International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2015, 5(3), 638-646.

An Empirical Study of the Relationship between Money Market Interest Rates and Stock Market Performance: Evidence from Zimbabwe (2009-2013)

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ABSTRACT

The research examines the long run relationship between money market interest rates and stock market returns in Zimbabwe from April 2009 to December 2013. The estimation model controls for money supply growth rate, inflation, volume of manufacturing index, crude oil price and political stability. All the variables were tested for unit root using augmented Dickey-Fuller test before Johansen cointegration tests. Based on vector error correlation Granger causality tests, findings show evidence of strong and statistically significant inverse causal relationship between money market interest and stock market returns. Findings also show existence of short run causality that runs from stock market returns to money market interest rates. This is believed to be caused by the passive nature of money market in Zimbabwe and non-functionality of Reserve Bank of Zimbabwe in controlling interest rates through monetary policy. There is therefore need to implement robust and pragmatic macroeconomic policies like the repo market to reactivate the money market.

Keywords: Interest Rates, Stock Market, Ordinary Least Regression
JEL Classifications: C19, C22, C32, E43, E44, G10, F59

1. INTRODUCTION

The performance of the equities market is determined by the share performance of listed companies. In Zimbabwe, the industrial index is a measure of how equity markets perform. On the other hand, the money market is where short term money is raised and this market is predominantly composed of such instruments as treasury bills, banker's acceptances, fixed deposit and other short-term money market instruments.

The stock exchange is an important economic health barometer, and a register of investors' confidence. Many researchers and authors in both developed and developing countries have studied the link between stock exchange performance and macro-economic variables like "gross domestic product, inflation, exchange rate, short term interest rates, fiscal balance, current account balance, industrial production rate so on" and investors believe on monetary policy and macroeconomic variables to have large weight on the volatility of stock returns (Christopher et al., 2006).

Smirlock and Yawitz (1985) stated that interest rate changes can impact equity by affecting the rate at which the firm's expected future cash flows will be capitalized and expectations about future cash flows. They argued that an increase in interest rates causes stock prices to decline and a decline in interest rates causes stock prices to rise, suggesting an inverse relationship.

Contrary, Elton and Gruber (1988) applied arbitrage pricing theory to Japanese stock returns and several macroeconomic variables like industrial production, money supply, crude oil price, and short-term interest rates, and showed that there existed a positive relationship between stock prices and short-term interest rates.

The relationship between money market interest rate and stock market performance in Zimbabwe has undergone various drifts since the introduction of the United States dollar (US$) on the local bourse on February 19 2009. In view of mixed results from previous studies, the present study sought to clarify the empirical relationship between money market interest and stock market returns based on Zimbabwe Stock Exchange monthly time series data. The varying relationship can be positive, negative, no relationship and significant and insignificant.

1.1. Stock Market Performance Determinants

Various authors and researchers have attempted to explain the performance of stock market performance and macroeconomic variables. In an elaborated search for answers, Chen et al. (1986) identified interest rate, expected rate of inflation and spread between high and low bond as variables. It was established that industrial production, changes in risk premium and yield curve are significant in explaining stock returns. Hsing (2011) used growth rate of GDP, ratio of money supply, government deficit to GDP, domestic real interest rates, exchange rate, domestic inflation rate and government bond yield to examine the effect on stock index.

Miller and Modigliani (1961) as cited by Osisanwo and Atanda (2012) used the dividend model to determine factors affecting stock returns, they explained stock returns as discounted value of expected cashflow. Therefore factors that affect corporate cashflows and discount rate factors are the same factors that affect stock returns. Clare and Thomas (1994) as in (Osisanwo and Atanda, 2012) investigated macroeconomic factors on stock return in the United Kingdom. They found out that oil prices, retail price index, banking lending rate and corporate default risk are important factors that explain stock returns.

Mukherjee and Naka (1995) as cited by (Maysami et al., 2004) used the vector correlation method to model Japanese stock return and macroeconomic variables. Co-integration was detected in the rate of currency exchange, inflation rate, money supply growth rate, real economic activity, long run bond rate and call money rate. A study by Professor Patel (2012) took into consideration interest rate, inflation, and exchange rate, index of industrial production, money supply, gold price, silver price and oil prices as key determinants of stock performance.

