The Influence of Time-Varying Property of Market Based Risk on Bank Stock Returns: GLS and GARCH Approach

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Abstract- In Kenya, the phenomenon of decline in stock returns due to increasing market based risk is triggering concerns on the stability banking sector in Kenya. The risk appetite at the Kenyan banking sector and the speculative nature of investors especially on banking stocks need to be supported with in-depth empirical evidence on the relationship that exist between risk and returns at Nairobi Securities Exchange (NSE). This study sought to investigate the influence of time-varying property of market based risk on bank stock returns at NSE using three model approach of GLS model, Fixed and Random long run and short run panel data estimation and GARCH model. The study used exchange rate and interest rate as exogeneous variables, stock return volatility as endogenous variable and bank stock returns as dependent variable. GLS regression established that interest rate is negatively significant on indexed bank stock returns while exchange rate was negatively insignificant on indexed stock returns. Hausman test indicated an efficient random model in long run and held that exchange rate and interest rates are individually and jointly negatively significant on bank stock returns. At the short run, Hausman test indicated that fixed model was efficient and held that the rate of change of exchange rate and rate of change of interest rates was individually negatively insignificant but jointly significant on bank stock returns. GARCH (1,1) model held that for short in the short run, stock return volatility and exchange rate influenced indexed stock returns at NSE while interest rate was held insignificant. The study concluded that market based risk determined by the rate of change on interest rate, exchange rate and stock return volatility are significant in influencing on bank stock returns. However, the level of significance depends on time, size of the bank, hedge capacity and ability to adequately respond to changing monetary policies. This research is a spatial extension of the previous researches. Unlike other studies that focus mainly on macro-economic variables, this research focused on exogenous and endogenous variables of market based risk and how they influence bank stock returns with reference to time variation and individual bank characteristic.

Index Terms- Market risk, Stock returns, Exchange rate risk, Interest rate risk, Volatility of stock returns.

I. INTRODUCTION

nvestorsat the stock market exist to maximize returns. A Stock markets is a pillar of investor wealth creation. It drives allocation of resources across different sectors of the economy. Banks, like stock markets, leverage investors objective to maximize wealth through their core function of financial intermediation. However, as banks undertake their core function of resource allocation, they face daunting task of systemic market based risk which if not managed could lead to bank runs thus affecting the economy adversely. Nonetheless, if banks avoid risk to minimize failure rates to zero, they inhibit their economic benefit to promote investor market value and efficient allocation of resources (Greuning&Bratanovic, 2009). To balance the extent of risk is crucial for survival of banks, economy and investor wealth. However, no investor will maximize their returns without engaging in risk. The impact of interest rate risk and exchange rate risk has been observed to be cyclical where systemic effects of market risk triggers emergence of other financial risks (Cheng & Nasir, 2010). Haque and Wani (2015) observed that financial risk exists in an eco-system of systemic risks where external financial risk triggers internal risk during economic recession and internal financial risk triggers external risk during boom. The impact of how market risk influence bank stock returns in Kenya need to be established to balance the uptake of risk in view of maximizing returns for investors at NSE.

Stock return is the measure of shareholder wealth at the stock market. Stock return volatility refers to the uncertainty of returns of the underlying assets due to changes in flow of information concerning the stock into the markets. Negative information increases the variability over varied periods making it difficult for investors to predict stock returns. Stock volatility is characterized by the ups and downs of the stock markets inferred by bull and bear episodes where the stocks prices increases from trough to peak and decreases from peak to trough by huge margins. Bull episodes are evidenced to last longer than bear episodes making it riskier for investors to hold stocks longer at bull phase (Ogilo, 2008). Stock market is a market that facilitates trade of securities from publicly quoted companies and government securities. A stock market form an important entity to the economy, investors and other stakeholders. It's a backbone of an economy since it promotes efficient capital allocation and wealth creation. Studies shows that stock markets are significant for economic growth (Sobia et al. 2015). Jorion (2007) referred market risk as the uncertainty that a bank may experience due to

unfavorable movement in price and price determining indicators such as interest rate and exchange rates volatilities which leads to potential financial loss to earnings and capital. Haque and Wani (2015) defined interest rate risk as the sensitivity to capital and income due to variations in interest rates arising from the mis-matches of the yield curve or repricing of assets and liabilities. The sensitivity of interest rates that arising due to mis-match of assets and liabilities maturities is established to have adverse effects on stock returns (Ryan & Andrew, 2004). Most studies have associated the direction of influence between interest rates and stock returns to be dependent on regulations and deregulations. Greuning&Bratanovic (2009) described exchange rate risk as the risk arising from mis-matches in value of assets and liabilities denominated in different currencies. The fluctuation of domestic currency over a foreign currency arises due to interest rates differentials between the two countries. These affects the inflation of the two countries and other macroeconomic factors which bear a resultant negative effect on shareholder market value.

Empirical literature remains nascent and contradictory on how financial risk affects stock returns sensitivity. However, Sukcharoensin, (2013) and Syed & Anwar (2012)argued that market risk theoretically and empirically is proven to influence stock returns. Sobia, et al. (2015) established that investors in emerging markets are mere herd and noise traders as they fail to consider external and internal risk in their investment decisions. To maximize wealth, investors require accurate and reliable information on the drivers of stock prices. Maxims of efficient market hypothesis contends that stock prices respond to news released to the markets which could be in the form of financial statements, press briefings or insider information. Market imperfection gravitates the impact of uncontrollable, unknown risk to shareholder market value. Notably, massive loss of investor's wealth in the stock markets due to market based risk got its epitome during the global financial crisis where systemic risk spiraled from one economy to another by due to sensitivities, volatility and interconnectedness of the world in interest rates and exchange rates (Mouna& Anis, 2015).

