

International Journal of
Economics
(IJECON)

**EFFECT OF MACROECONOMIC VARIABLES ON
PORTFOLIO RISK OF COMMERCIAL BANKS LISTED ON
NSE**

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EFFECT OF MACROECONOMIC VARIABLES ON PORTFOLIO RISK OF COMMERCIAL BANKS LISTED ON NSE

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Abstract

Purpose: This study sought to establish the effect macroeconomic variables on Portfolio Risk of commercial banks listed on the NSE for the period 2004 to 2013 and sought to empirically establish the impact of interest rates, exchange rates and economic growth on portfolio risk in Kenya.

Methodology: This study sought to establish the effect macroeconomic variables on Portfolio Risk of commercial banks listed on the NSE for the period 2004 to 2013 and sought to empirically establish the impact of interest rates, exchange rates and economic growth on portfolio risk in Kenya. The research used secondary quarterly data for 11 financial institutions listed at the NSE and adopted an explanatory research design. In order to achieve the stated objectives the research adopted a time series multivariate regression analysis.

Results: The long-run model indicated that the 32 percent of the variation in portfolio risk was accounted by the changes in the independent variables. It was also found that the long-run Interest rate had a significant negative relationship while the long-run GDP growth rate had a positive and significant relationship. Engle-Granger Cointegration tests was performed and the empirical results indicated that the variables were cointegrated and a short-run was thus adopted. The short run model indicated that 52 percent of the short-run variation in portfolio risk was explained in changes in the short-run Interest rate, foreign exchange rate and GDP growth rate and that the short-run Interest rate had a negative and significant relationship with the short-run portfolio risk whereas the other variables in the short run were insignificant.

Unique contribution to theory, practice and policy: The research concluded that despite the observed relationship between the variables policies designed should be meticulously be designed so as to maximize on the returns from investment in various portfolios as policies play a very crucial role in informing investors' decision to undertake investment opportunities.

Key Words: *Economic growth, Interest Rates and Exchange Rates*

1.1 BACKGROUND OF THE STUDY

The stock market is said to fluctuate every week, and as a result investors need a safety net to cushion them from the risk associated with these fluctuations, diversification can help mitigate the potential risks and thus help them avert the likelihood of their entire stock portfolio from losing value. Despite the fact the diversification is not an all fit solution it helps investors to reach their long-term financial goals while reducing the level of risk. Similarly, investors should keep in mind that diversification does not reduce the risk level down to zero and they are still likely to encounter risk but of less magnitude (Bekaert&Harvey, 2002; Henry, 2000).

Risk in this case is defined as the probability or likelihood of an investments return to be different from the expected. This would include the possibility of the original investment being lost. The more the disposable the income of an individual the more they are willing to take risk, and thus are considered as being risk lovers, but on the other hand the less the disposable income an individual has the more the risk averse they are (Pavabutr& Yan, 2003).

With risk and returns associated with an investment investors must therefore strike a balance, and thus are faced with a risk-return tradeoff. The risk return trade-off will require investors to make a decision regarding their lowest desired level of risk and the highest possible risk they are willing to face. If an investors chooses a lower level of risk they should as well be contended with the low returns, while a level of risk that is higher is usually associated also with a potential return that is higher (Stulz, 2009).

The standard deviation is the most commonly used in computing risk. The standard deviation measures how the actual return deviates from the expected returns and is computed by taking the square root of variance and thus variance is also one of the commonly referred concepts in determination of risk (Frankel, 2011). In determining the variance the difference between the actual and expected return is calculated and the outcome is squared to obtain the variance. To get the standard deviation the square root of the variance is computed and this is the risk associated with the stock. If there are two potential investments whose expected returns are similar then the one with a lower standard deviation would be most preferred as the risk associated with that investment is less (Rime, 2001).

The motive of individuals and investors investing in stocks is the anticipation or returns from them in monetary terms. Most institutional and individual investors invest I stocks with the anticipation of monetary benefits as returns to their investments. As a result the great anticipation of stock returns this usually leads to massive subscription of the public offers. Given the limited resources that the investors have, one of the most challenging tasks to them is where to invest their resources so as to maximize their future benefits (Bebczuk& Galindo, 2008, Berger et al. 2010; Winton, 2009).

Macroeconomic determinants of portfolio risk relates to all the variables that influence the variability of stock returns. This includes interest rates, foreign exchange rates, inflation rates and GDP. Empirical evidence show that interest rates have a positive relationship with variations

of stock returns, for instance when the interest rates increases the portfolio risk also increases as investors sell stocks and purchases bonds (Kidenda, 2013). Portfolio risk in developed economies In Russia, Gorjaev (2004) found that for firm listed on the Russian Stock Market, the difference in return for companies which were susceptible to risk in their country and whose profit are stable was about 59% premium. They also indicated that 25% of the risk premium was accounted by corporate governance, while 33% was accounted for by the traditional size and 39% was accounted by the dollar factor.

In the case of Banks in India they manage risk exposures arising from various risk category silos by following the set norm by the Reserve Bank of India. The prudential norms as set out by the RBI includes internal reporting and limit systems based on nominal exposure amounts among other norms. The gross and net limits were used to monitor bank's levels of exposure. According to Carey (2000) credit limits monitoring by banks internationally has been a part of credit risk management. Similarly, according to Cowan and Cowan(2004) the US sub-prime lenders used limits on dollar either by borrower or by geography to better manage exposure to credit risk. However, deliberation of risk mitigation approaches cannot be established under stressful market conditions since they cannot be explicitly captured in most measures. In this perspective, unknown correlation layers(particularly the systematic risk factor) should be well-understood to appraise the concentration risk tolerance level in line with the solvency target as laid down by b

The risk and return next frontiers is also characterized by small less risky and valued stock than large and growth stocks. The greatest impact on risk premiums is attributable to economic, financial and Political factors. Some factors that influence the return generating process in developed markets may behave differently in frontier markets (Girard & Sinha, 2008).