2. METHODOLOGY AND DATA

The causality relationship between the macroeconomic variables and stock market performance has stemmed different divergent views. Macroeconomic variables are generally expected to affect stock market performance in a way. The data on inflation, volume of manufacturing index was obtained from the Zimbabwe Statistics Office for the period 2009 to 2013. Money supply and money market interest rates were extracted from the Central Bank database for the period 2009-2013. The global aspect of crude oil prices were collected from Federal Reserve economic research division website.

2.1. The Modeling Approach

The relationship between interest rates and stock market returns was modelled as follows:

$$STR = \beta_0 + \beta_1 MMR + \beta_2 MSG + \beta_3 INF + \beta_4 MVI + \beta_5 COP + \xi \quad (2.1)$$

Where, STR: Monthly stock market returns
MMR: Money market interest rate
MSG: Money supply growth rate
INF: Monthly inflation rate
MVI: Volume of monthly manufacturing index
COP: Monthly crude oil price per barrel
ξ: Disturbance term expected to be zero
β_n: The coefficients of determination

The existence of error term, ξ is to improve the model by substituting all excluded or omitted variables from the model. Some of the data may not be available to include all variables and these will be catered for by ξ.

2.2. Economic Variables and their Characteristics

The monthly economic data were collected for all the variables. A variable is a concept that takes quantitative value and when a variable depends upon other variable it is called dependent variables and the variable that is an antecedent to the dependent is the independent variable (Kothari, 2004). The stock market performance is the dependent variable. This was measured by the stock market index on the sampled industrial counters. The market value weighted series was used to re-calculate the stock indexes generated by deriving the initial total market value of stock used in the series.

$$\text{Market value} = \text{Number of shares outstanding} \times \text{Current price} \quad (2.2)$$

The initial figure is established as the base and assigned an index value of 100 in line with the ZSE practice. The new index will be calculated as follows:

$$\text{New index value} = \frac{\text{Current market value}}{\text{Base value}} \times \text{beginning index value} \quad (2.3)$$

Therefore, $$\text{Index}_t = \frac{\sum PtQt}{\sum PbQb} \times \text{beginning index value} \quad (2.4)$$

$$= \frac{\sum \text{Market Capt}}{\sum \text{Market Capb}} \times \text{beginning index value}$$

Where: Index_t = Index value on day t
P_t= Ending price for stock on day t
Q_t= Number of outstanding shares on day t
P_b= Ending price of the stock on base day
Q_b= Number of outstanding shares on base day

The stock return is computed from the index value on monthly basis. The stock return is the gain or loss received from trading over a period of time and is expressed as a percentage (Reilly and Brown, 2003). The formula is given as below:

$$\text{Stock return} = \left[\frac{\text{Month closing index value}}{\text{Month opening index value}} - 1\right] \times 100 \quad (2.5)$$

Stock return was used to measure performance as it takes concentrate information on trading into single statistic. Returns can be compared to other trading periods even if there are different counter prices and outstanding number of shares and this allowed effective analysis of trading over a period of time.

2.3. Independent Variable

The independent variable is the money market interest rates. Traditional economic view claims that interest rate has a negative impact on stock market index. The main reason is that investors tend to shift investments from a higher risk instruments which is the stock market to savings or fixed deposit accounts where they can get a higher return. When interest rate is very low, they then move money out of these savings to stock market investments, with the hope of getting a better rate of return.

Chen et al. (1999) described stock price as a dividend where the discount rate is a function of risk free rate and firm-related risk premium. The influence of interest rate on stock return is inverse because increase of the risk free rate increases the discount rate. Lee (1992) found the relationship between these variables unstable over time. Lee used a 3 years rolling regression to analyse the relationship. He concluded that the nature of the relationship changes from significant negative to no relation, and even positive insignificant relationship.

Vast of literature pointed to inverse relationship, however, the relationship of the variables can be independent. Fama and Schwert (1977) as in (Osamwonyi & Evbayiro-Osagie, 2012) used stock return and treasury bill rate and the expectation model rejected the belief that interest rate can predict stock returns.

2.4. Control Variables

The following variables were introduced into the model in order to improve the explanatory power between stock market returns and interest rate; money supply growth rate, inflation rate, volume of manufacturing index, and an international aspect of crude oil price. They assisted also in minimizing the effects of extraneous variables. These are variables that may affect the dependent variable.

