies changes of the main trade countries. These were adjusted to factor in the impacts of inflation. The results showed that Ren- minbi's effective exchange rates and stock prices lack a stable long-term equilibrium relationship. Besides, it was established that based on spillover effects, international trade changes were critical to the economy and were transferred to stock prices. The spillover effect was characterized by bi-directional volatility, thus indicating the existence of a relationship between the two variables. As depicted in the flow model, the spillover effect is related as it flow from the exchange rates to stock returns.

Tian and Ma [42] investigated how financial liberalization relates with the exchange rates and the performance of the stock market. The focus country was China, from the financial liberalization experienced in 2005 onwards. The researchers used historical data on industrial production, money supply, exchange rates, and share index. The study found that the exchange rates and the stock prices are positively correlated. Tian and Ma [42] found that more money in the money supply originating from the hot money inflows and the Central Bank of China resulted in a positive correlation between the exchange rates and the stock returns. Moreover, the researchers found that the co-integration of the stock market with exchange rates against the H.K. dollar and U.S. dollar was due to the liberalization of the financial markets

3.2. Stock Model

According to Frankel [15], domestic and foreign assets are substitutes, and asset holders allocate their portfolios according to expected rates of returns. Low inflation could increase demand for a country's financial assets and appreciation of currency, while high inflation could decrease demand of its financial assets, and depreciation of currency. Since financial assets determine the behavior of exchange rates, causality is from stock returns to exchange rates.

3.2.1. Stock returns to Exchange rates - Stock Model

According to Moore and Wang [31], the correlations in Australia, U.K., and Canada were determined by the interest rate differential and depicted a negative dynamic relationship between the real exchange rates and the relative stock prices. Thus, the three countries depict good support for the stock-oriented model.

Zhao [45] established that the spillover bi-directional volatility effects depict the stock model since it flows in both ways.

Tsai [43] explored how the exchange rates and the stock price indices relate to each other in Philippines, Malaysia, Singapore, Taiwan, South Korea, and Thailand. The study aimed to understand the effects of the various market conditions on the relationships between the exchange rates and the stock returns in the Asian context. The nature of the relationship was investigated using the monthly stock indices and the foreign exchange rates for the period between January 1992 and December 2009. It was found that during the periods when there were high or low exchange rates, the relationships between the foreign exchange markets and the stocks were significant. The researcher also posited that the negative relationships were mostly experienced during financial crisis or bubbles in the stock market. This was due to the outflows and inflows of foreign cash that such a characteristic financial crisis causes. The exchange rate may not be influenced in case volatility like the profit opportunity fails to occur. According to Tsai, Asia has high number of export-oriented firms, and as a result, the exchange rates and the stock prices were positively correlated as the outflows and the inflows became low. Based on the results, the appreciation in the domestic currency was due to the increment in the domestic stock returns. Besides, a decrease in domestic stock returns causes a depreciation in the domestic currency, which means stock returns cause the exchange rate.

Kamal and Haque [22] investigated the pattern of dependence on the foreign ex- change and stock markets in Sri Lanka, India, and Bangladesh. The researchers collected historical data on exchange rates and the closing and opening indices for the stock markets in the three countries between 30th July 2009 and 31st July 2013. The data collected showed that the exchange rates and the stock returns in the markets of the three countries were negatively correlated, thus unravelling the presence of upper tail dependence. The dependence was an indication of an increase in the relationship in the bull market. The upper tail dependence can be described as the appreciation of the currency when the investors buy stocks [22]. These findings shows that the changes in the exchange rates are due to the stock returns.

Kanas [23] investigated how the exchange rates depend on the stock returns and vice versa in Canada, France Japan, U.S. Germany, and U.K. The researchers were motivated to conduct the study by the heightened cross-border equity flows, the beneficial effects and the risks associated with the reduced gains originating from the international diversification. The findings were drawn from the historical data that comprised of the stock returns and the closing stock prices between 1st January 1986 and 28th February 1998.

The study found that only Germany did not show causality from stocks to exchange rates [23]. Germany failed to have causality because of the Bundesbank intervention in the currency markets that lowered the exchange rate volatility. The study showed symmetric effects on exchange rates due to bad and good stock market news. The study also found

an insignificant impact of volatility from the exchange rates to stock returns due to the offsetting influence of positive and negative exchange rate volatility [23]. While a negative exchange rate volatility lowers the stock returns, the positive one increases the returns, thus giving the offsetting a weak overall effect. Besides, the hedging also showed connatural weak overall impacts on the exchange rates. These findings denote that the study countries have weak causality from exchange rates to stock returns and, therefore, against the flow model. Kanas [23] further found significant negative correlations between the exchange rates and the stock returns among the study countries. The researcher further established that an increase in the stock returns volatility post the crash in 1987 led to increased volatility of exchange rates [23]. This revealed a heightened integration of the study countries.

Lin [29] studied the dynamic long-term and short-term relationship between the stock prices and exchange rates in Thailand, the Philippines, India, Taiwan, Korea, and Indonesia. The researcher collected the historical data that comprised monthly exchange rates, interest rates, stock indices and foreign reserves between January 1986 and December 2010 [29]. It was established that the stock indices and the exchange rates had a strong relationship during the global financial crisis, the 1997 Asian financial crisis and stock market liberalization in the 1990s [29]. It was also established that a greater percentage of the spillovers stemmed from the stock returns to exchange rates. Compared to other industries, the causality in export-oriented industries was not stronger. This denoted that relationship between stock returns, and exchange rates were driven by international investment capital flows instead of international trade flows [29].

Tabak [41] investigated long run relationship and causality between stock prices, and exchange rates in Brazil. The country's data was collected between 1st August 1994 and 14th May 2002 regarding the foreign exchange rates of Real per U.S. dollar and the Sao Paulo stock exchange Index. The study showed a linear Granger causality from the stock returns to exchange rates. Besides, the co-integration test showed a long-run relationship does not exist between the nominal exchange rates and stock prices.

The studies below failed to use causation in establishing how exchange rates and stock returns relate. As a result, the stock or flow model was inapplicable to group them. Lestano and Kuper [26] investigated how the exchange rates and stock returns dynamically relate in the context of South Korea, Malaysia, Indonesia, Thailand, Singapore, and the Philippines. Data was collected between 3rd January 1994 and 27th September 2013 [26]. The study found a negative correlation between the exchange rates and the stock returns. The correlation was stronger during the Global Financial and Asian crises since there was a huge loss in stock markets and massive currency depreciation [26]. It was also established that more developed markets like Singapore had greater sensitivity to international capital mobility.

In addition to examining portfolio risk, Sirr et al. [39] evaluated how the exchange rates and the equity returns correlate in the U.S., Brazil, Argentina, Mexico, India, Russia, and China. The study found that the exchange rates and the stock returns are negatively related in the U.S., Argentina, and China. However, Brazil showed a positive correlation and less attractiveness to investors. In Russia, Mexico and India, the impact of correlation on risk was little.

¨Ulku¨and Demirci [44] investigated how the exchange rates and the stock markets in the European region relate in Ukraine, Croatia, Romania, Hungary, Czech Republic, Poland, Turkey, and Russia. The closing exchange rate values, the global market indices, and the stock market indices for daily and monthly were applied. The study found that global developed, and global emerging stock market returns explain a large portion of the relationship between stock index and currency value in emerging markets [44]. A small portion of the relationship that is not explained by these global returns is more evident in domestic countries with deep stock markets, but it is less persistent than what is explained by global returns [44]. The relationship in large external deficit European emerging markets

were a strong positive [44]. The source status and the stock market depth impacted how the stock markets and the exchange rates related. Croatia and Ukraine have less developed stock markets and thus have lag effects [44]. Thus, the exchange rates and stock returns relationship occurred after an extended period. The exchange rates and the stock returns had a stronger relationship during low source status, and deep stock market such as Turkey.

Katechos [24] utilized a global variable to study how the exchange rates and the stock market returns relate. The method that Katechos used could account for het- eroscedasticity in exchange rate data. The researcher used the exchange rate data for every week between January 1999 and August 2010. According to Katechos [24], the global stock market and the exchange rates are positively related at high-interest rates. The variables showed a negative relation at low-interest rates.