The financial sector is mainly composed of companies from the banking industry, insurance companies, micro finance institutions, mutual funds, capital markets and development finance institutions (CBK, 2007). Banks in Kenya, are the most important players in provision of financial services and their outreach is deeper than that of any other type of financial (ICA, 2002). They provide savings, credit and insurance services to a large portion of the population. In 1989, various financial sector reforms through Structural adjustment programs were adopted supported by World Bank. These financial sector reforms included interest rate and exchange rate liberalization which was eventually attained in July 1991 and October 1993 respectively. From the year 2010 new developments and intense competition in lending industry in Kenya's economy has been witnessed since the introduction of the economic liberalization which has posed serious challenges to the banks. The failure to exercise sufficient caution in credit provision by banks has often led to many banks in the country experience credit losses. When credit is allocated to highly leveraged borrowers, there is likely to be experienced large default losses. Similarly, debt restructuring and buyout strategies as well as structures that involve customer-written options introduce risks into a bank's portfolio and thus should only be used with financially strong customers. However, such kind of structures are most appealing to

weak borrowers since the deal would enable a significant upside gain if all goes well, while the borrower's losses are restricted to its net worth (Uchendu, 2009).

1.2 Statement Problem

In construction of portfolio investors rely on various indicators which are expected to determine the risk and return of the investments. However, the situation in Kenya is such that investors seem to ignore the determinants of risk and return of investments. This is evidenced by instances where investors use the gut feeling or use herd behavior when picking stocks for instance during the KenGen and Safaricom IPO. The implication of this is that investors do not use models to determine the choice of stocks, either because the models are complex or are not consistent. Many models on the determinants of portfolio risk exposure have been done (Bhole & Mahakud, 2009; Chau, 2012) advocate for the use of the CAPM in estimating the portfolio risk. Merton (2003) and Riley (2003) also propose that the Inter Temporal Capital Asset Pricing Model is better than the Capital Asset Pricing Model in the estimation of portfolio risk. Bai and Green (2008); Eita, (2011); Chau (2012) have also proposed that Arbitrage Pricing Model as a better approach in establishing the factors determining portfolio risk.

Locally Beck, Cull, Fuchs, Getenga, Gatere, Randa and Trandafir (2010), conducted a study on Kenya's financial sector with an emphasis on stability, efficiency and outreach but failed to establish the determinants of portfolio risk. Kidenda (2013) conducted a study on determinants of stock returns of commercial banks in Kenya but also failed to establish the determinants of portfolio risk. Olweny and Omondi (2012) also conducted a study on macro-economic factors on stock return volatility and also failed to establish the determinants of portfolio risk.

Local studies (Beck et al., 2010, Kidenda, 2013, Olweny & Omondi, 2012) and non-local studies (Bhole & Mahakud, 2009; Bai & Green, 2008 and Chau, 2012) attempted to establish the determinants of returns and failed to focus on the risk aspect. The scarcity of studies in Kenya on the effect of macroeconomic variables on portfolio risk of commercial banks listed on NSE forms the knowledge gap. It is for this research gap that this study seeks to bridge.

1.3 Research Objectives

- 1.3.1 To determine the effect of interest rates on portfolio risk in Kenya
- 1.3.2 To establish the effect of exchange rates on portfolio risk in Kenya
- 1.3.3 To determine the effect of economic growth on portfolio risk in Kenya

2.0 LITERATURE REVIEW

2.1 Theoretical Foundations of the Study

2.2.1 Investment Theory of Portfolio

The portfolio theory is an investment approach in which the investor balances risk against expected return to maximize earnings from an entire portfolio. The essence of Portfolios is to increase returns and to reduce investment risks. For this reason, portfolio selection strategies have received quite some attention in financial literature.

With the modern theory of portfolio investment Mean-variance analysis is introduced as this simplifies the problem associated with portfolio selection. Markowitz (1959) quantified risk and showed how the process of portfolio diversification reduced investors' risk. In order to determine the portfolio risk, the standard deviation of the return in a given period of time is computed, this process of computing the portfolio risk thus helps in determining the most efficient portfolio, a portfolio that minimizes the risk from a return for a fixed period.

According to the portfolio theory, the larger the expected return the better the investment, and the smaller the standard deviation of the return the more attractive the investment. Furthermore, the theory shows that we can reduce the standard deviation of the return or risk by combining anti-covariant securities. However, each class of assets has a different associated risk-return profile and behaves uniquely. One class of the asset may be increasing in its value while the other may be diminishing and vice versa. According to Sharpe (1964) this theory, however, has a shortcoming; it cannot allow both more and less risk averse investors to find their optimal portfolio, a problem surmounted by CAPM. The CAPM theory explains the risk of a particular asset or portfolio using the excess return on the market portfolio (Lintner, 1965) by suggesting that investors should hold diversified portfolios, and predicts that investors will hold some fraction of the market portfolio.

2.1.2 The Capital Asset Pricing Model(CAPM)

This theory was postulated by Sharpe (1964).The model makes very strong assumptions. It is hypothesized that the market portfolio is on the efficient frontier and in addition it is considered to super-efficient Tobin's portfolio. According to this theory, investors should hold the market portfolio, whether leveraged or not, with positions in the risk-free asset.

