Effects of the Volatility of Selected Macroeconomic Factors on Stock Market Returns in Kenya

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Abstract

The stock markets play a vital role in the development of the economy in a country by acting as a platform to raise business capital, mobilize savings, control the management of firms, and to raise government capital. The performance of the markets is influenced by different factors among them being macroeconomic factors. This study sought to determine the effects of the volatility of selected macro-economic factors on the stock market returns in Kenya, with a key focus on interest and foreign exchange rate volatility. The study used the NSE 20 share index to determine the stock market returns, the interbank rate to proxy interest rate and the USD/KES for the foreign exchange rate. Panel data from January 2009 to December 2018 was used and daily observations were applied. The study was based on the Markov switching model. The results indicated that during the period under study, there were three regimes characterized as low, medium and high volatility regimes. The longest regime was the moderate volatility regime followed by the high volatility regime. The shortest regime was the low volatility regime. During the high volatility regime, the stock returns followed a random walk with little levels of predictability. In the moderate volatility regime, the historical performance was positively correlated to the stock market returns, while there was no significant effect of the volatility of interest and foreign exchange rates on the stock market returns. The period of low volatility was characterized with significant positive and negative effects of the foreign exchange and the interest rates, and the historical performance on the stock market returns. Based on the results, the study found out that the effects of the volatility of the interest rate and foreign exchange rate differ depending on the distinctive volatility regimes. The study recommends that policymakers monitor volatility regimes to inform timely macroeconomic interventions, while investors incorporate regime-based strategies for asset selection, portfolio rebalancing, and active management to optimize returns.

Keywords: *Stock market returns, Macroeconomic volatility, Interest rate, Exchange rate, Markov Switching Model*

1.0 Introduction

The stock markets are vital in the development of the economy in a country. They play a significant role in raising business capital, mobilizing savings for the purpose of investments, controlling the management of firms, creating investment opportunities for investors, creating hedging and speculation opportunities for investors, and raising government capital. Further, they act as barometers to the performance of an economy through some of the indicators such as capital

investments, market capitalization, market turnover and total shares traded (Musyoka, 2012). The economic performance is also affected by other economic elements like interest rate, foreign exchange rate and inflation, which characterize the volatility of macroeconomic factors in an economy. The volatility of these factors is responsible for signaling investors' confidence in investing in an economy and also influences the operational and investing decisions for firms in an economy (Owiti, 2012). This indicates a bidirectional link between the stock market and the macroeconomic performance indicators.

The stock market returns fluctuate periodically depending on the trade activities on the stock markets. The fluctuations on the stock prices are based on the investors' activities, which are usually subject to their prospects concerning the movement of the stock prices over time. This further influences their investment horizons and their investment motives (Musyoka, 2012). Thus, the investors' anticipations are inclined to the economic conditions based on the prevalent macroeconomic factors such as interest rate and foreign exchange rate changes.

The expected connection between stock returns and the macroeconomic factors is a positive association. This is attributed to portfolio restructuring and rebalancing. In periods of high interest rates, investors will opt to restructure their portfolios so that they have a higher weighting on interest-related investments to take advantage of the high interest rates for a higher income. Hence, they may tend to draw their investments from the stock market and place them into the bonds market (Fabozzi & Markowitz, 2011). When the foreign exchange rates change, investors are exposed to foreign exchange risk, which demands that they repatriate their portfolios. In periods of local currency depreciation, the foreign stock holdings outdo the domestic holdings. The high foreign exchange exposure may require that the investor sells the overweight stock and simultaneously purchases the domestic currency (Constantinides, Harris, & Stulz, 2003). This will lead to the appreciation of the local currency following the demand during the portfolio adjustments.

The relationship between the stock returns and the volatility of the macroeconomic factors can be modeled using the risk-return trade-off model. According to the model, investors require a premium return for the additional risk presumed. This is stipulated by CAPM, which assigns a beta as a measure for the risk and is useful in the determining the additional compensation for the investors beyond the risk free returns (Womack & Zhang, 2003). Based on the study findings by Benigno (2016) and Muktadir-Al- Mukit (2013), the impacts of the volatility of macroeconomic factors have varying impacts on the stock market, which is dependent on the degree of the changes in the macroeconomic factors. This is according to the CMH whereby; the stock market performance is seen to encounter different market phases that are based on the prevailing market conditions.

A study by (Thuo, 2012) measured interest rate through the 3-month Treasury bills rate The 3-month Treasury bills are short-term debts to the government with a maturity term of 3 months and their yield over their term of issue is the 3-month Treasury bill rate. The interest rate volatility was measured using the Garch (1,1) model. Muktadir-Al- Mukit (2013) used the average interest rate on savings deposits to proxy interest rate. The savings deposit rate is the interest rate earned by bank account holders for holding their savings in the particular bank. The study used variance decomposition to determine the interest rate volatility. In the study by Oyinpreye and Moses (2015) that was based in Nigeria, the NGN/USD rate was used and its volatility was measured using the Garch (1,1). Hussain and Bashir (2013) conducted their study in Pakistan, India and China. The

foreign exchange rates used were PKR/USD, INR/USD and CNY/USD respectively. The volatility of the exchange rates was measured using the GARCH model.

The main capital market trading platform in Kenya is the Nairobi Securities Exchange. The NSE performance is measured through different indices (NSE, 2018). The forex market is guided by different exchange rate pairs against the shilling such as USD/KES, GBP/KES, EUR/KES, ZAR/KES, TZS/KES and UGX/KES among others (Central Bank of Kenya, 2018). The operating interest rates include the interbank rate, the CBK rate, repo and reverse repo, treasury bills rate and treasury bond rate, banks' lending rate and banks savings rate (Central Bank of Kenya, 2018).The stock returns on the NSE have experienced sporadic movements over time. Partially, this can be attributed to the dynamic changes in the macroeconomic factors, which largely influence the economy at large. This is seen from the periodic movements between the NSE 20 share index and macroeconomic factors. However, although the cause of the causality effects flowing from the volatility of the macroeconomic factors to the stock returns has been established, there are inconsistencies on the magnitude of the effect.

