A BAYESIAN ESTIMATION OF THE RELATIONSHIP AMONG ECONOMIC FUNDAMENTALS AND STOCK MARKET PERFORMANCE IN NIGERIA

Mustapha Saidi Atanda*, Nureni-Balogun Akeem Ade** and Yusuf Ismaila Akanni***

ABSTRACT
The traditional monetary transmission channels show the role of interest rates and money supply in stimulating asset prices and output in an economy. In an attempt to validate this claim the study verifies the interdependence among economic fundamentals and the stock market through the asset and credit channels. The empirical investigation was conducted using VEC causality and Bayesian VAR model. Macroeconomic variables of importance were money supply, inflation, monetary policy rate, credit to the private sector and exchange rate. The stock market index – All Share Index – is used to measure stock activities. Empirical results showed that both credit and asset channels were effective vantage point in transmitting macroeconomic responses to the economy. However, the results also showed that the stock market could be an effective channel of transmission in the near term. The monthly data used were sourced from the Central Bank of Nigeria and Nigerian Stock Exchange websites (2000-2011).

Keywords: Monetary Policy, Money growth, Asset Price Channel, Credit Channel, Causality, Vector Autoregressive model, Bayesian VAR model.

JEL Classification: C11, G10, G15, G19, N27

1. INTRODUCTION
The central banks’ monetary policy in a simplified analysis is the optimal quantity of money. In a financial sense, monetary policy is the optimal rate of growth of stock of money. More generally, monetary policy is a bundle of actions and regulatory stances taken by the central bank. Monetary policy decisions affect the economy in general and the price level to be specific, the process of achieving this impact assessment is known as the transmission mechanism of monetary policy. The transmission of monetary impulses to both the real and financial sectors involves a numerous mechanisms and actions by economic agents at various stages. As a result, monetary policy action, considerable time to affect price developments usually takes place. Furthermore, the size and strength of the different effects depend on the state, sectors’ elasticity and investors’
opinion of the economy, which makes the precise impact difficult to estimate and this form the
basis why this research is pertinent to the development of the Nigerian environs. More generally,
central banks typically see themselves confronted with long variable and uncertain lags in the
conduct of monetary policy.

In an attempt, to achieve a set of objective for the macroeconomic policy (Inflation, real
output and employment); monetary policy actions such as changes in the discount rate have an
indirect effect on these variables and considerable lags are involved in the policy transmission
mechanism. Broader financial markets though, for example the stock market, government and
corporate bond markets, mortgage markets, foreign exchange markets, are quick to incorporate
new information. Therefore, a more direct and immediate effect of changes in the monetary
policy instruments may be identified using financial data. Identifying the link between monetary
policy and financial asset prices is highly important to gain a better insight in the transmission
mechanism of monetary policy, since changes in asset prices play a key role in several channels
–other asset prices and credit channels.

According to the dividend discount and discounted cash flow models, stock prices are
equal to the present value of expected future met cash flows. Changes in stock prices determine
the responsiveness of investors to investment in securities and that explains the performance of
the stock market. Therefore, aggregate assessment requires better understanding of the impact
of macroeconomic variables on the performance of stock market which justifies the purpose of
this work. Monetary policy play important role in determining equity returns either by altering
the discount rate used by market participants or by influencing market participants expectations
of future economic activity.

Going by related channels of transmission, an expansionary monetary policy is commonly
viewed as good news for investors as this generates lower interest rate, increase future economic
activity and higher earnings for the firm in the economy. Thus, monetary policy tightening
should come with lower stock prices as interest rate rises which gives higher discount rate for
the expected stream of cash flows and lower the future expected returns and economic activity.
Therefore, stock market participants manage to understudy strategies base d on the stance of
the monetary authority as inferred by changes in indicators of the central bank policy. Therefore,
this paper focuses on the interdependence of monetary policy variables and the stock market
variable proxy by the All share Index.

Previous empirical results largely support the notion that expansionary (contractionary)
monetary policy increases (decreases) contemporaneous stock returns, as well as expected
returns\(^1\). In these studies they actually relate stock returns to measures of monetary policy
stringency in the context of single equation specifications and/or multivariate Vector
Autoregressions. Upward shift in risk premium, movements in monetary aggregates and
market interest rates are crucial factors that increase stock prices\(^2\) (Oyama, 1997). Previous
results indicate that for the majority of the countries reveal that monetary environment is an
important determinant of investors’ required returns. This holds across variety of returns
specifications. This clearly shows that expansionary monetary policy improves the stock
market and boost stock market performance. Policy implication of this result lies on the fact
the monetary authorities and stock market participants should be aware of the relationship
between monetary policy and stock market performance in order to understand the effects of policy shifts.

