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Full Length Research Paper

Analyzing the effect of macroeconomic variables on stock market returns: Evidence from Ghana

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This study investigates the relationship between macroeconomic variables and stock market returns using monthly data that spans from January 1992 to December, 2008. Macroeconomic variables used in this study are consumer price index (as a proxy for inflation), crude oil price, exchange rate and 91 day Treasury bill rate (as a proxy for interest rate). The ordinary least square estimation (OLS) model in the context of the Box-Jenkins time series methodology was used in establishing the relationship between macroeconomic variables and stock market returns. Empirical findings reveal that there is a significant relationship between stock market returns and consumer price index (inflation). On the other hand, crude oil prices, exchange rate and Treasury bill rate do not appear to have any significant effect on stock returns. The results may provide some insight to corporate managers, investors and policy makers.

Key words: Stock market returns, inflation, crude oil price, exchange rate, interest rate, Ghana.

INTRODUCTION

Over the years, economists, financial analysts, academicians and researchers have conducted numerous researches on the impact of macroeconomic variables on stock prices in the United States and other developed economies. However, the relationship between stock prices and fundamental economic activities in the less developed markets like Ghana has received little attention.

Financial sector developments and reforms in many Sub-Saharan Africa (SSA) countries aimed at shifting their financial systems from one of bank-based to security market-based has orchestrated the establishment of many stock markets over the last two decades. Liberalizations and deregulations of markets for financial sector development to facilitate economic growth have also been encouraged by the drastic shift towards property-owning economies and the concomitant growing demand for access to capital.

Interest in financial markets and the efforts to forecast their performance is connected to the growing recognition among economists, financial analysts, and policy makers of the increasing impact of macroeconomic variables on these markets.

From a policy maker perspective, the empirical relationship established in this study may provide some insights on how the formulation and implementation of appropriate monetary and fiscal policies could help to stabilize the financial market (Abugri, 2008).

The Ghanaian economy has over the last decade witnessed relative macroeconomic stability in terms of GDP growth, significant reduction of interest rates, and stability of the cedi/dollar exchange rate, crude oil price and inflation. This relative stability has been attributed to the growth of major sectors of the economy including the money markets (financial institutions) and the capital markets (debt and equity).

The drop of interest rate following declines in inflation and prime rates has shifted the attention of investors to the stock market as the better means of investments. Evidence from the Ghana Stock Exchange (GSE) indicates that the relative stability of the interest rates and other macroeconomics variables have been the contributory factor to the growth of the stock markets. The attention of most investors has been shifted from investing in Treasury bills and other financial instruments

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which are risk free, as a result of the stability of the interest rate. This has caused the returns on these investments to fall.

As a result of this, most investors have shifted their attention to the stock markets and so over the last decade stocks of some listed companies have been oversubscribed. Investing in stocks provides a higher return than the other financial instruments but there are also risks associated with these stocks. Most investors invest in the stock market with the objectives of maximizing their return without taking into consideration the effect of macroeconomic variables such as inflation, and exchange rate on the stock prices of companies listed.

The relationship between macroeconomic variables and stock returns has been extensively studied and documented in developed capital markets such as USA, Japan, Australia, Canada and European countries. Notable among them is one by Chen et al. (1986) on the US stock market, which set the tone for a series of recent studies within the Arbitrage Pricing Theory (APT) framework. Most of these studies relate to US and Japanese stock markets (Kaneko and Lee, 1995). Fama (1981) report a positive relationship between stock returns and macroeconomic variables. In spite of increasing migration of capital from developed market to emerging markets and associated high returns (Ushad et al., 2008; Osinubi, 2004) emerging stock markets in developing countries like Ghana have not been well studied. In 2006 for example, foreign equity accounted for 75.3% of the equity finance recorded in Ghana compared to 29.9% in 2001 according to Ghana Investment Promotion Centre quarterly report (2007).

As African economies attempt to develop their private sectors, it is becoming clear that the growth of the stock markets can serve as an important catalyst for sustainable development and growth. The emerging stock markets in developing countries like Ghana have also attracted world attention as markets of the future with a lot of potential for investors; it has become necessary to extend this type of study to the Ghana stock market. This study might also be relevant to private investors, pension funds and governments as many long-term investors base their investment in equities on the assumption that corporate cash flows should grow in line with the economy. Thus the expected return on equities may be linked to expectation on the future economic performance of Ghana.

