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Stock Market Reaction to Selected Macroeconomic Variables in the Nigerian Economy

Terfa Williams Abraham[1]

This study examines the relationship between the stock market and selected macroeconomic variables in Nigeria. The all share index was used as a proxy for the stock market while inflation, interest and exchange rates were the macroeconomic variables selected. Employing error correction model, it was found that a significant negative short run relationship exists between the stock market and the minimum rediscounting rate (MRR) implying that, a decrease in the MRR, would improve the performance of the Nigerian stock market. It was also found that exchange rate stability in the long run, improves the performance of the stock market. Though the results for Treasury bill and inflation rates were not significant, the results suggests that they were negatively related to the stock market in the short run thus, achieving low inflation rate and keeping the TBR low could improve the performance of the Nigerian stock market. Specifically, the study concludes that, by achieving stable exchange rates and altering the MRR, monetary policy would be effective in improving the performance of the Nigerian stock market.

Key Words: Stock Market, Macroeconomic variables, Error Correction Model

JEL Classification: G10; E44; C22;

1. INTRODUCTION

The stock market houses a large chunk of the nation's wealth and has continued to be the major discuss of various studies since the advent of the global financial crisis. With the recent decline observed in the Nigerian stock market, various studies have examined the effectiveness of monetary policy on improving the performance of the Nigerian stock exchange. While maintaining financial system stability remains a core objective of the Central Bank of Nigeria, the evidence concerning the relationship between the stock market and monetary policy variables in Nigeria still offers some methodological gaps. This study aims at providing empirical evidence concerning the relationship between the stock market and selected macroeconomic variables in Nigeria. The study builds on the works of Islam (2003); Maysami *et al* (2004); and Osuagwu (2009).

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The author was at the time of this research, a graduate student of economics at the Ahmadu Bello University, Zaria. The views expressed in the study are those of the author, and should not be regarded as those of the Ahmadu Bello University, Zaria or the Central Bank of Nigeria.

The rest of the paper is organized as follows: section two reviews relevant literature for the study, while the research methodology is presented in section three. In section four, the results obtained from the analysis are discussed and finally, section five presents the summary and conclusion.

2 THEORETICAL AND EMPIRICAL LITERATURE

There are several schools of thought that offer theoretical explanations for the behaviour of stock prices. Some of them include: the fundamentalist school, the technical school, the random walk hypothesis school and the macro-economic hypothesis school. Detailed explanations of these theories are presented in Maku and Atanda (2009).

According to the fundamentalist, the value of a corporation's stock is determined by expectations regarding future earnings and by the rate at which those earnings are discounted. The technical school on the other hand, oppose the fundamentalists' and argue stock prices tend to follow definite pattern and each price is influenced by preceding prices, and that successive prices depend on each other.

The random-walk hypothesis is based on efficient market assumption that investors adjust security rapidly to reflect the effect of new information. The theory postulates that stock prices are essentially random and therefore, there is no chance for profitable speculation in the stock market. The macroeconomic approach argues that stock prices are sensitive to changes in macroeconomic variables.

Other author's, have proposed more formal theories that explain the behaviour of asset prices. One of such theories is the capital asset pricing model (CAPM). This theory relates the expected price of an asset to its riskiness measured by the variance of the asset's historical rate of return relative to its asset class (Sharpe 1964; Lintner 1965). The CAPM takes the following linear form:

$$R_t = \alpha + \beta X_t + \varepsilon_t \qquad (2.1)$$

where R_t represents the return to an asset, X_t represents the return of an underlying portfolio of assets (often measured as a domestic market index), and ε_t represents the asset-specific return, all at time t. The key term in the model is β (i.e. beta), which indicates the statistical relationship between the asset's return and the return on the total portfolio of assets.