Purfield (2007) explains the relevance of asset prices as been leading indicators for future changes in economic activity because asset prices reflect the discounted value of expected future dividend vis a vis expected growth. Thorbecke (1997) finds out that positive monetary policy shocks increase stock returns when this happens, it suggests that monetary policy exerts real effects by increasing future cash flows or by decreasing the discount factors at which those cash flows are capitalized. Bernanke and Kuttner (2004) state that, a tightening monetary policy lead investors to view stocks as riskier investment and thus will demand for a higher return to hold stocks. From these review, it is clear that previous empirical work had found that the monetary authority’s decisions affect asset prices, including stock prices. Nevertheless, less attention had been directed to observe the link between monetary policy variables and the stock market in Nigeria even till date.

The overall objective of this paper is to provide empirical evidence on the relationship between economic fundamentals and one of the most pronounced branch of financial markets, the stock market. It is evident that stock price are amongst the most closely monitored assets prices in the world as they are highly sensitive to economic forces (Butt, 2010), therefore, critical examination of its response to changes in macroeconomic variables are major concern. The specific objectives contain the causal relationship between selected monetary variables and the stock market indicator. Secondly, stock prices often exhibit pronounced volatility and boom-bust cycles leading to concerns about sustained deviations from their fundamental values which when corrected have significant reverse consequence for stock market performance and economic growth. Thus, the existence of volatility strength of the stock market series shall also be verified. More so, establishing the existence of a stock market response to macroeconomic variables using quantitative methodology will not only be germane to research on stock market determinants but will also contribute to a deeper understanding of the conduct of economic and financial policy and of the potential economic impact of policy actions in Nigeria.

The organization of this paper is as follows: the next section discusses the review of related vast empirical literature while section three presents the theoretical framework and methodology design underlying the link between economic fundamentals and stock market. Section four consists of various methods to be employed. Section five comprises results and discussion and responses of the stock market. Lastly, section six provides conclusions and policy implications of the paper.

2. REVIEW OF LITERATURE

The fundamental approach is that the introduction of restrictive monetary policy to regulate the economy will leave the investors with no opportunity to raise fund except through the stock market⁴. Friedman (1956), attempted to integrate two separable decisions to be made by agents; the first relates to the decision on the quantity of savings and decision on how to allocate those savings among assets in a portfolio and in so doing transformed the liquidity preference theory of the demand for money. In other words, he proposed that portfolio allocation decisions could have an impact on consumption – investment decisions determined by the interest rate movements⁴.
Bernanke and Blinders (1992) observed that as interest rates are rising, firms that have their loan sourcing potentials eroded by high interest rates will suffer some adjustment costs which can be traced to the effect of monetary contraction which include a reduction in bank deposits and their holding of securities, a lagged decrease in bank loans, and measures of aggregate output will respond to monetary impulses with a similar lag and simultaneously bank loans will suffer a decline. The lending channel has often restricted the traditional monetary stance Bofinger (2001) illustrated this using a three variable model on an IS-LM framework which includes, money, bonds and reserves that banks hold with the central bank. Bernanke and Gertler (1995) found that monetary policy does not only affect the interest rate but also the external finance premium and this brings to light the notion of credit channel of monetary transmission mechanism. The lending channel however, is an extension of the credit channel, and the main focus is on banks which is consistent with the finding that banks are the major conveyors of monetary policy impulses to the real sectors of the economy.

Thorbecke (1997) makes use of quite number of alternative methodologies to examine the relationship between monetary policy and stock prices in the United States. He adopts the VAR modeling framework, his findings was that monetary policy shocks, measured by orthogonal innovations in the Fed funds rate have higher impact on smaller capitalization stocks, this is in line with the hypothesis that monetary policy affects firms’ access to credit. Cassola and Morana (2004) also employ VAR methodology, in their study they employed the cointegrated VAR system with variables like real GDP, Inflation< real money balances (M3), short term interest rate, bond yield, and real stock prices in order to examine the transmission mechanism of monetary policy in the Euro area. Their results indicate that a permanent positive monetary shock has a temporary positive effect on real stock prices.

Following Fama and French5 (1989), Patelis (1997) observed that predictability in excess US stock returns can be attributed to shifts in monetary policy stance. He also finds that monetary policy variables are significant predictors of future returns, although they cannot account fully for the observed stock return predictability. Jensen and Johnson (1995) also find that monetary policy developments are associated with patterns in stock returns. They were establish that long term stock returns following discount rate decreases are higher and less volatile than returns following rate increases. Their motivation for the use of discount rate as a proxy for the stance of monetary policy follows from the view that the discount rate is typically regarded as a signal of monetary developments. Conover, Jensen and Johnson (1999) argue that not only US stock returns, but also returns on foreign markets are related with US monetary environments. They find that stock returns in twelve OECD countries over the period 1956-1995 are generally higher in expansive US and local monetary environments than they are in restrictive environments.