Given the aforementioned background, this study seeks to answer the following questions: What is the relationship between the selected macroeconomic variables and the stock market returns? What is the relative effect of macroeconomic variables on the stock market returns?

The objective of this study is to examine the impact of macroeconomic variables on stock market returns within the APT framework. The study uses monthly data of stock market returns and macroeconomic variables that span from 1992 to 2008. Time and financial constraints and inability to lay hands on all corporate and market information relevant to this research might also affect the quality of this research.

LITERATURE REVIEW

Theoretical review

The relationship between macroeconomic variables and stock returns have been extensively studied and debated. This relationship is well illustrated by Miller and Modigliani (1961) Dividend Discount Model (DDM) than any other theoretical stock valuation model. According to the Dividend Discount Model, the current price of a stock is equal to the present value of all future cash flows to the equity. This can be written as;

$$P = \sum_t \frac{CF_t}{(r-g)^t} \qquad (1)$$

Where P is the stock price, C_F is the expected cash flows to equity to year n, g is the growth rate and r is the required rate of return. Thus the determinants of the share prices are the required rate of return, and the expected cash flows (Elton and Gruber, 1991).

Pricing of assets

Two main theories of assets pricing exist: The capital assets pricing model (CAPM) by Markowitz, Sharpe and Miller (Burton, 1998) and the arbitrage pricing theory (APT) by Ross (1976) are the most commonly discussed and tested models.

Capital assets pricing model (CAPM)

The capital assets pricing model (CAPM) was proposed as a model of risk and return by Sharpe (1964), Lintner (1965) and Mossin (1966), amongst others. It has become the most important model of the relationship between risk and return in asset pricing. This was celebrated by the works of Black et al. (1972) and Fama and Macbeth (1973).

CAPM has its basis in the construction of an efficient market portfolio that maximizes return, given a level of risk. The expected return of an individual security is a function of its risk covariance with the market. The model stipulates that the expected return on a stock is determined by the risk free interest rate and a risk premium which is a function of the stock's responsiveness to the overall movement in the market that is its beta coefficient. The CAPM can be written as;

$$E(R_i)=R_f+\beta^*E(R_m–R_f) \quad (2)$$

Where $E(R_i)$ is the expected return on a stock; R_f is the risk free rate of return; R_m is the expected market return (return on the market portfolio); β is the beta coefficient which is a function of the stock responsiveness to the overall movements in the market. It measures the volatility.

Early empirical tests of the model generally supported its main predictions as beta being the only explanatory factor in explaining the cross sectional variation across stock portfolios. However, more recent empirical works on asset pricing has identified a number of variables that help explain cross sectional variation in stock returns in addition to the market risk variable. Roll (1977) argued that the market portfolio should in theory include all types of assets that are held by anyone as an investment including works of arts, real estate, human capital etc. but said, in practice, such a market portfolio is unobservable and people usually substitute stock index as a proxy for the true market portfolio. Unfortunately, it has been shown that this substitution is not innocuous and can lead to false inferences as to the validity of the CAPM. It has been said that due to the inobservability of the true market portfolio, the CAPM might not be empirically testable. This is referred to as Roll's critique.

Arbitrage pricing theory

Arbitrage pricing theory is a general theory of asset pricing that has become influential in the pricing of assets. This theory was developed primarily by the economist Stephen Ross in 1976 as an alternative to the CAPM. It is a multi-factor model in which every investor believes that the stochastic properties of returns of capital assets are consistent with factors structure. Ross (1976) argues that if equilibrium prices offer no arbitrage opportunities over static portfolio of assets, then the expected returns on the assets are approximately linearly related to the factor loadings or beta. In other words, 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. The model-derived rate of return will then be used to price the asset correctly and the asset price should equal the expected end of period price discounted at the rate r, implied by the model. If the price diverges, arbitrage should bring it back into line. APT can be written as;

$$E(r_i)= r_f + \beta_{i1} RP_1 + \beta_{I2}RP_2 + \beta_{I3}RP_3 +\ldots\ldots\ldots.+ \beta_{in} RP_n \quad (3)$$

Where $E(r_i)$ is the risky asset's expected return; r_f is the risk free rate; B_{in} is the sensitivity of the asset to factor n, also called factor loading; RP_n is the risk premium.