According to Oloo (2017), stock returns are not influenced by the changes in interest rates. On the contrary, Dima (2015) indicated that the variations in interest rates cause positive, negative or insignificant impacts on the stock returns. Further, based on the findings by Nganga and Wanyoike (2017), there exists a negative correlation between interest rates and stock market returns. Regarding the effects of the volatility of foreign exchange rates on stock market returns, there exist a negative link according to Jumah (2013) and Musyoki (2017) and a positive relationship according to Mburu (2015) and Sangany (2015). This presents a hurdle in explicating the underlying impact of the volatility of interest and foreign exchange rates in Kenya.The contradictory findings across the studies formed the basis of conducting this study to expand the empirical knowledge on the effects of the volatility of macroeconomic factors on the stock market returns. Therefore, the study sought to answer the question: What is the effect of the volatility of the selected macroeconomic factors on the stock market returns in Kenya? This paper investigates the effect of interest rate volatility foreign exchange volatility on stock returns in Kenya.

2.0 Literature Review

2.1 Theoretical Framework

This study was anchored on the Capital Asset Pricing Model (CAPM), a foundational model developed by Treynor (1962), Sharpe (1964), Lintner (1965), and Mossin (1966), building on the portfolio theory of Markowitz (1952) and Tobin's (1958) mean-variance model. CAPM posits that the expected return on a risky asset is determined solely by its beta, a measure of systematic market risk, consistent with the risk-return trade-off principle. Hence, investors demand higher returns for assets with higher beta values due to greater exposure to market volatility (Womack & Zhang, 2003). The model has evolved over time, with Shanken (1985) introducing the multi-beta CAPM to account for multiple risk sources, and Abbas et al. (2011) proposing the downside-beta CAPM, distinguishing between downside and upside risks. In line with CAPM, this study expected stock returns to fluctuate in response to changing beta values driven by macroeconomic volatility, with higher returns anticipated during periods of elevated risk.

2.2 Empirical Review

Alam and Uddin (2009) assessed the association between interest rates and stock prices based on an examination of fifteen industrialized and emerging nations. Monthly data collected from

January 1988 to March 2003 was used. The data used for the interest rate was bank deposit rates and for the stock prices, the study used the respective share market indices. The study used panel regression to assess the relationship and it found out that the interest rate has a substantial negative association with share prices. For six countries, (Bangladesh, Colombia, Italy, Japan, Malaysia and S. Africa), the study established that the volatility of interest rates has a negative significant connection with the variations in stock prices. For eight countries, (Australia, Canada, Chile, Germany, Jamaica, Mexico, Spain, and Venezuela), although they indicated a substantial negative relationship between interest rates and the share prices, there was no relationship between the volatilities of both variables. Four countries, Bangladesh, Colombia, Italy, and S. Africa, indicated a significant negative connection between the interest rates and the stock prices and the changes between the interest rates and the deviations in the stock prices. The study indicated that the relation between interest rates and stock prices, and the volatility between the two variables may vary for different economies.

Muktadir-Al- Mukit (2013) examined the influence of the volatility of interest rates on stock returns in Bangladesh. The study was based on monthly data for the period from 1991-2012. The interest rate used was the average of the savings deposit interest rate while the stock returns were based on the DSE General Index. The study used the Granger causality test to assess the association of the variables and indicated that the causality was unidirectional, moving from the interest rates to the market index. The results also indicated independence of the stock market returns from impacts by other macroeconomic variables in the short-run. However, there was a negative steady and substantial correlation in the long-run between the changes in interest rate and the market index. Based on the study, interest rate volatility has very little impact on the stock market returns in the short-run while the there is a substantial negative impact in the long- run.

Benigno (2016) carried out a similar study and assessed the connection between the fluctuations in interest rates and the stock returns in fourteen developed countries for the period from 1999-2015. The interest rate changes were based on the yields on the 10-year government bonds in the respective countries while the stock returns were based on the stock market indices. The relationship was examined using the quantile-on-quantile approach. The study established a weak link between the interest rate variations and the stock returns for Australia, Germany, Netherlands, UK and US. Contrary, there was a significant link between the two variables for Greece, Ireland, Italy, Portugal and Spain. Also, the study established that the relationship between the variables was pronounced during the periods characterized with market turbulence. However, the magnitude of the relationship varied across the different quantiles. The study also found out that the negative shocks on interest rates led to a larger influence on the stock market returns compared to the positive shocks. Thus, the study indicated that the link between the interest rate fluctuations and the stock markets returns is asymmetrical.

Otieno, Ngugi, and Wawire (2017) assessed the link between interest rates and the stock market returns on the NSE. The data was examined from January 1993 - December 2015. The stock returns were assessed using the monthly NSE 20 share index while the interest rates were examined using the 3-month treasury bill rate and the monthly lending rate. The data was analyzed through ARFIMA and the Granger causality test. The results indicated that the variables are fractionally integrated. Also, the results indicated that in the long-run, the interest rates Granger cause the returns in the stock market. In the short-run, the study indicated that the returns in the stock market negatively lead the rates on the 3-month treasury bills and the lending rate. According to this study, there exists a bidirectional effect between the two variables that is dependent on time.

Oloo (2017) examined the influence of interest rates on the stock market returns based on an assessment of the NSE. The data used was the monthly observations of the NSE 20 share index and the CBK lending rate from January 2007-December 2017. The study used regression analysis to test the influence of the interest rate and stock returns. The results of the study indicated that the stock market is largely independent of other macroeconomic variables and therefore, interest rate was not significant in determining the NSE stock returns. According to this study, the volatility of interest rates has no influence on the stock market returns.

Dima (2015) assessed the effects of interest rates on the stock returns for the commercial banks listed on the NSE. The study assessed the stock returns for the banks against the CBR rate for the period from 2006-2014. The study indicated that the effects of interest rates on the stock returns varied from bank to bank. There was a noteworthy negative connection between interest rate variations and the stock returns for BBK while the relationship was positive for Standard Chartered Bank. For the rest of the banks, the positive and negative impacts were insignificant. Based on the study, the volatility of interest rates generates different results on the stock returns for different sectors and firms.