This model makes several assumptions, whereas diversification reduces investors' exposure to firm explicit risk, a good number of investors constrain their diversification to holding just a few assets. The reasons why investors stop diversifying their portfolio is twofold. First, investors receive more benefits of diversification from a relatively small class of portfolios. The marginal benefits derived from more portfolio diversification diminish as more and more diversification is pursued by the investors of mutual fund managers. Consequently, the benefits from increased diversification may not adequately compensate for the marginal costs of diversification, which includes monitoring and transaction costs. Secondly, by limiting diversification fund managers

and investors believe they can find assets which are undervalued assets and thus opt not to hold those assets in which they perceive to be fairly or overvalued.

Variation of portfolios by investors is enhanced by the existence of assumptions as no additional costs are incurred. At the cutting edge, despite the portfolios of these investors including every traded asset in the market they still have identical weights on risky assets. The inclusion of all traded assets in the market in the diversified portfolio is the reason as to why they are regarded as market portfolio. This should not be an unexpected result, since the advantages of diversification and the exclusion of transactions costs is incorporated in the capital asset pricing model. This brings about an argument that holding a small proportion of every traded asset in the market stands out as the optimal choice. This argument is supported by the fact that diversification minimizes exposure to firm-specific risk and there are no costs linked to adding more assets to the portfolio. Assuming that this is conceptual, then the market portfolio is an exceptionally well spread mutual fund constituting of stocks and real assets, and treasury bills as the riskless asset. Hence, in the CAPM, all investors will hold blend of treasury bills and the same mutual fund (Sharpe, 1964).

2.2.3 Arbitrage pricing theory

The theory of Arbitrage Pricing Theory is a one period model that was developed by Ross (1976). With regard to this model, investors concur with the fact that stochastic properties of returns of capital assets are in line with a factor structure. According to Ross, equilibrium price which fail to offer arbitrage over those portfolios that are static because the expected returns from these assets to be approximately linearly related to the betas (Ross, 1976). The linear relationship between the expected returns and the betas or factor loadings is equivalent to the recognition of the stochastic discount factor.

Basically, the argument for this theory relies on the anticipation of arbitrage. In this theory Ross (1976) argues that for equilibrium to be attained, the linear pricing relation is a vital condition particularly in a market where agents aim at maximizing some form of utility. Hence, the consequent work is derived either from the assumption of the anticipation of arbitrage or the utility-maximization equilibrium (Ross, 1976)

This theory was proposed by Ross (1976) as an alternate for CAPM introduced by Sharpe (1964). It is considered an alternative since both argue that a linear relationship exists between the expected returns of assets and their covariance with other random variables. With regard to CAPM the covariance is the market portfolio return and is explained as the amount/level of risk that investors cannot avoid in any way by diversification. In this relationship between expected returns and the covariance, the slope or gradient coefficient is referred to as the risk premium. Consequently, since a test of the APT it is not sufficient to explain that a set of betas of portfolios satisfies the linear relation threshold between the covariance and expected returns.

2.3 Empirical Literature Review

2.3.1 Effect of Interest Rates on Portfolio Risk

Beck, Cull, Fuchs, Getenga, Gatere, Randa and Trandafir (2010) looks at Kenya's financial sector with an emphasis on stability, efficiency and outreach. In order to examine the level of or efficiency of financial intermediation the interest rate spread is used as a proxy. Their study used ex post construed spreads, where these spreads were decomposed into a different set of factors including overhead costs, taxes and loan loss provision. Kidenda (2013) in his study examined volatility in interest rates, exchange rates and inflation rate had a cause-effect on the financial institutions returns in Kenya for the period January 2006 to June 2012. This study used the monthly returns of five banks that were listed at the NSE. The study concluded that exchange rate was the most predominant and significant in explaining the variations in stock returns. The observed relationship was negative in the long run. It was also concluded that the short run historical stock values exerted an impact on the current period's stock returns. Similarly, the study concluded that the short run risk free rate and short run inflation exerted an influence on the current period's stock returns.

Olweny and Omondi (2012) in their study examined the impact of macro-economic factors on stock return volatility. The study used monthly data spanning the period 2001 to 2010 and adopted both EGARCH and TGARCH models. The study found that the returns to stocks were symmetric but leptokurtic and not normally distributed. The study also found out that stock return volatility was affected by changes in foreign exchange rates, interest rates as well as variations in inflation rates. In detail the magnitude of volatility as explained by foreign exchange rate was relatively low at 0.21 but this relationship was significant implying that the effect of foreign exchange rate on stock returns is low. The persistence of stock Volatility was established to be significant and low implying that the effect of shocks takes a short time to dissipate. Evidence of leverage effect ($\lambda=0.6720$) was established implying that volatility rise more following a large price fall than following a price rise of the same magnitude.

Nampewo (2013) examined the determinants of interest rate spread for the banking sector in Uganda for the period 1995-2010. This study used the Engle and Granger two-step to test for Cointegration between the bank rate, exchange rate volatilities, treasury bill rate, the ratio of broad money to GDP as well as the proportion of non-performing to total private sector credit. The results from this study indicated that the interest rate spread is positively affected by the treasury bill rate, bank rate and non-performing loans. The study also found that the ratio of broad money to GDP (M2/GDP) and the real GDP had a negative and significant influence on the interest rate spread in Uganda. However the analysis is undertaken at macro level hence concealing micro and bank-specific characteristics.