An alternative framework to the CAPM is the arbitrage pricing model (APM), in which the return on an asset is specified as a function of a number of risk factors common to that asset class. The model assumes that investors take advantage of arbitrage opportunities in the broader market; thus, an asset's rate of return is a function of the return on alternative investments and other risk factors. A standard arbitrage model takes the following form:

$$R_t = \alpha + \beta_1 X_{1t} + \beta_2 X_{2t} + ... + \beta_k X_{kt} + \varepsilon_t \qquad (2.2)$$

The model is similar in form to equation 2.1, except that the X's represent a set of risk factors common to a class of assets, and the betas represent the sensitivity of the asset's return to each factor. As argued by Ferson and Harvey (1998) the CAPM and APM have advantages and disadvantages as models of asset returns. The CAPM is seen as parsimonious and commonly employed by equity analysts, but it requires a precise identification of the portfolio against which the asset is compared.

The APM, on the other hand, accommodates multiple sources of risk and alternative investments, suffers from a similar challenge of identification since many factors, both international and domestic, that could influence an asset's performance (Mosley and Singer, 2007). Thus this study will employ the asset pricing model as its theoretical framework where the all share index of the Nigerian stock exchange would be used to represent the asset price and exchange rates, inflation rates and interest rates will be viewed as their associated risk factors.

Islam (2003) examined the short-run dynamic adjustment and the long-run equilibrium relationships between four macroeconomic variables (interest rate, inflation rate, exchange rate, and the industrial productivity) and the Kuala Lumpur Stock Exchange (KLSE) Composite Index. The study found that there was significant short-run (dynamic) and long-run (equilibrium) relationships among the macroeconomic variables and the KLSE stock returns.

Maysami *et al* (2004) examined the long-term equilibrium relationships between selected macroeconomic variables and the Singapore stock market index (STI), as well as with various Singapore Exchange Sector indices. The study concluded that the Singapore's stock market and the property index form cointegrating relationship with changes in the short and long-term interest rates, industrial production, price levels, exchange rate and money supply.

Kandir (2008) investigated the role of macroeconomic factors in explaining Turkish stock returns from July 1997 to June 2005. Macroeconomic variables used were growth rate of industrial production index, change in consumer price index, growth rate of narrowly defined money supply, change in exchange rate, interest rate, growth rate of international crude oil price and return on the MSCI World Equity Index. The analysis was based on stock portfolios rather than single stocks. It was found that exchange rate, interest rate and world market return seem to affect all of the portfolio returns, while inflation rate was significant for only three of the twelve portfolios. On the other hand, industrial production, money supply and oil prices had no significant effect on stock returns.

Osuagwu (2009) investigated the impact of monetary policy variables on the performance of the stock market in Nigeria using quarterly data from 1984 to 2007. In his methodology, a linear combination of stock market index and monetary policy variables were estimated using ordinary least squares; co-integration and error-correction specification. It was found that stock market

performance was strongly determined by broad money supply, exchange rates and consumer price index in the short and long-run. On the other hand, minimum rediscount rate and Treasury bill rates showed mixed results and their relationship to changes in stock market index was not significant. The present study differs from Osuagwu (2009) in three ways: (1) it has an extended data set reaching 2008, (2) it makes use of annual data rather than quarterly data to see if consistent results will be yielded, and (3) it employs the engle-granger two step error correction model that rests on granger representation theorem to arrive at case specific results rather than the parsimonious error correction model employed in Osuagwu (2009).

Cointegration and Error Correction Models

The concept of cointegration and error correction model is extensively discussed in Rao (2005:9-25). The link between cointegration and error correction model stems from the Granger representation theorem (Engle and Granger, 1987). The theorem states that two or more integrated time series that are cointegrated have an error correction representation, and two or more time series that are error correcting are cointegrated.