Oyinpreye and Moses (2015) conducted a study to gauge the effects of the instability of exchange rates on the share prices in Nigeria. The study was undertaken from 1985-2012 and was based on monthly data. The study marked the transition between two exchange rate regimes: from the fixed rate to the floating and managed regimes. It applied the Granger causality and the the outcome indicated that the volatility of the exchange rates has a negative impact on the changes in the prices and causality effects run from the share prices towards the exchange rates. Sui and Sun (2016) conducted a study to assess the outcome of spillovers between the exchange rates and stock prices. Their study was executed based on the stock returns in the US and BRICS between 2007 and 2009. The study assessed two distinct periods: the crunch and the tranquil periods. The results of the study indicated that except for China, there was a substantial negative affiliation between stock prices and foreign exchange rates, which was more in the crisis period than the tranquil period. Thus, the changes in the foreign exchange rates affect stock returns significantly, indicating causality running from the foreign exchange rates to the stock returns.

Malarvizhi and Jaya (2012) examined the movement of the stock prices in the Indian stock market through the Nifty Index and the exchange rate. Their study involved an assessment of monthly data from April 2001 – March 2011 and used the Granger causality test to assess the causation effects between the variables. The study found a bidirectional causal association between the Indian stock market and the exchange rate. Thus, contrary to the results by Oyinpreye and Moses (2015), the study indicated that changes in the two variables affect the outcomes of each other.

Hussain and Bashir (2013) examined the dynamic link between the unpredictability of the exchange rates and stock returns. The study was based on PIC countries (Pakistan, India and China) for the period from 2007-2012. It assessed daily data of the variables whereby the volatilities of the variables were extracted using the GARCH model and the Johansen co-integration and the Granger causality tests were used to determine the correlation between the variables. The results indicated that there exists no causality association between the variables for India and China while it was found out that the variations in the exchange rates influences the volatility of the stock returns in Pakistan. Based on the study, the relationship between the variables varies across different countries.

Sifunjo and Mwasaru (2012) conducted a study to assess the causal connection between the

exchange rates and the stock prices. The study was based on an assessment of monthlyobservations for the period from November 1993- May 1999. The stock prices were assessed through the NSE 20 share index while the exchange rates were based on the USD/KES exchange rate. The study used the Granger causality test and established that both variables are cointegrated and have a causal relationship with Granger causality running from the exchange rates to the stock prices. Therefore, the foreign exchange rates impact the stock prices and thus the stock returns.

Jumah (2013) assessed the influence of foreign exchange rate volatility on the fluctuations of the stock returns on the NSE. The stock returns were based on the NSE 20 share index, which is a composite of 20 blue chip companies on the NSE. The study assessed monthly data covering the period from 1996-2012 and employed the EGARCH to test the effect. The study findings indicated that the foreign exchange unpredictability has a small negative influence on the volatility of stock returns. Therefore, the correlation between the two variables is negative.

Mburu (2015) examined the association between the exchange rate volatility and the performance of the stock market (NSE). The study employed the NSE 20 index and was carried out for the period between 2011 and June 2015. The assessment was based on monthly data for the two variables. The study employed regression analysis to assess the connection between the variables. The results of the study indicated that there is a positive link between the exchange rate volatility and the performance of the stock market on the NSE. Contrary to the findings by Jumah (2013), the study established a positive correlation between the two variables.

3.0 Research Methodology

The study was conducted as a descriptive study. Descriptive studies aim at describing the features of the population being investigated to establish relationships between the variables (Saunders, 2015). The aim of the study was to examine and measure the effect of the volatility of selected macroeconomic factors on stock returns on the NSE.

The study used panel data collected for a period of 10 years ranging from January 2009 to December 2018. The period features the trickle down effects of the 2007/08 global financial crisis, the operation of economic reforms such as the Vision 2030 following its launch in June, 2008 and the Privatization Law enacted in 2005, accelerated external borrowings, and two general elections (Global Security, 2010). Therefore, the period was deemed satisfactory in extracting the effects of the volatility of the selected macroeconomic factors on the stock returns across the period.

The study used secondary data that was collected from the NSE and the CBK. The data collected was the daily observations for the variables: the daily NSE 20 Share Index points for data, daily interbank rate and daily USD/KES floating exchange rate. The NSE 20 Share Index was selected because it comprises the largest securities on the NSE from the different sectors. Also, the securities on the index meet stringent qualifying conditions that include: being principally quoted on the exchange, a minimum of 20% of their free float be available for trading on the exchange, a continuous listing on the exchange for a minimum of 1-year, an ideally blue-chip company with a record of high profitability and dividend payout, and a market cap of KES 50 million and above (NSE, 2019). Thus, it was the ideal index since the securities included are prone to the dynamic movements of the macroeconomic factors.

Model Estimation

The daily changes in the interest rate and the foreign exchange rate over time were measured as shown in equations 1 and 2 below:

$$\Delta IR_t = \ln \frac{IR_t}{IR_{(t-1)}} \tag{1}$$

$$\Delta ER_t = \ln \frac{ER_t}{ER_{(t-1)}} \tag{2}$$

Model Estimation

Where; *IR* is interest rate, *ER* is foreign exchange rate, and *t* is the time period. The values for *IR* and *ER* as shown in Appendix V. The stock market returns will be measured as shown in equation 3 below:

$$NSER_t = \ln \frac{NSEi_t}{NSEi_{(t-1)}} \tag{3}$$

Where; *NSER* is stock market returns, *NSEi* is the stock market index points and *t* is the time period. The historical performance was measured as a lag of *NSER*. The study used standard deviation to derive the daily volatilities of the interest rate and foreign exchange rate as shown 4 and 5 below respectively.

$$\sigma IR_t = \sqrt{\frac{\sum_{t=1}^{n}(\Delta IR_t - \overline{\Delta IR_1})^2}{n}} \tag{4}$$

$$\sigma ER_t = \sqrt{\frac{\sum_{t=1}^{n}(\Delta ER_t - \overline{\Delta ER_2})^2}{n}} \tag{5}$$