In Kenya, investors at the NSE lost Ksh 157 billion in the first half year of 2015 in a bear run that plunged the main market index to a two-year low. According to market data, 48 counters out of 63 lost value with NSE 20 share index falling by 12.7% to 4463 points while absolute investments in this segment fell to Ksh 2.142 trillion (NSE, 2015). In the year of 2015, the stock market performed dismally with the financial sector being the biggest loser while the telecommunications and the agricultural sector proved resilient to the bear run. The banking sector suffered a 12.7% drop to 755 billion in capitalization recording a loss of Ksh 109 billion. Insurance sector shed 20.3% to Ksh 37.5 billion (NSE, 2015). Pension funds reduced their investments in stocks from 30% to 27.1% in first quarter of 2016 due to plunging of the banking stocks due to bad debts and bank failures. The returns of pension firms in Kenya in the past three years reduced by 6.6% (Forbes, 2016).

Financial theory has laid emphasis on risk as a key predictor of stock returns. According to theory of Markowitz (1952), Modern Portfolio Theory (MPT) and Capital Asset Pricing Model (Sharpe, 1964 and Lintner (1965), financial market players are concerned over a given level of risk and upon which they adjust their returns expectations. Ross (1976) with his Arbitrage Pricing Theory (APT) argued that besides beta risk, stock returns are driven by other market based risks to determine expected return on investments. In this regard, this study sought to establish the influence of interest rate risk, exchange rate risk and stock returns volatility on bank stock returns at NSE.

1.1 Statement of the problem

Globalization and web based financial interconnection has precipitated the increase of market based risks affecting investor value in the financial industry. Increased appetite for risk through innovation on financial products as banks strive to survive difficult financial environment is the main cause of concern for deteriorating investor value at the stock market. The state of risk has been heightened by the systemic, cyclical, and contagious nature of market based risk which has led to huge loses and uncertainties on stock portfolios to local and international investors. In Kenya, the phenomenon of decline in stock returns due to increasing market based risk and emerging complex banking operating environment is triggering concerns on the stability banking sector (Machuke, Mwita &Kihoro, 2014). The unprecedented loses has yielded concerns on whether investors at NSE care about risks when making investment decisions. The risk appetite of the Kenyan banking system and the speculative nature of investors especially on banking stocks at NSE need to be supported with in-depth empirical evidence on time-varying influence of market risk on bank stock returns.

Studies on the influence of market risk on stock returns are yet to provide a substantial causal link. Sobia, et al. (2015) concluded that interest rates and exchange rates hold negative significant relationship with stock returns. Naser et al. (2011) conducted a study to investigate the effect of credit and exchange risk on stock returns of banks in Australia using GARCH family models. The study concluded that credit risk and exchange risk are significantly positive in influencing bank stock returns. Haque and Wani (2015) undertook to examine the relationship between financial risk and financial performance of Indian banks. The study concluded that solvency risk, credit risk and capital risk significantly influenced financial performance while interest rate and liquidity risk was found insignificant. Sukcharoensin (2013) conducted a study to examine the influence of market, interest rate and time varying property of Thai banks stocks returns using GARCH framework. The study also established that interest rate and exchange rate are better predictors of stock returns sensitivity of Thai banks. In the long run, large banks are seen to hedge exchange rate risk and therefore exchange rate risk does not influence the stock return sensitivity

Locally, Koskei (2017) established that exchange rate was negative and significantly related to stock returns using panel data estimation. The study also showed that interest rates is insignificant on bank stock return. The study failed to specify and compare the relationship in both long run and short run. It also failed to estimated time varying property of stock returns. Wawire et al. (2017) established that interest rates and lending rates negatively granger cause stock market returns in the long run. The study failed to estimate panel data for individual banks effects, aggregate effect and time varying property of market risk on stock returns. In general, existing local studies have failed to incorporate time varying effect of stock returns, long term and

short term impact of exchange rates risk and interest rate risk on stock returns. By filling the gap, this study will help to establish the impact of hedging in banks, level information asymmetry and other risk management initiatives. Panel data estimation under long run and short run will help to ascertain on how exchange rate and interest rate affect stock returns at different time for different banks. Local studies have also failed to factor the long run and short run bank individual effects upon which market risk influences stock returns. These omissions form the basis of this study.

No study encountered in Kenya that has jointly considered the influence of market risk on aggregate bank stock returns at NSE, the long run and short run individual bank effects upon which market risk influence bank stock returns at NSE and influence of time varying stock return volatility on bank stock returns at NSE. The above forms the objectives that this study intend to address. Given the justification of study it is imperative to explore the influence of time-varying property of market based risk on bank stock at NSE forms the subject of this study.

II. LITERATURE REVIEW

2.1 Modern Portfolio Theory

Modern Portfolio Theory (MPT) is a finance theory developed in 1950 by Nobel Prize winner Harry Markowitz. It describes an optimal investment decision as one that maximizes the expected return of a portfolio for a given level of risk, or that investment decision that minimizes portfolio risk for a given amount of portfolio expected return. MPT describe investment as a principle of diversification where a collection of individual risky assets will form a portfolio with overall discounted risk for the same expected return. Stocks and bonds move in opposite directions, but a combination of a stock and a bond will yield a portfolio with overall lower risk for a given return.

MPT theory also observed that a portfolio constituted by positively correlated assets result to lower risk. The theory assumes an efficient market with rational risk averse investors; implying that one will only undertake a risky investment only if the returns were commensurate based on individual risk preference. MPT theory defined risk as the volatility of assets prices and the expected return as a collection of weighted asset returns. Harry Markowitz theory (1952) developed a mean variance formulation that combines assets portfolioto generate an efficient frontier curve which identifies the optimal portfolio for investment.

Hyde (2007) investigated the sensitivity of stock returns to market risk, interest rate and exchange rates in France, Germany, UK and Italy. The study established that the three risks exhibit a significant influence on excess returns and future cash flows. This empirical study confirms the relevance of modern portfolio theory by aligning the influence of diversified risk on stock returns.

2.2 Arbitrage Pricing Theory

Arbitrage pricing theory (APT) is an asset pricing valuation model that describes stock returns as a function of a series of risk factors. The theory was proposed by Roll and Ross (1976). The theory is an advancement of Capital Asset Pricing Model (CAPM) by Sharpe and Litner that contended that stock returns are a function of beta risk only. Unlike CAPM, APT describes that stock returns is a factor of a series of risk factors ranging from firm and macro risk factors. Compared to CAPM, APT theory is less restrictive in its assumptions. APT theory assumes the markets are perfectly competitive, Investors prefer more wealth to less with certainty and asset returns follow a stochastic process expressed a linear function of n risk factors. APT theory of n risk factor model can be expressed as below:

$$E(R_{it}) = \lambda 0 + \lambda 1 bi1 + \lambda 2 bi2 + \ldots + \lambda n bin$$

$E(R_{it})$ = the expected return on asset I during a specified period of time, i=1, 2, 3…n

$\lambda 0$ = the expected return on the asset with zero risk

λn =the risk premium related to the nth common risk factor; i.e. how responsive is returns of asset i to the nth risk common factor loadings.