2.4.1. Inflation changes

Fieldsten (1980) as cited by Nissim and Penman (2003) postulates that inflation results in increases in corporate taxes because costs of sales do not change spontaneously with inflation. In related findings Fama (1981) states that higher expected inflation lower real economic activity and thus reducing corporate earnings. It can therefore be explained that there is an association between stocks returns and inflation emanating from free cashflow and expected inflation, inflation therefore exerts negative impact on the stock return.

2.4.2. Crude oil prices fluctuation

The conventional wisdom according to Anoruo (2011. p. 1) holds that, "high crude oil prices promote economic growth for oil exporting countries, while on the other hand, stunts growth for oil importing countries." In line with the same findings, Cobo-Reyes and Quiros (2005) as cited by Siddiqui, 2014 studied the relationship of oil prices and stock returns. The results of the research concluded that oil prices increase affect negatively stock returns and industrial production. On the other hand, Basher and Sadostsky (2006) cited by Siddiqui, 2014 discovered a strong relationship between oil price and stock returns in emerging markets. The results of the study revealed a positive impact on stock returns for daily and monthly data, however for weekly and monthly data, oil prices decrease influenced stock market positively and the nature of the relationship significant.

A negative association has been generally found between oil price change and stock returns in oil importing countries. Park and Ratti (2008) in the study of common 13 oil importing nations in Europe, found out that oil price shocks has a negative impact on stock markets. Berk and Aydogan (2012) in the impact assessment on crude oil price movements on Turkish stock market. The emperical findings showed that oil price changes affect significantly on Turkish Stock Market. However, the authors did not show the sign of the relationship.

2.4.3. Industrial production volume

Filis (2009) studied the relationship between consumer price index, industrial production and stock market performance in Greece for the period between 1986 and 2008. Using vector autoregressive (VAR) model, the study revealed that industrial production affects stock returns with insignificant impact. Industrial production index is a measure of real economic activity, and Maysami et al. (2004) found out that industrial production rises during economic boom and fall during recession, therefore the rise of economic production boost economic growth and impact stock returns positively.

2.4.4. Money supply growth

An increase in money supply growth indicate sound liquidity, making resources available for buying securities resulting in higher security returns triggered by demand (Maysami et al., 2004).

There are various ways in which money supply affect stock market prices. Keysian economists argue that there is negative relationship between stock prices and money supply, on the other hand, real activity economistics argue that the nature of the relationship between the two variables is positive (Sellin, 2001).

The disparity in the relationship emanates from the discounted cashflow model. The present value or discounted cash flow model offers an insight into how stock markets are affected by monetary policy. The present value model stipulates that stock return is affected by the discount rate expectations by market participants (Ioannidis and Kontonikas, 2006).

Keysians postulate that the change in money supply will affect stock prices if the money supply alters the expectations about future money supply. A positive money supply shock leads to expectation of tightening monetary policy. Investors bid for funds will drive upwards the current interest rates, when interest rates increases, the discount rate also increases and the present value of future earnings falls and stock prices consequently decline. Generally, it has been observed that when interest rates increase, economic activities tend to decline and this depresses the stock market performance (Sellin, 2001).

However, the debate among different economistcs on money supply and stock returns is believed to respond differently to the anticipated and unanticipated components of money supply. Sellin (2001) in his reviewed studies, attributed the findings to the extent to which the market is efficient. Proponents of the efficient market hypothesis (EMH) hold that all available information is embedded in the stock prices and anticipated changes in money supply would not affect the stock prices. The unanticipated change will only affect stock prices. In contrast, opponents of EMH challenge that all available information is not embedded in stock prices and therefore, the anticipated changes in money supply affect stock prices (Corrado and Jordan, 2005).

2.5. Dummy Variables

Political stability has been introduced as a dummy variable. Stock return is not only affected by scale ratio variables but with also a qualitative variable. The variable is measured using binary coding, 1 being the existence of unity government in Zimbabwe and 0 otherwise. Economic time series data was based on monthly trend to show seasonal pattern and dummy variables de-season the trends.

In a democratic society, elections are a major political event for re-distribution of power and this has implications for future political and economic course. Political uncertainties affect real investments decisions. Most Foreign Direct Investments are to an extent irreversible and foreign investors tend to delay investment decisions amid political instability. This tends to slow down on stock market performance and economic growth of a country (Mei and Guo, 2002).