σIR_t was represented as IRV and σER_t was represented as ERV in the analysis of the data. A Markov switching model (MSM) was used to determine the effects of the volatility of the selected macroeconomic factors (interest rate and foreign exchange volatility) on the stock market returns. MSM is a non-linear model proposed by Hamilton (1989) to model disconnected changes between different economic states. According to Schaller and van Norden (1997), stock returns exhibit variations in both mean and variance resulting in regime switching. Under the Markov chain, current values are derived from a number of distributions to determine the most likely state to determine the particular observation. The transition from one state (*i*) at time *t-1* to another state (*j*) at time *t* follows a probability distribution as shown in equation 6 below:

$$\Pr(s_t = j | s_{t-1} = i) = p_{ij} \tag{6}$$

The transition matrix one state to another is as shown in equation 7 below:

$$\begin{matrix} p_{00} & p_{01} \\ p_{10} & p_{11} \end{matrix} \tag{7}$$

Where: $\sum_{j=0}^{n} p_{ij} = 1$

Based on the different regimes, the model estimated the stock market returns as follows:

$$NSER_t | s_t = \beta_0 | s_t + \beta_1 | s_t IRV_t | s_t + \beta_2 | s_t ERV_t | s_t + \beta_3 | s_t NSER_{(t-1)} | s_t + \varepsilon_t | s_t \tag{8}$$

Where; s_t at time t is either of the regimes where γ_{rt} lies and β represents the respective coefficients for each variable.

Model Validation

Model validation involves conducting particular statistical tests to ascertain the performance of the given model. The model used in the study was validated as follows using stationarity test, linearity test, lag selection, testing for ARCH effects, the augmented Dickey-Fuller (ADF) test was used to test the variables for stationarity. The ADF null hypothesis states that there is presence of a unit root in the sample being tested in the time series while the alternative hypothesis indicates absence of a unit root. The presence of a unit root shows that the time series is non-stationary. Using such data in data analysis produces unreliable models as the data is unpredictable. To make the data stationary, the time series is transformed or differenced (Brooks, 2008).

Scatter plots were used to assess whether the relationship between the response and the predictor variables was linear or non-linear. In linear relationships, the points depicting the relationship between the variables appear to fall along a straight line while the points in a nonlinear relationship may follow a curve on no particular pattern. Linear relationships are analyzed linear regression, which entails examining the strength of correlation between the variables. On the other hand, analyzing nonlinear relationships involves nonlinear transformation of the data to make it linear or using nonlinear regression models (Vonesh & Chinchilli, 1996).

The VAR lag order selection criterion was used to determine the optimal lags for each variable. Optimal lags are selected in regression to reduce or eliminate residual correlation. Different criteria are used, which include; Schwarz Criterion, Akaike Information Criterion and Hannan Quinn Criterion among others. Using the lag order selection criterion, the lowest value for all the criteria used is selected to determine the ideal number of lags (Asteriou & Hall, 2015).

The optimal number of regimes was determined using the log likelihood test together with the AIC, HQ criterion and SC tests, where two states were tested against three states. To select the optimal number regimes using the log likelihood test, the model with the highest value is selected while when using the AIC, SC and HQ criterion, the model with the lowest values is selected (Chevallier & Goutte, 2016).

The presence of ARCH effects indicates autocorrelation in the squared series or conditional heteroskedasticity in the error terms. It was evaluated using the correlogram of standardized residuals squared test. The null hypothesis for the test is that there are no ARCH effects in a model. The alternative hypothesis shows presence of ARCH effects in a model, indicating existence of autocorrelation and heteroskedasticity. The two can be removed from the model by using generalized least squares to improve the model's fit or ordinary least squares with robust standard errors to eliminate the effect of misleading or erroneous standard errors (Brooks, 2008).

4.0 Findings

This section outlines the results of the data analysis and discusses the results for the study. The objective of the study was to determine the effect of the volatility of selected macroeconomic factors on stock returns on the NSE. Secondary data was used and was collected from CBK and NSE. The study was a descriptive study and the data analysis was conducted with the aid of Eviews 9 student version. The Markov switching model was used to measure the effect of the volatility of the selected macroeconomic factors on stock market returns.

4.1 Descriptive Statistics

Table 1 is a summary of the descriptive statistics for the variables:

Table 1: Summary of Descriptive Statistics

	NSER	ERV	IRV
Mean	-9.21E-05	0.002586	0.055990
Median	-1.90E-05	0.001566	0.046686
Maximum	0.086344	0.031271	0.219510
Minimum	-0.086022	0.000207	0.004269
Std. Dev.	0.007317	0.003351	0.038439
Skewness	0.110744	5.210860	1.116726
Kurtosis	21.91721	41.13868	4.248835
Jarque-Bera	37043.69	161788.2	677.7074
Probability	0.000000	0.000000	0.000000
Sum	-0.228838	6.423211	139.0790
Sum Sq. Dev.	0.132940	0.027889	3.668720
Observations	2484	2484	2484

The distribution of the daily NSER was symmetric (skewness = 0.1107). This means that the frequency of both negative and positive returns was relatively the same. In relation to kurtosis, the distribution was leptokurtic (kurtosis = 21.9172). This implies that the frequency of small changes is lesser than that of the extreme changes, which means that the exceptional variations are more likely to occur compared to a normally distributed series.

4.2 Model Verification and Validation Results

The ADF test was conducted at level. The null hypothesis was rejected for all the variables (p-value<0.05), indicating that the variables were stationary at level as shown by the results in Table 2 below:

Table 2: Stationarity Test Results

Series	Prob.	Lag	Max Lag	Obs

NSER	0.0000	1	26	2482
ERV	0.0000	25	26	2458
IRV	0.0002	21	26	2462

The scatter plot analysis results are as shown in Figure 1. There was no distinct straight line to depict a linear relationship thus indicating a non-linear relationship between variables. Based on the VAR lag selection criterion, the lowest value of the different criteria used was under AIC lag 4 as shown in Table 3.
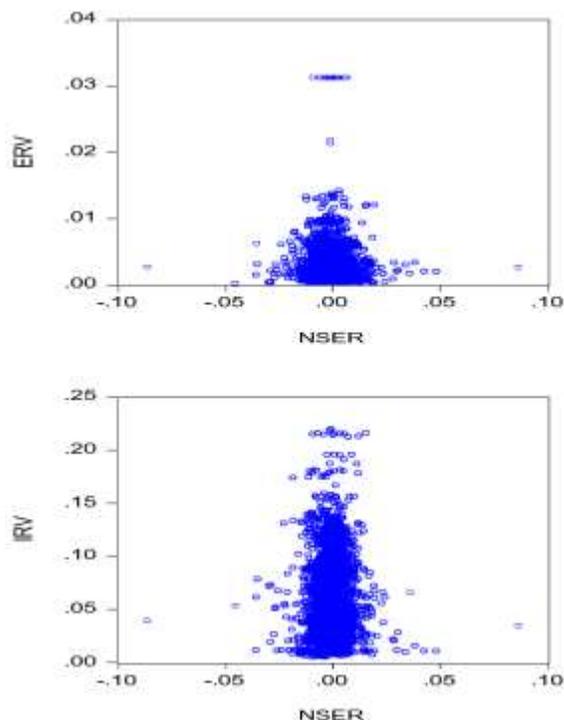

