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Macroeconomic Variables and Stock Market Prices in Nigeria: A Cointegration and Vector Error Correction Model Tests

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Abstract: ***This study was undertaken to evaluate the effect of macroeconomic variables on stock market prices using annual time series datasets for Nigeria for the period 1980-2013. The data were analyzed with the application of OLS regression technique. The study employs Johansen cointegration and VECM based on arbitrage pricing theory (APT) of Ross (1976). The macroeconomic variables utilized were gross domestic product (GDP) and broad money supply (M2). The results of the findings indicate that Nigerian stock market prices have long-run relationship with macroeconomic variables. However, GDP has significant long-run negative effect on stock prices contrary to a priori expectation that GDP has significant positive effect on stock prices. But M2 has significant long-run positive effect on stock prices, the result being consistent with a priori expectation. Again, there is unidirectional causal effect between GDP and stock prices with direction running from stock prices to GDP. Whereas there is no causal effect between stock prices and broad money supply. However, in the short-run both GDP and M2 have positive but insignificant effect on stock prices in Nigeria. This result suggests that stock market in Nigeria is informational inefficient. It shows that predicting stock prices based on macroeconomic factors is difficult.***

Keywords: GDP, Broad Money Supply, Cointegration and VECM, Nigeria

1. Introduction

Over the years the study of the relationships between stock market prices and macroeconomic variables has been a subject of interest among researchers, especially academicians. The argument has often been that stock prices are determined by some fundamental macroeconomic factors like the exchange rate, industrial production index, inflation rate and money supply. Investors generally believe that macroeconomic variables have great influence on stock prices (Maghayereh, 2002).

Early studies such as Chen, Roll and Ross (1986); Fama (1981, 1990); Fama and French (1989) and Ferson and Harvey (1991) using arbitrage pricing theory (APT) model developed by Ross (1976), indicated that macroeconomic variables like industrial production index, changes in risk premium, changes in interest rate are related to stock prices in the US. Recent studies such as Mireku, Sarkodie and Poku (2013), adopted APT and cointegration analysis, also show the same results as with early studies.

Early studies, like King (1966), indicated that stock prices are affected by macroeconomic factors up to 50% on average. Flannery and Protopapadakis (2002) also suggested that macroeconomic factors are the most significant indicators that determine the income from stocks because the factors have an impact on future cashflows of the society. Thus anyone that wants to invest in stocks should focus on macroeconomic factors when analyzing stocks. On the contrary, Chandra (2004) revealed that economic factors account for 35% of the changes that occur in the stock market prices, the rest being explained by non-economic variables.

Osisanwo and Atanda (2012) also identified factors other than macroeconomics, classified as non-macroeconomic factors, that affect the stock market prices and the general trend of the market, namely; seasonal variations, enlightenment of the investing public or general awareness of the market, political and social crisis, investment motives, random behaviour of investors, new listing of securities, individual investor's objective in the market (speculation on long-term investment), company's earnings release and activities of the market regulator. They also indicated that the key determinants of stock prices are gross domestic product, inflation rate, interest rates (both Treasury bill and lending rate) money supply and exchange rate.

Nigerian monetary authorities have set a number of macroeconomic policies to stabilize the macroeconomic variables which had little or no impact on the capital market. The knowledge of the proper nature of the relationships between stock market prices and macroeconomic variables will ensure that only significant policy variables are used to formulate intervention policy in areas of high priority in the economy such as the stock exchange market.

Despite the influx of the research interest, there are indications that the issue of relationships between stock market prices and macroeconomic variables is yet to be settled. The data, method and instrument of analysis, and variables to be included all influence the outcome of a study. Consequently the issue of causality between macroeconomic variables and stock market prices is yet to be resolved.

Specifically the objectives of this study are:

1) To evaluate the effect of GDP and M2 on stock market prices in Nigeria so as to find out whether the former have significant effect on the changes that occur on the later.
2) To examine the causal effect between GDP and stock market prices.
3) To examine the causal effect between M2 and stock market prices.

This focuses on three research questions, namely;

1) What is the effect of stock prices on GDP and M2?
2) What is the causal effect between GDP and stock market prices?
3) What is the causal effect between M2 and stock market prices?