Sobia et al. (2015) established that the factor loadings that determine the stochastic process of asset returns over time can be associated with macro and micro economic risk factors.

2.3 Conceptual Framework

A conceptual framework employed by the study discusses the foundation that influence of market risk on stock returns. The dependent variable in the study include bank stock returns while independent variables were exchange rate and interest rate. The study also included time varying property of stock returns as unobserved independent endogenous variable. Figure 2.2 represent the study's conceptual framework.

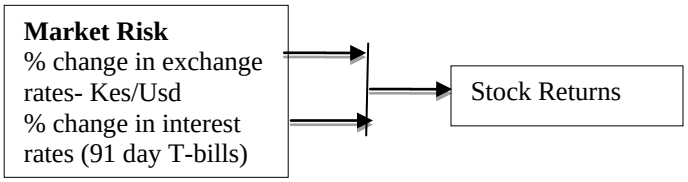

Figure 2.2 Conceptual Frameworks.

2.3.1 Exchange Rate

Exchange rate is described as the rate of change at which a county's currency is exchange for another country's currency. It is also refereed as the price of one currency expressed in terms of another currency (Olweny, 2011). The volatility of the exchange price affects the pricing of goods and services. It also affects the banks whenever there exist mis-pricing of assets and liabilities (Benita &Lauterbach, 2004). This study uses the rate of change of exchange rate as a measure of market risk (Mouna& Anis, 2015)

2.3.2 Interest Rate

Interest rate is the price of capital. It can also be described by the price an obligor pays to the lender to obtain a debt. Interest rate

may also represent the cost incurred to obtain resources for the purposes of lending or investment (Greuning&Bratanovic, 2009). For investors to determine their actual returns, they must therefore factor the variation of interest rates as an expense incurred to obtain capital. It affects the rate of foreign direct investments at the stock market. This study with support from empirical studies considers 91-day treasury bill a measure of market risk (Ryan & Andrew, 2004).

2.3.3 Stock returns

Stock return is the change in capital or wealth due to an investment. The changes could occur due to cash flows such as earnings, dividends or interest or due to negative or positive changes in prices (Mehri, 2015). To determine stock returns the study employed formula applied by Purnamasari et al. (2012) and Predescu and Stancu (2011) in calculating the stock returns:

Equation 2.1: Equation Formula on Determination of Stock Returns

$$R_{i,t} = \ln\left(\frac{P_t + Div}{P_{t-1}}\right)$$

Where, $R_{i,t}$ denote the continuously compounded individual bank stock returns at time t. P_t is the Stock price at the end of the period, $P_{t-1}$is the stock price at the end of the previous period and Div is the cash dividend during the period. Stock return was computed annually from 2006 to 2015. Logarithmic returns are preferred because they are tractable when handling many sub periods for a long horizon. They are also statistical and conform to normal distribution (Mouna& Anis, 2015).

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2.4 Empirical Review

Having laid pre-requisite theoretical foundation and conceptual framework defining the association of variables of study; the study reviewed empirical evidence on the influence of market risk on stock returns and related studies by various scholars.

2.4.1 Market Risk and Stock returns

Empirical study by Syed & Anwar (2012) provided evidence on the relationship between interest rate and stock returns. It confirmed the existence of significant negative relationship between interest rates and stock returns. In their study on the effects of interest rate, exchange rate and volatilities on stock prices in Pakistan found that exchange rate risk on commercial banks stock returns is significant. They argue that banks will never hedge their individual position perfectly and this exposes them to exchange rate risk.

Ryan and Andrew (2004) conducted a study on market, interest rate and foreign exchange risk in Australian banking sector for the period 1996 to 2001 using GARCH-in-Mean Approach to model stock return volatility on daily Australian stock returns. They concluded that market risk, short and medium term interest rates along with their volatility are significant determinant of bank stock returns. However, it was found that exchange rates and long term interest rates are not significant in influencing Australian bank stock returns.

Hyde (2007) investigated the sensitivity of stock returns to market risk, interest rate and exchange rates in France, Germany, UK and Italy. The study established that the three risks exhibit a significant influence on excess returns and future cash flows. This empirical study confirms the relevance of and modern portfolio theory by aligning the influence of diversified risk on stock returns. Predescu and Stancu (2011) analyzed portfolio risk in the pretext of global financial crisis using volatility models of ARCH and GARCH along three benchmark indexes of USA, UK and Romania. The objective of the study was to establish the uncertainties in the portfolio over time as a result of financial crisis. Modeling of stock returns volatility of the indexes established that portfolio risk was influenced by systemic forces of the financial crisis. The study also established that diversification of the portfolio along the three indexes during the crisis did not reduce portfolio risk.

Sukcharoensin (2013) conducted a study to examine the influence of market, interest rate and exchange rate on time varying property of Thai banks stocks returns using GARCH framework. The study established that market is a factor of stock return sensitivity to large banks than to small and medium Thai banks. The study also established that interest rate and exchange rate are better predictors of stock returns sensitivity of Thai banks. In the long run, large banks are seen to hedge exchange rate risk and therefore exchange rate risk does not influence the stock return sensitivity.

Mouna and Anis (2015) investigated the effect of market, interest rate and exchange rate risk of financial stock returns during financial meltdown using GARCH-in-Mean model. The study was conducted for eight countries within USA, European market and China for the period 2006-2009. The study established that market, interest rate and exchange rate positively and negatively influence the volatility of stock returns in USA, China and Europe economies during the financial crisis.