Figure 1: Linearity Test Results

Table 3: Lag Selection Results

Lag	LogL	LR	FPE	AIC	SC	HQ
0	23842.53	NA	8.70e-13	-19.25649	-19.24944	-19.25393
1	32350.04	16987.52	9.08e-16	-26.12119	-26.09301	-26.11096
2	32669.92	637.9588	7.07e-16	-26.37231	-26.32300*	-26.35440
3	32689.94	39.87766	7.00e-16	-26.38121	-26.31076	-26.35562*
4	32704.64	29.23201*	6.97e-16*	-26.38581*	-26.29423	-26.35255
5	32706.82	4.343073	7.01e-16	-26.38031	-26.26759	-26.33937
6	32713.68	13.61639	7.02e-16	-26.37858	-26.24473	-26.32996
7	32717.40	7.370706	7.05e-16	-26.37431	-26.21933	-26.31802
8	32724.17	13.39460	7.07e-16	-26.37251	-26.19639	-26.30854

The results for the log-likelihood and AIC, SC and HQ criterion tests indicated in Table 3 favored the use of three regimes as opposed to two regimes. The log-likelihood for 2 regimes was 9176.492, which was smaller than for 3 regimes (log-likelihood = 9290.715). The AIC, SC and HQ criterion estimators for 2 regimes were -7.37, -7.29 and -7.34 respectively, which were all greater than the estimators for 3 regimes, which were -7.45, -7.32 and -7.40 respectively. Therefore, 3 regimes were the most suitable for the model. For both regimes, the Durbin-Watson test outputs were 2.01 and 2.14 for 2 regimes and 3 regimes respectively, indicating absence of autocorrelation in the models.

Table 4: Regime Selection Results

1. Regimes

Mean dependent var	-0.000101	S.D. dependent var	0.007310
S.E. of regression	0.006992	Sum squared resid	0.119689
Durbin-Watson stat	2.013332	Log likelihood	9176.492
Akaike info criterion	-7.372978	Schwarz criterion	-7.293242
Hannan-Quinn criter.	-7.344018		

2. Regimes

Mean dependent var	-0.000101	S.D. dependent var	0.007310
S.E. of regression	0.006822	Sum squared resid	0.113195
Durbin-Watson stat	2.137759	Log likelihood	9290.715
Akaike info criterion	-7.448963	Schwarz criterion	-7.322324
Hannan-Quinn criter.	-7.402969		

The results of the correlogram of standardized residuals squared test were as shown in Table 5. The autocorrelation (AC) and partial autocorrelation (PAC) were zero or near zero and their respective probabilities were significant. Therefore, the null hypothesis was not rejected (p-value>0.05), indicating that there was no ARCH effects.

Table 5: ARCH Effects Test Results

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	0.003	0.003	0.0250	0.874
		2	0.009	0.009	0.2230	0.894
		3	-0.000	-0.000	0.2233	0.974
		4	-0.001	-0.001	0.2283	0.994
		5	0.005	0.005	0.2803	0.998
		6	-0.000	-0.000	0.2807	1.000
		7	-0.001	-0.001	0.2844	1.000
		8	-0.001	-0.001	0.2870	1.000
		9	-0.001	-0.001	0.2920	1.000
		10	-0.001	-0.001	0.2963	1.000
		11	0.002	0.002	0.3101	1.000
		12	-0.002	-0.002	0.3177	1.000
		13	-0.002	-0.002	0.3253	1.000

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		14	-0.001	-0.001	0.3308	1.000
		15	-0.002	-0.002	0.3383	1.000
		16	-0.002	-0.002	0.3444	1.000
		17	-0.002	-0.002	0.3508	1.000
		18	-0.001	-0.001	0.3557	1.000
		19	-0.001	-0.001	0.3601	1.000
		20	-0.001	-0.001	0.3616	1.000
		21	-0.001	-0.001	0.3631	1.000
		22	-0.001	-0.001	0.3658	1.000
		23	-0.001	-0.001	0.3682	1.000
		24	0.001	0.001	0.3732	1.000
		25	-0.001	-0.001	0.3775	1.000
		26	-0.001	-0.001	0.3829	1.000
		27	-0.001	-0.001	0.3878	1.000
		28	-0.002	-0.002	0.3952	1.000
		29	-0.002	-0.002	0.4011	1.000
		30	-0.001	-0.001	0.4054	1.000
		31	-0.002	-0.002	0.4139	1.000
		32	-0.002	-0.002	0.4214	1.000
		33	-0.002	-0.002	0.4294	1.000
		34	-0.001	-0.001	0.4324	1.000
		35	-0.001	-0.001	0.4353	1.000
		36	-0.002	-0.002	0.4442	1.000

*Probabilities may not be valid for this equation specification.

