THE CAUSAL RELATIONSHIP BETWEEN INFLATION, INTEREST RATE AND STOCK MARKET VOLATILITY IN KENYA

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ABSTRACT

This study examined the relationship between interest rate, inflation and stock market volatility in Kenya using both primary and secondary data. A monthly time series data for a period of 14 years from January 2001 to December 2014 was used to study the relationship. Additionally, 385 Questionnaires were distributed to individual investors to understand investor's perceptions on the relationship. The vector error correction model was used to analyse time series data for the long run causal relationship between inflation, interest rate and stock market volatility, while the granger causality test was used to analyse the short run relationship. Findings revealed that there was a positive and significant long run relationship between inflation rate and stock market volatility (t-statistic= 5.96). Findings also show a positive and significant short run relationship between inflation and stock market volatility (chi-square value of 13.39 and a p-value of 0.0039). The relationship between interest rate and stock market volatility was found to be negative and weakly significant both in the short run (p-value of 0.0683) and long run (t-statistic of -1.90). Results from investor's perception revealed that 69% of the respondents agreed that a change in inflation rate causes fluctuation in share prices. Additionally, primary data results show that 75% of the respondents agreed that sudden changes in the interest rate have always caused variations in the stock market returns.

Keywords: Volatility, Inflation, Interest rate, stock market volatility.

INTRODUCTION

Background and Research Gap

Stock markets play a critical role in shaping a country's economic growth and development. Volatility of stock markets threatens economic growth and efficient allocation of resources. It erodes investor confidence and has potential to slowdown the economic growth of a country. Daly, (1999) opines that volatility of security markets affect liquidity and erodes confidence in the capital market. According to Corradi *et al*. (2006), understanding the origins of stock market volatility has long been a topic of considerable interest to policy makers and financial analysts. This study was therefore, important to policy makers in providing knowledge, through its findings on the relationship between inflation, interest rate and stock market volatility in Kenya.

The sessional paper No. 10 of 2012 on Kenya Vision 2030 has outlined market volatility as one of the problems facing the Nairobi securities Exchange. Statistics confirm that the NSE is highly volatile. Records show that between July and December 2011 the NSE 20 share index recorded a variance from a high of 4495 points to a low of 3733 points with market capitalization declining from Sh1192.28 billion to Sh1049.56 billion (NSE, 2011). The privatization Act 2005 was an attempt by the Kenyan government to address the problem of market volatility. The aim of this policy was to deepen public participation in the stock

exchange with the goal of increasing participation and confidence in the Market. The privatizations Act 2005 led to a significant increase in stock market participants who joined the market through the initial public offerings. By 2008, the number of investors trading on the Nairobi Securities Exchange grew to approximately 1.4 million of which, more than 87% were registered as domestic individuals and 12% as domestic companies. Over the years since the privatisation Act of 2005, the stock market has remained volatile.

The period after the global financial crisis of 2007, witnessed a depressing global economic situation which raised concerns for policy makers and created a desire for proper understanding of factors affecting the proper functioning of securities markets. Daly (1999) opines that volatility of security markets is a disturbing concern to policy makers and market players because it erodes confidence in the capital market; it affects the liquidity of the market and also affects hedging techniques such as portfolio insurance. The Kenyan Capital markets were equally affected by the global financial crisis. The sessional paper No 10 of 2012 on vision 2030 identified market volatility as a major problem facing the Nairobi Securities Exchange.

The government of Kenya has put in place several measures to address market volatility and boost confidence in the market through the vision 2030 development plan. The Kenyan development plan, encapsulated in the vision 2030, aims to achieve an annual economic growth rate of 10%, with an investment rate of 30% being financed mainly from mobilization of domestic resources (Government of the Republic of Kenya, 2007). Knowledge of factors causing stock market volatility is therefore critical to policy makers. It is also critical that this knowledge enables policy makers to monitor stock market volatility levels through policy. Stock market volatility should be contained within levels that are not detrimental to the market and the economy large. According to Hongyu and Zhichao (2006) high volatility beyond a certain threshold will increase the risk that brings investor losses and raises concerns about the stability of the market.