A plethora of studies on the stock and flow model indicates that most of those that have applied data from developing countries can be categorized under the flow model. On the contrary, studies on developing and developed countries are under the stock model. This shows that factors influence the relationship, rendering the results inconsistent, thus failing to support the theories. Figure 4 below shows a generalization of what the theories, models and literature imply about relationship between stock index and exchange rates.

Figure 4: Summary of Literature Review

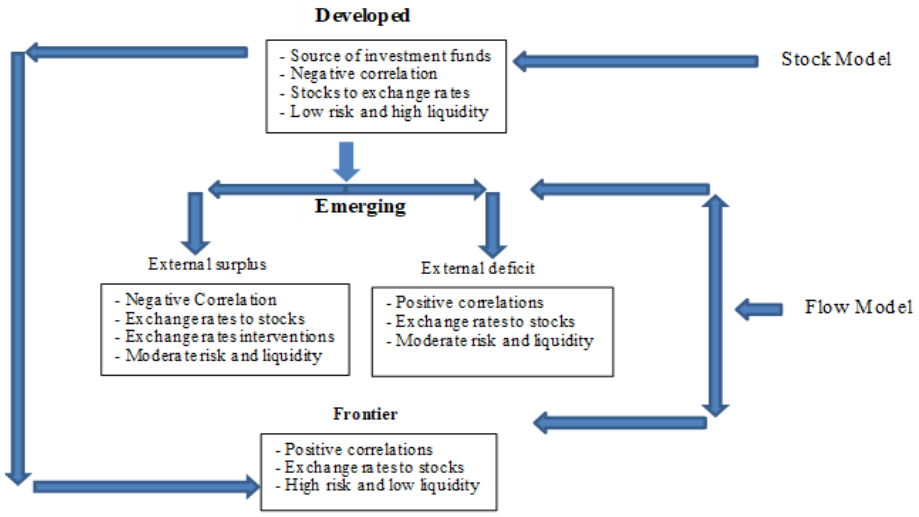


Figure 4 applies the MSCI [32] market classification to categorize stock markets into developed, emerging, and frontier. Frankel [15] asserts that stock performance can influence changes in exchange rates through portfolio re-balancing involving hedging and diversification. Notably, the stock model, associated with the portfolio balance approach, appears more applicable to developed countries, as illustrated in Figure 4. High-performing stock markets have the potential to trigger portfolio re-balancing, influencing exchange rates.

According to ¨Ulku¨ and Demirci [44], developed stock markets serve as sources of international investment funds, while developing stock markets act as recipients of these funds. Portfolio re-balancing in response to stock market outperformance could lead to fund outflows and currency depreciation, resulting in a negative correlation between stock returns and exchange rates. Hau and Rey [18] argue that exchange rates and stock returns should be negatively correlated due to portfolio re-balancing, wherein the high performance of the stock market leads to currency depreciation. Thus, the causation is from stock returns to exchange rates.

Goods market theory posits that changes in exchange rates impact a country's

competitiveness and output [12]. Figure 4 associates the flow model, linked with goods market theory, with developing countries (emerging and frontier). Ma and Kao [30] contend that currency appreciation negatively affects stocks in export-oriented economies but positively influences stocks in import-oriented economies. In Figure 4, import-oriented countries encompass external deficit and frontier markets. Invest- ment flows are expected to yield a positive correlation in external deficit and frontier. Countries due to their similar effects on stocks and exchange rates. ¨Ulku¨ and Demirci [44] note that the deficit and stock markets in external deficit countries are influenced by global risk appetite. During periods of high global risk appetite, portfolio flows towards risky assets in emerging and frontier markets, leading to appreciation in both stocks and exchange rates. Consequently, causation is from exchange rates to stock returns.

Conversely, external surplus or export-oriented countries exhibit a negative corre- lation, as illustrated in Figure 4, since they rely on a weak currency to boost exports. Sangar´e [38] highlights that some Asian countries employ managed floating to support.Exports and manage debt denominated in foreign currencies. When the local currency is weak, it enhances stock returns due to increased exports, resulting in a negative correlation between stock returns and exchange rates. Here, the determining factor is exchanging rates, establishing the causation from exchange rates to stock returns.

4. Results

In this section, we present the outcomes of our study, providing a detailed account of the empirical findings derived from the application of quantitative methods and statistical techniques. Through a meticulous examination of the data, we uncover patterns, relationships, and significant trends that illuminate the research questions posed at the outset. This section serves as a comprehensive showcase of the empirical evidence garnered from our analyses, offering a clear and objective presentation of the outcomes. By delving into the results, readers will gain insights into the key variables under scrutiny, enabling a nuanced understanding of the phenomena explored in this study.

Step 1: Descriptive statistics of the data were determined. Table 1 below summa- rizes the statistics of the data.

Table 1. Descriptive statistics

	Mean	Median	Std deviation	Variance	Kurtosis	Skewness
NSE 20 Share Index	4086.445	4008.015	738.402	545238.014	-1.146	0.002
Kshs/$	87.714	86.350	10.897	118.747	-0.646	-0.095
Kshs/£	134.837	134.082	10.945	119.796	-0.288	0.276
Kshs/€	111.572	111.006	7.788	60.659	1.043	0.647

The existence of skewness and kurtosis, as depicted in Table 1, indicates that the variables do not follow a normal distribution. Furthermore, the absence of normal distribution is underscored by the inequality between the mean and median.

Step 2: Structural break Analysis - Bai Perron procedure
Bai and Perron's procedure was applied to determine structural breaks. The pro- cedure applies (UDMax and WDMax tests) to see if there is at least one break [4]. If at least one break is present, Sequential L+1 breaks vs. L is applied to determine the number of breaks present [4]. Bai [2] indicated that (UDMax and WDMax tests) have high power of detecting difficult to identify breaks, while Sequential L+1 breaks vs. L has high power of accuracy.

4.1. Selection of Trimming

To determine suitable trimming and maximum number of breaks for the study, Sequential L+1 breaks vs. L and Global information criteria were applied. Sequential L+1 breaks vs. L has high power of accuracy while Global information criteria has low power of accuracy [2]. Results with predetermined trimmings on stock index using EViews are summarized in Table 2.

Table 2: Trimming summary.

	0.05	0.10	0.15	0.20	0.25
Sequential L+1 breaks vs. L	12	7	5	3	2
Global information criteria	13/14	7	4	3	2

Table 2 indicates that trimming for Sequential L+1 breaks vs. L and Global in- formation criteria differ at 0.05 and 0.15. Bai and Perron [4] indicate that if Global information criteria yields lower number of breaks compared to Sequential L+1 breaks vs. L. using same assumptions then Sequential L+1 breaks vs. L. is a better option because Global information criteria is biased downwards. Table 2 indicate Global information criteria has lower number of breaks than Sequential L+1 breaks vs. L at trimming of 0.15, which means 5 breaks using Sequential L+1 breaks vs. L are better option for our data. In addition, it means all breaks below 5 could be unsuitable. At 0.05 Sequential L+1 breaks vs. L, which is superior has fewer breaks than Global information criteria and therefore it's unsuitable. Bai [2] indicated that at 0.05 trimming, data with serial correlation and heteroskedasticity will result in size distortion. The size distortion for data with statistical errors disappear when trimming reaches 0.15 or 0.20 [2]. Further, sequential method is biased with a trimming of 0.05 but the bias disappears when trimming reach 0.10 [2]. At 0.10, Sequential L+1 breaks vs. L and Global information criteria have same number of breaks. Since Global information criteria has some weakness such as downward bias, problems dealing with serial correlation and heterogeneity, this choice may not be the best option. Further, Bai [2] indicated that a trimming of 0.15, which has a maximum of five breaks, is suitable for most empirical applications.

4.1.1. Bai Perron Procedure Using Stock Index.

Multiple breakpoint tests
Bai-Perron tests of 1 to M globally determined breaks
Date: 01/09/20 Time: 10:11
Sample: 1/02/2008 12/29/2017
Included observations: 2474
Breaking variables: C
Break test options: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Sequential F-statistic determined breaks:	5
Significant F-statistic largest breaks:	5
UDmax determined breaks:	2
WDmax determined breaks:	2

Breaks	F-statistic	Scaled F-statistic	Weighted F-statistic	Critical Value
1 *	444.6714	444.6714	444.6714	8.58
2 *	1162.922	1162.922	1381.976	7.22
3 *	863.1187	863.1187	1242.543	5.96
4 *	722.9447	722.9447	1243.059	4.99
5 *	507.7893	507.7893	1114.279	3.91

UDMax statistic*	1162.922	UDMax critical value**	8.88
WDMax statistic*	1381.976	WDMax critical value**	9.91

* Significant at the 0.05 level.
** Bai-Perron (Econometric Journal, 2003) critical values.