4.3 Simulation Results

4.3.1 Regression Output

All the variables were lagged to order 4. The estimated model output is as shown in Table 6. For each of the three regimes, the estimation equations are shown as follows:

Table 6: Simulation results

Regime 1: NSER = -7.72E-05 + 0.185828*NSER(-1) + 0.118252*NSER(-2) + 0.042477*NSER(-3) + 0.050710*NSER(-4) + 0.131810*ERV(-1) - 0.119984*ERV(-2) - 0.013047*ERV(-3) - 0.014933*ERV(-4) + 0.024527*IRV(-1) -0.010885*IRV(-2) + 0.005074*IRV(-3) - 0.016828*IRV(-4)

1: SIGMA = @EXP (-5.363326) = 0.004685   (9)

Regime 2: NSER = 0.001068 + 0.509257*NSER(-1) + 0.032944*NSER(-2) - 0.062615*NSER(-3) - 0.044381*NSER(-4) - 4.297979*ERV(-1) + 5.603106*ERV(-2) - 0.329905*ERV(-3) - 1.307768*ERV(-4)   -0.040467*IRV(-1)   -0.013436*IRV(-2)   +   0.051648*IRV(-3)   - 0.001601*IRV(-4)

2: SIGMA = @EXP (-4.672546) = 0.009348   (10)

Regime 3: NSER = -0.081852 - 0.563290*NSER(-1) + 0.743534*NSER(-2) -3.256725*NSER(-3) -0.151256*NSER(-4) + 21.63106*ERV(-1) + 36.60757*ERV(-2) + 194.9035*ERV(-3) - 212.3261*ERV(-4)   +   11.52190*IRV(-1)   -11.93655*IRV(-2)   +   2.292884*IRV(-3)   - 1.574967*IRV(-4)

3: SIGMA = @EXP (-7.204456) = 0.000743   (11)

Table 7: Regression Results

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
C	-7.72E-05	0.000231	-0.333847	0.7385
NSER(-1)	0.185828	0.032767	5.671194	0.0000
NSER(-2)	0.118252	0.027269	4.336571	0.0000
NSER(-3)	0.042477	0.020435	2.078672	0.0376
NSER(-4)	0.050710	0.019433	2.609442	0.0091
ERV(-1)	0.131810	0.082619	1.595385	0.1106
ERV(-2)	-0.119984	0.189854	-0.631980	0.5274
ERV(-3)	-0.013047	0.183782	-0.070993	0.9434
ERV(-4)	-0.014933	0.082357	-0.181316	0.8561
IRV(-1)	0.024527	0.023345	1.050634	0.2934
IRV(-2)	-0.010885	0.039617	-0.274766	0.7835
IRV(-3)	0.005074	0.034076	0.148908	0.8816
IRV(-4)	-0.016828	0.022204	-0.757905	0.4485
LOG(SIGMA)	-5.363326	0.036537	-146.7898	0.0000
Regime 2				
C	0.001068	0.001265	0.844210	0.3986
NSER(-1)	0.509257	0.073289	6.948647	0.0000
NSER(-2)	0.032944	0.061734	0.533645	0.5936
NSER(-3)	-0.062615	0.053070	-1.179860	0.2381

NSER(-4)	-0.044381	0.046023	-0.964324	0.3349
ERV(-1)	-4.297979	2.916902	-1.473474	0.1406
ERV(-2)	5.603106	4.916722	1.139602	0.2545
ERV(-3)	-0.329905	2.271168	-0.145258	0.8845
ERV(-4)	-1.307768	1.848696	-0.707400	0.4793
IRV(-1)	-0.040467	0.104561	-0.387019	0.6987
IRV(-2)	-0.013436	0.136397	-0.098509	0.9215
IRV(-3)	0.051648	0.092458	0.558613	0.5764
IRV(-4)	-0.001601	0.050484	-0.031714	0.9747
LOG(SIGMA)	-4.672546	0.072749	-64.22835	0.0000

Regime 3				
C	-0.081852	0.000564	-145.1926	0.0000
NSER(-1)	-0.563290	0.005652	-99.66037	0.0000
NSER(-2)	0.743534	0.052766	14.09110	0.0000
NSER(-3)	-3.256725	0.046568	-69.93413	0.0000
NSER(-4)	-0.151256	0.056391	-2.682257	0.0073
ERV(-1)	21.63106	0.556383	38.87801	0.0000
ERV(-2)	36.60757	0.484943	75.48835	0.0000
ERV(-3)	194.9035	0.040207	4847.490	0.0000
ERV(-4)	-212.3261	0.050532	-4201.810	0.0000
IRV(-1)	11.52190	0.001710	6737.893	0.0000
IRV(-2)	-11.93655	0.001416	-8429.279	0.0000
IRV(-3)	2.292884	0.014228	161.1480	0.0000
IRV(-4)	-1.574967	0.015266	-103.1706	0.0000
LOG(SIGMA)	-7.204456	0.273272	-26.36371	0.0000

In regime 1, the only significant variables were NSER(-1), NSER(-2), NSER(-3) and NSER(-4) (p-value<0.05). The constant, ERV(-1), ERV(-2), ERV(-3) ERV(-4), IRV(-1), IRV(-2), IRV(-3) and IRV(-4) were not significant (p-value>0.05). The volatility in the regime was 0.004685 and was significant (p-value<0.05). It was the second highest compared to regimes 2 and 3.

In regime 2, the only significant variable was NSER (-1)(p-value<0.05). The constant, NSER(-2), NSER(-3) and NSER(-4), ERV(-1), ERV(-2), ERV(-3) ERV(-4), IRV(-1), IRV(-2), IRV(-3) and IRV(-4) were not significant (p-value>0.05). The volatility in the regime was 0.009348 and was significant (p-value<0.05). It was the highest compared to regimes 1 and 3.

In regime 3, all the variables were significant (p-value<0.05). The volatility in the regime was 0.000743 and was significant (p-value<0.05). It was the lowest compared to regimes 1 and 3.