Problem Statement

Volatility of stock markets threatens economic growth and efficient allocation of resources. Available records indicate that the Nairobi securities exchange has witnessed persistent volatility in stock prices and market returns generally. The financial sector stability report, (2010), reported that the Nairobi Securities Exchange witnessed volatility in 2008 which persisted through 2010. The report also indicates that in December 2009, the NSE market volatility index stood at 56.93, rose to 150.16 in March 2010 and dropped to 67.84 in June 2010.

Volatility of the Kenyan stock market has affected investors' confidence and led to instability of stock prices which in turn has led to investor losses through price fluctuations. The fluctuation in stock prices and the trend of changes are always of interest to the capital market given their effect on the stock market stability and strategies adopted by investors (Wang, 2010). Knowledge of factors affecting stock market volatility would enable policy makers to control the direction, magnitude and stability of the economy by adjusting macroeconomic variables if the relationship between stock market volatility and economic activity has predictive power to stimulate the growth of the economy. This study therefore aims at contributing to the knowledge of the causes of stock market volatility by investigating the causal relationship between inflation, interest rate and stock market volatility.

Objectives of the Study

The study objectives were;
1. To establish the long run and short run causal relationship between inflation rate and stock market volatility in Kenya
2. To examine the long run and short run causal relationship between interest rate and stock market volatility in Kenya.

Scope of the Study

The study focused on the relationship between inflation rate, interest rate and stock market volatility over a period of 14 year starting January 2001 to December 2014..

LITERATURE REVIEW

A number of theories in finance provide an explanation to the relationship between inflation, interest rate and stock market volatility. Among the theories reviewed by this study include; the arbitrage price theory (APT), the present value model (PVM) and fisher effect theory.

The arbitrage pricing theory was developed by Stephen Ross in 1976 as an alternative to the capital asset pricing model. The APT proposes that, asset prices are driven by multiple macro-economic factors. According to the APT theory, expected returns of a financial asset or a share can be modelled as a linear function of various macroeconomic variables. As a single-factor model, uncertainty in asset returns is caused by a common or macroeconomic factor and a firm-specific cause, where the common factor has zero expected value (McMenamin, 2005).

The APT can be mathematically expressed as (Kevin, 2015);

$R_{it} = r_i^f + \beta_i X_t + \varepsilon_t$ ..... (1)

Where;

R_{it} is the return of the stock *i* at time *t*,

r_i^f is the risk free interest rate or the expected return at time *t*

X_t is a vector of the predetermined economic factors or the systematic risks and,

β_i is a measure of the sensitivity of the stock to each economic factor included in X_t

ε_t is the error term representing unsystematic risk or the premium for risk associated with assets that cannot be diversified where;

$E(\varepsilon_t|X_t) = 0, E(\varepsilon_t\varepsilon_t^{'}|X_t) = \Sigma$ ..... (2)

The APT though a one-factor model can be extended to a multifactor model by allowing for other macro-economic factors that affect stock returns. These factors could include; interest rates, inflation, gross domestic product and foreign exchange rate. The APT has not specified macro-economic factors believed to contribute most to stock market return or volatility. A consensus is yet to be reached on the effect of the various macro-economic factors on stock market volatility. Ross *et al.* (1987) examined the effect of four factors namely; inflation, gross domestic product, investor confidence, and the shift in the yield curve.

The Present Value Model

The present value model has been empirically tested for predicting stock prices (Frydman *et al*., 2015). The PVM explains the relationship between stock prices and macroeconomic variables (Sarkar, 2012). Theoretically, the profit opportunities represented by the existence of "undervalued" and "overvalued" stocks motivate investors to trade, and their trading moves share prices toward the present value of future cash flows (Gorton and Allen, 1993). Consequently, investment analysts' search for mispriced stocks and their subsequent trading makes the market efficient by causing prices to reflect intrinsic values.

In the present value model, stock prices are suggested to be a function of all the expected future dividends discounted at a discount rate which is normally the prevailing average rate of return in the market (Shiller, 1992). The interest rate prevailing in the market is therefore expected to have a significant relationship with stock prices and market returns. This makes the theory very important to this study.