Estimated break dates:
1: 6/02/2016
2: 1/14/2013, 8/25/2015
3: 7/11/2011, 1/09/2013, 8/25/2015
4: 1/25/2010, 7/13/2011, 1/11/2013, 8/25/2015
5: 1/19/2010, 7/07/2011, 1/07/2013, 7/14/2014, 1/04/2016

The findings underscore the significance of breaks in the dataset, with a noteworthy observation that the largest statistically significant number of breaks is 5. Analysis using UDMax and WDMax reveals that 2 is the determined number of breakpoints, leveraging

both unweighted and weighted maximized statistics.

Furthermore, when assessing the original, scaled, and weighted F-statistics, their values surpass the critical thresholds, leading to the rejection of the null hypothesis of no breaks.

Both UDMax and WDMax statistics also exceed the critical values, providing compelling evidence to reject the null hypothesis and accept the alternative hypothesis indicating the presence of at least one break.

Multiple breakpoint tests
Bai-Perron tests of L+1 vs. L sequentially determined breaks
Date: 01/10/20 Time: 19:53
Sample: 1/02/2008 12/29/2017
Included observations: 2474
Breaking variables: C

Break test options: Trimming 0.15, Max. breaks 5, Sig. level 0.05
Allow heterogeneous error distributions across breaks

Sequential F-statistic determined breaks: 5

Break Test	F-statistic	Scaled F-statistic	Critical Value**
0 vs. 1 *	1212.687	1212.687	8.58
1 vs. 2 *	1105.162	1105.162	10.13
2 vs. 3 *	214.5781	214.5781	11.14
3 vs. 4 *	149.0634	149.0634	11.83
4 vs. 5 *	87.02049	87.02049	12.25

* Significant at the 0.05 level.
** Bai-Perron (Econometric Journal, 2003) critical values.

Break dates:

	Sequential	Repartition
1	6/02/2016	1/21/2010
2	1/09/2013	7/11/2011
3	12/09/2014	1/09/2013
4	7/11/2011	12/09/2014
5	1/21/2010	6/02/2016

Given the indication from UDMax and WDMax statistics that the time series data incorporates at least one break, the Sequential L+1 breaks vs. L method [4] is employed to ascertain the precise number of breaks. This robust analytical approach allows for a nuanced understanding of the structural changes within the dataset, providing valuable insights for further investigation and interpretation.

The results elucidate that both the original and scaled F-statistics for breakpoints ranging

from 1 to 5 surpass the critical values, indicating the presence of 5 breakpoints. The comprehensive list of identified breakpoints is presented at the bottom, encom- passing both the original sequential procedure and the re-partition procedure. This breakdown offers a detailed insight into the specific points where structural changes oc- cur within the dataset, facilitating a more nuanced understanding of its dynamics.The detailed information encapsulated in this breakdown acts as a guiding resource, en- abling researchers and analysts to delve deeper into the nuances of the identified struc- tural changes and their implications.

4.1.2. Bai Perron Procedure using Kshs per Dollar

Multiple breakpoint tests
Bai-Perron tests of 1 to M globally determined breaks
Date: 01/09/20 Time: 10:14
Sample: 1/02/2008 12/29/2017
Included observations: 2474
Breaking variables: C
Break test options: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Sequential F-statistic determined breaks:	5
Significant F-statistic largest breaks:	5
UDmax determined breaks:	2
WDmax determined breaks:	2

Breaks	F-statistic	Scaled F-statistic	Weighted F-statistic	Critical Value
1 *	4608.960	4608.960	4608.960	8.58
2 *	7556.443	7556.443	8979.817	7.22
3 *	6179.756	6179.756	8896.360	5.96
4 *	4773.910	4773.910	8208.447	4.99
5 *	3592.764	3592.764	7883.867	3.91

UDMax statistic*	7556.443	UDMax critical value**	8.88
WDMax statistic*	8979.817	WDMax critical value**	9.91

* Significant at the 0.05 level.
** Bai-Perron (Econometric Journal, 2003) critical values.

Estimated break dates:
1: 3/30/2015
2: 2/21/2011, 5/06/2015
3: 7/10/2009, 3/04/2011, 5/06/2015
4: 7/10/2009, 3/02/2011, 11/13/2013, 5/12/2015
5: 7/10/2009, 1/11/2011, 7/05/2012, 1/16/2014, 7/09/2015

The findings demonstrate that 5 is the largest statistically significant number of breaks. Utilizing UDMax and WDMax, the analysis identifies 2 as the number of breakpoints based on both unweighted and weighted maximized statistics. Notably, the original, scaled, and

weighted F-statistics surpass the critical values, leading to the rejection of the null hypothesis that posits no breaks in the time series data.

Both UDMax and WDMax statistics exceeding critical values indicate the pres- ence of at least one break in the time series data. Subsequently, employing the Se- quential L+1 breaks vs. L method allows for a precise determination of the number of breaks. This multifaceted approach not only rejects the null hypothesis but also guides the exploration of the dataset to comprehend the nature and impact of the identified structural breaks.

Multiple breakpoint tests
Bai-Perron tests of L+1 vs. L sequentially determined breaks
Date: 01/10/20 Time: 19:59
Sample: 1/02/2008 12/29/2017
Included observations: 2474
Breaking variables: C
Break test options: Trimming 0.15, Max. breaks 5, Sig. level 0.05
Allow heterogeneous error distributions across breaks

Sequential F-statistic determined breaks:			3
Break Test	F-statistic	Scaled F-statistic	Critical Value**
0 vs. 1 *	9920.292	9920.292	8.58
1 vs. 2 *	2272.061	2272.061	10.13
2 vs. 3 *	205.0663	205.0663	11.14
3 vs. 4	9.291065	9.291065	11.83

* Significant at the 0.05 level.
** Bai-Perron (Econometric Journal, 2003) critical values.

Break dates:

	Sequential	Repartition
1	3/30/2015	5/26/2010
2	6/04/2010	7/09/2013
3	7/09/2013	5/08/2015

The results reveal that both the original and scaled F-statistics for breakpoints 1 to 3 surpass the critical values, indicating the presence of 3 breakpoints. However, for breakpoint 4, both the original and scaled F-statistics fall below the critical values, signaling the absence of a breakpoint at this juncture.

A detailed list of identified breakpoints is provided at the bottom, encompassing insights from both the original sequential procedure and the re-partition procedure. This breakdown offers a clear understanding of the specific points in the dataset where structural changes occur, facilitating a comprehensive analysis of the underlying dynamics.

4.1.3. Bai Perron Procedure using Kshs per Pound

Multiple breakpoint tests
Bai-Perron tests of 1 to M globally determined breaks
Date: 01/09/20 Time: 10:19
Sample: 1/02/2008 12/29/2017
Included observations: 2474
Breaking variables: C
Break test options: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Sequential F-statistic determined breaks:	5
Significant F-statistic largest breaks:	5
UDmax determined breaks:	1
WDmax determined breaks:	3

Breaks	F-statistic	Scaled F-statistic	Weighted F-statistic	Critical Value
1 *	2141.736	2141.736	2141.736	8.58
2 *	1591.941	1591.941	1891.808	7.22
3 *	1690.920	1690.920	2434.244	5.96
4 *	1320.692	1320.692	2270.849	4.99
5 *	1059.344	1059.344	2324.597	3.91

UDMax statistic*	2141.736	UDMax critical value**	8.88
WDMax statistic*	2434.244	WDMax critical value**	9.91

* Significant at the 0.05 level.
** Bai-Perron (Econometric Journal, 2003) critical values.

Estimated break dates:
1: 2/21/2011
2: 3/01/2011, 6/28/2016
3: 2/02/2011, 2/13/2014, 6/27/2016
4: 2/01/2011, 7/27/2012, 2/12/2014, 6/27/2016
5: 7/31/2009, 2/01/2011, 7/27/2012, 2/12/2014, 6/27/2016

The findings indicate that 5 is the largest statistically significant number of breaks. By utilizing both UDMax and WDMax, the analysis determines 1 and 3 as the num- ber of breakpoints using unweighted and weighted maximized statistics, respectively. Notably, the original, scaled, and weighted F-statistics all exceed the critical values, providing grounds to reject the null hypothesis of no breaks.

