The Impact of Macroeconomic Variables on Stock Prices: Evidence from the United States

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Abstract

This paper aims to examine the relationship between stock prices and macroeconomic variables in the United States using quarterly data for the period 1988 to 2012. We dentify five macroeconomic variables (i.e, gross domestic product, inflation, real money supply, Treasury bill rate, and oil prices) that researchers have linked to stock prices. We then examine the relationship between these macroeconomic variables and the S&P500 by estimating cointegration system using Johansen technique. Moreover, this paper will use Vector Error Correction Model (VECM) to test the short run relationships. Also, we use variance decomposition technique to understand which macroeconomic variable have more explantory power of the variation in the S&P500.

The cointegration test results suggest the existance of positive and significant long-run relationship between S&P500 and real money supply. However, It shows a negative and significant long run relationship between S&P500 and oil prices. On the short run, the VECM analysis illustrates a short-run relationship between real money supply on two quarter lag and S&P500. Moreover, variance decomposition technique shows that shocks to S&P500 explains approximately 85% of the variation of S&P500 at quarter ten whileshocks to real money supply explains more variations in S&P500 than any other variable at quarter 10 (8.49%). To sum up, the results confirmsthe influence of macroeconomy on the stock market especially when proxied by real money supply and oil prices.

1. Introduction

1.1. Motivation and Background:

The possible interaction between macroeconomic variables and stock prices has emerged as an important topic and attracted the attention of the academic society. A large body of the literature focuses on how macroeconomic factors influence stock prices. Nonetheless, there is an increasing recognition that the impactcan also be in the opposite direction – major events in the stock market are expected to have an impact on the real economy.

The empirical finance literature on the relationship between stock returns/prices and macroeconomic variables offers a number of methods to link stock returns to the economy. It starts with explaining current returns with current economic variables and vice versa. Then, there are many attempts to explain returns with future realisations of economic variables. Next, the Vector AutoRegressive (VAR) approach combines the two-way relationship without a prior specification of a theoretical framework. Finally, economic tracking portfolios (ETPs) are used to explain stock returns because ETPs are asset returns with an interpretable economic content.

Hence, we will attempt to answer two main questions: (i) whether a long-term relationship exists between five important macroeconomic variables and stock prices in the United States using S&P500 index; and (ii) whether this relationship also present in the short run.

1.2. Contribution

This study aims to revisit the evidence on the interaction between stock prices and macroeconomic variables in the United States on the basis of a more recent dataset (1988-2012). We dentify five macroeconomic variables (i.e, GDP, inflation, real money supply, treasury bill rate, and oil prices) that researchers have linked to stock prices. We then examine the long-term relationship between these macroeconomic variables and the S&P500 by estimating cointegration system using the Johansen technique.

Next, we use Vector Error Correction Model (VECM) to test the short-term relationship between the above mentioned macroeconomic variables and the S&P500. Moreover, this study will use variance decomposition technique to understand which macroeconomic variable have more explantory power of the variation in the S&P500.

In section two, we review the literature on the relationship between macroeconomic variables and stock prices and discuss different methods used to examine this relationship between macroeconomic variables and stock prices. Section three addresses the methodolgy used to examine existance or non-existance of long-run relationship between macroeconomic variables and stock prices. Section four presents the data sources and the sample selection criteria. Section 5 shows the results from different tests of long and short term relationships between macroeconomic variables and stock prices together with the accompanying required tests for the variance decomposition. Section 6 contains a summary of the results andlists the limitations of the study and outlines possible future research.

2. Previous Studies

A variety of approaches had been used to analyse the linkage between stock market and macroeconomic variables. Consider first the use of current economic variables to explain stock returns. This approach represents the underlying core of the asset-pricing literature. Chen *et al*. (1986) use the Arbitrage Pricing Theory (APT) in the US as a framework to find out whether risk related to certain macro-variables is reflected in expected stock returns. They find that term spread, expected and unexpected inflation, industrial production growth, and default spread are significantly priced.

In a comparable study, Breeden, Gibbons and Litzenberger (1989) test the consumption capital asset pricing model (CCAPM) usinga maximum correlation portfolio for current consumption. More recently, Fama and French (1993) use term spread and default spread as state variables to explain their 25 portfolio returns and find them significant in explaining stock returns.

Several studies published in the early 1990s examine whether stock return variations can be explained by future values of measures of real activity. Fama (1990) regresses real returns on contemporaneous and leads of production growth for the period from 1953 to 1987. He shows that leads of quarterly production up to three or four quarters ahead help to explain monthly, quarterly and annual US stock returns. Moreover, he finds that stock returns are significant in explaining future real activity over the whole period.