In a separate study, Bittlingmayer (1998) noticed that stock market volatility in German in 1920s was driven by exogenous political events such as the 1918/19 revolution, the Hitler putsch Munich and the French invasion of the Ruhr. He argues that stock prices become less stable during political uncertainty.

Khalid and Rajaguru (2010) noticed that political events have caused major shifts in the volatility of emerging stock markets. The 1987 stock market crush was a global event that caused high volatility in emerging markets. Marie-Claude et al. (2005) studied on political risk impact on volatility of stock returns and found that the two are linked.

2.6. Diagnostic Tests

A series of diagnostic tests were performed to check if data is adequate for the analysis. The correlation matrix and the test of stationarity were used.

2.6.1. Correlation analysis

Correlation measures the strength of linear association between variables, denoted by r where $-1 \leq r \leq 1$ (Gujarati, 2004). If variables are in a perfect linear correlation, the correlation coefficient $r \geq 0.8$, the variables share the same explanatory association and there might not all be included in model formulation. Correlation coefficient r is interpreted using Evans (1996) as in Table 1.

Table 1: Correlation table of analysis

Range	Explanation
0.00-0.19	Very weak
0.20-0.39	Weak
0.40-0.59	Moderate
0.60-0.79	Strong
0.80-1.00	Very strong

Table 1 interprets the level of the association ranging from very weak to very strong.

2.6.2. Stationarity process

According to Gujarati (2004. p. 799), "stochastic process is said to be stationary if its mean and variance are constant over time and the value of the covariance between the two periods depends only on the distance or gap or lag between the two periods and not the actual time in which the covariance is computed."

If $|p| > 1$, y is a nonstationary series and the variance will increase to infinity. If $|p| < 1$, y is a stationary series. The purpose of the unit root test is to determine whether the series is consistent with AR(p) process in a stochastic trend. A series is said to have a unit root and this is a situation of non-stationarity.

2.6.3. Cointegration tests

The cointegration analysis is possible for time series that are stationary at levels and first differences. The cointegration is performed to establish the existence of long run relationships between the variables.

x_t and y_t are said to be cointegrated if there is existence of a parameter $\propto$ such that

$\mu_t = y_t - \propto x_t$, is a stationery process. (2.6)

Cointegration tests determine if there is cointegration as well as the number of cointegration relationships. If variables are cointegrated, therefore variables move together in a long run relationship and it implies the existence of error correction model. Cointegration will be tested using Johansen cointegration test and the null hypothesis states that there is no cointegration equation and null hypothesis is rejected if the $P < 5\%$ level.

2.6.4. Vector error correlation model (VECM)

The VAR model is a general framework that is used to describe the relationship among stationary variables. Time series data can be stationary at different levels. When time series is not level stationary, then VAR will need to be modified to allow consistency in the relationship. The VECM is a special case of VAR for variables that are stationary in their differences. VECM does take account of cointegration among variables.

2.6.5. Granger causality test

Maxims by statistician postulates that "correlation does not imply causality." In a bivariate relation, say Cov(x,y) = Cov(y,x) does not infer the direction of Causality relation between x and y. Granger causality is used to determine the direction of the relationship between STR and MMR.

The Granger (1969) approach to the question of whether x causes y is to see how much of the current y can be explained by past values of y and then to see whether adding lagged values of x can improve the explanation. y is said to be Granger-caused by x if helps in the prediction of y, or equivalently if the coefficients on the lagged x's are statistically significant. This is tested using Wald F-test. Running each of these can yield four doable outcomes as in Table 2; no Granger causality, one-way Granger causality in either direction, or Granger causality in both ways.

2.7. Model Robustness Checks

The model was tested if it was the best regression model. Ordinarily, R^2 which measures the predictive strength of the model, F-statistic and its corresponding P-value, DW test and check of significant of variables using P-values are used. The model was tested further for its validity by testing the characteristic of residuals using the following techniques:

The residuals are checked for serial correlation, using the following hypothesis:
H_0: Residuals are not serially correlated.
H_1: Residuals are serially correlated.

Serial correlation happens once the observations between the variables in a series of order and also the error terms in numerous time periods are correlated. This affects the potency of the ordinary least squares (OLS) estimators.

The residuals should not have heteroscedastic and tested using the hypothesis testing:
H_0: Residuals are not heteroscedastic, which is homoscedastic.
H_1: Residuals are heteroscedastic.