Review of empirical studies

In an efficient capital market, stock prices rapidly adjust according to the new information available; therefore, the stock prices reflect all information about the stocks. This means that an investor cannot use the readily provided information to predict the stock prices movements and make profits by trading shares. In short, an efficient market incorporates new information quickly and completely. We also know that the stock prices reflect expectations of the future performances of corporate profit. As a result, if stock prices reflect these assumptions, then they should be used as indicators of economic activities. So, the dynamic relationship between stock prices and macroeconomic variables can be used to guide a nation's macroeconomic policies (Maysami et al., 2004).

Prices of stocks are determined by the net earnings of a company. It depends on how much profit the company is likely to make in the long run or the near future. If it is reckoned that a company is likely to do well in the years to come, the stock price of the company will rise to reflect the positive expectation. On the other hand, if it is observed from trends that the company may not do well in the long run, the stock prices may decline. In other words, the prices of stocks are directly proportional to the performance of the company. In the event that inflation increases, the company earnings (worth) will also subside. This will adversely affect the stock prices and eventually the market returns.

Under the APT framework, the economic variables which impact future cash flows and required returns of a stock can be expected to influence share prices. A number of studies have investigated the relationship between stock returns and the state of the economy and several economic variables are found to be associated with the risk-return of stock (Gangemi et al., 2006). Notable among these studies is the one by Chen et al. (1986) on the US stock market. The study set the tone for a series of recent studies using the arbitrage pricing theory (APT) framework.

They studied the impact of economic forces on stock returns using APT. They revealed that variables such as interest rates, inflation rate, exchange rate, bond yield and industrial production have major impacts on the stock market. Nishat (2004) analyze the long-term relationship between macroeconomic variables and stock prices of Karachi stock exchange using a unit root technique. He found a causal relationship between the stock price and the macroeconomic variables. Fama (1981) found a strong positive correlation between common stock returns and real variables (that is, industrial production, GDP, the money supply, lagged inflation and interest *rate*). Fama and Gibbon (1982) examine the relationship between inflation, real returns and capital investment. Their results support the finding by Mundell (1963) and Tobin (1965) that the expected real returns on bills and expected inflation rate are negatively correlated.

These authors suggest that this relationship arises with share return due to a positive relationship between expected returns on financial assets and real activity. Geske and Roll (1983) found that the US stock price is negatively related to inflation and positively related to the real economic activity. Gallager and Taylor (2002) analyze the relationship between macroeconomic variables and stock prices of US stocks and found that the stock returns are negatively affected by both expected and unexpected inflation. Using post-war data for the US, Canada, Germany and the UK, Kaul (1990) explains the relationship between stock returns and unanticipated changes in inflation under alternative monetary policy regimes. He found that countries where there is no change in the policy regime, negative relationship exist between stock returns and changes in inflation. Chatrath et al. (1997) examine the relationship between inflation and stock prices of India stocks. He found a negative relationship between stock return and inflation. Zhao (1999) found a strong relationship between inflation and stock prices of China stocks. Omran and Pointon (2001) studied how the inflation rate affects the performance of the market of Egypt and they found a negative relationship between them.

Contrary to these studies, Choudhry (2000) found a positive relationship between stock returns and inflation in four high inflation countries. Maysami et al. (2004) find a positive relationship between inflation rate and stock returns. This is contrary to other studies that suggest a negative relationship. The reason given by the authors is the active role of government in preventing price escalation after the economy continued to progress after the 1997 financial crises. Engsted and Tanggaard (2002) found a moderately positive relationship between expected stock returns and expected inflation for the US and a strong positive relation for Denmark.

According to the “Fisher effect” expected nominal rates of interest on financial assets should move one-to-one with expected inflation (Fisher, 1930). Moreover, changes in both short-term and long-term rates are expected to affect the discount rate in the same direction through their effect on the nominal risk-free rate (Mukherjee and Naka, 1995). Therefore interest rates are expected to be negatively related to market returns either through the inflationary or discount factor effect (Abugri, 2008). Some previous studies have reported that it is not interest rate itself that is relevant but the yield and default spreads that are more likely to influence equity returns (Chen et al., 1986). However, the continued use of interest rates may be attributed to the absence of active secondary markets for bonds issues and government paper in many emerging markets (Bilson et al., 2001).