The observation that both UDMax and WDMax statistics surpass critical values suggests the presence of at least one break in the time series data. Consequently, employing the Sequential L+1 breaks vs. L method enables the precise determination of the number of breaks. This comprehensive approach not only rejects the null hy- pothesis but also guides further exploration, shedding light on the nature and impact of the identified structural breaks within the dataset.

Multiple breakpoint tests
Bai-Perron tests of L+1 vs. L sequentially determined breaks
Date: 01/10/20 Time: 20:03
Sample: 1/02/2008 12/29/2017
Included observations: 2474
Breaking variables: C
Break test options: Trimming 0.15, Max. breaks 5, Sig. level 0.05
Allow heterogeneous error distributions across breaks

Sequential F-statistic determined breaks: 3

Break Test	F-statistic	Scaled F-statistic	Critical Value**
0 vs. 1 *	2777.373	2777.373	8.58
1 vs. 2 *	1012.418	1012.418	10.13
2 vs. 3 *	705.3273	705.3273	11.14
3 vs. 4	5.042209	5.042209	11.83

* Significant at the 0.05 level.
** Bai-Perron (Econometric Journal, 2003) critical values.

Break dates:

	Sequential	Repartition
1	2/21/2011	2/02/2011
2	6/28/2016	2/13/2014
3	2/13/2014	6/27/2016

The results reveal that both the original and scaled F-statistics for breakpoints 1 to 3 surpass the critical values, signifying the existence of 3 breakpoints. However, for breakpoint 4, both the original and scaled F-statistics fall below the critical values, indicating the absence of a breakpoint at this specific juncture.

Further details, including a comprehensive list of identified breakpoints from both the original sequential procedure and the re-partition procedure, are provided at the bottom. This breakdown enhances the clarity of the findings and serves as a reference for a more in-depth analysis or exploration of the identified breakpoints.

4.1.4 Bai Perron Procedure using Kshs per Euro

Multiple breakpoint tests
Bai-Perron tests of 1 to M globally determined breaks
Date: 01/09/20 Time: 10:22
Sample: 1/02/2008 12/29/2017
Included observations: 2474
Breaking variables: C
Break test options: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Sequential F-statistic determined breaks:	5
Significant F-statistic largest breaks:	5
UDmax determined breaks:	1
WDmax determined breaks:	1

Breaks	F-statistic	Scaled F-statistic	Weighted F-statistic	Critical Value
1 *	1271.449	1271.449	1271.449	8.58
2 *	848.0726	848.0726	1007.820	7.22
3 *	613.4509	613.4509	883.1222	5.96
4 *	485.1205	485.1205	834.1352	4.99
5 *	413.1156	413.1156	906.5299	3.91

UDMax statistic*	1271.449	UDMax critical value**	8.88
WDMax statistic*	1271.449	WDMax critical value**	9.91

* Significant at the 0.05 level.
** Bai-Perron (Econometric Journal, 2003) critical values.

Estimated break dates:
1: 1/24/2011
2: 9/29/2010, 3/21/2012
3: 9/22/2010, 3/14/2012, 9/17/2013
4: 9/29/2010, 3/21/2012, 9/26/2014, 3/17/2016
5: 7/10/2009, 1/18/2011, 7/12/2012, 9/26/2014, 3/17/2016

The results underscore that 5 represents the largest statistically significant number of breaks. Analysis using both UDMax and WDMax reveals that 1 is the determined number of breakpoints using unweighted and weighted maximized statistics, respec- tively. Notably, the original, scaled, and weighted F-statistics all surpass the critical values, leading to the rejection of the null hypothesis asserting no breaks.

The observation that both UDMax and WDMax statistics exceed critical values indicates the presence of at least one break in the time series data. Subsequently, applying the Sequential L+1 breaks vs. L method allows for a precise determination of the number of breaks. This holistic approach not only rejects the null hypothesis but also guides a detailed exploration of the dataset, unraveling the nature and implications of the identified structural breaks.

Multiple breakpoint tests
Bai-Perron tests of L+1 vs. L sequentially determined breaks
Date: 01/10/20 Time: 20:07
Sample: 1/02/2008 12/29/2017
Included observations: 2474
Breaking variables: C
Break test options: Trimming 0.15, Max. breaks 5, Sig. level 0.05
Allow heterogeneous error distributions across breaks

Sequential F-statistic determined breaks: 5

Break Test	F-statistic	Scaled F-statistic	Critical Value**
0 vs. 1 *	1774.132	1774.132	8.58
1 vs. 2 *	192.1560	192.1560	10.13
2 vs. 3 *	93.80229	93.80229	11.14
3 vs. 4 *	55.17130	55.17130	11.83
4 vs. 5 *	194.2676	194.2676	12.25

* Significant at the 0.05 level.
** Bai-Perron (Econometric Journal, 2003) critical values.

Break dates:

	Sequential	Repartition
1	1/24/2011	7/10/2009
2	7/10/2009	1/24/2011
3	7/18/2012	7/18/2012
4	3/17/2016	9/26/2014
5	9/26/2014	3/17/2016

The results indicate that both the original and scaled F-statistics for breakpoints 1 to 5 exceed the critical values, signifying the presence of 5 breakpoints. At the bottom is the comprehensive list of these identified breakpoints, stemming from both the original sequential procedure and the re-partition procedure.

Table 3: Structural breaks summary

	NSE 20 Share Index	Kshs/$	Kshs/£	Kshs/€
Break 1	1/21/2010	5/26/2010	2/2/2011	7/10/2009
Break 2	7/11/2011	7/9/2013	2/13/2014	1/24/2011
Break 3	1/9/2013	5/8/2015	6/26/2016	7/18/2012
Break 4	12/9/2014			9/26/2014
Break 5	6/2/2016			3/17/2016

Exchange rates represent value of a currency relative to another [33]. In all three exchange rates, the Kenya shilling does not change. Since exchange rates are relative values the difference in structural breaks is due to foreign factors such as Brexit, Eu- ropean debt crisis etc., that affect the currencies. Besides, the differences could be due to bank actions and trade balance between Kenya and other countries. In comparison, a stock index is made up of major companies that drive economic growth in a country. Since the study explores effects of fluctuating growth and politics on correlations and causations between Kenya stock returns and exchange rates, structural breaks based on stock index are the most suitable.

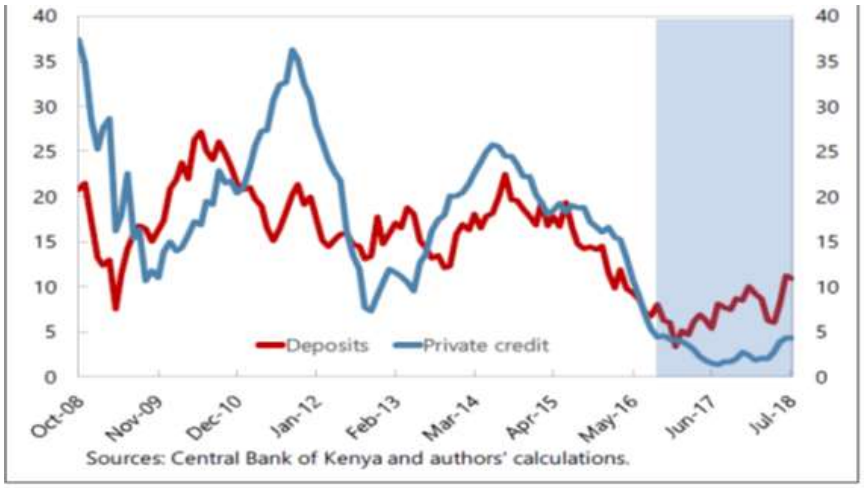
Events that had a significant role role in defining each period were used to label the period but other events in the period that played some roles are also mentioned in the discussion of the periods. Figure 6 shows the 6 break periods that were derived from structural breaks identified on Table 3. Fluctuating Kenya GDP growth rates in table 4, trends in private credit and deposits on Figure 5, and Kenya events were used to identify possible causes of different break periods on stock index data. Levine and Zervos [27] indicated that there is a positive association between stock market and economic growth.