2.1. Stock Market Operation and Performance

The Lagos State Exchange commenced operations in 1961; it was renamed the Nigerian Stock Exchange (NSE) in 1977. Branches were established in eight locations. The total number of listed stocks increased from 9 in 1961 to 52 in 1971 and 71 in 1978. It also increased to 157 in 1980, 276 in 1994, 277 in 2004 respectively. However, it declined to 260 in 2000, 202 in 2006
and further increased to 212 in 2007, 213 in 2008 and 266 in 2009. It noticed a sharp drop in 2010 to 217 (Ariyo and Adelegan, 2005; and Mustapha, 2011). The determination of share prices is not exclusively left to the forces of demand and supply. Both NSE and SEC, as market regulators, can and sometimes do impose a cap on share price movement. Nse has widened the price cap but that does not affect the efficiency of the market and its pricing policy, however, prices is known to reflect available market information (Olowe, 1998; Oludoyi, 1999; and Adelegan, 2003).

NSE transited from the call over trading system to the automated trading system (ATS). An electronic business platform was commissioned in 2003. The approach facilitates investors’ transactions in the Central Securities Clearing System (CSCS) database for easy monitoring of their accounts. The Nigerian securities market trade alert information was introduced in 2005. The mobile phone alert system alert stockholders of any transaction in their stock within 24 hours. Nigeria’s stock market is still developing. A number of studies have been conducted to identify the level of efficiency and the problem hindering development of the market (Omole, 1999; Oludoyi, 1999; Adelegan, 2003). Few description of the recent performance in the stock market is described below.

The profit-taking that started in May continued in June (see Figure 1). The Nigerian Stock Exchange All-Shares Index (NSEAI) fell by 524 points or by 2.38% in June. Market capitalization also fell as a result. On a year-to-date basis, NSEAI has been down by 503 points

![Figure 1: NSE All-Share Index and Market Capitalization (YTD)](image)

Source: Authors Computation
or by 2.28%. The trading volume increased compared to May. As clearly observed in figure 1, most year-to-date gains on the NSEAI were recorded in the second half of April making the last two weeks of April the most profitable period of 2012 so far. The NSEAI finished April at over 22,000 points. The rally lasted until May 4th reaching the YTD peak of 22,666 points and sliding ever since. The NSEAI lost 1123 points (close to 5% of its value) from the May 4th peak till the end of June. On a year-to-date(YTD) basis the NSEAI has been down by 503 points or by 2.28% and subsequently the market capitalization of the companies listed on the NSE has decreased by N344 billion or by 5% compared to 2011-end.

2.2. Macroeconomic Environs and Stock Market

Money Supply and Stock Prices

There has been no clear-cut on the effects of money supply on stock prices. A positive causal relationship which is hypothesized in financial theory literature by (Sprinkel, 1964, Homa and Jaffe 1971, Hamburger and Kochin 1972, Pearce and Roley 1985, Husain and Mahmood, 1999). This is based on the assumption of inverse relationship between money supply to interest rates, and negative causal relation from interest rates to stock prices (Alatiqi and Fazel, 2008). However, some studies found positive causal relationship and argue for non existence of a stable and structural relationship (Pesando, 1974. Kraft and Kraft, 1997, Gupta, 1974).

Money supply growth is expected to lead to a decrease in interest rates which will lead to a decrease in the discounting factor on future receipts. This is expected to lead to an increased demand for shares as the share prices and returns soar. However, an increase in money supply will also lead to an increase in money demand therefore the shift in the money demand function to the right would result in the simultaneous shift of the money supply to the right as well. This generates a new equilibrium interest rate above the old interest rate. Therefore, the assumption that is made is that the effects of factors that lead to a decline in interest rates outweigh those that may result in ultimately a higher equilibrium interest (Alatiqi and Fazel, 2008). Hashemzadeh and Taylor (1988) have found bi-directional causality present in the regression models between money supply and stock returns using stock indexes to estimate stock returns. Financial theory postulates that an increase in money supply increases the demand for stocks which rallies the price of shares.

Interest Rates and Stock Prices

Theoretically the interest rates and stock prices have an inverse relationship. The is because a rise in interest rate reduces the present value of future dividends income which should depress stock prices (Hamrita, Abdullah and Ammou, 2009). Conversely, low interest rates results in lower opportunity cost of borrowing. Lower interest rates stimulate investments and economic activities which will cause prices to rise. The direction of causality seems to be mostly running from interest rates to stock price but not the other way an indication of bi-directional causality. The link between stock prices and nominal interest rates mirrors the ability of an investor to adjust the structure of her portfolio between stock and bonds (Apergis and Eleftheriou (2000). The implication is therefore that an interest rate increase (decrease) prompts our representative
investor to change the composition of her portfolio in favour of (against) bonds. Malkiel (1982) and Modigliani and Cohn (1979) argue that the interest rates seem to be the most important determinants of stock prices. There is no consensus in literature over the actual relationship between stock prices and interest rates. Empirical attempts provide evidence in favour of a positive, rather than a negative relationship in other empirical studies (Asprem, 1989, Shiller and Beltratti, 1992 and Barsky, 1989). This paper therefore endeavours to link up and explain the nature that exists between stock prices and interest rates in Nigeria.