4.3.2 Regime Transition Output

The results of the probabilities for the transitions from each regime to the other and their respective durations are as shown in Figure 2 and Table 8. From the graphs in Figure 2, regimes 1 and 2 are persistent, indicating a probability for a longer stay in the regime as opposed to the intermittent occurrence in regime 3. Regime 3 is characterized with spikes, indicating that its happening is sporadic. As shown in Table 8, the probability of persistence in regime 1 was 0.9703 and it had the longest duration of 34 days. The probability of persistence in regime 2 was 0.8749 with duration of 8 days. Regime 3 had the lowest probability of persistence
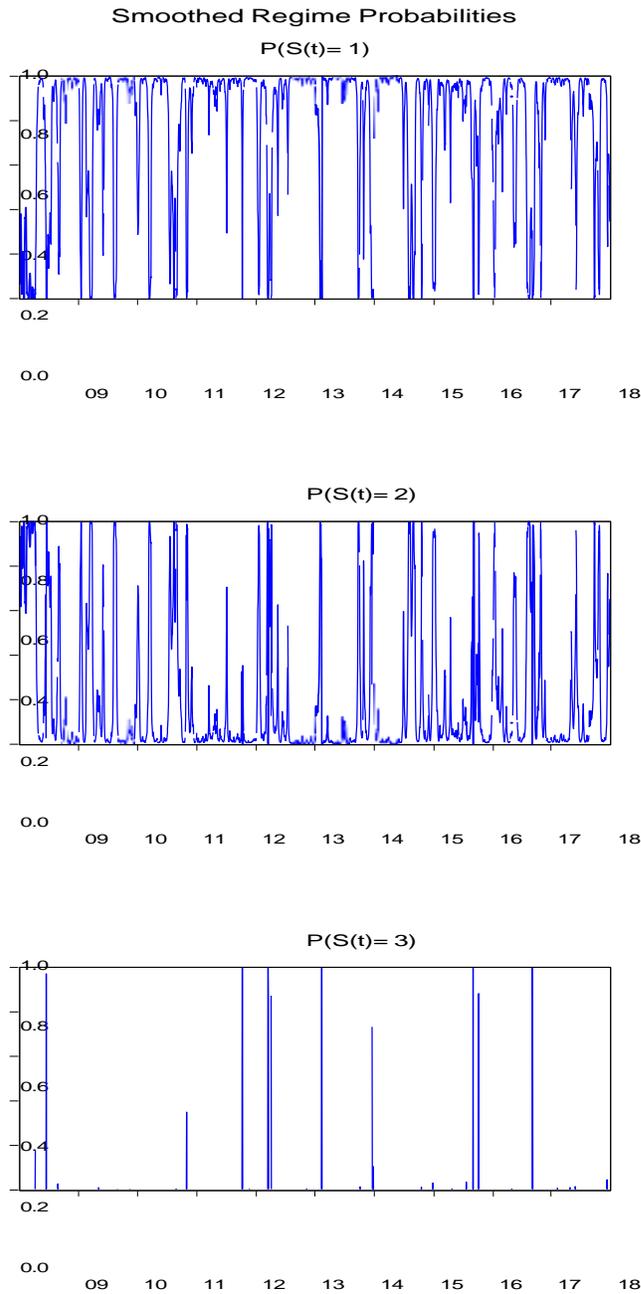
(0.4179) and duration (2 days).

Figure 2: Smoothed Regime Probabilities

Table 8: Regime Constant Transition Probabilities and Duration Results

Constant transition probabilities:
$P(i, k) = P(s(t) = k \mid s(t-1) = i)$
(row = i / column = j)

	1	2	3
1	0.970389	0.028227	0.001384
2	0.111634	0.874922	0.013444
3	0.068237	0.513850	0.417914

Constant expected durations:

	1	2	3
	33.77125	7.994991	1.717958

5.0 Discussion

This study investigated the effect of interest and foreign exchange rate volatility on stock market returns in Kenya, revealing that stock performance fluctuated across three distinct volatility regimes—moderate, high, and low. During the high volatility regime, stock returns exhibited a random walk behavior, with only the previous day's return (lag 1) showing statistical significance. Interest and exchange rate volatilities were not significant predictors, aligning with Fama's (1970) Efficient Market Hypothesis (EMH) that posits the unpredictability of asset prices in efficient markets. These findings were consistent with previous studies such as Oloo (2017) and Muktadir-Al-Mukit (2013), who also found no significant impact of interest rates on stock returns, and Hussain and Bashir (2013), who reported no causal relationship between exchange rate volatility and stock performance. In the moderate volatility regime, all four historical lags significantly influenced stock returns, though macroeconomic volatilities remained insignificant, suggesting that stock returns were primarily driven by price persistence, supporting findings by Salur (2013).

In contrast, the low volatility regime revealed significant effects from both historical stock performance and macroeconomic volatilities. Historical lags (except lag 2) showed negative correlations, indicating mean reversion. Meanwhile, interest and exchange rate volatilities had mixed coefficients across lags, demonstrating both the traditional risk-return trade-off (Sharpe, 1964; Treynor, 1962) and the inverse risk-return hypothesis (Vaga, 1990). These findings aligned with studies such as Benigno (2016) and Dima (2015), who noted both positive and negative impacts of interest rate volatility, though they contradicted Sui and Sun (2016), Jumah (2013), and Mburu (2015). Regime durations further indicated a dominant presence of moderate volatility (average 34 days), followed by high (8 days) and low volatility (2 days), reflecting the market's leptokurtic behavior (Ivanovski et al., 2015). These regime shifts and their characteristics affirmed the Cyclical Market Hypothesis (CMH), where returns oscillate between random, transitional, and coherent states based on investor sentiment and macroeconomic dynamics (Vaga, 1994).

5.0 Conclusion

The study concludes that the impact of interest and foreign exchange rate volatility on stock market returns in Kenya is regime-dependent. Specifically, these macroeconomic volatilities exhibit no significant effect during high and moderate volatility regimes, suggesting limited predictive value

during periods of heightened or transitional market turbulence. However, in the low volatility regime, both interest and exchange rate volatilities significantly influence returns—positively at lag 2 and negatively at lags 1, 3, and 4—indicating mean-reversion tendencies and market sensitivity to macroeconomic shifts in stable periods. These findings underscore the dynamic nature of market behavior and support the Cyclical Market Hypothesis, highlighting that stock return predictability is contingent upon the prevailing market state.

6.0 Recommendations

Based on the findings, the study recommends that policymakers closely monitor market volatility regimes to inform timely and appropriate macroeconomic policies that stabilize investor expectations and encourage sustained participation in the stock market. Stable economic conditions enhance investor confidence, reducing panic-driven withdrawal during uncertain times. For investors and portfolio managers, the study suggests integrating volatility regimes into investment strategies—particularly in asset selection and portfolio rebalancing. During low volatility regimes, active portfolio management should exploit both the risk-return and inverse risk-return trade-offs to maximize returns. Awareness of regime shifts enables investors to respond proactively to market dynamics, thereby optimizing their portfolios in alignment with macroeconomic signals.

References

Abbas, Q., Ayub, U., Sargana, S. M., & Saeed, S. K. (2011). From Regular-Beta CAPM to Downside-Beta CAPM. *European Journal of Social Sciences, 21*(2), 189-203.