Schwert (1990) replicates Fama's (1990) study for the relation between stock returns and real activity, but using an additional 65 years of data and two measures of industrial production. He confirms Fama's (1990) findings that future production growth explains a large fraction of the variation in stock returns over the period 1889 to 1988, although one measure of industrial production is more closely related to stock price movements than the other.

MacQueen and Roley (1993) examine the response of stock prices (proxied by the S&P500 Index) to future shocks in some macroeconomic variables, with and without conditioning on the state of the economy, from September 1977 to May 1988. They find that the S&P Index responds negatively and significantly to unanticipated change in the narrow money supply (M1). However, when distinguishing between three states of the economy (High, medium, and low based on the industrial production lowe and upper bounds), the S&P500index responds significantly to some economic information. More specifically, they find that good news about the economic activity in the high state is bad news for the stock market. For example, an unexpected increase of one percent in the industrial production decreases stock prices by about 0.8 percent in the high state. Likewise, an unexpected decline in the unemployment rate of one percent will lower stock prices by about 2.2% in the high state. However, the stock market response to these two information items changes signs in the low state, although their estimates of the responses are now statistically insignificant.

Binswanger (2000) tests whether the Fama (1990) results hold up in the stock market growth period from the early 1980s until 1995. He runs regressions of monthly, quarterly and annual returns on leads of quarterly production growth rates but finds them insignificant in explaining variations in stock return since 1984. He concludes that Fama's results do not hold up any more since 1984.He attributes his results to the possible existence of bubbles or fads which make stock prices movements more independent from subsequent changes in real activity.

Campbell and Ammer (1993) admit that the use of contemporaneous regressions to explain asset price variation is appealing because of its simplicity and because it is an extension of the well-established event study method in finance. However, they argue that one disadvantage of the use of both contemporaneous and future regressions is that they have little to say about the channels through which macroeconomic variables affect asset prices or to distinguish between the overlapping effects (e.g. industrial production and stock prices might move together in respond to interest rate movements).

The ICAPM of Merton (1973) falls into this category. In the ICAPM, the priced factors are shocks to state variables that predict future returns and not just any set of factors that are correlated with returns. However, the ICAPM tend to be lumped together with the APT as simply different examples of factor pricing models.

Brennan, Wang and Xia (2004) test the ability of a simple model of the ICAPM to price stock returns. They use shocks to real interest rate and shocks to the maximum Sharpe ratio as risk factors and assume that this model completely describes the investment opportunity test. They find that shocks to both state variables have significant risk premia in the cross-sectional asset pricing tests.

Still in the ICAPM framework, Hahn and Lee (2006) and Petkova (2006) test whether shocks to state variables are able to explain the cross-section of stock returns. Both papers suggest that shocks to those state variables are significant in explaining the cross-section of stock returns despite that the former uses changes in the states variables as proxy for shocks while the letter applies a VAR model to construct shocks to state variables.

The application of VAR models is one of the mainstream empirical approaches in financial market vs. macroeconomic analysis. These models provide a framework for formal examination of the two-way relationship between stock prices and macroeconomic variables without the need to specify theoretical assumptions *a priori*, and to construct shocks to state variables.

This VAR approach is based on the pioneering work of Campbell (1991), although it was initially suggested by Chen *et al*. (1986). However, the econometric modelling of the macroeconomic factors was not a concern of Chen *et al*. (1986) as they create the innovations as the change in, or the rates of growth of, the variables. Campbell (1991) uses lagged market return, the dividend-to-price (DP) ratio, and the relative bill rate as forecasting variables for market return in the VAR system for the period 1927 to 1988. He finds that these forecasting variables are jointly significant at the 1.8% level but the lagged stock return and the DP ratio are individually insignificant.

Moreover, Campbell (1991) uses the VAR approach to decompose the overall market return into news about dividends and news about future market returns. He shows that, for the whole sample period and one lag estimation, slightly more than a third of the variance of unexpected returns is attributed to the variance of news about future cash flows (dividends) whereas slightly less than a third is attributed to the variance of news about future returns, and the reminder is due to the covariance term.

Campbell and Ammer (1993) uses the VAR approach to decompose excess stock returns and 10-year bond returns into changes in expectations of future stock dividends, inflation, short-term real interest rates, and excess stocks and bond returns. Using monthly post-war US data from 1952 to 1987, they find that stock returns are driven largely by news about future excess stock returns while bond returns are driven largely by inflation. Moreover, they show that real interest rates have little impact on returns despite them affecting the short-term nominal interest rate and the slope of the term structure.