An increase in interest rate would increase the required rate of return and the stock return would decrease with the increase in the interest rate. An increase rate would raise the opportunity costs of holding cash, and the trade off to holding other interest bearing securities would lead to a decrease in share price. Theoretically, French et al. (1987) found negative relationship between stock returns and both long-term and short-term interest rate. Furthermore, Bulmash and Trivoli (1991) found that the US current stock price is positively correlated with the previous month’s stock price, money supply, recent federal debt, recent tax-exempt government debt, long-term unemployment, the broad money supply and the federal rate. However, there was a negative relationship between stock prices and the Treasury bill rate, the intermediate lagged Treasury bond rate, the longer lagged federal debt, and the recent monetary base. Abdullah and Hayworth (1983) found that stock returns are positively related with the money growth and inflation rate while interest rate reacts negatively on stock returns.

The link between exchange rates and equity returns is based on a simple financial theory. Exchange rate as an indicator of a currency is a monetary variable that affect the prices of stock in a way similar to inflation variables. When the domestic currency depreciates against foreign currencies, export product prices will decrease, and consequently, the volume of the country’s export will increase, assuming that the demand for this product is elastic. The appreciation of a country’s currency lowers the cost of imported goods, which in most cases constitute a large part of the production inputs for emerging market countries. According to Pebbles and Wilson (1996), an appreciating currency is generally accompanied by increases in reserves, money supply and a decline in interest rates. The resulting decline in cost of capital and/or imported inputs is expected to lead to an increase in local return. Such an expectation is also consistent with Bilson et al. (2001) conclusion that a devaluation of the domestic currency has a negative relationship with return. Mukherjee and Naka (1995) also confirmed that exchange rate positively relates to Japan and Indonesia stock prices, both two large export countries. Solnik (1987) employs monthly and quarterly data for eight industrial countries from 1973 to 1983 to examine the relation between real stock returns, exchange rates and reports a negative relation among variables. Soenen and Aggrawal (1989) re- assess this Solnik model using 1980 to 1987 data for the same industrial countries and report a positive relationship between stock returns and exchange rate for three countries and a negative correlation for five. Ajayi and Mougoue (1996) also showed that an increase in stock price has a negative short-term effect on domestic currency values but in the long term this effect is positive, while currency depreciation has a negative short-term and long-term effect on the stock market.

Employing monthly data, Aggarwal (1981) examines the relationship between stock market indexes and a trade weighted value of the dollar for the period 1974 to 1978 and found that the stock prices and exchange rates are positively correlated. In contrast, Soenen and

Table 1. Data description and source.

Variable	Concept	Description	Unit of measurement	Source
LASI	Natural logarithm of Ghana Stock Exchange Index	Ghana Stock Exchange All Share Index	1990 = 77.65 points	GSE
LCPI	Natural logarithm of consumer price index	Consumer Price Index	Percentage per month	GSS
'LEXR	Natural logarithm of exchange rate	Principal rate (Gh¢ per US Dollar)	GH¢ per US$	BoG
LTBR	Natural logarithm of 91-day Treasury bill rate	91-day Treasury bill rate	Percentage per month	BoG
LCRO	Natural logarithm of crude oil price	Crude Oil Price	US$ per barrel	BoG

Hernigar (1988) also using monthly data, report a strong negative relation between US stock indexes and fifteen currency weighted value of the dollar for the period 1980 to 1986. Bilson et al. (2001) tested whether local macroeconomic variables (money, goods prices and real activity) have explanatory power over stock return of 20 exchange emerging markets for the period 1985 to 1997. The results indicate that the exchange rate variable is clearly the most influential macroeconomic variables.

Anokye and Tweneboah (2008) examined the role of macroeconomic variables on stock returns movement in Ghana. They used the Databank stock index to represent Ghana Stock market and the macroeconomic variables are; inward foreign direct investment, Treasury bill rate (as a measure of interest rate), consumer price index (as a measure of inflation) and exchange rate. They analyze both long-run and short-run relationships between the stock market index and the economic variables with quarterly data for the aforementioned variables from 1991 to 2006 using Johansen's multivariate cointegration test and innovation accounting techniques. They revealed that there is cointegration between macroeconomic variables identified and stock prices in Ghana indicating long run relationship. Result of impulse response function (IRF) and forecast error variance decomposition (FEVD) indicate that interest rate and foreign direct investment (FDI) are the key determinants of the share price movements in Ghana.