There are three important points in this definition. First, cointegration refers to a linear combination of nonstationary variables. Secondly all variables must be integrated of the same order. However, this is only true for a two-variable case, if these two variables are integrated at different orders of integration, then these two series cannot possibly be cointegrated. However it is possible to have a mixture of different order series when there are three or more series under construction in which various subsets may be cointegrated. Thirdly, if Xt has n components, there may be as many as *n-1* linearly independent cointegrating vectors. If X_t contains only two variables, there can be at most only one independent cointegrating vector.

Engle and Granger (1987), proposed a two step procedure to test for cointegration. Prior to estimation, the variables are pre-tested for their order of integration. Based on the definition given by Engle and Granger (1987), cointegration necessitates that the variables be integrated of the same order. Therefore, each variable has to be pre tested by using the augmented dickey fuller (ADF) and Phillip Perron (PP) test to determine its order of integration. If the variables are integrated of different orders, possibly these variables are not integrated.

If the variables are cointegrated, the second step of the EG procedure involves specifying an error-correction model (ECM) for each equation in the system. The multivariate EG two-step procedure for estimating ECM however, requires that there are only two variables in the system.

The multivariate maximum likelihood cointegration testing procedure was developed by Johansen (1988) and Stock and Watson (1988) and Johansen and Juselius (1990). There are two basic test statistics involved in Johansen and Juselius's maximum likelihood test. The first test statistic is the *trace test* while the second is the maximal *eigenvalue test*. The Johansen's multivariate maximum-likelihood procedure though more robust in models involving more than two variables, is not

applied in two variable cases. In such cases, the Engle-Granger two step ECM procedures are preferred (Rao, 2005). In this study, the EG two – step procedure is followed.

3. RESEARCH METHODOLOGY

Time series data were collected for the all share index of the Nigerian stock exchange and selected macroeconomic variables in Nigeria from 1985 to 2008. The data were collected from the 2008 50th anniversary version of the Central Bank of Nigeria statistical bulletin downloadable from www.cenbank.org.

For the Nigerian stock exchange, the all share index was used as proxy while interest rates (minimum rediscounting and Treasury bill rates), inflation and exchange rates were the selected macroeconomic variables. The choice of the macroeconomic variables selected is to capture monetary policy variables of the Central Bank of Nigeria.

The all share index (ASI) was specified as the dependent variable while exchange rate (ER), minimum rediscounting rate (MRR) – sometimes referred to as the monetary policy rate, treasury bill rate (TBR) and the 12month moving average inflation rate (INF) were specified as the independent variables.

Though the study adopts the Ferson and Harvey (1998) Asset Pricing Model as the theoretical framework, the Engle-Granger (1987) two-step error correction model procedure discussed in Rao (2005), was adopted for the estimation of the models. The models are specified below:

$$\Delta \text{LogASI}_t = a_0 + a_1 \text{LogMRR}_t + a_2 U_{t-1} + \varepsilon_t \quad (3.1)$$

$$\Delta \text{LogASI}_t = b_0 + b_1 \text{LogTBR}_t + b_2 U_{t-1} + \varepsilon_t \quad (3.2)$$

$$\Delta \text{LogASI}_t = c_0 + c_1 \text{LogER}_t + c_2 U_{t-1} + \varepsilon_t \quad (3.3)$$

$$\Delta \text{LogASI}_t = d_0 + d_1 \text{LogINF}_t + d_2 U_{t-1} + \varepsilon_t \quad (3.4)$$

Where Δ denotes the first difference operation on the respective variables; a_1, b_1, c_1, and d_1 are the coefficients showing the short run equilibrium relationship connecting the independent and the dependent variable; a_2, b_2, c_2, and d_2 are the coefficient showing the long run relationship connecting the explanatory variables and the dependent variable. It has an a priori expectation sign of minus.

U_{t-1}, is the residual obtained from the linear regression of the I(1) variables and lagged by one as a requirement of the *granger representation theorem*. Lastly, ε_t, v_t, u_t and e_t are the disturbance term for the models. The estimation of the models were done using Eviews software.