Table 4: Kenya annual GDP growth rates

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Annual GDP growth (%)	1.5	2.7	8.4	6.1	4.6	5.9	5.4	5.7	5.9	4.9

Source: CBK [10]

Figure 5: Trends in Private Credit and Deposits.



Source: Alper et al. [1]

The structural breaks for stock index in table 3 were used to derive 6 break periods shown in figure 6.

Figure 6: Break periods

Period 1 falls between January 2008 and January 2010 in Figure 6. The period is

characterized by low growth rates as indicated in table 4, declining stock index as indicated in Figure 6, and declining credit as indicated in Figure 5. Ryan and Maana [37] indicate that Kenya experienced shocks from global recession, high oil prices and post-

election crisis. These events negatively impacted private credit, as shown in figure 5, causing a decrease in investments and consumption and, consequently, low growth rates. Low growth rates lead to low stock prices due to lower profits. Since high oil prices and post-election crisis were only present at the beginning of 2008, the main cause of structural break in this period is global recession.

The global recession, as characterized by Bordo and Bordo and Landon-Lane [7], unfolded from late 2007 to the summer of 2009. Notably, this period does not entirely align with ”period 1” in the context of the Kenyan data, which spans from January 2008 to January 2010. This discrepancy in timelines suggests a distinct phase in the Kenyan economic landscape.

Additionally, it’s noteworthy to mention the findings of Gil-Alana et al. [16], which point out a minimal degree of co-integration between African stock markets and their global counterparts. This observation underscores the relatively isolated nature of African stock markets concerning the global financial system.

Furthermore, Figure 6 illustrates the gradual decline in the stock index, commenc- ing in mid-2008. This decline in the Kenyan stock market serves as an indication of a delayed response to the global recession, emphasizing the lag between global economic events and their impact on the local market.

Periods 2 falls between January 2010 and July 2011, as illustrated in Figure 6. Figure 5 shows a rise in private credit during this period, and thus high economic growth due to consumption and investments. Table 4 shows the period had high growth rates of 8.4% and 6.1%. Further the stock index rose due to high growth and expected high returns. These events indicate that the main cause of the break in this period is recovery from global recession.

Period 3 falls between July 2011 and January 2013 in Figure 6. The period had three major events. First, there was decline of credit to private sector from Kshs 316.7 billion in 2011 to Kshs 197.4 billion in 2012 due to monetary tightening and uncertainty of 2013 elections [9]. Figure 5 shows a slowdown of private credit during this period. IEBC [20] indicate that Kenya elections are linked to violence. The 2013 elections were initially scheduled to happen in August 2012, but Kenya’s High Court pushed it to March 2013 to comply with constitution [36]. The extended election period led to slowdown of lending by banks, and low GDP growth as shown in figure 5 and table 4.

Second, the European debt crisis caused flight to US dollar by foreign investors in Kenya CBK [9]. Exit of foreign investors caused the drop of stock index at the beginning of period 3 as shown in figure 6. The US dollar is considered a safe haven during crisis.

Third, the oil discovery in March 2012 as indicated by BBC [5] led to rise of stock index in Figure 6. IMF [21] indicate there was rise in oil exploration related investments in 2012. These were expected to enhance local oil production and incomes as is generally the occurrence in such times [8]. The rise in the stock index in 2012 despite being an election period was associated with future profits from oil discovery and associated investments. The elections are anticipated to be the major reason for the drop in the stock index than the European debt crisis because elections are associated with violence that influences both foreign and local investors. Thus, the oil discovery and elections are the major causes of period 3.

Period 4 falls between January 2013 and December 2014 in figure 6. The election’s

conclusion was peaceful, making the economy recover [9]. Figure 5 shows growth of private credit. It is believed the results were GDP growth as shown on table 4 due to increase in investment and consumption. Further, the government resolved to borrow $2.75 billion in sovereign bond, and $3.75 billion in commercial loans from China Exim

Bank to finance a standard gauge railway [19]. Infrastructure spending facilitated growth of GDP and stocks. Two terrorist attacks in June 2014 and September 2013 had a minute impact on the stock index. The risk of terror attacks led to a slowing down of credit growth in September 2014 [1]. The GDP was 5.9% in 2013 but reduced to 5.4% in 2014 in table 4.

Period 5 falls between December 2014 and June 2016 in figure 6 and is characterized by terrorist attacks [35]. These events greatly affected tourism which contributes greatly to the economy. Credit became expensive as terrorism was factored as a risk. Figure 5 indicate there was slowdown of private credit, which is the reason for weak investment and consumption, and uncertainties in the stock market. The stock index dropped but GDP growth rose to 5.7% in 2015 and 5.9% in 2016, as depicted in table 4. The GDP growth was associated with an investment in infrastructure starting from period 4 and less from consumption and investments due to slowdown of private credit. Period 6, spanning from June 2016 to December 2017 as illustrated in Figure 6, was marked by three pivotal events: heightened political polarization, a severe drought, and weakened bank lending due to controls on interest rates [21]. The repercussions of political polarization were evident as investor confidence waned, subsequently dampen- ing economic activities in 2017. Towards the close of 2016, credit standards tightened due to escalating political risks associated with the impending elections [10].

The nullification of the 2017 election by the Supreme Court and the subsequent boycott of the repeat presidential elections intensified tension, significantly impacting both investment and consumption patterns, ultimately contributing to a decline in GDP growth [21]. It's worth noting that Brexit also unfolded during this timeframe; however, being a regional crisis, its impact on Kenya was deemed negligible, as asserted by [6].

Inflation increased due to a severe drought between February and July 2017 [21]. Besides, it increases interest rates retarding the lending to businesses which greatly affects investments. According to Alper et al. [1], borrowing requirements and heavy government deficits raised interest rates, thus crowding out the private sector. Due to the high interest rates, a cap was introduced by Kenya parliament in September 2016, which imposed a ceiling for lending rates at four percentage points above a Central Bank Policy Rate and a floor on deposits at 70 percent of the Central Bank Policy Rate [1]. When interest rate cap was introduced, 60% of loans had interest rates above the cap set by the law of 14.5% [1]. The purposes of the interest rate control were to reduce the cost of borrowing, expand access to credit, and increase the return on savings but it led to collapse of credit to micro, small, and medium enterprises [1]. Figure 5 shows decline of private credit during this period. Weak lending affected consumption and investments, and as a result there was slowdown in growth. CBK [10] indicate that the third quarter of 2016 had severe tightening of credit standards mainly due to the interest rate cap. Table 4 and figure 6 show slowdown of growth to 4.9% and decline in stock index prior to the elections. The main cause of this break was the 2017 election and 2016 interest rates cap because they had a longer effect compared to effects of drought, which lasted about 5 months.

Table 5: Definition of Periods

Breaks	Periods	Definition
	Period 1	Global recession
Break 1 - 01/21/10		
	Period 2	Recovery from global recession

Break 2 - 07/11/11		
	Period 3	2013 Kenya election and oil discovery
Break 3 - 01/09/13		
	Period 4	Post election
Break 4 - 12/9/14		
	Period 5	Terrorist attacks
Break 5 - 06/02/16		
	Period 6	2017 Kenya elections and 2016 interest rates cap

Table 5 presents a noteworthy distinction, revealing that one of the periods un- der examination was influenced by a global event, whereas the remaining five were associated with local events. A meticulous analysis of these distinct groups holds the potential to yield valuable insights into the impact of foreign funds on the correlation and causation dynamics between the stock index and exchange rates in Kenya. Fur- thermore, delving into these events offers an opportunity to comprehensively grasp the ramifications of fluctuating economic growth and political shifts on the intricate relationships between stock returns and exchange rates. This exploration contributes to a deeper understanding of the nuanced interplay among various factors shaping financial markets in the Kenyan context.