DATA AND METHODOLOGY

The empirical analysis is carried out using monthly data. The data period spans from January 1992 to December 2008 and the study was carried out using 204 monthly observations. The study employed GSE All Share Index (ASI) to proxy for Ghana stock market returns. The macroeconomic variables are obtained in monthly intervals from the Central Bank of Ghana (BoG) and Ghana Statistical Services (GSS). The macroeconomic variables are nominal interbank exchange rate (EXR), 91-day Treasury bill (T-bill) yield to proxy for Interest rate (TBR), crude oil price (CRO) and consumer price index to proxy for inflation (CPI). All the macroeconomic data were obtained from the Central Bank of Ghana except the consumer price index which was obtained from the Ghana Statistical Services. The GSE All share Index was obtained from Ghana Stock Exchange (GSE). The brief description for each variable used is presented in the Table 1 In order to smooth the data, all variables were converted to natural logarithm, except the 91-day Treasury bill rate. The use of natural logarithm, rather than levels and percentage changes, mitigates correlations among the variables. Also, it helps in reducing heteroscedasticity as it compresses the scale in which variables are being measured.

Selecting variables in similar studies is usually subject to criticism on the grounds of subjectivity. Fama (1981) has argued that such criticism is an unavoidable problem associated with this area of research. This study bases its selection of variables on theoretical propositions and evidence in the literature.

Four macroeconomic variables, namely, inflation (measured by the Consumer Price Index), 91-day Treasury bill rate used as proxy for interest rate and nominal inter-bank exchange rate (measured by the US$/GH¢) and crude oil price (US$ per barrel) have been selected as critical variables for this research. Our selection is influenced by the various works that have been carried out and reviewed in the literature about their relationships with stock returns, in other economies like US, Japan, Sri Lanka, India, Jordan, Pakistan and UK.

Inflation rate

Inflation is measured by changes in the Ghana Consumer Price Index (GCPI) which was collected from the Ghana Statistical Services database. High rate of inflation increase the cost of living and a shift of resources from investments to consumption. This leads to a fall in demand for market instruments which lead to reduction in the volume of stock traded. Also the monetary policy responds to the increase in the rate of inflation with economic tightening policies, which in turn increases the nominal risk – free rate and hence raises the discount rate model. High Inflation affects corporate profits, which in turn causes dividends to diminish. Consequently, the expected return of stocks decreases thereby causing stocks to depreciate in value. Conversely, low inflation implies lower cost of borrowing. Corporate performance goes up leading to increase in production and corporate profit. This results in the payment of attractive dividends by companies. The monthly inflation was computed as the natural logarithm of consumer price index at month t.

Interest rate

The 91-Day Treasury bill rate is used as proxy for interest rate since Treasury bill serves as the opportunity cost of holding shares and as a benchmark for measuring interest rate. Chen et al. (1986), Beenstock and Chan (1988), Fifield et al. (2002), provide evidence on the relationship between interest rates and stock returns. High interest rate regimes lead to high cost of borrowing and hence a reduction in economic activity. This also affects corporate profit,

Table 2. Descriptive statistics of the variables.

Statistic	Variable				
	LASI	LCPI	LCRO	LEXR	LTBR
Mean	6.903504	4.07489	3.329112	-1.0655	3.244853
Median	6.766509	4.155852	3.171364	-0.54988	3.360722
Maximum	9.295674	5.603828	4.940427	0.193382	3.869742
Minimum	4.108508	2.02792	2.347558	-3.24419	2.256541
Std. Dev.	1.45156	1.079273	0.597055	1.036062	0.500429
Skewness	0.111867	-0.38563	0.806761	-0.54516	-0.61132
Kurtosis	2.072223	1.938091	2.654122	1.911149	2.246309
Jarque-Bera	7.742022	14.6411	23.1462	20.18243	17.53475
Probability	0.020837	0.000662	0.000009	0.000041	0.000156
Sum Sq. Dev.	427.7265	236.4605	72.36435	217.905	50.83712
Observations	204	204	204	204	204

future cash flow of business and dividend. According to the “Fisher effect”, expected nominal rate of interest on financial assets should move one-to-one with inflation (Fisher, 1930). Moreover, changes in both short term and long-term rates are expected to affect the discount rate in the same direction through their effect on the nominal risk-free rate (Mukherjee and Naka, 1995). Therefore interest rates are expected to be negatively related to market returns either through the inflationary or discount factor effect. However, the continued use of interest rates may be attributed to the absence of active secondary markets for bond issues and government paper in many emerging markets (Bilson et al., 2001). The three month T-bill rate at month t was used as a proxy for interest rate in this study.