The following hypotheses are formulated to test the validity of our findings:

H_{O1}: GDP does not have significant effect on stock market prices in Nigeria.

H_{O2}: M2 does not have significant effect on stock market prices in Nigeria.

$H_{O3:}$ There is no causality between stock market prices and GDP in Nigeria

$H_{O4:}$ There is no causality between stock market prices and M2 in Nigeria.

The findings of this study will be beneficial to policy makers, investors, stock market dealers, macroeconomists and researchers. The result can help policy makers to draw and implement relevant policy regulations to improve stock market conditions. The findings would help potential investors not only to be familiar with the theories of stock pricing, but also to enable them to calculate more accurately solutions to problems of optimal portfolio selection, and to efficiently monitor and manage financial risks. The knowledge of this study would help macroeconomists in formulating macroeconomic policies that could impact on the economic activities for the benefits of the economy as a whole. It will serve as a research material.

Macroeconomic factors considered for analysis are: gross domestic product (GDP) and broad money supply (M2), and stock market index (as a measure of stock market prices). Stock market index is dependent variable, while the other variables are the independent variables which in this study are explanatory variables for stock price movements in Nigeria. The study covers 34-year time series data-period of **1980 to 2013.** For any meaningful econometric analysis Gujarati (2003) recommends 25 periods and above. This study meets the requirement.

The remaining part of this section consists of Statement of the Research Problem; Objective of the Study; Research Questions; Research Hypotheses; Significance of the Study and Scope and Limitations of the Study. Other sections into which this study is divided are: Section Two –Literature Review; Section Three – Research Methodology; Section Four – Analysis and Results of the Findings and Conclusions.

2. Literature Review

2.1 Theoretical Framework

This study adopts macroeconomic hypothesis school of thought that believes that stock prices are sensitive to changes in macroeconomic variables. Stock valuation models such as Asset Pricing Theory (APT), introduced by Ross (1973, 1976), specify that the current price of equity share is approximately equal to the present value of all future cash flows to the equity. It then follows that any economic variable that affects cash flows and required rate of return in turn influences the share price as well. The model emphasizes long-run relationship between macroeconomic variables and stock market prices. This study adopts APT model which theoretically explains this relationships between macroeconomic variables and stock market prices.

Asset pricing explains how financial assets are priced, why prices change, as well as how the prices are related to the underlying macroeconomic variables. APT model is a general theory of asset pricing that has become influential in the pricing of assets. APT model is based on multi-factor model in which every investor believes that the stochastic properties of returns of capital assets are consistent with factors structure. APT assumes that investors take advantage of arbitrage opportunities in the broader market. Consequently, an asset rate of return is a function of the return on alternative investment and other risk factors. It argues that the expected returns of a financial asset can be modeled as a linear function of various macroeconomic variables or theoretical market indices where the sensitivity to change in each factor is represented by a factor-specific beta coefficient. APT further argues that financial assets are correctly priced with modeled-derived rate of return. Consequently, it then follows that if price diverges, arbitrage should bring it back into line. APT model can be stated as follows:

$$E(R_i) = R_f + \beta_{i1} R P_1 + \beta_{i2} R P_2 + \beta_{i3} R P_3 + \ldots + \beta_{in} RP_n \quad (1)$$

Where, $E(R_i)$ = risky assets expected returns

R_f = risk-free rate

β_{in} = sensitivity of the asset to factor n (or factor loading)

RP_n = risk premium.

As earlier stated, stock price is related to future expected cash flows and future discount rate by which future expected cash flows are discounted. Prices of stock are determined by the net earnings of corporations. If a corporation is likely to do well in the near future, the stock price will rise to reflect this expectation. The stock price may fall if it is anticipated that the corporate cash flows will fall in the future. All this changes are reflection of macroeconomic factors.

Chen, Roll and Ross (1986) argue that any factor that could influence cashflows or discount rate by which cashflows can be discounted in turn affects stock prices. According to Fama (1970), the factors that generally influence stock prices are gross domestic product, inflation, money supply, interest rates and exchange rate. Muthike and Sakwa (2012) also opine that the variables which influence stock prices include goods and services prices, money supply, real economic activity, exchange rate, interest rates, political

risk, unemployment or employment, export earning, regional stock market indices, broadband internet penetration, regional retail sales and bankruptcies.