4.2. Correlations and Causations

Table 6: Correlations with structural breaks

	NSE/Dollar Ex. Rate	NSE/Pound Ex. Rate	NSE/Euro Ex. Rate
Period 1	0.304	0.152	0.181
Period 2	0.103	0.060	0.045
Period 3	-0.031	-0.044	-0.018
Period 4	0.170	0.072	0.066
Period 5	-0.008	-0.026	0.010
Period 6	0.017	-0.045	-0.081

Figure 7: Correlations with structural breaks

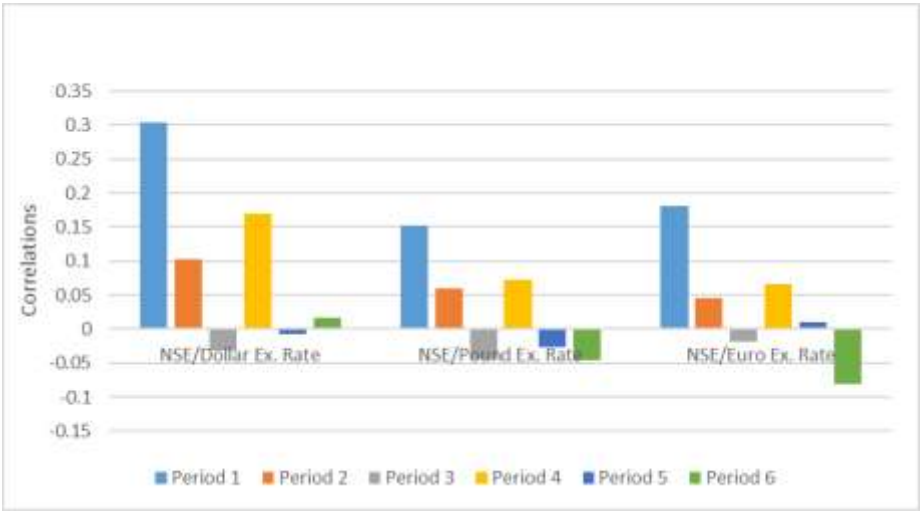


Table 6 and Figure 7 offer a comprehensive view of the correlations across distinct time intervals delineated by structural breaks. Notably, during the global recession (period 1),

robust correlations emerged, surpassing those observed in the context of local events spanning periods 2 to 6, across the three exchange rates. Specifically, the 2013 Kenya elections and oil discovery (period 3) were marked by negative correla- tions for all three exchange rates. Subsequently, in the post-election phase (period 4), correlations exhibited greater strength compared to the recovery from the global recession (period 2) for the same set of exchange rates.

Conversely, the aftermath of terrorist attacks (period 5) witnessed the lowest cor- relations with each of the three exchange rates. Noteworthy negative correlations manifested during the 2017 election and the 2016 interest rate cap (period 6) for the euro and pound exchange rates, while a relatively weak positive correlation was ob- served for dollar exchange rates. Remarkably, the dollar exchange rate consistently demonstrated the most robust correlations among the three exchange rates during cor- responding periods. This nuanced exploration provides a nuanced understanding of the dynamic interplay between structural breaks and exchange rate correlations across various pivotal events.

Table 7 illuminates that the predominant causal relationships in the short run emanated from exchange rates to the stock index. Notably, during the global recession (period 1), short-term causation from the stock index to exchange rates was discernible across all three exchange rates. However, long-term causation was only observable during the 2017 election and the 2016 interest rate cap (period 6), specifically in the context of pound exchange rates.

Throughout periods 2 to 6, causal links associated with local events exhibited a weaker influence compared to those observed during the global recession (period 1). Rigorous testing and adjustments for statistical errors were diligently conducted where applicable prior to the tabulation of results. Instances marked with stars in the results indicate the presence of statistical errors, cautioning users to interpret them judiciously. This meticulous approach ensures the reliability and validity of the reported causal relationships, fostering a more robust understanding of the dynamic interplay between exchange rates and stock indices across diverse temporal contexts.

Table 7: Granger Causalities with Structural Breaks

	NSE/Dollar Ex. Rate				NSE/Pound Ex. Rate				NSE/Euro Ex. Rate			
	Short Run		Long Run		Short Run		Long Run		Short Run		Long Run	
	ER to NSE	NSE to ER	ER to NSE	NSE to ER	ER to NSE	NSE to ER	ER to NSE	NSE to ER	ER to NSE	NSE to ER	ER to NSE	NSE to ER
Period 1	X*	X*			X*	X*			X*	X*		
Period 2					X*				X*			
Period 3												
Period 4	X*											
Period 5	X*											
Period 6							X*		X*			

5. Discussion

Structural breaks based on stock returns were found to represent events in Kenya better, than those based on the three exchange rates. There were varying struc- tural breaks for each of the three exchange rates due to the different factors in the foreign countries, and trade balance. The break periods and the dates that events occurred were matched, thus making it possible to define the possible events that led to structural breaks. The effects of the fluctuating growth and politics on rela- tionships were determined using causation and correlation on sub-samples created by structural breaks. The researcher used data from the Central Bank of Kenya and the Nairobi Securities Exchange. The study results revealed stronger positive correlations between the stock index and the dollar exchange rates compared to euro and pound exchange rates with the stock index in corresponding periods. Correlations and cau- sations between stock index and the three exchange rates were stronger during global recession (period 1) than during local events (periods 2 to 6). Most causations were from exchange rates to stock index in the short run. Causations during global reces- sion (period 1) ran in both directions i.e., from exchange rates to stock index, and from stock index to exchange rates in the short run for the three exchange rates.

The movement observed in the study can be attributed to several mechanisms that influence the relationship between exchange rates, stock indices, and other economic variables. While the specific mechanisms may vary depending on the country and context, some general mechanisms can help explain the observed movements:

Macroeconomic conditions, such as economic growth, inflation rates, interest rates, and fiscal policies, play a crucial role in shaping the movement of exchange rates and stock

indices. Changes in these factors can impact investor sentiment, market expecta- tions, and the overall economic environment, leading to fluctuations in exchange rates and stock prices.

Global events and shocks, such as recessions, financial crises, geopolitical tensions, or commodity price fluctuations, can have a significant impact on exchange rates and stock indices. These events can disrupt economic activities, affect investor confidence, and alter the flow of capital, resulting in movements in currency values and stock prices.

Investor sentiment and market psychology can drive short-term movements in ex- change rates and stock indices. Factors like investor expectations, risk appetite, mar- ket sentiment, and herd behavior can influence buying and selling decisions, leading to price fluctuations.

Exchange rates and stock markets can have a feedback loop, where changes in one variable can affect the other. For instance, a depreciating currency can make exports more competitive, leading to increased corporate profits and potentially boosting stock prices. Conversely, a strengthening currency can have the opposite effect. This inter- play between exchange rates and stock markets can create a self-reinforcing cycle of movements.

Fundamental factors, such as company earnings, economic indicators, industry performance, and market valuations, can influence stock prices. Similarly, economic fundamentals, including trade balances, interest rate differentials, and inflation rates, can impact exchange rates. Changes in these underlying factors can drive movements in stock indices and exchange rates.

6. Conclusions

1. Do Kenyan stocks correlate with the Kshs per pound, Kshs per dollar, or Kshs per euro?

The examination revealed discernible correlations between the Kenya stock index and the

three exchange rates. Notably, positive correlations were markedly stronger than their negative counterparts.

During the 2013 Kenyan election and oil discovery (period 3), all three exchange rates exhibited negative correlations. Similarly, the 2017 Kenya election and the 2016 interest rates cap (period 6) saw negative correlations for the euro and pound exchange rates, albeit with a weak positive correlation for the dollar exchange rates. Post- election (period 4) revealed stronger correlations than the recovery from the global recession (period 2), while terrorist attacks (period 5) resulted in the weakest correla- tions across all three exchange rates.

A noteworthy observation is the marked influence of global events compared to local events on the correlations between the three exchange rates and the Kenya stock index. Positive correlations predominated and were consistently stronger than negative correlations, indicating a shared direction of depreciation or appreciation. This aligns with the flow model, asserting that positive correlations in frontier markets stem from foreign cash inflows.

In line with the findings of Tian and Ma [42], the positive correlation between ex- change rates and stock returns is accentuated in import-oriented countries. Moreover, in external deficit countries, such as Kenya, global factors drive the positive associa- tion between exchange rates and stock returns [44]. This finding is in tandem with the Central Bank of Kenya's declaration of an external deficit throughout the study period. The instances of negative correlations, notably during Kenyan elections and the period of terrorist attacks, suggest a foreign cash outflow and the presence of local demand in the domestic market.

These insights contribute to a nuanced understanding of the intricate relationship between Kenyan stocks and exchange rates in the context of both global and local events.

2. Is there causality from Kenyan stocks to Kshs per euro, Kshs per pound, or Kshs per dollar?

This investigation unveiled a notable causal relationship from Kenyan stocks to exchange rates in the short run, particularly evident during the global recession (period 1). However, in subsequent periods (2 to 6), causation from the stock index to exchange rates did not manifest. Consequently, the study posits that the likelihood of causation from the stock index to the three exchange rates is heightened during significant global events, such as global recessions, as opposed to local events.