The PVM can be expressed as follows (Semmler, 2006, & McMillan, 2010);

$$p_t = \sum_{t=1}^{\infty} \frac{E_t(R_t + i)}{((1 + k_t)^i}$$

Where;
p_t is the stock price
$E_t(R_t + i)$, is the expected stream of returns
k_t is the factor associated with the discount rate of future cash flows.

Fisher Effect Theory

The Fisher effect theory states that nominal interest rates in two or more countries should be equal to the required real rate of return to investors plus compensation for the expected amount of inflation in each country (Dimand, 2003). Fama and Schwert (1977) explains the fisher effect theory by stating that, if the market is efficient and reflects all the available information at time t-1, the price of common stocks will get adjusted so that the expected nominal return from t-1 to t is the sum of the appropriate equilibrium expected real rate and the market's assessment of expected inflation rate for the same time period. According to the fisher effect theory, shares act as a hedge against inflation because they represent claims on real assets, which suggest that a positive share price is correlated to expected inflation (Dimand, 2003).

RESEARCH METHODOLOGY

Research Design

The study adopted a descriptive research design. It assumed a quantitative approach where data was measured and analysed in a numerical form to give precise description. A quantitative research often entails objectivism, positivism and deductive approach (Collis & Hussey, 2009).

Population

The population was made-up of companies listed on the Nairobi Securities Exchange between January 2001 and December 2014 together with investors in shares of these companies. The NSE had 60 listed companies and 866,835 individual investors as at December 2004 (CMA, 2014).

Sampling and Sample Size

The study used the Krejcie and Morgan (1970) formula to arrive at a sample size of 385 respondents. A simple random sampling approach was used to distribute questionnaires. According to Orodho (2005), simple random sampling ensures that each unit has an equal probability of being chosen, and the random sample is the most representative of the entire population.

Data Analysis

Qualitative and quantitative data analysis techniques were used to analyse the data. Time series data was analysed using e-views version 8 software packages and qualitative data was analysed using SPSS. Correlation and regression analysis were used to express the relationships. The short run and long run causal relationships were established by carrying out the Granger Causality test and specifying the Vector Error Corrections Model (VECM).

The multiple regression model specified for the study was;

$$SMV = \beta_0 + \beta_1 INF + \beta_2 INT + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(i)}$$

Where:
SMV is the stock market volatility
INF is the inflation rate
INT is the interest rate
ε is the error term.

RESEARCH FINDINGS AND DISCUSSIONS
Response Rate

A total of 385 questionnaires were distributed out of which 197 were completed and returned. This translated to 51.12% response rate for primary data. In relation to time series data, a total of 167 monthly observations were made translating to 99% of the 14 years data required for the study. According to Mugenda and Mugenda (2003) 50% response rate is adequate and representative. The response rate in this study was therefore adequate and satisfactory to make conclusions.

Reliability and Validity Test

The validity and reliability of the questionnaire was tested using Cronbach's alpha coefficient. According to Nunnally (1978), a coefficient greater than or equal to 0.5 is considered acceptable and a good indication of construct reliability. The Cronbach's alpha coefficients were; 0.9307 and 0.8759 for interest rate and inflation respectively having four questionnaire items each. The questionnaire was found to be reliable.

Multicollinearity Test

The time series data was tested for multicollinearity using the variance inflation factor (VIF). The rule of thumb under this method is that if the VIF of explanatory variables is above ten, then variables are said to be collinear. From the results, the multicollinearity factor for inflation was 1.04633 and that of interest rate was 1.20108. Results show lack of collinearity in the variables.

Auto Correlation Test

According to Koutsoyiannis (1993), autocorrelation, refers to the relationship, not between two (or more) different variables, but between the successive values of the same variable. The Lagrange *Multiplier* (LM) tests were used to test for autocorrelation. Result in table 1 shows absence of auto correlation since the p-values were above 0.05 at lag 2.

Table 1: Auto correlation Lagrange Multiplier Test Results

Null Hypothesis: no serial correlation at lag order 2

Lags	LM-Stat	Prob.
1	52.44605	0.0376
2	41.42835	0.2458

Normality test

The Shapiro Wilk test for normality was used to test whether macro-economic variables and stock market volatility follow normal probability distribution. Results in table 2 shows that the variables were normally distributed.