Lee (1992) uses a multivariate VAR approach to investigate the causal relations, and dynamic interactions, among stock returns, interest rates, real activity, and inflation in the post-war United States. He finds that stock returns are Granger-caused and help explain a reasonable fraction of the variance in real activity. Numerically, 92.67% of the 24-month forecast error variance in real stock returns is explained by its own innovations, while 10.61% of the 24-month forecast error variance in industrial production is explained by real stock returns. Moreover, he shows that stock returns explain little variation (2.37%) in inflation, whereas interest rates explain a substantial fraction (38.78%) of the variation in inflation. Finally, he finds that inflation explains little variation (3.35%) in real activity, and shocks to inflation have a negative impact on real activity for the post-war period.

Canova and De Nicolo (2000) use VAR models to examine whether shocks to nominal stock returns influence real activity and inflation, and, in turn, whether and how nominal stock returns respond to shocks in real activity and inflation for four countries, the US, the UK, Japan and Germany. First, they examine closed-economy VAR models for each country alone. Then, they use a number of bilateral VAR models with the US as one country and Germany, Japan, or the UK as the other country. They find that shocks to nominal stock returns are not significantly related to real activity or inflation. Moreover, the term structure of interest rates predicts both domestic and foreign inflation rates and domestic future real activity only for the US.

A more recently advocated approach in studying the relationship between financial markets and the macroeconomy is introduced as the ETP analysis in Lamont (2001). Lamont (2001) argues that the ETP approach represents a middle ground between the long tradition of explaining returns with other returns and the other tradition of explaining returns with contemporaneous or future economic variables. He gives two reasons for this.First, tracking portfolios are in fact asset returns, and second, they have an interpretable economic content.

The first attempt to construct ETPs is performed by Breeden *et al.* (1989) who construct maximum correlation portfolios for current consumption to test the CCAPM. However, Lamont (2001) constructs tracking portfolios for future (not current) economic variables, and consequently he uses only the unexpected component of returns and not total returns in constructing the tracking portfolios.

Vassalou (2003) addresses the question of how good is the news related to future GDP growth in explaining the cross-section of stock returns in comparison with the Fama-French factors. She constructs a mimicking portfolio for news related to future GDP growth from a combination of six stock portfolios and two bond portfolios. She finds that the mimicking portfolio for news related to future GDP growth can price the cross-section of stock returns as well as the Fama-French factors.

Junttila (2002) adopts an international view of the ETP framework by using a set of US and three EU countries (Germany, Italy, and France). He finds that, using ETP, it is possible to forecast future values of inflation and changes in industrial production in the three EU countries and the US using only current and past financial market information. However, the tracking and forecasting power of the portfolios and also control variables is highly dependent on the country and the forecasting horizon. He argues that the forecasting performance of this form of ETP outperforms the use of the traditional VAR approach for the analysed countries.

Xue (2003) uses the semi-parametric reduce-rank regression (SPARR) technique to regress five macroeconomic variables (the term yield spread, the one month treasury bill rate, the default yield spread, the monthly growth of industry production, and the monthly change of CPI) on the three Fama-French factors simultaneously. He finds that about 23% of the variations in Fama-French factors can be explained by these macroeconomic variables.

On the flip side of the coin regarding the macroeconomy vs. financial market analysis, Andreou, Osborn and Sensier (2000) examine whether financial variables (interest rates, stock market price indices, dividend yields, and monetary aggregates) predict economic activity over the business cycle for the US, the UK, and Germany for the period 1955-1998. They use cross-correlation coefficients to establish leading or lagging indicator properties where they define a financial variable as leading (lagging) if the maximum absolute cross-correlation value associates with a lag (lead) of the variable relative to contemporaneous production. They find that the most reliable leading indicator among the three countries is the term structure, although other variables also seem to be useful for specific countries (e.g. dividend yield looks a more useful leading indicator of economic activity than stock returns in the UK). Moreover, they report that the volatilities of the important leading indicators are also useful leading indictors for both the growth and volatility of industrial production.

Another paper on this “flip-side” framework is carried out by Christoffersen and Slok (2000) who apply a fixed-effect panel regression of monthly data for the Czech Republic, Hungary, Poland, Russia, Slovakia and Slovenia to test whether asset prices contain information about future economic activities. They find that historical values for interest rates, exchange rates, and stock prices signal future movements in real economic activity and particularly in industrial production.

In the same direction, Liew and Vassalou (2000) examine whether some return factors, namely, HML, SMB, and WML, predict the economic growth for ten developed markets. They run univariate and bivariate regressions of future growth in GDP on past holding period returns on HML, SMB, and WML individually and with past returns on the market factor respectively. They find that at least HML and SMB have predictive ability for future GDP growth, independent of any information contained in the market factor.