However, APT model does not provide any guidance as to which variables should be included in the analysis. Consequently, the choice depends on individual whims and caprices.

2.2 Empirical Literature

2.2.1 Gross Domestic Product

Early studies conducted in developed countries (as well as developing countries) like the U.S indicated that real economic activity has positive relationship with stock market prices. Fama (1981) and Chen, et al (1986) indicate that the relationship between stock market prices and gross domestic product is positive and significant in the U.S.

In a similar study concerning macroeconomic determinants of stock market changes, Campbell, Lettau, Malkiel and Xu (2001) show stock price has a positive correlation with gross domestic product in the US.

Ewing and Thompson (2007) show that gross domestic product is related to stock market index. Specially, Booth and Booth (1997); Ibrahim and Aziz (2003), in Malaysia; Wongbangpo and Sharma (2002), in ASEA-5 countries; Mukherjee and Naka (1995), in Japan; Mohammad, Hussain, Jalil and Ali (2009), in Pakistan; Clare and Thomas (1994), in the UK; and Brown and Otsuki (1990), in Japan; in their separate studies show that gross domestic product is one of the most popular significant factors that explain the stock market performance.

Mahmood and Dinniah (2009) reveal that gross domestic product has long-run equilibrium effect on stock prices in Japan, Korea, Hong Kong and Australia out of the 6 Asian-Pacific countries selected for a study between 1991 and 2002. However, Tan, Loh and Zainudin (2006) reveal that gross domestic product is negatively related to stock prices in Malaysia. Buyuksalvarci (2010) also shows negative relationship between industrial production and stock prices in Turkey.

Tursoy, Gunsel and Rjoub (2008) indicate that GDP affects stock prices with some differences among the various industry sectors in Turkey. But Kwon and Shin (1999) show that gross domestic product relates with stock market prices in Korea. Chandra (2004) shows that gross domestic product has positive effect on stock prices in the U.S.

Singh, Mehta and Varsha (2011), using Taiwan data-sets, found that gross domestic product is a significant factor that affects stock return. Mohammad, et al (2009) observed that gross domestic product is insignificant in explaining stock prices in Pakistan. Liu, Li and Hu (2006) found that gross domestic product leads to fluctuation in stock prices in China. Mansor and Hassanuddee (2003) analyzed the dynamic linkages between stock prices and four macroeconomic variables for Malaysia. Employing standard and well accepted methods of cointegration and vector auto-regression (VAR) on monthly data for the period of January 1970 to August 1998, they found a positive long-run relationship between stock prices and gross domestic product. Cointegration test analysis is a standard method usually adopted in analyzing the long-term relationship between macroeconomic variables and stock markets.

Suleiman, Hussain and Ali (2009), utilizing multiple regression analysis on a sample covering the period 1986-2006 for Kalachi Stock Exchange, found that index for industrial production does not significantly affect stock prices.

Most studies in Nigeria indicate that the relationship between stock market prices and gross domestic product is positive. Prominent among the studies conducted in Nigeria are Maku and Atanda (2000); Amadi, Onyema and Odubo (2002); Nwokoma (2011); Asaolu and Ogunmuyiwa (2011) and Olasumbo (2012). However, Osamwuyiwa and Evbayiro-Osagie (2012) indicate that stock price is affected negatively by industrial production in Nigeria. Oluwe (2007) indicated that gross domestic product has a long-run effect on stock market in Nigeria. Ajao and Oseyomon (2010) with cointegration test found that GDP has long-run significant effect on stock prices in Nigeria. Most of these studies concluded that there is a causal relationship between gross domestic product and stock prices, and that stock prices can be predicted by macroeconomic variables (including gross domestic product). This is an indication that Nigerian stock market is not efficient. In the study conducted in Ghana, Osei (2005), show that stock prices relate positively with gross domestic product. Owusu-Nantwi and Kuwornu (2012) indicated consistent results with Osei (2005) in Ghana. Dagadu (2010) established a long-run positive between stock price and gross domestic product in Ghana. The study used cointegration and ECM tests on monthly time series data for 1991-2008.