Heteroscedastic represent unequal spread of the variables. The OLS will be "blue" and it will not provide the estimates with the smallest variance. Homoscedastic, V (ξ_j) = σ^2 for all j, that is, variance of error term to be constant is desirable for a good model.

For an ideal model, the residuals should be normally distributed and this was tested using the following hypothesis:
H_0: Residuals are normally distributed.
H_1: Residuals are not normally distributed.

Table 2: Granger causality test outcomes

Condition	Fail to reject: $\beta_{yx1}=\beta_{yx2}=\ldots\ \beta_{yxs}=0$	Reject: $\beta_{yx1}=\beta_{yx2}=\ldots\ \beta_{yxs}=0$
Fail to reject: $\beta_{xy1}=\beta_{xy2}=\ldots\ \beta_{xys}=0$	$y \not=> x$ $x \not=> y$ (no Granger causality)	$y \not=> x$ $x => y$ (x Granger causes y)
Reject: $\beta_{xy1}=\beta_{xy2}=\ldots\ \beta_{xys}=0$	$y => x$ $x \not=> y$ (y Granger causes x)	$y => x$ $x => y$ (bi-directional Granger causality, or feedback)

Source: Sims (1980)

This test checks if the data set is well-modeled by a normal distribution curve and it measures the goodness of fit of the model. In each of the above, null hypothesis is desired if $P > 5\%$ and the model will be the best OLS estimators.

3. EMPIRICAL RESULTS

3.1. Correlation Test

The hypothesis was stated as follows:
H_0: Model suffers from correlation.
H_1: Model is free from correlation.

The correlation coefficient r is interpreted using Evans (1996) scale. Table 3 shows that all the variables selected are not highly correlated since the absolute value of $r < 0.8$. The strength of the association between the variables ranges from weak to moderate form hence we reject the null hypothesis that the model suffers from correlation.

3.2. Test of Stationarity

The unit root test is to check for stationarity given time series data. The augmented Dickey-Fuller (ADF) test statistic was employed to test for stationarity. For each of the coefficient of the variables, the null hypotheses of unit root exist, meaning data sets are not stationary against the alternative, and there exist no unit root in the data set, meaning the data sets are stationary. We reject the null hypothesis whenever the absolute value of the ADF statistic is greater than the critical value.

From Table 4, COP is level stationary at 10%, because the t-statistic value 2.68 is greater than the absolute value 2.60. INF is level stationary at 1%, MMR level stationary at 1% and STR level

Table 3: Correlation test results

Variable	STR	MMR	MSG	INF	PST	COP	VMI
STR	1						
MMR	−0.478	1					
MSG	−0.154	0.573	1				
INF	−0.603	0.251	0.015	1			
PST	0.088	0.076	0.284	0.253	1		
COP	−0.503	0.099	−0.213	0.209	−0.372	1	
VMI	−0.367	0.151	−0.077	0.066	−0.295	0.773	1

STR: Monthly stock market returns, MMR: Money market interest rate, MSG: Money supply growth rate, INF: Monthly inflation rate, VMI: Volume of monthly manufacturing index, COP: Monthly crude oil price per barrel

Table 4: Results of the ADF unit root test

Variable	t-Statistic	1% level	5% level	10% level	Lag length
COP	−2.68	−3.55	−2.92	−2.60	1
INF	−5.05	−3.55	−2.91	−2.59	0
MMR	−3.63	−3.57	−2.92	−2.60	6
[1](D) MSG1	−5.91	−3.56	−2.92	−2.60	0
STR	−6.13	−3.55	−2.91	−2.60	0
[1](D) VMI	−8.58	−3.56	−2.92	−2.60	1

ADF: Augmented Dickey-Fuller, COP: Monthly crude oil price per barrel, MMR: Money market interest rate, MSG: Money supply growth rate, STR: Monthly stock market returns, VMI: Volume of monthly manufacturing index, INF: Monthly inflation rate

[1]D(MSG) and D(VMI) are first differenced.

stationary at 1%. MSG and VMI are stationary when first differences at 1%. We reject the null hypotheses and all the variables do not have a unit root and are stationary.

3.3. OLS Regression Model

The OLS regression model now estimates the model;

$$STR = \beta_0 + \beta_1 MMR + \beta_2 MSG + \beta_3 INF + \beta_4 MVI + \beta_5 COP + \xi ,$$

from the equation by determining the value of β_i where $i = 0,1,2,3,4$ and 5. β_0 is the intercept of the regression model.