Cheung and Ng (1998) examine the interactions between national stock market prices and aggregate economic variables by adopting cointegration analysis to quarterly data fromCanada, Germany, Italy, Japan and the US. They find evidence of long run co-movements between the national stock market index levels and country-specific measures of aggregate real activity such as real oil prices, real output, real money supply and real consumption.

Likewise, Choi, Hauser and Kopecky (1999) test the relationship between industrial production (IP) growth and lagged real stock returns for the G-7 countries, applying both in-sample cointegration and error-correction models and the out-of-sample forecast evaluation procedure. Their cointegration test results confirm a long-run equilibrium relationship between IP growth and real stock prices, whereas the error-correction models identify a correlation between IP growth and lagged real stock returns for all countries except Italy. Their out-of-sample tests indicate that, in several sub-periods, the US, UK, Japanese and Canadian stock markets are prescient for future IP in their respective economies.

In this study, wewill concentrate on one direction of the interaction between stock returns and the economy which goes from the economy to the stock market. This direction is the underlying core of the asset-pricing literature. Moreover, we use a mixture of methods to test how the economy affects stock returns, namely, the cointegration test to examine the impact of macroeconomic variables on stock returns on the long run and Vector Error Correction Model (VECM) technique and the variance decomposition technique to test the short impact.

Upon this review of the United States literature on the macroeconomic factors that affect stock returns, it can be noted that the relation between stock returns and macroeconomic factors has been studied according to the four different approaches. Moreover, the main economic factors that are found to be significant in explaining United States's stock returns, in at least one paper, aregross domestic product (GDP), inflation, real money supply, Treasury bill rate, and oil prices. we will concentrate on these variables in our tests.

3. Methodology

3.1. Unit Root Test: Augmented Dickey-Fuller test

In order to perform a cointegration test, all variables need to be integrated to order one (i.e., I(1)). It can be said that a series is I(1) if its first difference is stationary. Brooks (2002, p.367) defines a stationary series as "one with constant mean, constant variance and constant autocovariances for each given lag".

One way to test whether a series y is stationary is by performing an ADF test, usually referred to as a unit root test. The basic objective of the test is to examine the null hypothesis that $y = 0$ from the following equation where q is the number of lags and u is the error term;

$$\Delta y_t = c + y\, y_{t-1} + \sum_{i=1}^{q} l_i \Delta y_{t-1} + u_t \qquad (1)$$

Where:

y_t is the tested variable,

c is the constant term,

$y = f - 1$ where f is from $y_t = f y_{t-1} + u_t$

u_t is the error term.

Hence, all variables are subjected to an ADF test with twelve lags of the dependent variable in a regression equation (1) on the raw data series of the used variables. If the test statistic exceeds the critical value, the null hypothesis of a unit root in the series is rejected. In contrast, if the test statistic does not exceed the critical value, the null hypothesis of a unit root in the series cannot be rejected. Similarly, if p-value is less than 5 percent, the null hypothesis of a unit root in the series is rejected. Two specifications are used; one with constant only while the other is with both constant and trend.

3.2. Cointegration test

In order to examine the existance of long-run relationship between the tested variables, a cointegration systems using the Johansen technique based on Vector AutoRgression (VAR) is employed.

If the tested variables (g≥2) are I(1) and thought to be cointegrated, a VAR with k lagscontaining these variables could be set up as follows:

$y_t = \beta_1 y_{t-1} + \beta_2 y_{t-2} + \ldots\ldots + \beta_k y_{t-k} + u_t$ (2)

Where:

y_t, y_{t-k}, and u_t are vectors of the rank $g\times1$

β_t is a matrix of the rank $g\times g$

Brooks (2002) argues that in order to use the Johansen test, the VAR (equation 2) above needs to be turned to a vector error correction model (VECM) of the following form:

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta y_{t-i} + u_t \quad (3)$$

Where: $\Pi = (\sum_{i=1}^{k} b_i) - I_g$ and $\Gamma_i = (\sum_{j=1}^{i} b_j) - I_g$

The VECM allows to test for cointegration in the whole system in one step without imposing the restriction that each variable needs to be normalized. Hence, the VECM avoids carring out errors from the first step to the second step (as in Engle-Granger method) and does not require prior assumption of endogenity or exogenity.

However, one disadvantge with Johansen test is that it can be afftected by the lag length employed in the VECM. Hence, it will be useful to select the lag length optimally using the well-known information criteria; Schwarz, Akaike and Hannan-Quinn information criterion.