Mannasoo (2012) in his study investigated the role played by the global financial crisis on the interest spreads in Estonia. The methodological approach used in this study followed the approached adopted by Ho and Saunders (1981), where spreads were decomposed into two

different components. One of the components was a pure spread while the second component was the component that was explained by the market structure factors. The first component which is the pure spread was explained by the extent of bank risk aversion and the market structure faced by the banking industry. It was found that the volatility of money market interest rates had a long-run impact on the spread. It was also established that the bank's efficiency, regulatory variables and bank-portfolio effects influenced the interest margins. Credit risk was found to contribute a minimal role whereas higher bank liquidity was associated with lower interest margin.

Gambacorta (2004) also, studied factors that influenced cross-sectional differences of bank interest rates in Italy by considering both microeconomic and macroeconomic factors. The variables used in the study were loan and deposit demand, the structure of the industry, operating cost, impact of monetary policy through changes in policy rates and reserve requirements, and credit risk and interest rate volatility. The results indicated that those interest rates on short term lending of liquid and well capitalized banks react less to monetary policy shocks.

Brock and Franken (2003) examined interest rate spread in Chile, this study found that business cycle variables, monetary policy as well as the influence of industry on interest rate differed depending on whether the spreads were computed from disaggregated loan and deposits data or whether they were computed from data in the balance sheets.

2.3.2 Effect of Exchange Rates on Portfolio Risk

In the study of Biger (2009) it is revealed that from an international perspective, taken as a whole the rate of return from holding foreign financial assets consists of investment return on the assets plus gains and losses from the movements in exchange rate. The fluctuation of exchange rate is additional source of uncertainty that may generate both potential gains and losses to investors across countries. Besides, his work reveals that the movements in exchange rate drastically increase foreign investment risk in holding bonds and stocks; nevertheless, the impact of exchange rate movements on international investment risk for bonds is significantly greater than for stocks due mainly to the reason that stocks are more volatile when compared with bonds.

Eun and Resnick (2008) examine the impact of exchange rate fluctuation on the risk of foreign stock market investment and reveal that under the Modern Portfolio Theory (MPT), investors estimate the risk-return characteristics of financial assets when constructing optimal portfolios. In this case, exchange rate variation leads to the portfolio risk. On the contrary, according to efficient international portfolio strategy, the fluctuation of exchange rate is rather important to multinational investors owing to its capability to capture the potential gains from international diversification. Further, they also conclude that the exchange rate variability accounted for fifty percent of the dollar returns variability from equity investment in countries such as Germany, Japan, and the U.K.

Prasad and Rajan (2005) investigates the effect of interest rate risk and currency on equity valuation in five countries and find that exchange rate fluctuation is priced in most markets while

interest rate risk is not priced in any countries. Solnik (2005) studies the link between exchange rate variation and risk as well as return on foreign investment covering the period 1994 to 2004. They concluded that contribution of variation in exchange rate to the aggregate investment risk is rather small whether investment in a single stock market index or investment in an internationally diversified portfolio of stock market indices. In case of the contribution of currency variation to return on investment, his results further show that exchange rate variation is the major source of investment return in short time. For long periods of time, capital gains or investment income is the determinant of return on a diversified portfolio simply because an appreciation of one currency is generally offset by a depreciation of another.

2.3.3 Effect of Economic Growth on Portfolio Risk

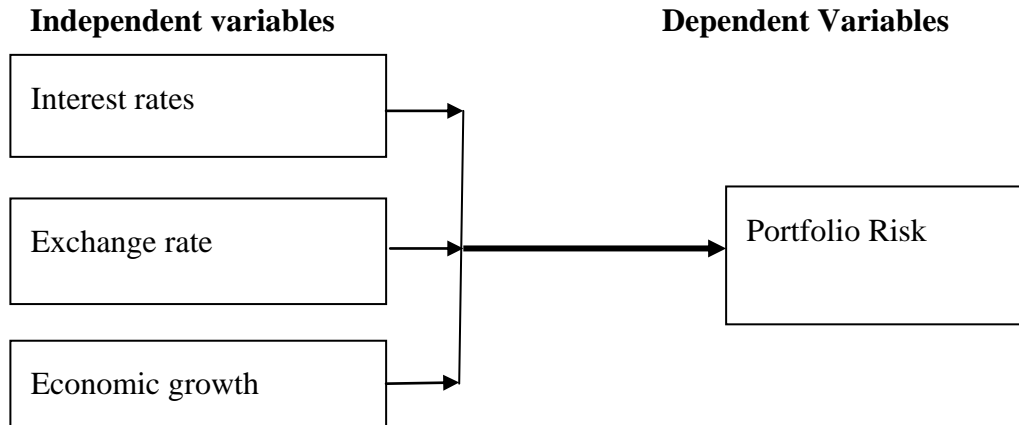
It is abundantly documented that a growth portfolio is outperformed by a value portfolio over long periods in most markets worldwide. Despite this observation, it is not well known how this outperformance is achieved. Chaves and Arnott decomposed the total returns of these strategies and found that the value portfolios earn higher dividend income, the average growth stock enjoys faster dividend growth than the average value stock, but surprisingly and value portfolios experience higher growth in dividends than growth portfolios. The finding is an effect of the nature of the rebalance rules for value and growth portfolios. The rebalancing rules ensures that lower yielding value stocks are replaced with new higher yielding value stocks and replaces higher yielding growth stocks with new lower yielding growth stocks. It is, therefore, the act of rebalancing and reconstituting the growth and value portfolios that increases the growth rate for dividend income in value strategies and rather sharply reduces it in the case of growth strategies (Chaves & Arnott, 2012). Quaden (2004) asserts that a banking system that is efficient benefits the real economy by allowing 'higher expected returns for savers with a financial excesses, and lowers the borrowing costs for investing in new projects that need external finance.