**Stock Prices and Inflation**

Sourial (2002) observes that inflation is positively related to interest rates and negatively related to stock prices. This is referred to as inflation expectation hypothesis. Modigliani and Cohn (1979) argue that stock market react inappropriately to inflation due to investors’ ignorance that interest rate rise to compensate for the rise in inflation. When interest rates increase investors view this as an increase in the cost of production since cost of capital has increased and they increase prices of their goods and services. The price level rises yet the objective of monetary authorities is to curtail the pressure of inflation which is interpreted wrongly by the market. However, stock prices of firms go down, since stocks are now less attractive, on top of that companies’ profitability is affected by rising inflation as households reduce their consumption in expectation of tougher times ahead.

### 3. THEORETICAL FRAMEWORK

This section points out the theoretical link between monetary policy and the stock market. Previous argument in this respect had two broad divisions; the first division is the group that believes that the link runs from monetary policy to the stock market. Whilst the other group argues that the link runs from the stock market to monetary policy. Stock market players need to be aware policy direction as it affects their activities and decisions. Theory acknowledges that market reacts to unexpected changes which are surprise announcements by the monetary authorities. The major theoretical link between monetary policy and stock market to be adopted by this study is based on the interest rate channel.

#### 3.1. Money Supply and Interest Rate Channel

Interest rate channel is the traditional transmission mechanism. It can be easily regarded as the main channel since it has an indirect impact on other monetary channels. Adjustment and variations in interest rates have impact on asset prices by altering the discount rate which is an important determinant of asset pricing (Faure, 2003). An interest rate adjustment also has an effect on the exchange rate through its impact on capital flows and exchange rate is part of the relevant variable monitor by the central bank of an economy (Neri, 2004).

A central bank can pursue an expansionary monetary policy by adjusting its policy instrument, either decreasing its policy interest rate or increasing its monetary aggregate under its control. A restrictive monetary policy involves increasing the policy interest rate or decreasing monetary aggregate under the Central Bank control. For instance, a tightening monetary policy in most cases this result in the decline of money supply, this policy is associated with higher
interest rates. Cost of capital increases when interest rates have been increased consequently leading to a reduction in the demand for credit which leads to decline in investment and aggregate demand and output decline for there no longer meaningful investment.

Figure 2: A Schematic Flow Chart of Macroeconomic Variables, Stock Price and Aggregate Output Monetary Variables

![Flow Chart](source)

Source: Author’s Computation

There are various ways of valuing equity but the interest in this paper goes for two approaches, Smith (1925) and Gordon Growth Model (1962), net present values models. The interest rate just discussed is a component of these valuation methods indirectly through the rate of return. Therefore the review of stock valuation methods shall be discussed in the subsection below:

### 3.2. Stock Market Valuation and Interest Rates

In financial theory, issues relating to valuation of shares in the stock market are based on the present value model. There are two versions of the present value in the literature namely Smith (1925) and Gordon (1962) version (Moolman, 2004). The purpose of stock valuation methods is to attempt to estimate the intrinsic value of a share. The major reason for adopting stock valuation methods is to attempt to estimate the intrinsic value of a share. The current interest rate is used to discount future dividend flows. Lucas (1978) postulated that the price of a stock
is given by the discounted sum of future dividend payments. A change in supply of money will lead investors to revalue the stock market (Sellin, 2001).

The theory of the present value model of share valuation according to Smith (1925) postulates that the equilibrium price of a share at a point in time is equal to the discounted present value of the expected future flows from that share; in other words, the model advocates that any factor that alters the expected future profits of firms will affect their dividend payment, and as a result affect the share valuation (Jefferis and Okeahalam, 2000). Smith (1925) presented the present value model as follows:

\[ P_e = \sum \frac{D}{(1+w)^t} + \frac{E(P_{en})}{(1+w)^n} \]  

(1)

Where:

\[ E(P_{en}) = \frac{D_{n+1}}{w-g_n} \]

\( E(P_{en}) \) is the expected price of the share in year \( n \), this equation says that the value of equity is the discounted value of all the dividend payments due plus the discounted expected value of the share in year \( n \).

Gordon (1962) developed a model to develop the major problems of the present value model as presented by Smith (1925). The major weakness of the present value model is the assumption that dividend payments \( D \) are fixed especially in the long run. It is more rationale to assume that dividend payments are prone to change. This assumption is carried; following a model put forward by Gordon (1962), which is a variant of the present value model as presented by Smith (1925). The Gordon constant growth model argues that, overtime dividends will grow at a certain consistence growth rate of \( g \) percent per annum. Value of share according to the Gordon growth (1962) is computed as follows:

\[ V = \frac{D_1}{k-g} \]  

(2)

Where:

\( V = \text{value of share} \)

\( D_1 = \text{expected dividends per share in one year time} \)

\( k = \text{Shareholders rate of return} \)

\( g = \text{Constant dividend growth rate.} \)

At all times \( k \) should be greater than \( g \) for the formula to make sense and avoid the possibility of a negative or infinite share price. Interest rate represented by \( r \) in the formula is the variable affected by monetary policy directly. Whenever interest rates increase rate of return has to increase as well but the increase in the denominator reduces the value of share. Then investors find that alternative investments like Treasury bills, negotiable certificates of deposit (NCDs) become more desirable than equity. Investors sell stocks and stampede on the money market. A decrease in \( k \) reduces the discount rate on future dividends. The denominator in the formula
is smaller which increases the value of shares. An expansionary monetary policy makes the stock market more attractive than money market investments.