After deciding the lag length, the test for cointegration between the variables is computed by looking at the rank of the Π matrix via its eigenvalues (λs). Brooks (2002) argues that there are two test statistics for cointegration under Johansen approach, trace and maximum eigenvalues, which are formulated as follows:

$$l_{trace}(r) = -T \sum_{i=r+1}^{g} \ln(1 - \hat{l}_i) \quad (4)$$

and

$$l_{\max}(r, r+1) = -T\ \ln(1 - \hat{l}_{r+1}) \tag{5}$$

where r is the number of cointegrating vectors under the null hypothesis, T is the number of observations, and $\hat{l}_i$ is the estimated value from the Π matrix.

The first test l_{trace} is a joint test where the null hypothesis is that the number of cointegrating vectors is less than or equal to r against the alterntive that there are more than *r* cointegrating vectors. However, the second test $l_{\max}$ runs separate tests on each eigenvalues, and its null hypothesis states that the number of cointegrating vectors is r against an alternative of *r*+1.

3.3. Variance Decomposition:

A variance decomposition is employed to understand which macroeconomic variable have more explantory power of the variation in the S&P500. Brooks (2002) argues that the variance decomposition give the proportion of the movements in dependent variable (i.e, S&P500) that is due to its own shock, in comparison to shocks to the other variables.

4. Data and Sample Selection

4.1 Sample Selection

The quarterly time-series data are collected from the Federal Reserve Bank of ST. Louis website. The sample period is twenty five years from the second quarter of 1988 to the fourth quarter of 2012 (99quarterly observations). We intentionally start our sample from 1988 to avoid any bias due to the impact of the great recession, which took place on 1987, on the results of the study.

4.2 Variables

Following is the variables' definition:

a) **S&P500** is used as a proxy for the stock market performance and is calculated as the value-weighted of a group of large-cap500 companies listed atNew York Stock Exchange (NYSE) and NASDAQ which cover around 75% of the market capitalization of U.S stocks.

b) **Gross Domestic Product**(GDP) is the quarterly gross domestic product.

Fama (1990) argues that an increase in economic activity would result in an increase in stock prices through its impact on future cash flows. Chen et al. (1986) document a positive realtionship between industrial production and stock prices in the US. However, The UK evidence reported by Beenstock and Chan (1988) documents no significant impact of industrial production on stock returns although they expect that an unexpected increase in economic activity would increase dividends and the returns on capital assets. However, Poon and Taylor (1991) find mixed results on the sign of the relationship between industrial production and stock prices. This research hypthesis positive relation between stock prices and GDP growth.

c) **Inflation** is the monthly percentage change in the Consumer Price Index(CPI). There are mixed arguments regarding the relation between inflation and stock prices.Chen et al (1986) document a negative relationship between inflation rate and stock prices and attribute this negative relationship to the following impact of increasing inflation on higher nominal risk-free rates and discount ratesand as a result lower stock prices. Moreover, Defina (1991) and Mukharjee ad Naka (1995) argue that the negative relationship is due to the decrease in cash flows due to the quick adjustement of input costs to inflation faster than output prices. However, Beenstock and Chan (1988) document a positive relation between inflation and stock prices in the UK.

d) **Oil Prices** is the monthly price of crude petroleumFor oil consuming companies, an increase in oil prices is expected to increase costs and reduce future cash flows. Consequently, we expect a negative relation between stock prices of theses companies and oil prices. However, the opposite would be true for oil producing companies as it will reflect in higher cash flows and hence increase in their stock prices.

Beenstock and Chan (1988) suggest a negative and significant relation between stock prices and fuel and material input. Moreover, Chen et al. (1986) suggest a negative, though insignificant impact of oil prices on stock returns.

e) **Real money supply** is the United Statesseasonally adjusted money supply M2 deflated by the Consumer Price Index (CPI). This number is calculated as M1 plus (i) savings deposits (whichinclude money market deposit accounts, or MMDAs); (ii)small-denomination time deposits (time deposits in amounts of lessthan $100,000); and (iii) balances in retail money market mutual funds(MMMFs).

There are different points of view regarding the impact of money supply on the stock market. On the one hand, an increase in money supply increases inflation and thus has a negative impact on stock prices. On the other hand, Friedman and Shwartz (1963) argue that an increase in money supply will increase liquidity in the stock market and consequently results in higher stock prices. This paper hypthesis a negative relation between stock prices and real money supply.

f) **Three month treasury bill rate (TB)** is the interest rate on a three month treasury bill.The relationship between interest rates and stock prices can vary over time. Madura (2010) argues that a high interest rate should increase the required rate of return by investors and consequently reduce the present value of future expected cash flows of a stock. However, interest rates usually increase when economic growth increases, so stock prices may rise as a result of an increase in expected cash flows even if the required rate of return by investors increase.On the other hand, a lower interest rate should increase the present value of cash flows and hence boost stock prices. However, lower interest rates commonly happen as a result of weak economic conditions, which are likely to reduce future expected cash flows of firms. Taken as a whole, the impact of interest rates on the stock market should not be considered alone but along with economic growth and other factors to offer a more complete explanation of stock price movements.