After determining the coefficients as in Table 5, the fitted model is given by:

$$\text{STR}=39.52-1.33\text{MMR}-0.02\text{MSG}-12.85\text{INF}+4.51\text{PST}+0.02\text{VMI}-0.27\text{COP} \quad (3.1)$$

DW statistic of 1.72 is strongly close to 2 and there is no problem of spurious regression model. The coefficient of determination, R^2 is fairly strong giving the model predictive strength of 63%.

From the above model, the intercept of 39.52 is the mean effect of STR of other variables omitted in this model. MMR affect STR negatively by 1.33%. Money supply growth rate reduces the STR by 0.02%. Inflation rate has unfavorable impact on the economy, 12.85% will impact on STR.

Politics has an impact on the stock exchange market, when there is political stability, about 4.51 points influence stock performance positively, so is the manufacturing sector as denoted by VMI. Every barrel of crude oil imported by the country contributes negatively 27 cents per every $1 import on oil into the economy. MMR, COP and INF are significant variable has the *P*-values were <5%. MSG, PST and VMI has insignificant impact, they will however, not be dropped from the model because they have an impact on stock returns. Since 50% of the variables are significant and the variables jointly are significant because F-Statistic probability is <5%. Therefore this OLS equation is a good model.

3.4. Testing the Regression Model

The Breusch-Godfrey serial correlation test was used to check for serial correlation in the formulated model. The Table 6 shows the results of the test and the *P*-value of the observed R^2 is 73.40%, which >5%. Therefore we don't reject the null hypothesis, and conclude that residuals are not serially correlated.

Heteroskedastic test as per the Table 7 shows that the observed R^2 is 12.24%. Since observed R^2 is >5%, we accept the null hypothesis and concluded that the model is not heteroscedastic.

Normality test of the model is shown in Figure 1.

Using the hypothesis testing that:
H_0: Residuals are normally distributed.
H_1: Residuals are not normally distributed.

In Figure 1, P = 69.85%, we accept the null hypothesis and conclude that all the test of the model attained the expected standards of the good model. Therefore the OLS model can be used for forecasting or estimation as it passed all the tests for an efficient model.

Table 5: OLS

Variable	Coefficient	SE	*t*-statistic	*P*
C	39.51871	9.839931	4.016157	0.0002
MMR	−1.331866	0.561376	−2.372504	0.0216
COP	−0.267863	0.114252	−2.344498	0.0231
INF	−12.85026	2.602389	−4.937872	0.0000
MSG	−0.019995	0.022161	−0.902255	0.3712
PST	4.506965	3.433574	1.312616	0.1953
VMI	0.021337	0.236509	0.090218	0.9285
R^2	0.629113	Mean dependent variable		2.899605
Adjusted R^2	0.584607	SD dependent variable		9.662232
SE of regression	6.227404	Akaike info criterion		6.610382
Sum squared residuals	1939.028	Schwarz criterion		6.861283
Log likelihood	−181.3959	Hannan-Quinn criteria		6.707891
F-statistic	14.13535	Durbin-Watson statistics		1.723159
P (*F*-statistic)	0.000000			

OLS: Ordinary least squares, SD: Standard deviation, SE: Standard error, MMR: Money market interest rate, MSG: Money supply growth rate, COP: Monthly crude oil price per barrel, VMI: Volume of monthly manufacturing index, INF: Monthly inflation rate

Table 6: Breusch-Godfrey serial correlation LM test

F-statistic	0.263328	*P F* (2,48)	0.7696
Obs*R^2	0.618616	*P* Chi-square (2)	0.7340

LM: Lagrange multiplier

Table 7: Heteroskedasticity test: Breusch-Pagan-Godfrey

F-statistic	1.784628	*P F* (6,50)	0.1214
Obs*R^2	10.05379	*P* Chi-square (6)	0.1224
Scaled explained SS	6.948115	*P* Chi-square (6)	0.3257

3.5. Cointegration

The results on Table 8 shows that the *P*-values are <5%, and we there reject the null hypothesis that there are no co-integrating equations.

Since the results of tests using both trace test and Max-Eigenvalue test indicates four cointegration equations at the 5% level as shown in Table 8, therefore it can be concluded that there exist a long run relationship between interest rates and stock market returns and this substantiates the need for VECM.