Sobia et al. (2015) executed a study to investigate the effect of financial risk on the sensitivity of stock returns. The study was conducted during the year 2003 to 2012 based on the data of 115 companies at Karachi Stock Exchange in Pakistan focusing on financial risk at industry level, firm specific level and that of exporting and non-exporting firms. Stock return was used as dependent variable while independent variable of financial risk was represented by interest rate, exchange rate, financial exposure, and total risk. Firm size was employed as a control variable. The study findings concluded that interest rates and exchange rates at industry level and firm level hold a negative significant relationship with stock returns while total risk, growth rate, firm size and financial exposure was insignificant on industry and firm level. Interest rates held a positive significant relationship on stock returns for exporting and non-exporting while exchange rate held a negative significant relation for the same group.

Naser et al. (2011) conducted a study to investigate the effect of credit and exchange risk on stock returns of banks in Australia

using GARCH family models. The study established that credit risk and exchange risk influence the behavior of stock returns. The study concluded that credit risk and exchange risk significantly positive in influencing bank stock returns and therefore the financial risk was useful tool for investors in return maximization.

Haque and Wani (2015) undertook to examine the relationship between financial risk and financial performance of Indian banks. The study also investigated the influence of financial risk on financial performance of Indian banks. Financial risk was defined as interest rate risk, liquidity risk, credit risk, capital risk and solvency risk. The findings established all financial risk studied depicted a relationship with financial performance. The study concluded that solvency risk, credit risk and capital risk significantly influenced financial performance while interest rate and liquidity risk was insignificant to financial performance.

Koskei (2017) studied effects of exchange rate risk on stock returns. The study established that exchange rate was negative and significantly related to stock returns using panel data estimation. The study also shows that interest rates was insignificant on bank stock return. The study failed to specify short term relationship. It also failed to estimated time varying property of stock returns. Wawire et al. (2017) investigated effects of interest rates on stock market returned. The study held that interest rates and lending rates negatively granger cause stock market returns in the long run. The study omitted the analysis of aggregate influence of interest rates, long run and short run analysis and analysis time varying property of interest rates on stock returns.

III. METHODOLOGY

This study adopted descriptive and correlational research design. Mehri (2015) used descriptive correlational research design in the analysis of effects of financial risks on the relationship between earnings and stock returns.

Target population comprised of all 43 commercial banks licensed by the Central Bank of Kenya and in operation as at 31st December 2015. Accessible population comprised of 11 commercial banks licensed by CBK and listed at NSE. The study assumed stratified purposive sampling technique to objectively select sample elements which best represent the population.

The sample of secondary data comprised of 9 commercial banks listed at NSE from year 2006 to 2015 namely: Barclay, CFC Stanbic, Diamond Trust, Equity, Housing Finance, Kenya Commercial Bank, National Bank of Kenya, National Industrial Credit Bank (NIC) and Standard Chartered. The study dropped the effects of corporate events such as M & A and rights issues around the announcement dates with an event window of ±10 days. This is because corporate events contain temporary effects on stock returns which are not related to market risk (Predescu&Stancu, 2011).

10-year annual secondary data for the period 2006 to 2015 was obtained from Nairobi Securities Exchange and Central Bank of Kenya. Data from Central bank of Kenya was used to show the rate of change of exchange rate between the USD and KSh and the rate of change in 91-day T-bills. Data on Nairobi securities exchange was used to calculate the stock returns for the listed banks. The study incorporated method of data collection based on quantitative and qualitative data collection approaches.

Econometric techniques were used to describe the influence of market risk on stock returns of commercial banks listed in Kenya. The data was first subjected to diagnostic test of normality using Jacques Bera test, Breusch-Pagan Godfrey test was used to test non-constant variance where acceptance of the null hypothesis for constant was deemed appropriate, stationary test done using Phillips Perron test where autocorrelation test was done using Durbin Watson test. T-test was used to administer for significance of market based risks on stock returns. The model is as described below

Model Specification

The sensitivity of bank stock returns to exchange rates risk and interest rate risk is established through estimation of below multi-index model:

Full Model Specification

$$\mathbf{R_{it}=\acute{\alpha}_0-\beta_1}FX_{i,t}\mathbf{-\beta_2}IR_{i,t}\mathbf{+\varepsilon}_{i,t} \quad \text{.....1}$$

Where R_{it} represents Stock Returns at time t; $FX_{i,t}$ is the rate of change of Exchange rate between Ksh and USD at time *t*; $IR_{i,t}$ is the rate of change of interest rate for 91-day T-bill at time *t*; $\acute{\alpha}_0$ is the constant representing the sensitivity of bank stock returns under risk free conditions. $\boldsymbol{\varepsilon}_{i,t}$ is the error term; **β r**epresent the measure of change of stock returns due to 1 unit change in market risk.

GLS model was used to analyze annual secondary data to established the impact of market risk on aggregate/indexed bank stock returns. It is worth noting that the financial data used by the study is characterized by seasonality, temporal effects, and non-stationarity. These features make financial data feasible to serial correlation, heteroscedasticity, and non-normality which are the pre-requisites for financial data violating the assumptions of OLS model. It is for this justification that the study resulted on the use of GLS model. GLS models controls for serial correlation, non-constant variance and non-normality and still yields unbiased estimators for the model. Unlike OLS estimators, GLS estimators accounts for the differences in variances of exchange rate, interest rate and stock returns along periods of time (Meshki, 2011). GLS has been extensively used to model macro-economic and financial data. R studio analytical software was used for GLS modeling.