Exchange rate

In recent year, all businesses are directly and indirectly affected by international activities as a result of globalization. In other words, exchange rate changes may affect the competitive position of companies and hence industries operations. As a result, cost of goods and services, sales and cash flows may change with changes in exchange rate. Ozcam (1997) and Altay (2003) revealed that exchange rates influence stock returns. In Ghana, the cedi-dollar exchange rate is important in assessing the stock market because, being the major international trading currency, any hike is translated in the cost of importing raw material, and other imports. Since Ghana’s economy is also import-demand driven, changes in the exchange rate affects most sectors of the economy as well as the pricing of goods and cost of production. The exchange rate therefore affects business cash flow and profitability. Investors may also evaluate this as an important risk factor. According to Pebbles and Wilson (1996), an appreciating currency is generally accompanied by increases in reserves, money supply and a decline in interest rates. The resulting decline in cost of capital and/or imported inputs is expected to lead to an increase in local returns. Such an expectation is consistent with Bilson et al. (2001) conclusion that a devaluation of the domestic currency has a negative relationship with returns. The change in exchange rate is calculated as the natural logarithms of the exchange rate at month t.

GSE All Share Index

The study included the GSE All Share index to proxy the state of Ghana Stock Market. GSE All Share Index which is the broad market indicator of the stock market measures the overall performance of the stock market. This index is computed by the Ghana Stock Exchange. The GSE All share index is calculated as natural logarithms of GSE All share index at month t.

Crude oil price

Crude oil is an essential input for production and so the price of oil is included as a proxy for real economic activity. An increase in the price of oil in the international market means lower real economic activity in all sectors, which will cause stock returns to fall. The crude oil price is calculated as the natural logarithm of crude oil price at month t.

Descriptive statistics

Table 2 presents the descriptive statistics for the macroeconomic variables. All variables exhibit a positive mean return except for exchange rate. Also the sum squared deviation row represents the net change over the sample period. It shows that the exchange rate declined by about 217%. In terms of skewness, GSE All share Index and crude oil prices have return distribution that are positively skewed. Consumer price index, exchange rate and 91 day Treasury bill rate exhibit a negative skewness which implies that they have a long left tail. All the variables are relatively normally distributed as indicated by the p values of Jarque Bera statistic.

The APT model

This study uses a four-variable APT model to investigate the potential relationship between the selected macroeconomic variables and stock returns. The APT model is an effective means of characterizing the dynamic interactions among economic variables. Arbitrage pricing theory is a general theory of asset pricing that has become influential in the pricing of assets. This theory was developed primarily by the economist Stephen Ross in 1976 as an alternative to the CAPM.

It is a multi-factor model in which every investor believes that the stochastic properties of returns of capital assets are consistent with factors structure. He argues that if equilibrium prices offer no arbitrage opportunities over static portfolio of assets, then the expected returns on the assets are approximately linearly related to the factor loadings or beta. In other words, 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. The model-derived rate of return will then be used to price the asset correctly and the asset price should equal the expected end of period price discounted at the rate implied by the model. If the price diverges, arbitrage should bring it back into line.

The APT model can also be written as:

$$r_{it} = a_i + \beta_{i1} f_{jt} + \ldots\ldots\ldots\ldots + \beta_{ij} f_{jt} + \varepsilon_{it} \quad (4)$$

r_t is an (nx1) matrix containing the expected return on risky asset, f is an (kx1) matrix of the factors(random variables) in the model, β is an (nxk) matrix measuring the sensitivity of r_t to changes in f, and ε is a (nx1) matrix containing the error terms and is assumed to be white noise. Estimation of the factor loading matrix β entails at least an implicit identification of the factors. Three approaches are usually used in the identification of the factors. These are;

1. The first consist of an algorithmic analysis of the estimated covariance matrix of asset returns;
2. The second approach is one in which a researcher starts at the estimated covariance matrix of asset returns and uses his judgment to choose factors and subsequently estimate the matrix β;
3. The third approach is purely judgmental in that it is one in which the researcher primarily uses his intuition to pick factors and then estimates the factor loadings and checks whether they explain the cross-sectional variations in estimated expected returns. Chen et al. (1986) select financial and macroeconomic variables to serve as factors. They include the following variables: The return on an equity index, the spread of short and long term interest rates, a measure of the private sector's default premium, the inflation rate, the growth rates of industrial production and the aggregate consumption.