3.6. VECM

As noted earlier in time series data stationarity test, some variables were stationary in their difference and also at the different lag length, therefore there is need of an error correlation model.

The model has moved in terms of its predictive strength from 63% to 65%, as shown in Table 9, after taking into account errors correction. The inclusion of more variables is penalized by the R^2 adjusted.

From the Table 10, shows that in a long run, MMR Granger cause STR but STR does not Granger cause MMR.

Figure 1: Model normality tests

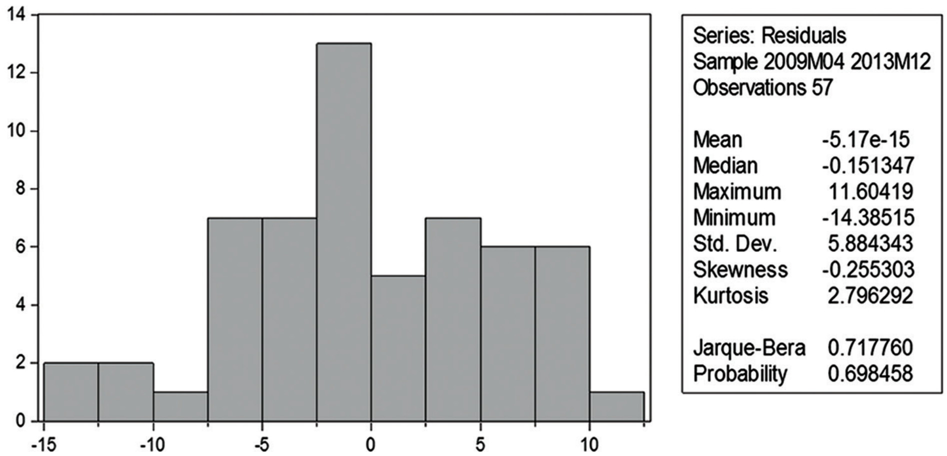

Table 8: Cointegration tests

Sample (adjusted): 2009M06 2013M12
Included observations: 55 after adjustments
Trend assumption: Linear deterministic trend
Series: MMR STR COP MSG
Lags interval (in first differences): 1 to 1
Unrestricted cointegration rank test (Trace)

Hypothesized number of CE (s)	Eigenvalue	Trace statistic	0.05 critical value	*P***
None*	0.562509	94.61064	47.85613	0.0000
At most 1*	0.386820	49.14222	29.79707	0.0001
At most 2*	0.271920	22.24189	15.49471	0.0041
At most 3*	0.083372	4.787955	3.841466	0.0287

Trace test indicates 4 cointegrating eqn (s) at the 0.05 level
*Rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) *P* values
Unrestricted cointegration rank test (maximum Eigenvalue)

Hypothesized number of CE (s)	Eigenvalue	Max-Eigen statistic	0.05 critical value	*P***
None*	0.562509	45.46842	27.58434	0.0001
At most 1*	0.386820	26.90033	21.13162	0.0069
At most 2*	0.271920	17.45393	14.26460	0.0151
At most 3*	0.083372	4.787955	3.841466	0.0287

Max-eigenvalue test indicates 4 cointegrating equation (s) at the 0.05 level. *Rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) *P* values, MMR: Money market interest rate, MSG: Money supply growth rate, COP: Monthly crude oil price per barrel, STR: Monthly stock market returns

3.7. Granger Causality Test

The pair-wise Granger causality test was performed between MMR and STR variables in order to determine the direction of causality.

The test of causality was conducted in the VAR environment. The null and alternative hypotheses are given as follows:
H_0: MMR does not Granger cause STR.
H_1: MMR does Granger cause STR.

In Table 11, $P = 60.22\%$ which is >5%. Therefore, we cannot reject the null hypothesis. We accept the null hypothesis and conclude that money market interest rates do not cause the performance of stock market performance. Rather, the second null hypothesis is rejected and accepts the alternative hypothesis that STR granger causes MMR. The results suggest that investors may not be willing to take financial instruments in the stock market. The scenario shows a passive market money market and activities from the stock market are observed to Granger causes fixed deposit investments in the short run.