The discussion on equity valuation models was explored since monetary policy particularly surprise policy moves is likely to have an impact on stock prices directly through the discount (interest) rate channel. Monetary policy is most likely to affect output, employment and inflation and this will affect company profitability indirectly through these variables. This will affect dividends companies pay eventually, which will lead to decrease in stock prices if a tightening monetary policy is implemented.

4. METHODOLOGY

Several empirical works on this kind of study had made use of various estimations. The bulk of them made use of the Ordinary Least Square (OLS) and the Maximum Likelihood (ML) estimators. The Vector Autoregressive technique (VAR) was also part of the paraded estimation techniques used in previous research. However, various literatures showed the VAR be ill with over-parameterization, and many different approaches have been proposed in order to obtain a more efficient and robust estimates. The most celebrated approach was put forward by Litterman (1979, 1986) and Doan et al. (1984) using the Bayesian estimation procedure popularly known as Bayesian VAR model. In Bayesian setting, data are not the only sources of information, but they are combined with prior distribution so as to produce a posterior probability density function for parameters.

In the literature, the classical Bayesian VAR takes into account that most observed economic time series possess long run behavior similar to the random walk process. This is added into a prior distribution framework by requiring that in every equation the parameter on the first lag of dependent variable is equal to one, and all the other parameters are given zero prior mean. In other words, the Bayesian approach to the over-parameterization is to specify unclear restrictions on the coefficients, rather than excluding the restriction or assuming their lag coefficient to be zero.

\[ \text{Data + Prior belief} = \text{Posterior Probability Density Function} \]  \hspace{1cm} (3)

Although the Bayesian approach has been applied in several finance literature, it has been criticized that the choice of the prior tends to be arbitrary. In a study on estimating mutual fund returns, Atiya and Magdon-Ismail (1999) employed an approach to obtaining the prior buy using the density of general market returns as the priors. This is followed in our case as our All Share Index (ALSI) cover the returns and/or performance of the whole market; therefore, the density of general market return will also be used in this study as the priors.

4.1. Data Depiction

This subsection is used to describe the data needed for the analysis in this study. The Nigerian stock market performance is measured by the All Share Index (ALSI) this will also be adopted. For data on economic fundamentals, the study shall considers macroeconomic variables such as inflation rate (INF), discount rate (DRT), monetary growth which will be captured by the growth of money supply (GRM2), credit to the private sector (CPS) and exchange rate (EXCH). The data duration for this study ranges between Jan. 2000 and Dec. 2011.
**All Share Index**

The All Share Index is a broad index as it allows seeing the market spectrum at a glance. The market index represents the most liquid stocks on the floor of the exchange. The index includes companies stocks that have been actively traded and the source of the data is from the Nigerian Stock Exchange Market (NSEM). Monthly returns are calculated as continuously compounded returns at time $t$, $A_t$.

In other words, as the natural log difference in the closing market index $ALSI_t$ between two months as shown below:

$$ A_t = \ln \left( \frac{ALSI_t}{ALSI_{t-1}} \right) = \ln(ALSI_t) - \ln(ALSI_{t-1}) \quad (4) $$

**Inflation Rate**

Inflation rate has been always announced on monthly series within a month lag. The major source of inflation data in Nigeria is National Bureau of Statistics (NBS). In this study the month on change data series shall be considered.

**Broad Money Supply (M2)**

The broad money supply data is obtained from the Central Bank of Nigeria (CBN) and the monthly growth rate of M2 has been calculated using the logarithmic form below:

$$ g(M2)_t = \log(M2)_t - \log(M2)_{t-1} \quad (5) $$

**Monetary Policy Rate**

The rate is decided by the monetary policy committee of the Central Bank of Nigeria and is announced on monthly basis.

**Credit to the Private Sector**

This includes both private business and household borrowings. The monthly growth in credit to the private sector $gcps$ is calculated as follows:

$$ (gcps)_t = \log(cps)_t - \log(cps)_{t-1} \quad (6) $$

**Exchange Rate**

Similar studies on the subject matter had made use of exchange rate as one of the explanatory variables. Based on the significant changes in the exchange rate of Nigeria with the estimation period; this study shall also consider exchange rate as one of its regressors to measure the influence of international activities as the exchange rate determines international price of transaction.

4.2. Empirical Investigation

The standard procedure when using time series is to do stationarity tests. Due to the nature and features of time series data, it is require that series are of zero mean and constant variance that
is, integrated of order zero, $I(0)$. Gujarati (2005) describes a stationary stochastic process as containing constant mean and variance overtime and a non-serially correlated covariance. This study uses two popular tests. The first is unit root test Augmented Dickey Fuller (ADF) test and the second is a stationarity test Dickey Fuller Generalized Least Square (DF-GLS) test. Since the former is extensively discussed in the literature (See Enders, 2004 and Brooks, 2008) it shall not be discussed but the DF-GLS is considered because of the presence of trend in any of the data. DF-GLS de-trending nature takes care of this. As it is done in related studies which work with financial data, common tests for financial time series will be conducted.