4. RESULT AND DISCUSSION

When tested for stationarity using the augmented dickey fuller (ADF) unit root test, all the variables were found to be stationary at first difference i.e. I (1), Table 1. Thus, a simple linear regression was estimated connecting the independent variables to the dependent variable and their residual obtained. The residual was tested for unit root using the ADF statistic.

Table 1: STATIONARITY TEST Results Using Augmented Dickey Fuller (ADF) Procedure

Level test I(0)		Critical Values		
ADF Stat	Variables	1%	5%	10%
-1.1982	All Share Index (ASI)	-3.7497	-2.9969	-2.6381
-2.9637	Exchange Rate (ER)	-3.7497	-2.9969	-2.6381
-2.6474	Minimum Rediscount Rate (MRR)	-3.7497	-2.9969	-2.6381
-1.8261	Treasury Bill Rate (TBR)	-3.7497	-2.9969	-2.6381
-2.5629	Inflation Rate (INF)	-3.7497	-2.9969	-2.6381
First Difference Test I(1)				
-5.3646	All Share Index (ASI)	-3.7667	-3.0038	-2.6417
-3.9891	Exchange Rate (ER)	-3.7667	-3.0038	-2.6417
-5.8455	Minimum Rediscount Rate (MRR)	-3.7667	-3.0038	-2.6417
-5.5479	Treasury Bill Rate (TBR)	-3.7667	-3.0038	-2.6417
-3.8275	Inflation Rate (INF)	-3.7667	-3.0038	-2.6417

Source: Researchers Estimation - Eviews Output

Table 2: Residual Test for Stationarity

ADF Test Statistic	-2.940034	1% Critical Value*	-3.7497
		5% Critical Value	-2.9969
		10% Critical Value	-2.6381

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RES)
Method: Least Squares
Sample(adjusted): 1986 2008
Included observations: 23 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RES(-1)	-0.585588	0.199177	-2.940034	0.0078
C	279.3568	1496.671	0.186652	0.8537

R-squared	0.291589	Mean dependent var	406.5995
Adjusted R-squared	0.257855	S.D. dependent var	8328.451
S.E. of regression	7174.781	Akaike info criterion	20.67747
Sum squared resid	1.08E+09	Schwarz criterion	20.77621
Log likelihood	-235.7909	F-statistic	8.643799
Durbin-Watson stat	1.926043	Prob(F-statistic)	0.007821

Source: Researchers Estimation - Eviews Output

The result showed that, the variables were co-integrated at 10 percent level of significance (see Table 2) Following the granger representation theorem, the error correction models (i.e. equations 3.1 to 3.4) were then estimated. The results are presented in Tables 3 to 6 respectively.

Table 3: Estimated Result for Equation 3.1

Dependent Variable: D(ASI)
Method: Least Squares
Sample(adjusted): 1986 2008
Included observations: 23 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.102384	0.035979	2.845697	0.0100
D(MRR)	-0.703333	0.351157	-2.002902	0.0589
RES(-1)	-0.067320	0.045212	-1.488980	0.1521
R-squared	0.198610	Mean dependent var		0.105199
Adjusted R-squared	0.118471	S.D. dependent var		0.183567
S.E. of regression	0.172351	Akaike info criterion		-0.557463
Sum squared resid	0.594096	Schwarz criterion		-0.409355
Log likelihood	9.410819	F-statistic		2.478324
Durbin-Watson stat	2.567501	Prob(F-statistic)		0.109254

Source: Researchers Estimation - Eviews Output

Table 4: Estimated Result for Equation 3.2

Dependent Variable: D(ASI)
Method: Least Squares
Sample(adjusted): 1986 2008
Included observations: 23 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.101933	0.038827	2.625281	0.0162
D(TBR)	-0.293754	0.321375	-0.914054	0.3716
RES(-1)	-0.056344	0.051343	-1.097405	0.2855
R-squared	0.069371	Mean dependent var		0.105199
Adjusted R-squared	-0.023692	S.D. dependent var		0.183567
S.E. of regression	0.185729	Akaike info criterion		-0.407949
Sum squared resid	0.689905	Schwarz criterion		-0.259841
Log likelihood	7.691411	F-statistic		0.745417
Durbin-Watson stat	2.336428	Prob(F-statistic)		0.487267