2.2.2 Money Supply

Theoretically, the volatility in money supply alters the equilibrium position of money supply, thereby changing the structure of assets in investors' portfolio. According to Rogalski and Vinso (1977), innovation in money supply may affect real economic variables which may lead to a lagged positive impact on stock market prices. Early studies conducted in developed countries indicate that money supply is negatively related with stock market prices. Fama (1981) suggests that the negative relationship can be observed by looking at direct relationship between money supply and inflation whereby the increase in money supply increases the discount rate and in turn decreases stock prices. Many researchers believe that the negative effects of money supply on stock prices is perhaps the innovation in money supply which is not accompanied by proportionate increase in output growth.

Ajao (2010) advanced two economic reasons why money supply must be included as a relevant macroeconomic factor in the determination of stock prices. The first reasoning is that changes in money supply will alter the equilibrium position of money supply thereby altering the composition and price of asset in an investor's portfolio. The second point is that changes in money supply may impact on real economic growth, and may have a lagged influence on

stocks. Hossein, Ahmad and Lai (2011), in their work in China and India, observed that money supply is likely to affect stock market index through at least three ways, namely;

(1) Innovations in the money supply may be correlated to unexpected increases in inflation and future inflation uncertainty and negatively correlated to the stock market index.
(2) Innovations in the money supply may positively affect the stock market index through its effect on economic activity.
(3) Portfolio theory says that a positive relationship exists between money supply and stock price changes.

In other words, increase in money supply will increase money holding and at the same time increase demand for stock, thus increasing stock prices. Maysami and Koh (2000) found that a positive relation exists between money supply innovation and stock market prices in Singapore.

Wongbangpo and Sharma (2002), Mukherjee and Naka (1995), Booth and Booth (1997), Chen, Kim, and Kim (1986, 2005), Ibrahim and Aziz (2003), found that money supply is an important significant factor in determining the stock market indices. But in the work of Buyuksalvarci (2010), as well as Gunasekarage, et al (2004), money supply was found to be positively related to stock market prices. Abdullah and Hayworth (1993) obtained similar result on the US stock Market.

Maysami and Koh (2000) found that money supply has positive relationship with stock returns in Singapore for the period 1988-1995. They found, however, for Indonesia and Philippine that money supply has long-run negative relation with stock prices, but with Malaysia, Singapore and Thailand, it was positive.

Cheung and Ng (1998) showed that money supply has long-run effect on stock market prices in developed countries such as Canada, Germany, Italy, Japan and the US.

Humpe and MacMillan (2007) provide evidence that stock prices are negatively related to money supply in Japan; but in the US, they found that money supply had an insignificant influence over the stock price. Singh, et al (2011) observed that money supply is insignificant in determining stock prices on Taiwan market. Mohammad, et al (2009) found that money supply is a significant factor in explaining movement in stock prices in Pakistan. Liu, Li and Hu (2006) found that money supply affects stock prices in China. Patra and Poshakwale (2006) found that short-run and long-run equilibrium relationship exists between money supply and the stock prices in Athens Stock Exchanges.

Maku and Atanda (2010) and Adaramola (2011) indicated that stock market prices and money supply are positively related in Nigeria. However, contrary to these results, Amadi, et al (2000) and Isenmila and Erah (2012) show that stock prices relate negatively with money supply in Nigeria. Asaolu and Ogunmuyiwa (2011) tested the Granger-causality between stock prices and money supply. The results indicate that money supply does not Granger-cause stock prices.

Adam and Tweneboah (2008) indicated that money supply and stock prices are negatively related in Ghana. Adu (2012) applies cointegration tests based on arbitrage pricing theory (APT) model with results showing that money supply possesses statistically significantly influence on stock market price changes in Ghana. The study also indicated that there is uni-directional causal relationship between stock price and money supply with direction running from money supply to stock price. Kpanie, Vivian and Sare (2014) used ECM and ADF cointegration analysis on quarterly time series data for Ghana for the period 1995-2011. Results indicated that money supply is statistically significantly related to stock prices in Ghana. The results also indicate a long-run negative relationship between stock market prices and money supply. Ogiji (2013) indicated that money supply has long-run significant positive relationship with stock market prices in Nigeria. The study applies cointegration and error correction model tests on time series annual data for 1980-2012. But Osisanwo and Atanda (2012) show that stock prices relate negatively with money supply in Nigeria. However, Nkoro and Uko (2013) indicated that money supply has no significant effect on stock market price changes in Nigeria. We expect money supply to have positive relationship with stock market prices in Nigeria, and in other developing economies.