Huang, Zhou, and Zhu (2009) conducted a study to investigate the sources of financial instability and to also allocate each financial institution with its respective systemic portfolio risk. They defined systemic risk as being cost incurred to cushion against distressed losses in a banking system, which is a risk-neutral concept of capital based on publicly available information that can be appropriately aggregated across different subsets. An application of the methodology to a portfolio of twenty-two major banks in Asia and the Pacific illustrates the dynamics of the spillover effects of the global financial crisis to the region.

2.4 Conceptual Framework

A conceptual framework sets out the actualization process of the entire research process. In this case the predictor variables and the outcome variables are presented. The predictor variables in this study being interest rates, Gross Domestic Product growth rate while the outcome variable was portfolio risk.

Figure 1: Conceptual Framework



3.0 RESEARCH METHODOLOGY

This study sought to establish the effect macroeconomic variables on Portfolio Risk of commercial banks listed on the NSE for the period 2004 to 2013 and sought to empirically establish the impact of interest rates, exchange rates and economic growth on portfolio risk in Kenya. The research used secondary quarterly data for 11 financial institutions listed at the NSE and adopted an explanatory research design. In order to achieve the stated objectives the research adopted a time series multivariate regression analysis.

4.0 RESULTS AND DISCUSSIONS

4.1 Descriptive statistics

The descriptive statistics of Portfolio Risk, interest rates, foreign exchange rates and gross domestic product are presented in the table 4.1 below. Portfolio risk had a mean of 23.97 with maximum and minimum values of 321.13 and 2.016 respectively. The mean value of portfolio risk deviated from its mean by 49.5449.

The Interest rate as well had an average of 14.75725 with a maximum of 20.21333 and a minimum 12.2033. The standard deviation from the mean for interest rate was 2.20. Foreign exchange rate had an average value of 78.01474 with a maximum value of 97.29 and a minimum value of 62.64 and its standard deviation was 7.554437. GDP had a mean of 4.12 which deviated over the study period by 2.25 and the maximum and minimum values being recorded for this variable being 8.80 and -0.60 respectively.

Table 1 Descriptive statistics

	Portfolio Risk	Interest Rate	Foreign Exchange	GDP
Mean	23.96818	14.75725	78.01474	4.817500

Median	11.85656	13.93000	78.08082	5.100000
Maximum	321.1372	20.21333	97.29186	8.800000
Minimum	2.016441	12.20333	62.64148	-0.600000
Std. Dev.	49.54490	2.196747	7.554437	2.247493
Observations	40	40	40	40

4.2 Long-run Model Results (Spurious Regression Model)

Long-run model consists of the multiple linear regression estimation of variables in their non-stationary level. The model is assumed to be spurious unless Cointegration is proved. The long run results presented in table 4.2 are generated from the non-stationary variables. The model r squared was 0.3358. This implied that the goodness of fit of the model explained 33.58% of the variation in Portfolio risk was explained by the independent variables. The overall model was significant as demonstrated by an F statistic of 5.90 (p value= 0.002280). This further implied that the independent variables were good joint good predictors of the Portfolio risk.

The results indicate shows that the Interest Rates in long run had a negative ($\beta = 1.716168$) and significant relationship (p-value = 0.0233) with Portfolio Risk. This implies that a unitary increase in interest rate was associated with 1.716168units decrease in Portfolio Risk.

The results in the table 4.2 also indicate that the long-run GDP growth rate (LNGDP) had a positive ($\beta = 0.343707$) and significant relationship (p-value = 0.0309) with Portfolio Risk. The implication of this finding being a unitary increase in long-run GDP, leads to Portfolio Risk increase by 0.343707units.

Table 2 Long-Run Model Results

Dependent Variable: LNPORTFOLIORISK

Method: Least Squares

Date: 08/07/14 Time: 14:45

Sample: 2004Q1 2013Q4

Included observations: 39

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNINTERESTRATE	-1.716168	0.723173	-2.373109	0.0233
LNGDP	0.343707	0.152801	2.249374	0.0309
LNFOREX	-0.396612	1.122260	-0.353404	0.7259
C	8.498426	4.081952	2.081952	0.0447
R-squared	0.335800	Mean dependent var		2.737701
Adjusted R-squared	0.278869	S.D. dependent var		0.639075
S.E. of regression	0.542699	Akaike info criterion		1.712392
Sum squared resid	10.30829	Schwarz criterion		1.883013
Log likelihood	-29.39164	Hannan-Quinn criter.		1.773609
F-statistic	5.898323	Durbin-Watson stat		1.571694
Prob(F-statistic)	0.002280			

Long-run Model Equation

$$\text{LnPortfoliorisk} = 8.50 - 1.72 \text{ LnInterest rate} + 0.34 \text{ LnGDP} - 0.40 \text{ LnForex} \dots \text{Eq. (4.1)}$$

4.3 Pre-Estimation Tests and Post-Estimation tests

Before the long-run regression model was run the following estimation tests were performed to ensure that the OLS assumptions are not violated; Normality of results, Test for Multicollinearity, test for Heteroskedasticity and test for serial correlation.