4. CONCLUSION

OLS regression model was used to explain the relationship between stock market returns and interest rate. MSG and VMI were stationary in their differences while all other variables were level stationary, therefore the model was improved using VECM. It has been empirical proved that there exist a negative relationship between MMR and STR and the relationship holds if cross sectional regression is done and the nature of the relationship is inverse and significant. There exist a causality relationship between MMR and STR when controlled for VMI, INF, PST, and COP. In the short run, it was discovered that STR granger causes MMR; this might be caused by passive money market in Zimbabwe and the non-functionality of Reserve Bank of Zimbabwe (RBZ) by failing to set rates on quarterly basis. The central bank lost control of interest since dollarisation in 2009. The research concludes by noting a negative long run relationship between the MMR and STR.

Mankiw (2000) aforementioned that when stock market experiences a substantial decline, there is fear for recession. So

Table 9: VEC estimates

Sample (adjusted): 2009M07 2013M12
Included observations: 54 after adjustments
Standard errors in ( ) and *t*-statistics in [ ]

Cointegrating equation	Coint Eq1	
STR(−1)	1.000000	
MMR(−1)	0.146064	
	(0.58374)	
	[0.25022]	
C	−3.112725	
Error correction	**D (STR)**	**D (MMR)**
CointEq1	−1.078690	−0.033551
	(0.15506)	(0.01741)
	[−6.95647]	[−1.92715]
D (STR(−1))	−0.004261	−0.004331
	(0.11637)	(0.01307)
	[−0.03661]	[−0.33147]
D (STR(−2))	0.047885	−0.002417
	(0.10276)	(0.01154)
	[0.46598]	[−0.20945]
D (MMR(−1))	−0.050087	0.547432
	(1.22670)	(0.13773)
	[−0.04083]	[3.97468]
D (MMR(−2))	−2.610860	−0.298770
	(1.15899)	(0.13013)
	[−2.25270]	[−2.29598]
C	8.505524	1.988031
	(10.5299)	(1.18227)
	[0.80775]	[1.68154]
COP	−0.105048	−0.005558
	(0.10344)	(0.01161)
	[−1.01556]	[−0.47860]
INF	−4.601947	0.237459
	(2.65057)	(0.29760)
	[−1.73621]	[0.79792]
MSG	−0.019285	−0.004993
	(0.01731)	(0.00194)
	[−1.11406]	[−2.56920]
PST	2.323631	−0.025104
	(2.72612)	(0.30608)
	[0.85236]	[−0.08202]
VMI	0.013443	−0.027025
	(0.20689)	(0.02323)
	[0.06498]	[−1.16345]
R^2	0.649313	0.545637
Adjusted R^2	0.567758	0.439971
Sum square residuals	1026.796	12.94382
SE equation	4.886613	0.548652
F-statistic	7.961652	5.163804
Log likelihood	−156.1435	−38.05682
Akaike AIC	6.190499	1.816919
Schwarz SC	6.595663	2.222083
Mean dependent	−0.431773	0.069087
SD dependent	7.432664	0.733149
Determinant residuals covariance (dof adj.)		7.019350
Determinant residuals covariance		4.450884
Log likelihood		−193.5591
AIC		8.057746
Schwarz criterion		8.941739

VEC: Vector error correlation, SE: Standard error, SD: Standard deviation, MMR: Money market interest rate, MSG: Money supply growth rate, COP: Monthly crude oil price per barrel, STR: Monthly stock market returns, AIC: Akaike information criterion

measuring the stock market efficiency is very important to policy makers. Stock market is indeed an important vehicle for a country to facilitate flow of investment into businesses to accelerate economic growth and to reduce external debt. It is recommended to set up a Repurchase Agreement (Repo) Market by RBZ as a monetary policy measure to control interest rates.

Table 10: VEC granger causality tests

Sample: 2009M04 2013M12
Included observations: 54

Excluded	Chi-square	df	*P*
Dependent variable: D (STR)			
D (MMR)	7.045475	2	0.0295
All	7.045475	2	0.0295
Dependent variable: D (MMR)			
D (STR)	0.115459	2	0.9439
All	0.115459	2	0.9439

VEC: Vector error correlation, STR: Monthly stock market returns, MMR: Money market interest rate

Table 11: The pair-wise granger causality test

Sample: 2009M04 2013M12
Lags: 2

Null hypothesis	Obs	*F*-statistic	*P*
MMR does not Granger cause STR	55	0.51232	0.6022
STR does not Granger cause MMR		4.14578	0.0216

STR: Monthly stock market returns, MMR: Money market interest rate

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