We use Eviews program to calculate the descriptive statistics and to run the required empirical tests. Table(1) shows the quarterly descriptive statistics of the stock market index (S&P500) and the five tested macroeconomic variables. It can be seen that quartely average growth in GDP during the sample period is 0.6% with a maximum of 1.93% and a minimum of -2.33% quarterly. Inflation ranges between 1.71% and (-2.32%) quartely with a mean of 0.695%. The maximum oil price during the sample period is $121.2 while the minimum is $11.21 with a mean of $40.83. The average real money supply during the sample period is $3486.5 billions with a maximum of $5180.296 billions and a minimum of $2688.35 billions. S&P500 ranges between 1497.18 point and 263.27 point while average treasuary bill rate during the sample period is 0.883%.

Table (1) Descriptive statistics for S&P500
and five macroeconomic variables for the sample period 1988:2-2012:4

Statstics	S&P500	GDPGROWTH	INFLATION	OIL Price	REALMONEY	TB
Mean	917.95	0.006073	0.00695	40.83	3486.501	0.00883
Median	1056.45	0.006566	0.007402	25.82	3219.587	0.009829
Maximum	1497.18	0.019316	0.017122	121.2	5180.296	0.020698
Minimum	263.27	-0.023276	-0.023167	11.21	2688.351	2.50E-05
Std. Dev.	398.36	0.006337	0.005048	31.90	723.9177	0.005795

5. Empirical Results

5.1. Unit Root Test:

Table (2) Augmented-Dickey Fuller Test

Variable	Level including intercept (p-value)	Level including intercept & trend (p-value)	First difference including intercept (p-value)	First difference including intercept & trend (p-value)
LS&P	0.3278	0.6429	0.0000	0.0000
gdp growth	0.0024	0.0000	0.0001	0.0000
Inflation	0.0000	0.0000	0.0000	0.0000
LReal money	0.9998	0.6022	0.0000	0.0000
LOil prices	0.8983	0.2196	0.0000	0.0000
LTB	0.9174	0.7833	0.0000	0.0000

Variables are transformed using the natural logarithm for two reasons; first of all, Brooks (2002) argues that the stationarity of a variable does not change whether it is transformed or not. Second, if the variables are expressed in logs, their coefficients can be considered as elasticity. This will make explaining the coefficients of the cointegration tests easier and meaningful.Table (2) depicts the Augmented Dickey–Fuller(ADF) results for all time series to test stationarty of all selected variables in the study which must be integrated at the same level to confirm the existance of cointegration relationship. The null hypothesis of unit rootassumes the variablefollows a common unit root process

The test was reported with interecept and interecept with trend for level and first differnces. The only stationary variables at levels are inflation and GDP growth. Hence, we exclude those two variables from our analysis because we need all variables to be integrated in the first order (1).However, the results for the remaining variables suggest that the null hypothesis of a unit root can be rejected for allthe remaining variables where the test includes the intercept and intercept with trend. Therefore,we can proceed to the cointegration test.

5.2. Cointegration test and Vector Error-Correction Model (VECM):

Table (3) presents the results of the cointegration test from applying both the unrestricted cointegration rank (λ trace) and (λmax Eigenvalue) tests. The results obtained from cointegration test (λ trace) indictethat at 1 percent level of significance (λ trace) test,the null hypothesis of (r=0) is rejected in favour of the alternative of (r>0) where r is the number of cointegrating vectors.The results of (λ max Eigenvalue) test also suggest that at 1 percent level of significance (λ trace) test, the null hypothesis of (r=0) is rejected in favour of the alternative of (r > 0) where r is the number of cointegrating vectors.

However, the null hypothesis of (r =1) is neither rejected for the unrestricted cointegration rank (λ trace) with p-value of 0.193 nor for the unrestricted cointegration rank test (maximum eigenvalue)with p-value of 0.2136. Hence, we conclude the existance of one cointegration relationship between the examined variables. Put another way, there is a long relationship between stock prices and macroeconomic varabiles.