4.3.1 Correlation Analysis

The table 3 below presents the correlation between variables. The results indicate that portfolio risk is negative and significantly related with lending rate. The correlation coefficient between them is -0.462253 indicating a weak correlation. The correlation coefficient between GDP and portfolio risk is 0.310474 and thus also indicating a weak correlation between them. The results further show that the correlation coefficient between GDP and Foreign Exchange rate is -0.242913 and is insignificant at 5% critical value. On the other hand the degree of correlation between lending rate and GDP is -0.194980 while the correlation between lending rate and foreign exchange rate is 0.588237. Finally, the results indicate that the correlation coefficient between GDP and Foreign exchange rate is -0.051265.

Table 3 Correlation Matrix

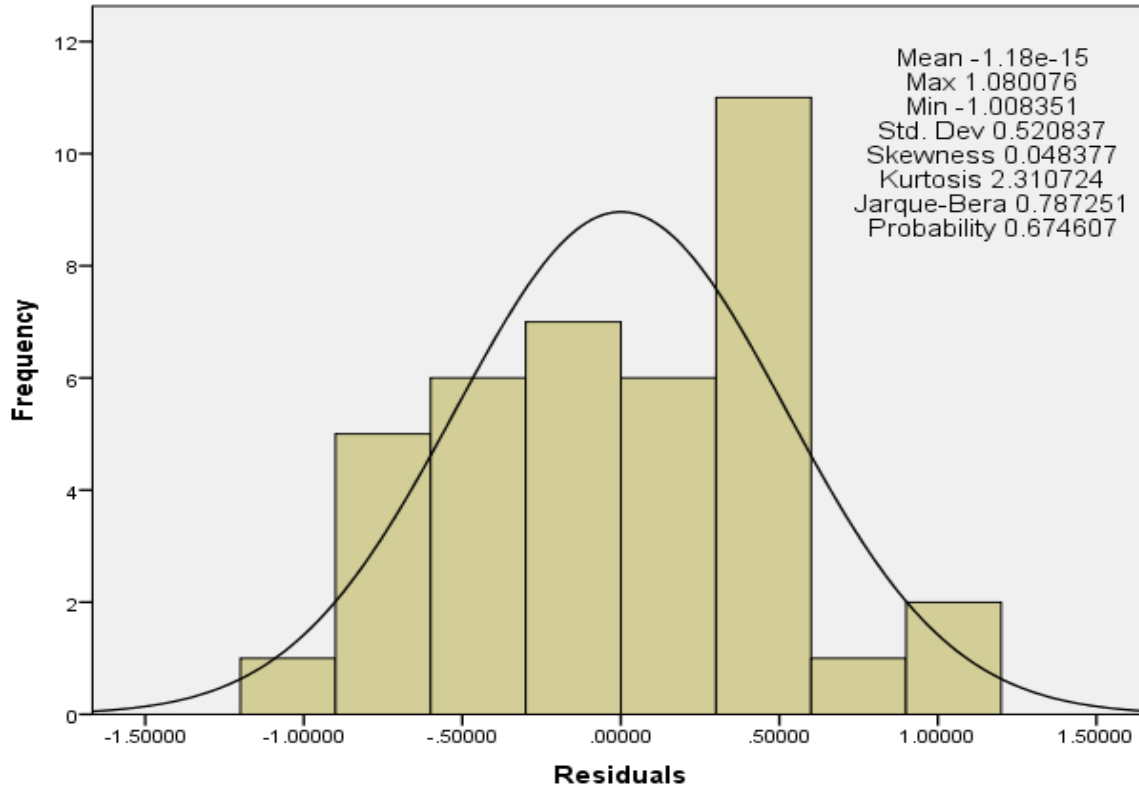
Correlation				
Probability	Portfolio Risk	Lending Rate	GDP	Foreign Exchange Rate
Portfolio Risk	1.000000			
Lending Rate	-0.462253 (0.0027)	1.000000		
GDP	0.310474 (0.0512)	-0.194980 (0.2279)	1.000000	
Foreign Exchange Rate	-0.242913 (0.1310)	0.588237 (0.0001)	-0.051265 (0.7534)	1.000000

Values in brackets indicates the p-values

4.3.1 Test for Normality of Results

The classical OLS assumption requires that the residuals be normally distributed other the conclusions that will be derived if they are not would be unreliable and biased. In this study a histogram, which is a visual inspection method for checking normality was adopted and this was also combined with Jarque-Bera test for normality which is a more conclusive test. The figure 4.1 below shows a histogram of the residuals. In this case the histogram shows that the residuals are normally distributed and this is further reinforced by a Jarque-Bera probability of 0.675. It is therefore concluded that the data is not significantly different from a normal distribution.

Figure2 Test for Normality of Residuals



4.3.2 Test for Multicollinearity

The Classical OLS assumption stipulates that the independent variables should not be correlated in any case. The Variance Inflation Factor (VIF) and the Tolerance are used to check for the presence or absence of Multicollinearity between the independent variables. Multicollinearity between the variables is said to exist if the VIF values reported are in excess of 10. The table 4.4 below gives results for the Variance Inflation factor and Tolerance values for the independent variables and it can be concluded that the variables are not correlated given that the reported values of VIF are a lesser amount of 10.