Cointegration has been commonly investigated prior to the estimation of VAR models by quite number of studies. However, Fuller (1976) and Sims (1980) argued that the goal of the VAR model is to determine the interrelationships among the variables and not to determine the impact assessments. Hence, the empirical investigation is conducted using a version of the VAR model i.e. the Bayesian VAR (BVAR) model. The classical Bayesian VAR methodology shows that the prior is specified taking into consideration that most observed economic time series have long run behavior similar to the random walk process; this is accommodated by the prior distribution framework. The prior distribution requires that in every equation the parameter on the first lag of dependent variable is equal to one, and all the other parameters are given zero prior mean. In other words, the Bayesian approach to the over-parameterization is to specify (unclear) restrictions on the coefficients, rather than assigning lag coefficient to zero. This is done by putting long lags normal prior distribution with zero mean and small standard deviation. The standard deviation of prior distribution is presented as follows:

$$S(i, j, k) = \frac{\{\alpha h(k)g(i, j)\} s_i}{s_j}$$  \hspace{1cm} (7)

Where $s_i$ is the standard error of univariate autoregression on equation $i$. The variables in the right hand side between brackets are product of various options of control and represent the tightness or weight of the prior on coefficient $i$, $j$ and $k$. The first option is the overall tightness which represents the standard deviation on the first own lag. Second option is the tightness on the lag relative to lag 1. Finally, the tightness on variable $j$ in equation $i$ relative to variable $i$ is specified as 1. If $i = j$ or otherwise the bracket is multiplied by the ratio of the standard error of $i$ and $j$ to correct for different scales of the variables.

The decomposition of variance is done following (Sims-Bernanke Decomposition) structural decomposition model such that the non-orthogonal innovation process $\mu_i$ will be as follows:

$$\begin{bmatrix} \mu_{ulst, t} \\ \mu_{urst, t} \\ \mu_{gms, t} \\ \mu_{gcps, t} \\ \mu_{lft, t} \\ \mu_{evr, t} \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} v_{ulst, t} \\ v_{urst, t} \\ v_{gms, t} \\ v_{gcps, t} \\ v_{lft, t} \\ v_{evr, t} \end{bmatrix}$$
Where the left hand side is the matrix of the residuals and the right hand side is the innovations of the corresponding variables. The ordering matrix is assigned to show the contemporaneous response of the index variable (ALSI) to shocks in monetary policy variables. Similarly the Granger causality tests to detect the causation of the shock among the variables.

5. RESULTS AND DISCUSSION

A cursory reflection of Appendix 1 shows that most of the series have features of non normality; this is common in financial time series data. The Jarque-Bera statistics tests the normality of the series and the null hypothesis is that series are normally distributed. Hence, the null hypothesis can be rejected for variables like GALSI, GCPS, GMS, MPR. Except for inflation and exchange rate that evidence reveals that they are normally distributed. Table 1 presents the stationary test results and there is evidence of stationarity at levels for variables like GALSI, GCPS, GMS and INFL, I (0). However, EXR and MPR attained their stationary point at first difference, I (1) respectively.

<table>
<thead>
<tr>
<th>Variables</th>
<th>ADF Test (t-values)</th>
<th>DF-GLS Test (t-values)</th>
<th>I(d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth of ALSI (GALSI)</td>
<td>-9.921</td>
<td>-9.517</td>
<td>I(0)</td>
</tr>
<tr>
<td>Money Growth (GMS)</td>
<td>-14.381</td>
<td>-7.977</td>
<td>I(0)</td>
</tr>
<tr>
<td>Growth of CPS (GCPS)</td>
<td>-17.014</td>
<td>-15.222</td>
<td>I(0)</td>
</tr>
<tr>
<td>Monetary Policy Rate (MPR)</td>
<td>-11.761</td>
<td>-11.778</td>
<td>I(0)</td>
</tr>
<tr>
<td>Inflation Rate (INFL)</td>
<td>-3.354</td>
<td>-4.119</td>
<td>I(0)</td>
</tr>
<tr>
<td>Exchange Rate (EXR)</td>
<td>-8.497</td>
<td>-8.515</td>
<td>I(0)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Critical Values for each Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1%</td>
</tr>
<tr>
<td>5%</td>
</tr>
</tbody>
</table>

Definitions:
ADF = Augmented Dickey Fuller Test
DF-GLS Test = Dickey Fuller Generalized Least Square Test
I (d) = Order of Integration

Source: Author’s Computation

The results of the stationary test reveal that variables exhibit different levels of stationary points. This necessitates the performance of the cointegration test, which will be done through the Joahansen and Jesulis (1991) multivariate procedure. The cointegration results in table 2 report an existence of long term relationship among the variables as we given by significance of two cointegrating vectors using the MHM p-values.
Table 2  
Multivariate Co-integration Test  