Source: Researchers Estimation - Eviews Output

Table 5: Estimated Result for Equation 3.3

Dependent Variable: D(ASI)
Method: Least Squares
Sample(adjusted): 1986 2008
Included observations: 23 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.101192	0.042149	2.400849	0.0262
D(ER)	0.014909	0.239304	0.062300	0.9509
RES(-1)	-0.263445	0.117432	-2.243385	0.0364

R-squared	0.209102	Mean dependent var	0.105199
Adjusted R-squared	0.130013	S.D. dependent var	0.183567
S.E. of regression	0.171219	Akaike info criterion	-0.570641
Sum squared resid	0.586318	Schwarz criterion	-0.422533
Log likelihood	9.562373	F-statistic	2.643860
Durbin-Watson stat	2.317475	Prob(F-statistic)	0.095764

Source: Researchers Estimation - Eviews Output

Table 6: Estimated Result for Equation 3.4

Dependent Variable: D(ASI)
Method: Least Squares
Sample(adjusted): 1986 2008
Included observations: 23 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.105604	0.036960	2.857235	0.0097
D(INF)	-0.181238	0.113627	-1.595024	0.1264
RES(-1)	-0.064015	0.046035	-1.390570	0.1796

R-squared	0.156062	Mean dependent var	0.105199
Adjusted R-squared	0.071669	S.D. dependent var	0.183567
S.E. of regression	0.176867	Akaike info criterion	-0.505731
Sum squared resid	0.625638	Schwarz criterion	-0.357623
Log likelihood	8.815910	F-statistic	1.849217
Durbin-Watson stat	2.311333	Prob(F-statistic)	0.183275

Source: Researchers Estimation - Eviews Output

For equation 3.1, it was found that MRR had a significant negative short run relationship with the stock market at 10 percent significance level, while its long run component was not significant. This implies that, while lowering the MRR would improve the performance of the stock market in the short run, it is not certain that lowering the MRR would improve stock market performance in the long run.

For equation 3.2, the short run relationship between the stock market and exchange rate was positive but not significant. The long run coefficient however, was significant; implying that,

stable exchange rates would in the long run help to improve the performance of the Nigerian stock market. The result was significant at 5 percent level. The results for equations 3.3 and 3.4 relating stock market performance to Treasury bill and inflation rates respectively were not significant.

The long run equilibrium coefficients for all the equations however, had the expected *a priori* negative sign implying that, the models where appropriately specified. Only the coefficient (with a value of 0.2634) relating the stock market to exchange rate however, was significant. This further implies that 26.34 percent of the short run distortions affecting the performance of the stock market, could be corrected in the long run (in approximately four years) if stable exchange rate policies are consistently pursued.

5. SUMMARY AND CONCLUSION

This study examined the relationship between the stock market and macroeconomic variables in Nigeria. The all share index was used as a proxy for the stock market while inflation, interest and exchange rates were the selected macroeconomic variables considered. Employing error correction model, it was found that a significant negative short run relationship exists between the stock market and the minimum rediscounting rate (MRR) implying that, a decrease in the MRR, improves the performance of the Nigerian stock market. It was also found that exchange rate stability in the long run, improves the performance of the stock market. Though the results for Treasury bill and inflation rates were not significant, the results suggests that they were negatively related to the stock market in the short run thus, achieving low rates of inflation and keeping the TBR low might be good for the performance of the Nigerian stock exchange. The conclusion is that by achieving stable exchange rates and maintaining low monetary policy rates, monetary policy could be effective in improving stock market performance in Nigeria.

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