3. Research Methodology

3.1 Sources and Description of Data

The main sources of data for this study are secondary sources. The data are annual time series data from 1990-2012. Macroeconomic data on gross domestic product (GDP) and money supply (M2) were obtained from the World Development Indicators (World Bank publication). NSI (proxy for Nigeria stock prices) obtained from the CBN Annual Reports and Financial Statements, and Nigeria Stock Exchange Fact-book (various issues).

Descriptive Statistics on NSI, GDP AND M2

	NSI	GDP	M2
Mean	14167.00	5.299630	28.55556
Median	8111.000	6.000000	22.60000
Maximum	57990.22	10.60000	64.20000
Minimum	345.5000	0.100000	10.00000
Std. Dev.	14181.96	2.843495	15.58987
Skewness	1.159610	-0.091293	1.025446
Kurtosis	4.253583	2.123993	2.938314
Jarque-Bera	7.819031	0.900817	4.736204
Probability	0.020050	0.637368	0.093658
Observations	27	27	27

Source: Output Data

3.2 Model Specifications

The research focus lies in examining the contemporaneous relationship between stock market prices and macroeconomic variables. The model follows the works of extant studies (with modifications) such as, Hosseini, et al (2011); Maku and Atanda (2010); the model is expressed

implicitly and explicitly in (4) and (5), respectively as follows:

NSI = f(M2, GDP) (2)

$NSI = \beta_0 + \beta_1 GDP_t + \beta_2 M2_t + e_t$ *(3)*

NSI is a function of the macroeconomic variables, where, *NSI* = Nigerian Stock Exchange All-share Index; *M2* = money supply and *GDP* = *gross* domestic product; β_0 is constant and β is coefficient of the variables, and β is expected to be greater than zero, while e is the residual error of regression representing global financial crisis and other exogenous factors that may not be readily measurable. Ordinary least squares (OLS) multiple regression (Zhang, 2009) method is adopted to compute the estimates of the regression model. All the estimations were performed in the econometrical software programme E-Views. Cointegration analysis, vector error correction and Granger-causality tests are to establish the relationships between GDP and M2, and stock prices. Augmented Dickey-Fuller test (developed by Dickey and Fuller, 1979) and Philips-Perron test procedure was adopted.

4. Results and Discussion of the Findings

4.1 Unit Root Test

The order of integration of the series is explained by the results from the unit root test results (Table 4.1).

Table 4.1: Unit Root Results

Variable	ADF Stats	Order of Integration
LNSI	-4.128790*	I(1)
GDP	-5.797371**	I(1)
M2	-4.323347*	I(1)

(*) = significant at 1%(5%) level. ***Source: Output Data from E-views 3.1*

The results presented in Table 4.1 shows that all the variables are integrated of the same order, I(1). Thus, there is the possibility of the existence of a long-run relationship among the variables.

4.2 Cointegration Analysis:

Table 4.2 below presents the results for cointegration tests.

Table 4.2: Cointegration Tests Results

H_0	H_1	Likelihood Ratio	5% Critical Value
r = 0	r > 0	31.45966*	29.68
r ≤ 1	r > 1	16.04828*	15.41
r ≤ 2	r > 2	3.446476	3.76

*= significant at 5% level. LR test indicates 2 cointegrating equations at 5% level.

Source: Output Data from E-views 3.1

The results indicated that there are two co-integrating equations at 5% level since the LR do not lead to the rejection of the null hypothesis r ≤ 2. Based on these results, it can be said that a long-run relationship exists among LNSI, GDP, and M2 in Nigeria.

4.3 Normalized Co-integrating Vectors Test Results

Table 4.3 presents the normalized cointegrating vectors test results.