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Eigen Values</th>
<th>Trace Stats</th>
<th>C.V. (0.05)</th>
<th>Prob.**</th>
</tr>
</thead>
<tbody>
<tr>
<td>None*</td>
<td>0.278</td>
<td>141.7</td>
<td>95.753</td>
<td>0.000*</td>
</tr>
<tr>
<td>At most 1*</td>
<td>0.251</td>
<td>96.412</td>
<td>69.818</td>
<td>0.000*</td>
</tr>
<tr>
<td>At most 2*</td>
<td>0.195</td>
<td>56.172</td>
<td>47.856</td>
<td>0.006*</td>
</tr>
</tbody>
</table>

*denotes rejection of the hypothesis at 0.05 level  
**Mackinnon-Haug-Michelis (1999) P-Values  

Source: Author’s Computation

As discussed from the cointegration test that a long term relationship exist among variables the paper can employ a vector error correction (VEC) modeling to estimate its joint causality results but before that, the lag selection criteria for the VEC model is presented in table 3 with the optimum lag and serial autocorrelation result, note that the probability value of the autocorrelation LM test is reported for simplicity. The optimal lag length chosen has to be smallest lag length among the ones that eliminate serial autocorrelation, thus, the researcher can use discretion as well. An optimum lag length of 2 lags is chosen in the study.

Table 3  
Lag Length Criteria and Autocorrelation Test  

<table>
<thead>
<tr>
<th>Information Criteria</th>
<th>VEC Lag</th>
<th>Autocorrelation Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified LR Test Statistics</td>
<td>2</td>
<td>0.05</td>
</tr>
<tr>
<td>Final Prediction Error (FPE)</td>
<td>1</td>
<td>0.01</td>
</tr>
<tr>
<td>Akaike Information Criterion (AIC)</td>
<td>1</td>
<td>0.02</td>
</tr>
<tr>
<td>Schwarz Criterion (SC)</td>
<td>1</td>
<td>0.01</td>
</tr>
<tr>
<td>Hannan-Quinn Information Criterion (HQ)</td>
<td>1</td>
<td>0.28</td>
</tr>
<tr>
<td>Optimum Lag</td>
<td>2</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Source: Author’s Computation

5.1. Causation, Shocks and Innovations
The causality results in table 4 and the Bayesian VAR estimate show that the growth of the market index vis-à-vis the index returns respond positively to inflation rate shock as reported by the empirical result. A 0.12% positive shock response exist between inflation and market growth and the causality test also gave a unidirectional causation running from inflation to the stock market. The positive relation between inflation rate and asset returns in domestic currency is in line with Tobin’s q and Fisher effect hypotheses that suggest that nominal asset returns should move in the same direction with inflation (Mishkin, 1995). Intuitively, for the positive response between Nigeria’s stock market and inflation rate; money illusion does exists as inflation is on the rise and considerably low real interest rates which debar investment (Modigliani and Cohen, 1979; Mishkin, 1995). This is observed in the movement of the capitalization and analyst comments of profit takings as been sole responsible for the downward trend (see figure 1).
The stock market growth responded positively to shocks in money growth and exhibited significant coefficient. The coefficient shows 0.90% this contradicts Sourial (2000), implying that the shock from money growth is a supply shock and not a demand shock. Instinctively, the supply shock could be due to the tightening monetary policy adopted by the monetary authority to tame inflation pressure and it could also be as a result of reallocation of investments from the stock market by foreign investors who possess a huge capital stake in securities on the floor of the Exchange. The unanticipated shock in money supply growth i.e. liquidity effect hypothesis is consistent with the contractionary monetary policy set by the government to control liquidity. There is possibility of inadvertent vulnerability of capital inflows as the real interest is low due to high persistent inflation. Furthermore, money growth shock had its positive response to financial wealth of individuals and investors (Mishkin, 1995). A unidirectional causality exists between the money growth and the growth of the stock market; this supports the claim of the empirical evidence.

Monetary policy rate and Exchange rate have no significant impact on the growth of the stock market. The causality results in table 4 show that there is zero causation among the three variables namely policy rate, exchange rate and stock market growth. This is in line with findings of Oyinlola (2011) that finds no causation between exchange rate and stock market growth.

Positive growth in credit to the private sector is one of the engines of investment growth in emerging economies. However, this study finds negative relationship between growth in credit to the private sector and the stock market; this result supports the claim of Mauro (2000) findings which showed 2 out of 6 emerging markets and 4 out of 18 advanced markets exhibited negative response to a positive shock in growth in credit to the private sector (sourial, 2000). It implies that the growth in credit is not productive that is, credit is either been directed to financing consumption or concentrated on non-performing sectors and not the stock market.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Chi-Square</th>
<th>Prob.</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth of MS Causes Growth of ALSI</td>
<td>27.757</td>
<td>0.000***</td>
<td>Unidirectional Causation</td>
</tr>
<tr>
<td>Exchange Rate Causes Growth ALSI</td>
<td>3.929</td>
<td>0.14</td>
<td>No Causation</td>
</tr>
<tr>
<td>Growth of CPS Causes Growth of ALSI</td>
<td>1.429</td>
<td>0.489</td>
<td>Zero Causality</td>
</tr>
<tr>
<td>Inflation Causes Growth ALSI</td>
<td>7.631</td>
<td>0.022**</td>
<td>Unidirectional Causality</td>
</tr>
<tr>
<td>Monetary Policy Rate Causes Growth ALSI</td>
<td>4.689</td>
<td>0.095</td>
<td>No Causation</td>
</tr>
</tbody>
</table>