The study also employed panel data estimation using fixed and random effects model to control for specific bank effects on the influence of market risk on stock returns. This guarantees that the overall study is not privy to omitted variable bias due to individual bank effects (Wooldridge 2002). The study presented short run dynamic fixed and random model by lagging stock returns by lag one. This is to establish whether investors use previous investment returns to determine their present investment decision today. To select the model that provides efficient estimators the study conducted a Hausman test to select the preferred model between long run fixed or random and between short run dynamic fixed models against short run dynamic random model. Eviews software package was used for this analysis. Below is the description of long run and short run model specification

Long run Model Specification

$\mathbf{R_{it}=\acute{\alpha}_0-\beta_1}FX_{i,t}\mathbf{-\beta_2}IR_{i,t}\mathbf{+\Theta+\varepsilon_{it}}$ 2

Short run Model Specification

$\mathbf{R_{it}=\acute{\alpha}_0+R_{it-1}-\beta_1}FX_{i,t}\mathbf{-\beta_2}IR_{i,t}\mathbf{+\Theta+\varepsilon_{it}}$ 3

Where $\mathbf{R_{it-1}}$ represents previous period stock returns lagged by one period. $\mathbf{\Theta}$ represents bank individual effects for heterogeneity to eliminates endogeneity bias.
The study also used GARCH (1,1) model to examine the sensitivity of bank stock returns to exchange risk and interest risk exposures using monthly data from 2005 to 2015. The study is anchored on the problem of declining stock prize which is an indication a volatile stock market environment. It is due to this fact that GARCH model is employed to model the non-constant residuals and confirm whether they are time varying and conform to a stock return generating process over a long period of time. This confirms whether arbitrageurs can benefit to the mis-pricing in the stock market (Sukcharoensin, 2013). GARCH technique is employed for empirical investigation as follows:

Model Specification
$R_{i,t}=\mathbf{\acute{\alpha}_0}-\beta_1 FX_{i,t}-IR_{i,t}+\epsilon_{i,t}$ .....4 (overall mean model before modeling)
Where,
$\epsilon_t{}^2=\alpha_1+\alpha_1\epsilon_{i,t-1}^2+\alpha_2\epsilon_{i,t-2}^2+\cdots+\alpha_q\epsilon_{i,t-q}^2+v_t$ .....5 (residual model equation)

$\sigma_{i,t}^2=w+\sum_{i=1}^{q}\alpha_1\epsilon_{i,t-1}^2+\sum_{j=1}^{p}\beta_1\sigma_{i,t-1}^2+$ 6
(conditional variance equation)

Overall model (Mean and Variance equation combined)

$R_{i,t}=\acute{\alpha}\mathbf{0}-\beta_1 FX_{i,t}-IR_{i,t}+(w+\alpha_1\epsilon_{i,t-1}^2+\beta_1\sigma_{i,t-1}^2)$ Or
$R_{i,t}=\acute{\alpha}\mathbf{0}-\beta_1 FX_{i,t}-IR_{i,t}+\sigma_{i,t}^2$ .....7 (being GARCH Model after volatility modeling)

Where $FX_{i,t}$ being change in exchange rate and $IR_{i,t}$ being change in interest rates are the *mx1* vector exogenous explanatory variables measuring market risk;$\epsilon_{i,t}$ represents the unexplained residuals being mx1 endogenous explanatory variable on stock returns. Equation 4 is an overall model before volatility modeling that represent that stock returns is a linear function of market risk and the error term. The error term of time series is usually non-linear and therefore requires modeling to establish whether stock returns volatility is mean reverting and exhibit a stock return generating process effect. Equation model 5, 6 and 7 indicates GARCH modeling process of the error term. The model show that conditional variance $\sigma_{i,t}^2$ is linearly dependent on the past behavior of squared error terms $\sum_{i=1}^{q}\alpha_1\epsilon_{i,t-1}^2$; the ARCH term, and its past values $\sum_{j=1}^{p}\beta_1\sigma_{i,t-1}^2$; the GARCH term. The parameter α_1 indicates the sensitivity of stock returns conditional variance to past values of squared errors where as β_1 indicates the sensitivity or measures the variance responsiveness to its own past behavior. The sum of α_1 and β_1 measure the persistence of volatility. As $\alpha_1+\beta_1$ increase towards one, persistence increases indicating that stock return volatility is time varying, mean reverting and therefore can be used to predict stock returns. Incase $\alpha_1+\beta_1>1$ the conditional variance of the error term is deemed non-stationary and therefore will not converge at their unconditional values as period increases.

IV. DATA ANALYSIS AND DISCUSSIONS

4.1 Descriptive Results

Table 4.1 provides the summary of descriptive statistics of the sample showing mean, standard deviation, skewness, kurtosis, minimum and the maximum of the study variables. The results show that a 10 years' investment in the banking stocks obtained a monthly average stock return of -0.2% with a deviation of 5.1%. The average monthly rate of change of exchange rate increased 0.3% with a deviation of 2.4% signifying devaluation of ksh against the USD. The rate of change 91-day treasury bills returned a monthly average of 0.4% with a 16.3% deviation. Interest rates held the highest deviation being the highest risk possibility on investor market value. The parameters demonstrated average returns not significantly different from zero giving indications of stationarity of the variables a condition necessary to establish time varying property of stock return.

Table 4.1 Descriptive Statistics

Descriptive	Rt	FX	IR
Mean	-0.002	0.003	0.004
Median	0.005	0.003	0.001
Maximum	0.128	0.073	0.527
Minimum	-0.197	-0.084	-0.630
Std. Dev.	0.051	0.024	0.163
Skewness	-0.829	-0.424	-0.302
Kurtosis	4.886	6.550	7.459
Jarque-Bera	29.171	61.610	93.635
Probability	0.000	0.000	0.000
Observations	120	120	120

4.2 Diagnostic Test

Normality test was conducted using JarqueBera test. The test obtained p-values below 5% level of significance for all variables which indicate non-normality. The generalized least square model ideal for modeling data that violate linear assumptions was used to solved the exception of non-normality on estimation of influence of market risk on indexed bank stock returns. For estimating time-varying property of stock returns using GARCH (1, 1) the study tested for stationarity using Phillips Perron test. Results in table 4.2 show all the variables of stock returns, exchange rate and interest rate were stationary. Stationarity was determined at a point where PP t-statistic was higher than the critical value with significant p-values which means under such circumstances unit root does not exist. We therefore reject null hypothesis and conclude stationarity exist.

Table 4.2

Variable	PP t-Statistic	Critical Values 1%, 5%, 10%	P-Value
		1%, 5%, 10%	
Stock Returns (**Rt**)	-8.08	-3.49, -2.88, -2.58	0.000
Exchange Rate	-7.58	-3.49, -2.88, -2.58	0.000
Interest Risk	-7.55	-3.49, -2.88, -2.58	0.000

Heteroskedasticity test for non-constant variance for time series data was done using Breusch-Pagan Godfrey test. Test results in table 4.3 shows a p-value of 0.8671 which signify absence for no constant variance. Autocorrelation test of serial correlation on the residual was done using Durbin Watson test which found an appropriate DW parameter of 1.6 which is closer to parameter 2 for zero serial correlation.