Table (3)Number of Cointegration Equations Test Results

Unrestricted Cointegration Rank Test (Trace)				
Hyothesied No. of CE(s)	Eigenvalue	Trace Satistic	0.05 critical value	P-value
None *	0.256353	52.61195	47.85613	0.0167
At most 1	0.155254	24.17783	29.79707	0.1930
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hyothesied No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 critical value	P-value
None *	0.256353	28.43412	27.58434	0.0389
At most 1	0.155254	16.19706	21.13162	0.2136

Table (4) presents the results of the cointegration tests that examine the long run relationship between stock price index and the selected macroeconomic variables.This table shows that real money supply have positive impact on US stock prices with a coefficient of 3.67 which is significant at 1% level of significance. This result confirm Friedman and Shwartz (1963) argument that an increase in money supply will increase liquidity in the stock market and consequently results in higher stock prices.

The oil prices has a negative effect on US stock prices which is also significant at 1% level of significance. This result is consistent with Beenstock and Chan (1988) who find a negative and significant relation between stock prices and fuel and material input. It is also in agreement with Chen et al. (1986) who document a negative impact of oil prices on stock returns.

Treasury bill rate comes with insignificant coefficient of 0.072. This result is on line with Madura (2010) who discuss the varying nature of the impact of changing Treasury bill rate on stock prices discussed in section 4.2.

Table (4)CointegrationEquation

Variable	Coefficient
Λ1LREAL MONEY t-1	3.669619***
Λ2LTBt-1	0.071600
Λ3 LOilt-1	-0.861064***
αConstant	-33.21763

Note: ***,** denote significance at 1% and 5% respectively.

Table (5)illustrates the short run equation for Error Correction Model (ECM). It shows the existence of short run significant relationship between stock prices and both its one-period lag with a coefficient of 0.48. The real money supply has a positive short run impact on stock prices both on one and two lags. However, the real money supply at the second lag comes with a positive and significant impact on stock prices at the 1% level of significance.

Table (5) also shows that Treasury bill rate has a positive impact on the short run on stock prices at both the first and second lag although this impact seems insignificant in the short run. This again confirms the complex nature of the relationship between Treasury bill rate and stock prices suggested by Madura (2010) and suggests that caution needs to be taken when analysing the influence of changing interest rates on stock prices.

Table (5) Error Correction equation

Variable	Coefficient
C Constant	-0.011880
β1 ΔS&P t-1	0.483302***
β2 ΔS&P t-2	-0.055964
β 3 ΔLREAL MONEY t-1	1.515037
β 4 ΔLREAL MONEY t-2	2.270537***
β 5 ΔLTB t-1	0.005902
β 6 ΔLTB t-2	0.025579
β 7 ΔLOIL t-1	-0.012237
β 8 ΔLOIL t-2	0.067133
Adj. R-squared	0.193794
Log likelihood	142.3269
F-statistic	3.537328
Sum sq. resids	0.289768

Note: ***,** denote significance at 1% and 5% respectively

In addition, Table (5) shows that, in the short run, there is a negative impact of oil priceson stock prices in one lag and positive impact in two lags, though both are insignificant. This result indicates that the stock market reacts negatively to oil prices increase but absorbs this change in one period.

The Adjusted R-squared indicates that the VECM explains approximately 19.38% of the short run variation in stock prices. The small explanatory power is understandable given that the model is meant to capture the short run variation in stock prices. The F-statistics of approximately 3.54 rejects the null hypothesis that the independent variables are jointly zero.

5.3. Variance Decomposition

We employ the variance decomposition test to examine which variable has more explantory power of the variation in the S&P500. This test alsogives the proportion of the movements in dependent variable (i.e, S&P500) that is due to its own shock, in comparison to shocks to the other variables (Brooks,2002).

Table (6) gives variance decompositions for the S&P500 of the VAR for 1 to 10 quarters. It shows that shocks to S&P500 explains 84.57% of the variation of S&P500 at quarter ten. Shocks to real money supply explains more variations in S&P500 than any other variable at quarter 10 (8.49%). Oil prices shocks come second by explaining (6.84%) in the variations in S&P500variable at quarter 10. However, Treasury bill rate explain less variations in S&P500 than any other variabes at the same quarter (0.11%). Figure (1) in the appendix graphically shows how variance is decomposed through time as it shows the behaviour of variance that settle down to a steady state very quickly.