Table 2: Normality Test Results

Macro Variable	Mean	Standard deviation	Skewness	Kurtosis
Stock Market Volatility	1.192	0.899	0.735	2.541
Interest Rates	7.735	3.650	0.560	4.371
Inflation Rate	8.300	4.917	0.638	2.340

Stationarity and Unit root test

A stationary time series data is one that exhibits near constant mean, variance and autocorrelation. A stationarity test was conducted to determine the statistical properties of the time series data using both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. Results in table 3 indicate that the null hypothesis of unit root cannot be rejected for all the variables in levels. However, it is rejected in first differences. Thus all variables become stationary after differencing them once i.e. each of them is integrated of order one.

Table 3: Unit Root Test Results

Variable	ADF Test		PP Test		Order of Integration of Variable
	At Levels	At First Difference	At Levels	At First Difference	
SMV	– 2.50	– 6.30***	– 2.246	– 7.647***	I(1)
INF	– 2.958	– 5.553***	– 2.956	– 7.575***	I(1)
TBILL	– 3.053	– 4.613***	– 3.042	– 8.991***	I(1)

Note: *** indicates the rejection of the null hypothesis of unit root at 1% level of Significance.

Descriptive Statistics

Table 4: Descriptive Statistics (Secondary Data Analysis)

Variable	Obs.	Mean	Std. Dev.	Min	Max
INF	167	8.296331	4.917111	.4612105	19.71573
TBILL	166	7.73488	3.649142	.83	20.56
SMV	168	1.191787	.8990608	.0087774	3.624102

Inflation

Descriptive statistics in Table 4 show a total of 167 observations of monthly inflation movements with a mean of 8.296331 and standard deviation of 4.917. The inflation trend in Figure 4 indicates that inflation was low in January 2002, March 2007, August 2010 and October 2012 and high in October 2004, May 2008, and in October 2011. The lowest inflation rate was recorded in January 2002 and the highest in October 2011.

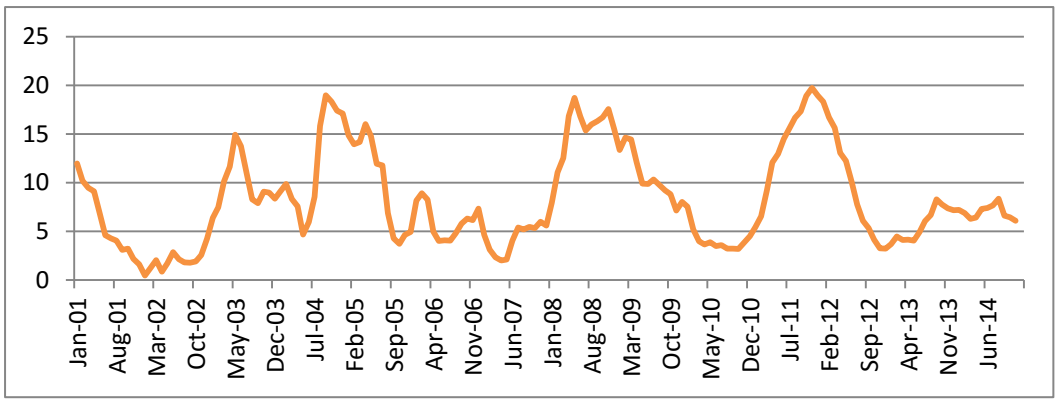

Figure 4: Monthly inflation trend from January 2001 to December 2014

Table 6 shows that 63.8% agreed that prices of shares have always dropped whenever there is an increase in the inflation rate. Majority of respondents (67%) agree that rapid changes in the inflation rate cause fluctuations in share prices, while 69% of the respondents agreed that a change in the inflation rate causes fluctuations in the stock market volatility.