Table.4 Multicollinearity Test

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
LNLENDINGRATE	0.522979	490.4778	1.550053
LNGDP	0.023348	8.252611	1.026844
LNFOREIGNEXCHANGE	1.259469	3160.593	1.517500

C	16.66233	2206.388	NA
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4.3.3 Test for Heteroskedasticity

The third Classical OLS assumption on Heteroskedasticity requires that the error terms or the residuals of the model should have a constant variance or simply they should be Homoskedastic. In this case a whites test ascertains whether the error terms have constant variance or not. The white's test null hypothesis is that the residuals have constant variance, or stated differently the error terms do not suffer from Heteroskedasticity. The table 4.5 below presents the results for Heteroskedasticity test and it indicates that the error terms have constant variance (p-value = 0.4167)

Table 5 White's Test for Heteroskedasticity

Fisher's -statistic	0.916811	P(F(3,35))	0.4428
Observed R-squared	2.841474	P(Chi-Square(3))	0.4167

4.3.4 Test for Serial Correlation

Among the Classical OLS assumptions the assumptions that the error terms should not be serially correlated over a time period must also not be violated. This is assumption is a time series assumption and thus an LM Test was performed to checked whether the error terms are serially correlated or not. The null hypothesis in this case being that the error terms are not serially correlated over the period adopted for study. From the table 4.6 below the p-value is 0.1973 and therefore concludes that the error terms are not serially correlated.

Table .6 Serial Correlation Test

Fisher's -statistic	1.513663	Probability F(1,34)	0.2270
Observed R-squared	1.662258	Probability Chi-Square(1)	0.1973

4.4 Time Series Analysis

Time series analysis includes testing for unit roots, among other tests. If the variables are stationary at level, then the model to be estimated is the long run model, if the variables are non-stationary at level then an error correction model should be run. However, Cointegration must first be run before testing for stationarity.

4.6 Cointegration tests

4.6.1 Engle-Granger Test of Cointegration

The two step Engle granger test was conducted to establish whether there exists Cointegration and results are presented in table 4.7. The first procedure is to run the long run

equation was run after which the residuals were generated. The residuals were then lagged. The second step was to test for stationary of the residuals using the ADF test. Results indicated that the lagged residuals were stationary at 1%, 5% and 10% levels. This implies that the lagged residuals were stationary and that there is Cointegration among the long run variables and thus variables converge to long run equilibrium.

Table 7 Engle-Granger Cointegration Test

ADF Test statistic		-4.918134	0.0003
p-values	0.01	-3.626784	
	0.05	-2.945842	
	0.10	-2.611531	

A more robust test for Cointegration is the Johnsen test as it indicates the order of Cointegration.

4.6.2 Johnsen Test for Cointegration

While performing the Johansen Cointegration test the study considered the automatic optimal lag length for each variable using Schwarz Information Criterion (SIC). In order to determine the existence of Cointegration between the variables Rank Test (Trace) statistic was adopted. The null hypothesis for this case is that there is no Cointegration among the variables. The results presented in the tables below fail to reject the null hypothesis of no Cointegration at 5% level of significance for the period under study. The table 4.8 indicates that there exist threecointegrating relationships. This implies that there exists a long-run relationship (i.e. Cointegration)

Table.8 Johansen Cointegration Test

Series: LNPORTFOLIORISK LNLENDINGRATE LNGDP LNFOREIGNEXCHANGE

Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized	Trace	0.05		
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.968403	138.1972	47.85613	0.0000
At most 1 *	0.505590	38.01078	29.79707	0.0045
At most 2 *	0.397152	17.58346	15.49471	0.0239
At most 3	0.095376	2.906854	3.841466	0.0882

Trace test indicates 3 cointegratingeqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

4.4.1 Unit root Tests

Unit root tests were conducted using the ADF test to establish whether the variables were stationary or non-stationary. The purpose of this is to avoid spurious regression results being obtained by using non-stationary series. Results in table 4.9 indicated that all variables are non-stationary (i.e. presence of unit roots) as the ADF test statistic is greater than the 5% levels of significance with the exception of LnPortfolio risk which is stationary. This calls for first differencing of the non-stationary variables.

Table 9 Unit root Tests at level

Variable	ADF Test	Critical values			Comment
		1%	5%	10%	
LnPortfolio risk	-4.856357	-4.211868	-3.529738	-3.196411	Stationary
LnGDP	-2.182569	-4.262735	-3.552973	-3.209642	Non-stationary
LnInterest rate	-3.389467	-4.219126	-3.533083	-3.1983212	Non-stationary
LnForex	-2.767789	-4.211808	-3.529758	-3.196411	Non-stationary

Given that the variables LnGDP, LnInterest rate and LnGDP were established to be non-stationary at level (i.e. the ADF test was greater than the 5% critical value). In order to achieve stationarity to be achieved the variables have to be differenced. Table 4.10 displays the unit root tests after first differencing. It is clear from the results in table 4.7 that all the variables become stationary (unit root disappears) on differencing as the ADF test statistic reported is less than the 5% critical value..

Table 10 Unit root Tests at First Difference

Variable	ADF Test	Critical values			Comment
		1%	5%	10%	
DLnPortfolio risk	-9.11	-4.22	-3.53	-3.53	Stationary
DLnGDP	-9.12	-4.28	-3.56	-3.22	Stationary
DLnInterest rate	-4.60	-4.22	-3.53	-3.20	Stationary
DLnForeign Exchange	-5.64	-4.22	-3.53	-3.20	Stationary

4.6 Error Correction Model Results

Since the variables in the model are cointegrated, then an error-correction model can be specified. The error correction model is the model linking the short-run equilibrium model to the long-run equilibrium model. The adjustment/correction term (lagged residuals) is generated from the residuals from the cointegrating regression which is then inserted into the short-run model. The specific lagged residual term is LAGRESIDUAL. The estimates of the error-correction model are given in table 11

Results revealed that the short run Interest rate has a negative relationship ($\beta = -3.454677$) with short run Portfolio Risk. This implies that a unitary increase of short run Interest rate leads to a decrease in short run Portfolio risk by 3.45 units.