Table 4.3 Breusch-Pagan Godfrey Test

Statistic	0.1428
P-value	0.8671

Pearson correlation test was done to confirm the degree of multi-collinearity amongst the variables. Table 4.4 revealed stock returns are negatively related to exchange rate and interest rates with correlation coefficients of -0.298 and -0.0862. The study notes that relationships between the variables exist although they are low. These findings justify the study use of GLS non-linear model, fixed and random model for endogeneity bias for short run and long run models and GARCH (1,1) model. However, correlation test shows absence of multi-collinearity among selected variables which is ideal diagnostic results for modeling.

Table 4.4: Correlations Matrix

Parameter	Rt	fx	ir
Rt	1		
Fx	-0.298	1	
Ir	-0.0862	0.044	1

4.3 Regression analysis and hypothesis testing

Hypothesis testing was done using GLS model, Panel data estimation of fixed and random effects model and GARCH model regression of market risk variables on stock returns. The decision criteria were based on probability of entry of 5% where the t-test and *p*- value was deemed to determine the variables to be incorporated in the model.

4.3.1 Influence of market risk on aggregate bank stock returns

GLS model

The study regressed the rate of change of exchanges rate on KES against US (fx) and the rate of change of interest rates on 91-day treasury bills as independent variables against indexed bank stock returns (R_{it}). Table 4.5 shows GLS regression results based on the correlation structure of ARMA (1, 1). The regression results on the influence of market risk measured by rate of change of interest rate on aggregate stock returns was found to be negatively significant with a p-value of 0.0219 which is lower than 5% level of significance. The regression results on the influence of market risk measured by rate of change of exchange rate on stock returns was found to be negatively insignificant with a p-value of 0.1265 which is higher than 5% level of significance. This finding on interest rates is in accordance to the studies of Syed (2012) and Anwar and Hooy et al (2004). The findings on exchange rate is similar to findings of Sukcharoensin (2013) who held that in the long run, large banks are seen to hedge exchange rate risk and therefore exchange rate risk does not influence the stock return sensitivity.The study results indicate that excessive risk is negatively related to stock returns. The null hypothesis is therefore rejected that;
market based risk does not influence stock returns for banks listed at NSE.

Table 4.5: Regressing FX, IR on R_{it}

Predictors	Dependent variable:		Stock	Return
	Coefficient	S E	t-value	p-value
Intercept	0.127	0.039	3.26	0.014
Rate of change of interest rates (ir)	-0.285	0.097	-2.933	0.022
Rate of change of exchange rate (fx)	-1.428	0.824	-1.734	0.127

Table 4.5 provides regression coefficients result on influence of market risk on stock returns. The results indicate that the rate of change of interest rates on 91-day T-bills (ir) influences stock returns (R_{it}) with a negative beta coefficient of 0.2847. The results also indicate that the rate of change of exchanges rate on KES against US (fx) influences stock returns (R_{it}) with a negative beta coefficient of 1.4279. This means that all factors held constant a unitary increase in rate of change of interest rates will lead to decrease in shareholder market value by 0.2847 while a unitary increase in the rate of change of exchange rate will lead to a decrease in shareholder market value by 1.4279. The constant signifies the risk-free premium; that at zero risk, investors in listed bank will still enjoy stock returns 0.127 times. This is findings are summarized by the model below;

$$R_{it} = 0.127 - 0.2847IR - 1.4279FX$$

4.3.2 Individual bank effect on the influence of market risk on bank stock returns: Long run and Short run model

Fixed and Random Effect Model

Table 4.6 shows a comparative regression analysis on fixed effects (FE) and random effects (RE) to establish the impact of unobserved individual bank effects upon which market risk influences bank stock returns using panel data estimation. Despite the comparative and mixed findings on long run FE and RE the study employs Hausman test to discriminate the models and establish the model with most efficient estimators.
Hausman test reveals a p-value of 0.06 which indicates that we accept the null hypothesis that unobserved individual bank

effects are uncorrelated with components of market risk denoting that the long run random effect model is desirable for interpretation. The analysis on long run random effects specification indicates interest rates and exchange rate are negatively related to stock returns. The findings show R-square of 0.13 which indicated components of market risk assuming bank individual fixed effects are uncorrelated with the disturbance term jointly determine 13% change in stock returns. Long run random effects shows an F statistic of 6.78 with a p-value 0.000 indicating that components of market risk are individually and jointly significant in influencing stock returns. This is findings of the long run random effect model are summarized by the model below;

R_{it}= 0.128 - 0.222IR – 1.638FX + Ɵ

Table 4.6: Influence of Market Risk on Stock Returns

	Long Run Models		Short Run Models	
Variables	**Fixed Effects**	**Random Effects**	**Dynamic Fixed Effects**	**Dynamic Random Effects**
Constant	0.174 -0.234	0.128 -0.080	0.192 -0.203	0.087 -0.001
R_{it-1}			-0.194 -0.104	0.412 0.000
% change in Interest rate	-0.199 (0.357)	-0.222 (0.008)	-0.245 (0.276)	-0.174 0.000
% change in Exchange rate	-3.992 (0.391)	-1.638 (0.037)	-3.958 (0.409)	-0.910 (0.002)
Observations	90.000	90.000	90.000	90.000
R-Squared	0.775	0.135	0.783	0.606
Hausman Test		0.056		0.000
F statistic	24.378	6.776	20.114	39.025
P-value	0.000	0.002	0.000	0.000
DW.	2.155	2.224	2.146	2.146

Table 4.6 also shows the results on short run specification. Hausman test on short run FE and RE reveals a p-value of 0.000 which indicates that we reject the null hypothesis that unobserved individual bank effects are uncorrelated with predictor variables of market risk hence the fixed effect model is desirable for interpretation in the short run.