Table 5: Respondents Perception of Relationship between Inflation and Stock Market Volatility

Likert Item	Agree %	Not Sure %	Disagree %
Prices of shares have always dropped whenever there is an increase in inflation	63.08	17.44	19.49
Prices of shares have always increased whenever inflation drop in the market	36.07	25.89	38.07
Rapid changes in inflation cause fluctuations in share prices.	67.01	24.37	8.63
Changes in inflation causes fluctuations in stock market returns	69.04	22.84	8.12

Interest rate

Descriptive statistics in table 4 show that a total of 166 observations were made of the time series interest rate data. The 91 day Treasury bill rate had a mean of 7.73488 and a standard deviation of 3.649142. The interest rate trend as per Figure 5, shows that the interest rate was lowest in July 2007, May 2004 and June 2006 and highest in January 2001and January 2012.

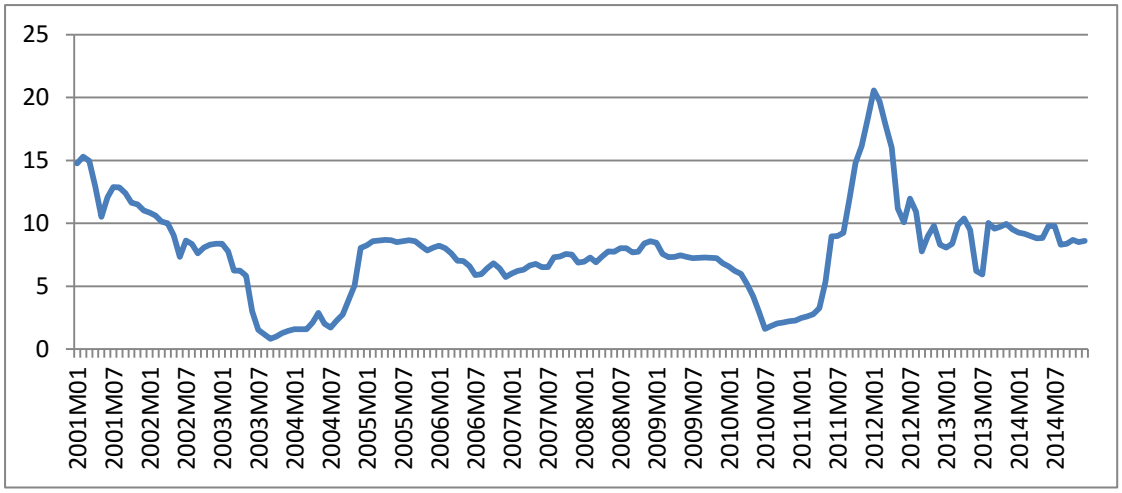

Figure 5: T bill rate trend from January 2001 to December 2014

Table 7 shows respondents perception of the relationship between interest rate and stock market volatility. From the table, we observe that 78% of the respondents agree that a change in interest rates in the market has always affected share prices. Results in table 7 also show that 75.63% of the respondents agreed that sudden changes in the interest rate have always caused variations in the stock market return (stock market volatility).

Table 6: Respondent's Perception of the Relationship between Interest Rate and Stock market volatility

Likert Item	Agree %	Not Sure %	Disagree %
A change in the interest rates has always affected shares prices	78.17	14.72	7.11
A rise in interest rates has always lead to a drop in shares prices	48.22	25.38	26.4
An increase in interest rates has always led to an increase shares prices	31.98	30.96	37.06
Sudden changes in interest rate have always caused variations in stock market return	75.63	16.24	8.12

Stock Market Volatility

Descriptive statistics in Table 4 shows that a total of 168 observations were made on stock market volatility. Stock market volatility had a mean of 1.1917, and a standard deviation of 0.899. The trend in Figure 5 shows that the NSE registered high volatility in June 2001, June 2002, December 2006 and December 2014 and low volatility in September 2003, August 2004, March 2005, October 2008, April 2010, May 2011 and July 2012.