An intriguing aspect that emerges is the potential role of portfolio re-balancing in influencing this observed behavior. It is conceivable that, during major events like global recessions, investors may actively re-balance their portfolios to mitigate risks, potentially contributing to the observed causal link from Kenyan stocks to exchange rates. This nuanced understanding of causation dynamics provides valuable insights into the intricate mechanisms at play during different market conditions, thereby in- forming strategic decision-making for investors and financial analysts alike.

3. Is there causality from Kshs per euro, Kshs per pound, or Kshs per dollar to Kenyan stocks?

The study discerned a prevalence of causalities from exchange rates to the stock index, outnumbering those from the stock index to exchange rates across the three currency pairs. During the global recession (period 1), a bi-directional causality was observed among the three exchange rates in the short run. Notably, a singular long- run causality emerged for pound exchange rates during the 2017 Kenya elections and the 2016 interest rates cap (period 6), while no causalities were recorded during the 2013 elections (period 3).

The complexity of causal relationships unfolded during the 2017 Kenya elections and the

2016 interest rates cap (period 6). Long-run causality was evident for pound exchange rates, whereas short-run causality characterized the euro exchange rates. Conversely, no causalities were identified for dollar exchange rates during both election and interest rate cap periods (period 3 and period 6). In the recovery from the global recession (period 2), short-run causalities were noted for euro and pound exchange rates, while dollar exchange rates exhibited causalities during post-election (period 4) and terrorist attacks (period 5).

The overarching conclusion drawn from these findings is that causation demon- strated greater intensity during the global recession (period 1) compared to local events (periods 2 to 6), with portfolio re-balancing identified as a contributing factor in mit- igating portfolio risk. Moreover, the study revealed that causations between Kenya stock returns and exchange rates were predominantly short-term in nature, suggesting a higher risk profile for long-term funds in the stock market. This insight underscores the importance of tailored risk management strategies for investors navigating the intricate dynamics of the financial landscape.

4. Are relationships between Kenyan stocks and Kshs per euro, Kshs per pound, or Kshs per dollar impacted by fluctuating growth and politics?

The study delves into the diverse effects of fluctuating growth and political events on the correlations and causations between the stock index and exchange rates in Kenya. Firstly, the global recession (period 1) exerted a more pronounced influence on correlations and causations compared to local events (periods 2 to 6) across the three exchange rates. Notably, during this period, Table 4 illustrates that GDP growth reached its nadir due to the global recession, heightened oil prices, and post-election crises, leading to elevated interest rates. This, in turn, negatively impacted invest- ments and consumption, resulting in subdued growth rates. Investor sell-offs and the flight of foreign investors caused stocks to decline, contributing to a decrease in ex- change rates. The global recession's overarching influence rendered correlations and causations during period 1 notably stronger than those in periods 2 to 6, which were predominantly shaped by local events.

Secondly, Kenya's elections and the interest rate cap (periods 3 and 6) were char- acterized by negative correlations and a weak positive correlation, with correspond- ingly weak causations. During these periods, GDP growth rates remained below 5%, the second-lowest after the global recession (period 1). Exchange rates experienced a decline, while stocks witnessed modest appreciation, resulting in the emergence of negative correlations and a weak positive correlation. These findings underscore the nuanced risk perceptions of local and foreign investors, impacting the movement of exchange rates and stocks in divergent directions. It is noteworthy that local events can trigger varied risk perceptions among investors, unlike the more uniform impact of global events, as highlighted by Dvorak [13], who emphasizes the susceptibility of countries to the capricious sentiments of foreign investors in contexts of free capital mobility and open capital markets.

Thirdly, despite high growth rates exceeding 5%, terrorist attacks (period 5) yielded weak negative and weak positive correlations, alongside weak causations. The volatility induced by terror attacks contributed to these subdued correlations and cau- sations. The paradox of robust economic growth amid heightened risk from terrorist attacks can be attributed to ongoing infrastructure projects, notably the standard gauge railway, during this period. This insight suggests that certain events affecting stocks and exchange rates may not necessarily align with their impact on GDP growth. Lastly, the post-election period (period 4) exhibited stronger correlations com- pared to the recovery from the global recession (period 2), despite the latter boasting a higher GDP growth rate. This intriguing finding implies that high GDP growth does not consistently result in stronger correlations. The heightened volatility during the recovery from the global recession, driven by increased uncertainties, may have undermined correlations compared to the post-election period. This underscores the complex interplay of economic dynamics, highlighting that factors beyond GDP growth alone contribute to the strength of correlations between stock indices and exchange rates.

The financial implications of these movements are significant. Portfolio optimiza- tion, asset allocation, and hedging strategies need to consider the changing dynamics of the stock index and the impact of various factors on investment opportunities. Investors may need to adjust their portfolios based on the prevailing economic condi- tions, such as low growth rates or recovering from a recession, to optimize returns and manage risks.

The observed periods also have policy implications for sustainable development goals. Understanding the mechanisms behind the movements in the stock index and economic growth can guide policymakers in formulating strategies to mitigate risks and promote sustainable development. Measures to enhance stability during election periods, address external shocks like global recessions, and manage the impacts of crises such as terrorism can contribute to achieving sustainable development goals.

Overall, the movement from Period 1 to Period 6 involves a combination of eco- nomic mechanisms, financial implications for investment strategies, and policy consid- erations for sustainable development goals. Understanding these dynamics is crucial for making informed decisions and formulating effective policies.

This research carries implications that extend beyond Kenya and can be relevant for other countries as well. The findings and insights gained from studying the relation- ship between exchange rates, stock index, and various economic factors can provide valuable information and lessons for policymakers, investors, and researchers in other countries.

Here are some potential implications:

Understanding the impact of global events: The research highlights the influence of global factors, such as the global recession and the European debt crisis, on the dynamics of exchange rates and stock indices. This finding emphasizes the intercon- nectedness of economies and the need to consider global events and their spillover effects when analyzing financial markets. Policymakers and investors in other coun- tries can consider the lessons learned from these events and their impact on domestic markets.

Policy implications for crisis management: The study examines the effects of polit- ical instability, post-election crises, and terrorism on economic variables. The insights gained can help policymakers in other countries develop strategies to manage and miti- gate the negative consequences of similar crises. Understanding the impact of political polarization, violence, and security issues on financial markets can guide policymakers in implementing measures to maintain stability and minimize disruptions.

Portfolio optimization and risk management: The research explores the relation- ship between exchange rates, stock index, and economic variables, providing insights into portfolio optimization, asset allocation, and hedging strategies. Investors in other countries can draw lessons from these findings to improve their investment decisions and manage risks. Understanding the interplay between different economic factors and their impact on financial markets can help investors diversify their portfolios ef- fectively.

Sustainable development considerations: The study's policy implications for sus- tainable development goals can be relevant for other countries striving to achieve similar objectives. Policymakers can learn from the experiences of managing exter- nal shocks, promoting stability during elections, and addressing challenges related to infrastructure development, terrorism, and drought. The research can inform the for- mulation of policies that support sustainable economic growth and social development. Methodological approaches: The use of econometric techniques such as Granger causality, correlation analysis, and structural break tests provides a framework for analyzing the relationship between economic variables. Researchers in other countries can adopt similar methodologies to investigate the dynamics of their own financial markets and explore the relationships between relevant economic factors.

In summary, this research offers implications that can be valuable for policymakers, investors, and researchers in other countries. The findings shed light on the impact of global events, crisis management strategies, portfolio optimization, sustainable de- velopment considerations, and methodological approaches. Applying these insights to other contexts can help improve decision-making, risk management, and policy formulation in different countries around the world.

This study acknowledges a couple of limitations that warrant consideration. Firstly, it's essential to recognize that both Pearson correlation and Granger causality em- ployed in this research are linear models, which may not fully capture the inherent non-linear nature of the data. The cautious application of starred Granger causal- ity is particularly emphasized, underscoring the need to interpret these results with prudence.

Another limitation stems from missing dates in the time series data used for the study. To address this, the researcher engaged in meticulous data matching to elim- inate instances where dates appeared in one time series but not in the other. While this step was necessary for data coherence, it introduces a potential influence on data trends and, subsequently, the derived relationships.