The results also indicate that interest rates and exchange rate are negatively related to stock returns in the short run. The findings on the short run fixed effects model show R-square of 0.78 which indicates that components of market risk jointly determine 78% change in stock returns. Joint effect on short run fixed effects show an F statistic of 20.11 with a p-value of 0.000 indicating that variables of market risk are jointly significant in influencing shareholder market value. This is findings of the short run fixed effect model are summarized by the model below;

R_{it}= 0.1922 – 0.1943 R_{it-1}–0.2453IR – 3.9576FX + Ɵ

4.3.3 Influence of time varying stock return volatility, exchange rate and interest rate on bank stock returns

GARCH model

This section shows a GARCH (1, 1) model to analysis the influence of exchange rate risk, interest rate risk and stock return volatility on stock returns. GARCH (1, 1) is preferred compared to higher order GARCH models in stabilized series since it captures the greatest variability of the dependent variable over a long period of time. Simple GARCH models are preferred as it is characterized with lowest AIC and BIC values (Waititu et al., 2013). Based on this evidence, the study adopted simple GARCH (1, 1) for numerical stability and parsimony. Table 4.7 results indicates R^2 =0.0687. This shows that there exists a relative explanatory power of market based risk on stock returns. This implies that 6.87% variation in stock returns is explained by the model $R_{i,t}= u - \beta_1 FR_{i,t} - IR_{i,t} + \sigma_{i,t}^2$. Adjusted R^2= 0.0601 is slightly lower than the R^2which indicates 6.01% precise explanatory power of endogenous and exogeneous variables on dependent variable.

Table 4.7: Exchange rate risk, Interest rate risk, Stock returns volatility and Stock Returns

Dependent Variable R_{it}
Method: ML - ARCH- Normal distribution
Sample: 120
Mean Equation: $R_{i,t} = \boldsymbol{\alpha_0} - \beta_1 FX_{i,t} - IR_{i,t} + \epsilon_{i,t}$
Variance Equation : $\sigma_{i,t}^2 = w + \alpha_1 \epsilon_{i,t-1}^2 + \beta_1 \sigma_{i,t-1}^2$

Mean Model

Variable	Coefficient	S. E	Z-Stat	Prob.
fx	-0.344	0.1418	-2.424	0.015
ir	-0.029	0.0319	-0.911	0.362

Variance Model

w	0.000199	0.0001	1.21	0.226
$\epsilon_{i,t-1}^2$	0.192431	0.09	2.138	0.033
$\sigma_{i,t-1}^2$	0.714136	0.1262	5.658	0.000

R-squared	0.076
Adjusted R-squared	0.068
S.E. of regression	0.049
AIC	-3.276
Log likelihood	186.832

The overall GARCH (1, 1) model on mean and variance equation can therefore be fitted as below:

$R_{i,t}= \boldsymbol{\alpha_0} - \beta_1 FX_{i,t} - IR_{i,t} + \epsilon_{i,t}$ Overall model before volatility modeling

$R_{i,t}$= 0- 0.3438$FX_{i,t} - 0.0290IR_{i,t}$..... Modeled mean equation

$\sigma_{i,t}^2$=0.000199+0.192431 $\epsilon_{i,t-1}^2 + 0.714136\ \sigma_{i,t-1}^2$....Modeled variance equation

$R_{i,t}$=0.3438$FX_{i,t}$ − 0.0290$IR_{i,t}$+(0.000192+0.200999 $\epsilon^2_{i,t-1}$ + 0.714096 $\sigma^2_{i,t-1}$)….Overall model (Mean and Variance equation combined)

The model can be interpreted to mean that other factors held constant a marginal increase in foreign exchange risk (FX) would results to a marginal decrease of stock returns ($R_{i,t}$) by 0.3438. Interest rate risk (IR) would results to a negligible marginal decrease of stock returns ($R_{i,t}$) by 0.029. The constant for mean model is not significantly different from zero signifying that NSE investment has no risk- free return. However, there exist high persistence as ARCH and GARCH coefficients increases towards one $\alpha_1+\beta_1 < 1$signaling a high sensitivity of bank stock returns to stock return generating process. Positive α_1 and $\beta_1$coefficients imply that as risk increases, the expected return also increases. The p-value of $\epsilon^2_{i,t-1} = 0.0325$ and $\sigma^2_{i,t-1} = 0.000$ indicate the significance of the influence of stock volatility to expected stock returns. This positive relationship of risk and returns aligns to modern portfolio theory.

4.4 Discussion of findings

GLS regression results shows market risk measured by rate of change in exchange rates on Kes/Usd is insignificantly negative against stock returns. The results are related to the study of Ryan and Andrew (2004) which held foreign exchange is insignificant in influencing stock returns. However, the direction of influence is related to the study of Mouna and Anis (2015) which established exchange rate positively or negatively related to stock returns depending with the period and hedging capacity of the bank. These findings are also related to the study of Sukcharoensin (2013) which established that in the long run, banks hedge exchange rate exposures and therefore exchange rate does not influence stock returns. An increase in the rate of change of kes/usd indicate that Kenya shilling is losing at the expense of USD. This phenomenon is advantageous to net exporters and disadvantageous to net importers. Kenya imports most of its major commodities such as oils, machinery, and major inputs. Devaluation of the shillings therefore results to a slowed economic growth which adversely affects banks transactional income and the economy appetite for credit. The resultant effect is reduced returns on investments.

GLS regression results indicates that market risk measured by rate of change of interest rates on 90 day-T bills is significantly negative in influencing stock returns in the long run. The results are related to the study of Syed & Anwar (2012) which held interest is negatively significant on stock returns. However, the findings are contra to the study findings of Wycliffe and Muriu (2014) who established interest rates are insignificant in determining stock returns alongside macro-economic variables. Short term interest rates on government securities are used by the government to regulate amount of liquidity in the economy due to the long-term effect on other macro-economic indicators. Higher rates attract investment in government securities depriving banks cheap fund to lends. Consequently, investment in government securities deprive the stock market necessary market liquidity to stir the prices of stocks upwards. Analysis of GLS regressions signify that stake stakeholders in the banking industry pay attention change in monetary policies by the central bank of Kenya such as interest rates and exchange rates and how such policies would affect the relationship between market based risk and stock returns.