*Source: Author’s Computation*

### 6. CONCLUSION

In an attempt to establish the degree of interdependence of the stock market and macroeconomic variables through various transmission channels; the study employs the VEC causation test and Bayesian VAR model consisting of six endogenous variables with two lags and a constant. Data used was obtained from the Central Bank of Nigeria (CBN) and the Nigerian Stock Exchange (NSE) websites and it ranges from 2000 to 2011 on monthly frequency.
The empirical results provided new evidence of interdependence of macroeconomic variables and stock market in Nigeria. The insignificant of some of the estimated coefficients are not surprising as it is similar to the findings of Erb et al. (1995), Mauro (2000) and Sourial (2000). The results proved that both the asset price channel (Tobin’s q and Wealth effects) and credit channel (balance sheet and bank lending effects) are effective ways of transmission of macro variables in Nigeria. It was evident that the tightening monetary policy increase cost of borrowing to investors and consequently, borrowers financial strength declined, consumption dropped, aggregate demand fell and firms’ revenue deepened while net worth is been eroded. Finally, growth in broad money and inflation control are efficient ways of bridging the illiquidity gap in the Nigerian stock market.

Notes
3. In the case of improving consumption in the current period, investors raise fund through the stock market with the intention of paying back through their reserve investment; a complete case of consumption and investment with capital market under the flexible capital market line. In a bid to boost demand for their stock, the price falls up to a level that will attract investors at least in the short run.
4. According to J. M. Keynes (1936), the liquidity preference theory of demand is divided into three categories namely: transactional, precautionary and speculative demand. Here, the Keynesian money is cash, though some literature gave it broader definition.
5. Fama and French (1989) regress stock returns at increasing time horizons on the dividend yield, the default spread and the term spread. They find that predictability increases with the time horizon.
6. The head office in Lagos was opened in 1961, Kaduna branch was opened in 1978, Port Harcourt, 1980, Kano, 1989, Onitsha, 1990, Ibadan, 1990, Abuja area office, 1999, Yola, 2002 and Benin, 2005. The Abuja Stock Exchange was established in 1998. Because of unified operation and political reasons, it was later converted to commodity exchange on 9 of August 2001. Commodity exchange as the name implied is a forum where farmers can trade their commodities.
7. Loayza et al., 2002 in their analysis present the Keynesian model as the main channel of monetary transmission.
8. The inflation rate has been on double digits - 10.3% as at the December 2011 - since the beginning of the financial crisis in June 2008 where the rate rose from 9.7% to 12.0% within the period of 30 days. A decline in inflation rate has been anticipated due to the commitment of monetary authority to lower inflation as part of the policy objective of the monetary policy department of the Central bank of Nigeria.
9. Wealth and Credit effect hypotheses.

References


Appendix 1: Descriptive Statistics

<table>
<thead>
<tr>
<th>Variables</th>
<th>GALSI</th>
<th>GMS</th>
<th>GCPS</th>
<th>MPR</th>
<th>INFL</th>
<th>EXR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.893</td>
<td>2.173</td>
<td>2.446</td>
<td>12.722</td>
<td>12.393</td>
<td>129.493</td>
</tr>
<tr>
<td>Median</td>
<td>0.18</td>
<td>1.475</td>
<td>2.18</td>
<td>13</td>
<td>12.35</td>
<td>128</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>7.52</td>
<td>5.898</td>
<td>8.241</td>
<td>4.365</td>
<td>5.612</td>
<td>14.877</td>
</tr>
<tr>
<td>Skewness</td>
<td>-0.514</td>
<td>0.863</td>
<td>0.399</td>
<td>0.002</td>
<td>0.097</td>
<td>-0.049</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>8.667</td>
<td>17.718</td>
<td>43.356</td>
<td>1.926</td>
<td>3.361</td>
<td>2.213</td>
</tr>
</tbody>
</table>

Normality Test

| Jarque-Bera | 199.053 | 1317.729 | 9775.876 | 6.91 | 4 | 1.013 |
| Probability | 0.000*** | 0.000*** | 0.000*** | 0.031** | 0.602 | 0.151 |

Note: ***/** indicate 1% / 5%/ 10% levels of significance

Source: Author’s Computation

Appendix 2: Stability of the VEC Model

Inverse Roots of AR Characteristic Polynomial

Source: Author’s Computation
Appendix 3: Graphs of Residuals

Source: Author’s Computation
Appendix 4: Trend of Selected Macroeconomic Variables

Source: Author’s Computation