Moving forward, the study proposes several recommendations to enhance decision- making and guide future research endeavors. Firstly, Kenya investors are encouraged to consider short-term gains, such as stock appreciation and dividends, for optimal investment strategies. Secondly, recognizing the relationship between exchange rates and the stock index, the study advocates utilizing this knowledge for hedging and arbitrage trades, particularly in Kenya's emerging derivatives market. Lastly, future researchers are urged to explore the impact of lag time on the identified relationships and enhance accuracy by incorporating non-linear models into their analyses. These recommendations collectively contribute to a more comprehensive understanding of the dynamics between financial variables and provide valuable insights for both investors and researchers in navigating the complexities of the market.

References

Alper, E., Clements, B., Hobdari, N., and Moya Porcel, R. (2020). Do interest rate controls work? evidence from kenya. Review of Development Economics, 24(3):910– 926.

Bai, J. (2000). Multiple structural change models: a simulation analysis.

Bai, J. and Perron, P. (1998). Estimating and testing linear models with multiple structural changes. Econometrica, pages 47–78.

Bai, J. and Perron, P. (2003). Computation and analysis of multiple structural change models. Journal of applied econometrics, 18(1):1–22.

BBC (2018). Kenya profile – timeline, A chronology of key events. https://www. bbc.com/news/world-africa-13682176. Accessed: 08/15/2019.

Bello, J., Guo, J., and Newaz, M. K. (2022). Financial contagion effects of ma- jor crises in african stock markets. International Review of Financial Analysis, 82:102128.

Bordo, M. D. and Landon-Lane, J. S. (2010). The global financial crisis of 2007-08: Is it unprecedented? Technical report, National Bureau of Economic Research.

Cavalcanti, T., Da Mata, D., and Toscani, F. (2019). Winning the oil lottery: The impact of natural resource extraction on growth. Journal of Economic Growth, 24(1):79–115.

CBK (2013). The financial sector stability report, 2012. https://www.centralb ank.go.ke/images/docs/kfs/2012.pdf. Accessed: 09/20/2018.

CBK (2018). The impact of interest rate capping on the kenya economy. https:
a. //www.centralbank.go.ke/wp-content/uploads/2018/03/Interest-Rate-Caps_
b. -March-2018final.pdf. Accessed: 09/25/2018.

Chen, P. Y., Smithson, M., ter Y, C., Popovich, P. M., et al. (2002). Correlation: Parametric and nonparametric measures. Sage.

Dornbusch, R. and Fischer, S. (1980). Exchange rates and the current account.
c. The American Economic Review, 70(5):960–971.

Dvorak, T. (2001). Does foreign trading destabilize local stock markets. Unpub- lished paper, Depart& ment of Economics, Williams College.

Engle, R. F. and Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. Econometrica: journal of the Econometric Society, pages 251–276.

Frankel, J. A. (1992). Monetary and portfolio-balance models of exchange rate determination. In International economic policies and their theoretical foundations, pages 793–832. Elsevier.

Gil-Alana, L., Carcel, H., and Abakah, E. J. A. (2018). On the linkages between africa's emerging equity markets and global markets: Evidence from fractional in- tegration and cointegration. Review of development finance, 8(2):96–105.

Granger, C. W. (1969). Investigating causal relations by econometric models and cross-spectral methods. Econometrica: journal of the Econometric Society, pages 424–438.

Hau, H. and Rey, H. (2006). Exchange rates, equity prices, and capital flows. The Review of Financial Studies, 19(1):273–317.

IDA and IMF (2015). Kenya, first review under the twelfth-month stand-by arrangement and the arrangement under the standby credit facility, requests for waivers for non-observance of performance criterion, and request for modification of performance criteria -Debt Sustainability Analysis update. https://www.imf. org/external/pubs/ft/dsa/pdf/2015/dsacr15269.pdf. Accessed: 04/25/2020.

IEBC (2018). The post-election evaluation report. https://www.iebc.or.ke/u ploads/resources/V9UUoGqVBK.pdf. Accessed: 03/17/2019.

IMF (2018). Kenya, 2018 Article IV consultation and establishment of perfor- mance criteria for the second review under the standby arrangement – press re- lease; staff report; and statement by the executive director for Kenya. https:

d. //www.imf.org/~/media/Files/Publications/CR/2018/cr18295.ashx.

Accessed: 04/25/2020.

Kamal, J. B. and Haque, A. E. (2016). Dependence between stock market and foreign exchange market in south asia: A copula-garch approach. The Journal of Developing Areas, pages 175–194.

Kanas, A. (2000). Volatility spillovers between stock returns and exchange rate changes: International evidence. Journal of business finance & accounting, 27(3- 4):447–467.

Katechos, G. (2011). On the relationship between exchange rates and equity returns: A new approach. Journal of International Financial Markets, Institutions and Money, 21(4):550–559.

Kisaka, S. E. and Mwasaru, A. (2012). The causal relationship between ex- change rates and stock prices in kenya. Research Journal of Finance and Accounting, 3(7):121–130.

Lestano and Kuper, G. H. (2016). Correlation dynamics in east asian financial markets. Emerging Markets Finance and Trade, 52(2):382–399.

Levine, R. and Zervos, S. (1996). Stock market development and long-run growth.

e. The world bank economic review, 10(2):323–339.

Liang, C.-C., Lin, J.-B., and Hsu, H.-C. (2013). Reexamining the relationships between stock prices and exchange rates in asean-5 using panel granger causality approach. Economic modelling, 32:560–563.

Lin, C.-H. (2012). The comovement between exchange rates and stock prices in the asian emerging markets. International Review of Economics & Finance, 22(1):161–172.

Ma, C. K. and Kao, G. W. (1990). On exchange rate changes and stock price reactions. Journal of Business Finance & Accounting, 17(3):441–449.

Moore, T. and Wang, P. (2014). Dynamic linkage between real exchange rates and stock prices: Evidence from developed and emerging asian markets. International Review of Economics & Finance, 29:1–11.

MSCI (2019). Market classification. https://www.msci.com/market-classific ation. Accessed: 10/12/2019.

Nasdaq (2019). Glossary of stock market terms. https://www.nasdaq.com/glo ssary/e/exchange-rate. Accessed: 10/20/2019.

Ogaki, M. et al. (1993). Unit roots in macroeconometrics: A survey. WORKING PAPER-ROCHESTER CENTER FOR ECONOMIC RESEARCH.

OSAC (2015). Kenya 2015 crime and safety report. https://www.osac.gov/Con tent/Report/94cd906f-6dbe-4040-8804-15f4ad91e445. Accessed: 09/15/2019.

Reuters (2012). Update 3-, Kenya high court delays elections to March 2013. https://www.reuters.com/article/kenya-elections-idUSL6E8CD1E720120113. Accessed: 10/26/2019.

Ryan, T. and Maana, I. (2014). An assessment of kenya's public debt dynamics and sustainability. Central Bank of Kenya, Nairobi.

Sangar´e, I. (2016). External shocks and exchange rate regimes in southeast asia: A dsge analysis. Economic Modelling, 58:365–382.

Sirr, G., Garvey, J., and Gallagher, L. (2011). Emerging markets and portfolio foreign exchange risk: An empirical investigation using a value-at-risk decomposi- tion technique. Journal of International Money and Finance, 30(8):1749–1772.

Sui, L. and Sun, L. (2016). Spillover effects between exchange rates and stock prices: Evidence from

brics around the recent global financial crisis. Research in International Business and Finance, 36:459–471.

Tabak, B. M. (2006). The dynamic relationship between stock prices and exchange rates: Evidence for brazil. International Journal of Theoretical and Applied Finance, 9(08):1377–1396.

Tian, G. G. and Ma, S. (2010). The relationship between stock returns and the foreign exchange rate: the ardl approach. Journal of the Asia Pacific economy, 15(4):490–508.

Tsai, I.-C. (2012). The relationship between stock price index and exchange rate in asian markets: A quantile regression approach. Journal of International Financial Markets, Institutions and Money, 22(3):609–621.

¨Ulku¨, N. and Demirci, E. (2012). Joint dynamics of foreign exchange and stock markets in emerging europe. Journal of International Financial Markets, Institu- tions and Money, 22(1):55–86.

Zhao, H. (2010). Dynamic relationship between exchange rate and stock price: Evidence from china. Research in International Business and Finance, 24(2):103– 112.