The results on fixed and random effect model considering individual bank effect upon which market risk influences stock returns indicates market based risk of exchange rate and interest rate are negatively significant on stock returns in the long run under random effect model. Components of market risk (exchange rate and interest rates) are jointly negatively significant on stock returns in the short run under fixed effects; however, they are found individually insignificant on stock returns. These finding implies that bank individual effects bear a significant impact on how of exchange rate and interest rates influences stock returns. This estimation is important since different banks respond to risk and regulatory environment differently. Large banks adopt a wait and see approach monetary policy especially on interest rates to design the balance between loan portfolio and investment in government securities. This decision has a cyclical impact on the stock market and other sectors of the economy thus affecting investor market value directly. Contrary, Banks hedge exchange rate risk long term rendering exchange rate to have a tendency of no impact on stock run in the long run. However, the result signify that some bank could manage to hedge exchange risk completely in the long run (Syed & Anwar, 2012). The findings on individual bank effects could imply that in the short run, the impact of interest rate is insignificant due to the lag upon which the market receives the disclosures and reacts to it. Overall, these findings imply that after controlling for endogeneity bias of unobserved individual bank effect on the influence of market risk on stock returns, investors consider market risk as valuable component in making stock investment decisions both in the long run and in the short run.

GARCH (1, 1) model indicate that market risk influences stock returns on the account of foreign exchange risk and stock return volatility while interest rate risk is found negatively insignificant. Given that GARCH (1,1) is based on monthly data, it follows that the findings are consistent with empirical literature that exchange risk will have an impact on stock returns on the short term and fall irrelevant after banks adapt to necessary hedging strategies. Interest risk will be impactful in the long term when all factors of macro-economic variables have adjusted to interest rate changes. GARCH model also establishes that stock returns volatility is mean reverting implying that loses and gains of banking stocks revolve along the same mean over a long period of time making it possible for arbitrageurs and speculators investors to predict returns.

The findings on high persistence indicated by the variance equation of GARCH model is evidence that stock return volatility is a predictor of stock returns. The influence of volatility of stock returns on stock returns is evidenced by significance of ARCH and GARCH terms and therefore means variance theory holds for this model. It is also an indication that market based risk is contagious, systemic and cyclical. The findings on the significant influence of time-varying property of market risk on bank stock returns conform to findings according to the studies of Mouna and Anis (2015); Wycliffe and Muriu (2014); Sobia et al. (2015); (Syed & Anwar, 2012) and Sukcharoensin (2013). The results met the expectation of the

study and conform to the basics of Modern Portfolio Theory that excessive risk decreases return on investments. Overall indication is that time and bank size are critical upon which market risk bank stock returns at NSE.

V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS.

5.1 Summary of Findings

The results from GLS regression shows that at the long run, the rate of change in exchange rates on Kes/Usd is insignificantly negative on bank stock returns index while the rate of change of interest rates is significantly negative on bank stock returns index. The long run fixed and random effect regression using panel data estimation to accommodate unobserved individual bank effect for different size and time held that the rate of change of exchange rate and rate of change of interest rates are individually and jointly negatively significant on bank stock returns at the long run. Similarly, the short run fixed and random effect regression using panel data estimation to accommodate unobserved individual bank effect for different size and time held that the rate of change of exchange rate and rate of change of interest rates are individually negatively insignificant but joint regression is held negatively significant on bank stock returns at the short run. GARCH (1,1) regressions held that for short term monthly data, over a long period stock return volatility, exchange rate influence bank stock return index. However, interest rate is held insignificant.

5.2 Conclusion

Market based risk determined by the rate of change on interest rate, exchange rate and stock return volatility are significant in influencing on bank stock returns. However, the significance depends on whether the influence is short term, long term, size of the bank with regards to capacity to hedge and respond to changing monetary policies. Overall, the influence of exchange rate is concluded negatively significant in the short run than in the long run while the influence of interest rate is concluded negatively significant in the long run than in the short run. Stock return volatility is found to be time varying and stock return generating. This implies that even without focusing on risk, speculators, arbitrageurs, and herd investors, are able to make risk free return with monthly investments held over a longer period of time. This information is helpful to long term investors that they don't need to sell their portfolio over short term due temporary peaks and troughs. The study concludes that as interest rates increases, investors change investment focus from the equity market to bond markets and related fixed income investments. This variability triggers a momentum that leads to capital outflow from capital market to money market. De-valued Kenya shilling against USD makes imports expensive which reduce transaction and lending business in banks thus reducing profitability. The magnitude of influence is established high on exchange rate than interest rate and stock return volatility taking the three models three models into account.

5.3 Recommendations

Based on findings, conclusions and implications, the study recommends bank top management should ensure that the amount of loans in foreign currency are adequately funded and mitigate foreign exchange exposure that comes with borrowing. Management should also ensure prudent hedging on exchange rate exposures is done on profits from subsidiaries to minimize on translations losses. Bank management should be scaling up the scenario stress test on asset and liabilities to minimizes likelihood of unforeseen funding gaps. Central bank of kenya monetary policy should reguate the Ksh vs USD rate of exchange and control 90-day T-bill rates to tame the volatiltiy of the interest and exchange rates. The government shouls ensure the level of domestic and external debt are manageable to eleviate strain on the countries foreign exchange reserves. Investors and bank managers should interpret periodical monetary policies accurately and promply to minimise loses in the short run due to volatilities. Since time-varying property of stock returns is established to be mean reverting and stock return generating, speculators, arbetrageous and heard investors are advised to take advantage of predictable stock retruns by investing long term.

5.4 Suggestions for further research

This study is an extention of previous literature in Kenya in two ways. First, the study attemped to represent multiple model to test the influence of interest rate, exchange rate and stock return volatility on stock returns on listed banks in Kenya. Secondly, the study also extends to established how time-varying market based risk affects bank stock returns with respect to time and bank size. Nonetheless, the study is subject to future directions. The study suggest a comparative study to be explored with other sectors sensitive to financial risk such as insurance and bondmarket sector. Further, whereas this study is achored on post global financial crisis and post quantitative easing era, it does not indicate how this compares with pre-global financial crisis and pre-quantitative easing period. A longer sample period could be considered under the new dimension.

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