The adjustment term (lagresid) indicates the rate at which the short-run variations adjust to the long run equilibrium in the dynamic model. The correction term is negative ($\beta = -0.855065$) and significant (p-value = 0.000). This result implies that there is a negative gradual adjustment (convergence) to the long run stability. The coefficient of (0.855065) indicates that 85.51% of the disequilibria in short run Portfolio risk achieved in one period are corrected in the subsequent period. The other short-run variables however were insignificant.

Table.11 Error Correction Model/ Short-Run Model

Dependent Variable: DLNPORTFOLIORISK
 Method: Least Squares
 Date: 08/08/14 Time: 11:38
 Sample (adjusted): 2004Q2 2013Q4
 Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLNINTERESTRATE	-3.454677	1.485463	-2.325656	0.0265
DLNGDP	0.249441	0.132354	1.884648	0.0686
DLNFOREX	-3.572867	2.013337	-1.774600	0.0855
LAGRESIDUAL	-0.855065	0.164716	-5.191159	0.0000
C	0.042207	0.083177	0.507440	0.6153
R-squared	0.524867	Mean dependent var		0.007403
Adjusted R-squared	0.465475	S.D. dependent var		0.686149
S.E. of regression	0.501652	Akaike info criterion		1.583268
Sum squared resid	8.052947	Schwarz criterion		1.800959
Log likelihood	-24.29045	Hannan-Quinn criter.		1.660014
F-statistic	8.837375	Durbin-Watson stat		1.937998
Prob(F-statistic)	0.000063			

Short-Run Model Equation

$$\text{DlnPortfoliorisk} = 0.042 - 3.45 \text{ DlnInterstrate} + 0.25 \text{ DlnGDP} - 3.57\text{DlnForex} - 0.86 \text{ Lagresidual} \dots\dots\dots \text{Eq. (4.2)}$$

5.0 SUMMARY, CONCLUSIONS & RECOMMENDATIONS

5.1 Summary of Findings

5.1.1 Effect of Interest Rates on Portfolio Risk

The study findings indicate that the long-run interest rates had a negative ($\beta = 1.716168$) and significant relationship ($p\text{-value} = 0.0233$) with Portfolio Risk. This implies that a unitary increase in interest rate was associated with 1.716168 units decrease in Portfolio Risk. The results also indicated that the short-run Interest rate has a negative relationship ($\beta = -3.454677$) with short run Portfolio Risk. This implies that a unitary increase of short run Interest rate leads to a decrease in short run Portfolio risk by 3.45 units. This finding is consistent with that of Mannasoo (2012) who also found the interest rate was significant especially in Estonia during the financial crisis experienced globally.

5.1.2 Effect of GDP growth rate on Portfolio Risk

The study finds that long-run GDP growth rate (LNGDP) had a positive ($\beta = 0.343707$) and significant relationship ($p\text{-value} = 0.0309$) with Portfolio Risk. The implication of this finding being a unitary increase in long-run GDP, leads to Portfolio Risk increase by 0.343707 units. The findings are consistent of this study as compared with that of Huang, Zhou, and Zhu (2009) who examined the financial instability in Asia and Pacific. Their study found that GDP growth rate was significant. On the other hand short-run GDP rate was positive though insignificant.

5.1.3 Effect of Foreign Exchange Rate on Portfolio Risk

The findings of this study indicates that long-run foreign exchange rate had a negative relationship ($\beta = -0.3966$) with the portfolio risk but, this relationship was insignificant ($p\text{-value} = 0.7295$) in explaining the variation in the portfolio risks of the financial institutions stocks listed at the NSE. The short-run foreign exchange rate also had a negative relationship ($\beta = -3.572867$) with the portfolio risk but, this relationship was insignificant ($p\text{-value} = 0.0855$). This finding seems divergent compared to those presented in the review of literature such as Solnik (2005) who studied the link between exchange rate variation and risk as well as return on foreign investment covering the period 1994 to 2004 concluded that exchange rate variation was the major source of variation in the return on portfolios.

5.2 Conclusions

It was concluded that there was Cointegration among the long run variables. Results also indicated that in the long run, the relationship between interest rate and portfolio risk was negative and significant. Therefore, an increase in interest rate resulted to a decrease in portfolio risk. This was also the case with the short-run interest rate and Portfolio Risk as they exhibited a

negative and significant relationship and thus the conclusion that both the short-run as well as the long-run variations in Portfolio Risk was due to the variations of both the short-run and long-run interest rates.

5.3 Recommendations

Based on the study findings discussed above two recommendations are provided based on the objectives of the study. First given that the relationship between interest rates and portfolio risk was negative and significant it is recommended that despite the fact that an increase in interest rates is associated with a decline in the portfolio risk a policy aimed at reducing the portfolio risk faced by investors should consider among other things such as inflation rates as an increase in the interest rate with the intention to reduce the portfolio risk by investors may end up discouraging investors from investing in these portfolios.

Secondly, given the significant positive relationship between GDP growth and Portfolio Risk, it is recommended that in making decisions of whether to invest in portfolio stocks listed at the NSE investors should consider the economy's overall performance as proxied by the GDP growth rate. Despite the fact that the relationship was positive for the period of study, the dynamic nature of the stock market should also be considered so as to ensure that sound investment decisions are made.

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