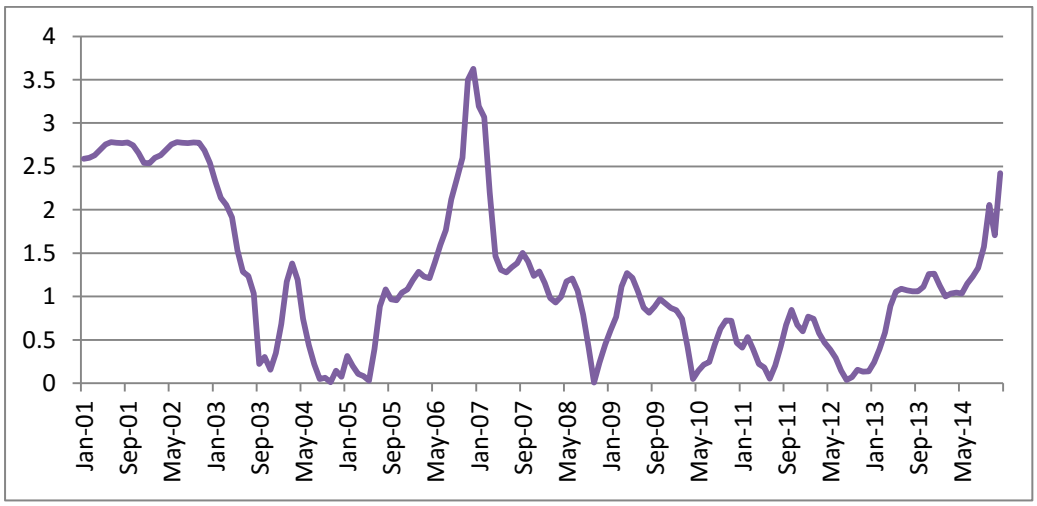

Figure 5: Stock Market Volatility Trend from January 2001 to Dec 2014

Correlation Analysis

Correlation analysis was carried out to establish the association between inflation, interest rate and stock market volatility. The study found interest rate and stock market volatility to be positively and significantly correlated ($r = 0.2402$; p-value = 0.0018). Results also revealed that there was a negative and significant association between stock market volatility and inflation ($r = -0.4535$; p-value = 0.0000).

VECM Causality Test

Having established the correlation between the variables in the study, a long run causality test was carried out between inflation, interest rate and stock market volatility by employing the Vector Error Correction Model (VECM). Results in table 7 show that the t-statistics were greater than the critical five per cent value of 1.96 and therefore significant.

Table 7: VECM results

Variable	Coefficient	Standard error	t-statistics
INF	0.239745	(0.04017)	[5.96881]**
TBILL	-0.118562	(0.06231)	[-1.90268]**

KEY: ** Significant at 5 per cent

Granger Causality Tests

The Granger test (1969) is suitable for analysing the short-run relationship if no cointegration exists among the variables. Granger Causality tests were performed to investigate the short run causal relationship among the variables. The Granger test examines whether including lags of one variable have predictive power for another variable. According to the concept of Granger's causality test (1969, 1988), a time series *X* is said to be causing *Y* when past values of *X* can predict future values of *Y*. In this case we can say that *X* granger causes *Y*. The two variables had a p-value less than 0.05 which was significant.

Table 8: Granger Causality Test Results

Dependent variable: (SMV)

Excluded	Chi-sq.	Df	P-Value.
D(INF)	13.39024	3	0.0039
D(TBILL)	7.121743	3	0.0681

SUMMARY OF FINDINGS

The first objective of the study sought to establish the long run and short run causal relationship between inflation rate and stock market volatility. Findings in Table 7 show that in the long run the coefficient of inflation rate was 0.24 with t-statistic of 5.96 which is greater than the critical five per cent value of 1.96. This implies that in the long run the coefficient of inflation is positive and significant. Consequently, we interpret this finding to suggest that an increase in inflation by one percentage point increases stock market volatility by approximately 24 percentage points. The short run equation as shown by the Granger causality test results in table 8 indicates that the test statistic had a chi-square value of 13.39 and a p-value of 0.0039 which is less than 0.05. This means that in the short run, inflation and its lags jointly Granger cause stock market volatility at one per cent level of significance.

Results from primary data in table 5 confirm findings from the VAR models, where majority of investors surveyed (69.04%) agreed that a change in inflation causes stock market volatility. When asked whether a rapid change in the rate of inflation causes fluctuations in prices of shares, 67.01% of respondents agreed. Additionally, 63.08% of the respondents

agreed that share prices have always dropped whenever there was an increase in the rate of inflation.