Table 4.3: Normalized Cointegrating Vectors

LNSI	GDP	M2
1.000000	-0.243857**	0.305288*
	(0.10645)	(0.15674)
	[-2.2908126]	[1.9477351]

(*) = significant at 5%(10%) level. Note: figures in () and [] are Std. errors and t-statistics respectively. ***Source: Output data from E-views 3.1*

One can write the above co-integrating vectors in the form of an equation as shown below;

LNSI = -0.243857GDP + 0.305288M2 ---------- (4.1)

The equation indicates that GDP has a negative and significant effect on the Nigeria Stock Exchange all-share index in the long-run while money supply (M2) has significant positive effect on the Nigeria Stock Exchange all-share index in the long-run.

4.4 Vector Error Correction Model (VECM)

The estimation of VECM (Table 4.4) makes it possible to separate the long-run relationship between economic variables from their short-run responses.

Table 4.4: VECM Results with Respect to LNSI. Dependent Variable: ΔLNSI

Constant	ΔGDP	ΔM2	ECM(-1)
0.194033**	0.005898	0.004470	0.064991*
(0.0014)	(0.3252)	(0.2248)	(0.0556)

**(*) = significant at 1%(10%) level. R^2 = 0.201503, Adj R^2 = 0.101691, DW = 1.65,
F-Value = 2.018821, prob.(F-Value) = 0.03809. ***Source: Output Data from E-views 3.1***

The results indicate that the error correction term ECM (-1) appearing in the equation is statistically significant at 10% level of significance. The coefficient of the error correction term is about 0.06 with the expected negative sign. A significant error term with the right sign indicates a strong feedback effect of deviation of LNSI from its long-run growth path. The value of the coefficient of the error term represents the speed of adjustment. The coefficient 0.06 of the error correction term shows that about 6% of the discrepancies between the actual and equilibrium value of the LNSI is corrected in each period in Nigeria.

4.5 Granger Causality Tests

The granger causality tests results show that there is unidirectional causal relationship running from NSI to GDP, and no causality between NSI and M2 in Nigeria (Table 4.5).

Table 4.5: Granger Causality Tests

Direction of Causality	F-Value	Decision
GDP → LNSI	0.09954(0.90564)*	Do not reject H_0
LNSI → GDP	2.77022(0.08357)**	Reject H_0

M2 → LNSI	0.61348(0.55047)*	Do not reject H_0
LNSI → M2	0.31047(0.73626)*	Do not reject H_0

Note: figures in () are the p-values. **(*) = significant at 10% (not significant at any level). ***Source: Output Data from E-views 3.1from E-views 3.1***

4.6 Conclusion and Recommendations

Based on the results of the unit root tests there is indication of a long-run relationship between gross domestic product and stock market prices, on one hand, and money supply and stock market prices on the other hand. The findings of co-integrating vectors indicated that gross domestic product has significant long-run negative effect on stock market prices contrary to the *a priori* expectation Money supply has long-run positive effect on stock market prices which is consistent with the *a priori* expectation. However, the results of the error correction model show that both gross domestic product and money supply have positive and insignificant effect on stock market prices in Nigeria.

Again, there is unidirectional causal effect between gross domestic product and stock market prices with direction running from stock market prices to gross domestic product, and no causal effect between money supply and stock market prices in Nigeria. The non-causal effect between macroeconomic variables and stock market prices is an indication of informational inefficiency market. The adjusted R^2 value of 0.101691 implies that about 10% of the variations in stock market prices are accounted by changes in macroeconomic variables (specifically, GDP and M2) in Nigeria. F-statistic value of 2.018821 with p-value of 0.038097 indicates that these variables have insignificant effect on stock market prices in Nigeria. F-statistic confirms the result of the adjusted R^2 that GDP and money supply account for about only 10% of the variations in stock market prices in Nigeria.

The implication is that predicting stock market prices based on macroeconomic factors will be difficult to make. Again monetary policy makers will not find it easy to plan and forecast macroeconomic variables that help to boost the stock market. Investors should not rely on the announcement of macroeconomic variables in deciding whether or not to invest or not to invest. This is because stock price changes are influenced not just by macroeconomic factors but some other intervening factors that may not be readily amenable to measurement. Firms should also focus on improving their profitability performance so as to attract more investors. By so doing they would be able to maximize the value of their firms. In future investigation should be conducted to find out the best macroeconomic variables that impact positively on stock market prices in Nigeria.

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