Alam, M., & Uddin, G. S. (2009). Relationship between Interest Rate and Stock Price: Empirical Evidence from Developed and Developing Countries. *International Journal of Business and Management, 4*(3), 43-51. Retrieved from https://pdfs.semanticscholar.org/2d4e/7e55632e1109dd89c1ed771972b954c74cd6.pdf

Asteriou, D., & Hall, S. G. (2015). *Applied Econometrics.* London: Macmillan International Higher Education.

Benigno, A. M. (2016). *Relationships between Interest Rate Changes and Stock Returns: International Evidence using A Quantile-on-Quantile Approach.* Complutense University of Madrid.

Brooks, C. (2008). *Introductory Econometrics for Finance.* Cambridge: Cambridge University Press.

Chevallier, J., & Goutte, S. (2016). On the estimation of regime-switching Lévy models. *Studies in Nonlinear Dynamics & Econometrics, 21*(1), 3-29.

Constantinides, G., Harris, M., & Stulz, R. M. (2003). *Handbook of the Economics of Finance: Financial Markets and Asset Pricing.* London: Elsevier.

Dima, M. O. (2015). *The Effects of Interest Rates on Stock Returns of Listed Commercial Banks in Kenya* (Unpublished MBA Thesis). University of Nairobi, Nairobi.

Fabozzi, F. J., & Markowitz, H. M. (2011). *Equity Valuation and Portfolio Management.* New Jersey: John Wiley & Sons.

Hamilton, J. D. (1989). A New Approach to the Economic Analysis of Nonstationary Time

Series and the Business Cycle. *Econometrica, 57*(2), 357-384.

https://pdfs.semanticscholar.org/a447/5882982f68062563c56269ea7cde1aff2994.pdf

Hussain, M., & Bashir, U. (2013). Dynamic Linkages of Exchange Rate and Stock Return Volatility Evidence from Pakistan, India and China (PIC). *International Review of Management and Business Research, 2*(2), 345.

Jumah, I. M. (2013). *Effects of Foreign Exchange Rate Fluctuation on Stock Returns Volatility: A Case Study of Nairobi Securities Exchange (NSE)* (Unpublished Masters Thesis). University of Nairobi, Nairobi.

Karoui, A. (2006). *The correlation between FX rate volatility and stock exchange returns volatility: An emerging markets overview.* Retrieved from http:// http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.583.4123&rep=rep1&type=pdf

Lintner, J. (1965). Securities Prices, Risk and Maximal Gains from Diversification. *The Journal of Finance, 20*(4), 587-615. doi:10.1111/j.1540-6261.1965.tb02930

Malarvizhi, K., & Jaya, M. (2012). An Analytical Study on the Movement of Nifty Index and Exchange Rate. *International Journal of Marketing and Technology, 2*(7), 274-282.

Markowitz, H. (1952). Portfolio Selection. *The Journal of Finance, 7*(1), 77-91. doi:10.1111/j.1540-6261.1952.tb01525

Mburu, D. M. (2015). *Relationship between Exchange Rate Volatily and Stock Market Performance* (Unpublished MSc. Thesis). University of Nairobi, NairobiMossin, J. (1966). Equilibrium in a Capital Asset Market. *Journal of the Econometric Society, 34*(4), 768-783. doi:10.2307/1910098

Moya-Martínez, P., Ferrer-Lapena, R., & Escribano-Sotos, F. (2014). Interest rate changes and stock returns in Spain: A wavelet analysis. *Business Research Quarterly, 18*(2), 95-110. doi:10.1016/j.brq.2014.07.004

Muktadir-Al- Mukit, D. (2013). The Effects of Interest Rates Volatility on Stock Returns: Evidence from Bangladesh. *International Journal of Management and Business Research,3*(3), 269-279. Retrieved from http://ijmbr.srbiau.ac.ir/article_2004_ed99403b37940473333c13694d557da3.pdf

Musyoka, M. (2012). *Effects of Stock Market Development on Economic Growth: A Case of Nairobi Securities Exchange* (Unpublished Masters Thesis). University of Nairobi, Nairobi.

Oloo, B. A. (2017). *Effect of Interest Rates on Stock Market Returns at the Nairobi Securities Exchange* (Unpublished MBA Thesis). University of Nairobi, Nairobi.

Otieno, D. A., Ngugi, R. W., & Wawire, N. H. (2017). Effects of Interest Rate on Stock Market Returns in Kenya. *International Journal of Economics and Finance, 9*(8), 40-50. Retrieved

Owiti, J. (2012). *The Relationship between Stock Market Development and Economic Growth in Kenya* (Unpublished MSc. Thesis). University of Nairobi, Nairobi.

Oyinpreye, A. T., & Moses, k. T. (2015). The Effect of Exchange Rate Volatility on Share Price Fluctuations in Nigeria. *International Journal of Management and Applied Science, 1*(7),

88-94. Retrieved from http://www.iraj.in/journal/journal_file/journal_pdf/14-179-143946716888-94.pdf

Salur, B. V. (2013). Investor Sentiment in the Stock Market. West Lafayette: Purdue University.

Saunders, M. N. (2015). *The (re)emergence of mixed methods research: to combine or not combine?* The Surrey Business School.

Shanken, J. (1985). Multi-Beta CAPM or Equilibrium-APT?: A Reply. *The Journal of Finance, 40*(4), 1189-1196.

Sifunjo, E. K., & Mwasaru, A. (2012). The Causal Relationship between Exchange Rates and Stock Prices in Kenya. *Research Journal of Finance and Accounting, 3*(7), 121-130. Retrieved

Thuo, A. N. (2012). *The effects of interest rates volatility on stock returns: evidence from the Nairobi securities exchange* (Unpublished MBA Thesis). University of Nairobi, Nairobi.

Treynor, J. L. (1962). *Toward a Theory of Market Value of Risky Assets.* doi:10.2139/ssrn.628187

Vonesh, E., & Chinchilli, V. M. (1996). *Linear and Nonlinear Models for the Analysis of Repeated Measurements.* Florida: CRC Press.

Womack, K. L., & Zhang, Y. (2003). *Understanding Risk and Return, the CAPM, and the Fama-French Three-Factor Model.* Tuck School of Business.