Findings on the relationship between inflation and stock market volatility were consistent with theory and findings from other similar studies. Ouma *et al.* (2014) studied the impact of macro-economic variables on stock market returns in Kenya using ordinary least squares and found that there was a positive relationship between inflation and stock prices. Ochieng *et al.* (2012) studied the relationship between macro-economic variables and stock market performance in Kenya and found that inflation had a weak and positive relationship with the stock market returns.

In theory, the fisher effect explains how in the long run, inflation and the nominal interest rate should move one-to-one, implying that a higher inflation should increase the nominal stock market return as the real stock market return remains unchanged and therefore compensating investors fully. According to the fisher effect theory, equities serve as a hedge against inflation because they represent claims to real assets, and therefore a positive stock price is correlated to expected inflation and appreciation in stock prices (Dimand, 2003)

The second objective sought to examine the long run and short run causal relationship between interest rate and stock market volatility in Kenya. Findings in table 7 show a T-bill rate coefficient of 0.12 with t-statistic of -1.90 which is greater than the critical value of 1.645 at 10 per cent level and therefore negative and weakly significant. This could suggest that in the long run a unit increase in interest rate decreases stock market volatility by approximately 0.12 per cent.

The short run relationship as shown by Granger causality test in table 8 indicates that a change in T-bill rate and its lags had chi-square statistic of 7.1217 with a corresponding p-value of 0.0683 and therefore significant at 10 per cent. This means that T-bill rate and its lags Granger cause stock market volatility in the short run. Consequently, at 10 percent level of significance, the study finds a significant causal relationship between interest rate and stock market volatility.

Findings from the primary data in table 6 show that a majority of investors surveyed (78.17%) agreed that a change in the interest rates has always affected share prices . When asked if an increase in interest rates has always led to a drop in shares prices, 48.22 agreed. Concomitantly, when this question was asked in the negative 37.06 per cent of the respondents disagreed confirming the response in the first question. When asked if a variation in interest rates causes variations in stock market returns 75.63% of investors surveyed agreed.

Findings on the relationship between interest rate and stock market volatility are therefore consistent with theory and confirm results from similar studies. Zakaria, (2012), Kadir *et al.* (2011), Z. Chinzara, (2010), Omorokunwa *et al.* (2014), Olweny *et al.* (2011), Waweru (2013) and Ochieng *et al.* (2012), found that a change in interest rate as measured by the 91 day T bill rate had a negative relationship with stock market returns and volatility.

Finance theory offers a number of explanations for the causal relationship between interest rates and stock market volatility. According to Bernanke (2005), interest rates affect stock market volatility due to the fact that investors value shares by discounting future dividends to the present time and interest rates serve as a discount rate. Therefore, a high interest rate

makes a given future dividend less valuable in today's money, implying that the value of that share or stock will drop. Another explanation offered in theory is that, an increase in interest rate causes investors to sell shares and invest proceeds in fixed income instruments causing decreased demand for shares and a drop in stock prices.

CONCLUSION

Based on the findings, we conclude that inflation rate has a positive and significant long run and short run causal relationship with stock market volatility in Kenya. Accordingly, an increase in inflation, both in the short run and long run leads to an increase in stock market volatility. Findings on the second objective makes the study conclude that there is a weak and significant short run and long run causal relationship between interest rate and stock market volatility.

RECOMMENDATIONS

In light of these findings, the study recommends a strict policy intervention to regulate factors contributing to fluctuations in the rate of inflation in order to reduce the volatility witnessed on the stock market. The government of Kenya through its fiscal and monetary policy intervention can stabilize the rate of inflation to reduce volatility in the securities market. This study recommends that policies on interest rate be observed closely to contain rapid changes in the interest rate movement which is found to contribute weakly but significantly to stock market volatility.

SUGGESTIONS FOR FURTHER RESEARCH

Further research should be done to investigate the nexus between other macro-economic variables, especially those not used in this study, and stock market volatility. New studies can be carried out using different methods to narrow the inconsistency in finding of similar studies.

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