Table (6)Variance Decomposition

Period	S.E.	LSP	LTB	LREALMONEY	LOIL
1	0.058047	100.0000	0.000000	0.000000	0.000000
2	0.099892	99.23746	0.032048	0.667069	0.063427
3	0.131297	95.64168	0.021060	3.438109	0.899146
4	0.155644	91.73416	0.018407	6.382879	1.864556
5	0.176097	88.88983	0.033878	8.225034	2.851254
6	0.194519	87.12207	0.060956	8.979269	3.837708
7	0.211560	86.05447	0.086242	9.137624	4.721661
8	0.227306	85.37874	0.102160	9.034459	5.484646
9	0.241868	84.91122	0.109758	8.801434	6.177584
10	0.255442	84.56672	0.112550	8.485647	6.835086

6. Conclusion

This paper reports the results from studying the long run relationship between a set of macroeconomic variables and the S&P500 from applying Johansen's Cointegration model. This study usesquarterly time series data of the natural logarithm of S&P500 along with the natural logarithm of a set of macroeconomic variables reresented by GDP growth, inflation rate, real money supply, and oil prices. Unit root test suggests that all these variables, apart from GDP growth and inflation rate, are integrated or order one (I(1)) which permits performing a cointegration test.

The cointegration test results suggest that the macroecomoy affects the stock market. The results confirm the existance of positive and significant long-run relationship between S&P500 and real money supply. However, there is negative and significant long run relationship between S&P500 and oil prices. The only insignificant variable is Treasury bill rate which confirms the complicated nature of this variable.

To measure the speed of adjustment, a vector error correction model (VECM) is applied followed by variance decomposition analysis to examine how much of the variation in the S&P500 is explained by the selected macroeconomic variables. The VECM analysis (short-run analysis) suggests the existance of short-run relationship between real money supply on two quarter lag and S&P500. Moreover, the variance decomposition analysis shows that only 15 percent of the variation in the S&P500 is explained by the set of macroeconomic variables after 10quarters with real money supply contributing almost 8.49of this percentage.

7. Limitations and Future Research

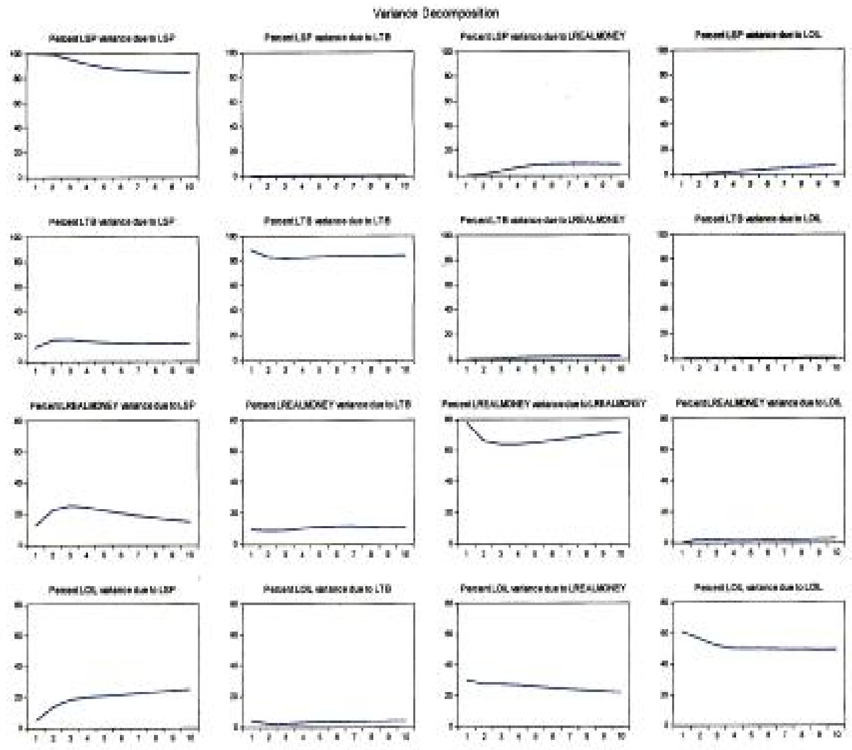
We limit our study to five macroeconomic variables and examine their long and short-term relationship with S&P500. However, we admit the existence of a wealth of literature that link other macroeconomic variables to stock prices such as term spread and default spread (see for example, Hahn and Lee (2006)). Those variables may be at work in the Unites States. Hence, it will be useful to examine the long/short- term relationship between macroeconomic variables and stock prices.

Also, this study tests for the existance of long-run relationship usingJohansen cointegration tehnique. However, other methods can be used such as Engle-Granger and Engle-Yoo. Moreover, this study does not take into account the reversing effect inthe value of some of the macroeconomic variables nor it takes into account the impact of late release of some of these variables. It will be of interest to know whether the results of this sudy alters due to taking these effects into account.

The limitations of this study, as the case with any research in general, are opportunities for future research.

Appendix

Figure 1: Variance Decomposition



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