This study adopts the third approach aforementioned in the selection of the factors or random variables.

The focus of the study is investigating the effect of macroeconomic variables on stock returns. The expected return on a stock is assumed to be generated by its exposure to macroeconomic risk sources. A multiple regression model is designed to test the effects of four macroeconomic variables on the stock portfolio returns. The APT models used in this study are expressed as follow:

$$r_t = \mu_t + \beta f_t + \varepsilon_t \quad (5)$$

lnASIt = β0 + β1t ln CPIt + β2t ln EXRt + β3t lnTBRt + β4t lnCROt +εt (6)

Where ln is the natural logarithm, *ASI* is the GSE All share Index (return on stock portfolio), CPI_t is change in consumer price index, TBR_t is 91-day Treasury bill rate, EXR_t is the nominal exchange rate, CRO_t is the international crude oil price, β_0 is the intercept of the regression and is the constant term representing risk free rate, β_1, β2, β3, β_4 are the coefficient of variables, ε_t is the residual error of the regression. The first model (equation 6) is a multivariate raw return model. In this model, all the variables are entered into the model as total shocks (that is in their "raw" form) and so the shock contains both expected and unexpected components.

Econometric methodology

The methodology details the approach adopted to achieve the objective of this empirical research. The study employs econometric technique to determine the relationship among the variables. The ordinary least square (OLS) within the context of the Box–Jenkins time series methodology was employed in the estimation. Prior to the regression analysis, we test for the stationarity of the variables to avoid spurious regression. The procedure is explained in the following.

Unit root test

Prior to deciding on the appropriate econometric method to be employed for the estimation, a preliminary examination of the data is analyzed. Time series data are generally non-stationary and so running a regression without controlling for that problem will yield spurious regression results meaning the results may appear good but do not make economic sense. In other words, economic time series tend to have a strong trend which causes these series to depict rising or falling patterns. We follow the standard procedure of unit root testing by employing the Augmented Dickey Fuller (ADF) test developed by Dickey and Fuller (1979). The Augmented Dickey-Fuller test is employed to determine the level or degree of integration of the variables and also to correct for higher order serial correlation by adding lagged differenced terms on the right hand side of the equation as indicated in Equation 9. That is, how many times the variables need to be differenced to attain stationarity. Thus ADF test equation is;

$$\Delta Y_t = \mu + \gamma T + \delta Y_{t-1} + \sum_{i=1}^{k} \lambda_i \Delta Yt_{-1} + \varepsilon_t \quad (7)$$

Where Y_t represents the variable in question, T is the trend, k is the lag length and ε_t is a random variable assumed to be a white noise. This augmented specification is then used to test for the following hypothesis:

H_o: Y_t has a unit root/or non stationary ($H_o : \gamma = 0$);
H_1: Y_t has no unit root/ or stationary ($H_1 : \gamma < 0$).

Thus, stationarity of the variables are checked using the Augmented Dickey Fuller test. Presence of heteroscedasticity is also tested by "White General Heterodescedasticity Test. Finally, ordinary least square (OLS) regression in the context of Box-Jenkins methodology was applied to Equation (7) using EVIEWS Statistical package.

EMPIRICAL RESULTS AND DISCUSSIONS

Unit root test results

ADF test indicates that the series are not stationary at levels but stationary at first differences. In empirical analysis using time series data, it is important that the presence or absence of unit root is established. This is because contemporary econometrics has indicated that regression analysis using time series data variables with unit root produce spurious or invalid regression results (Townsend, 2001). Most time, series are trended over time and regressions between trended series may produce significant parameters with high R^2s, but may be spurious or meaningless (Granger and Newbold, 1974). When using the classical statistical inference to analyze time series data, the results are only stationary when the series is stationary. The solution to this problem was initially provided by Box and Jenkins (1976), by

Table 3. Results of unit root test in levels and first difference.

Variable	Level (Intercept Only)		Stationarity	First difference (Intercept Only)		Order of Integration
	ADF	P-Value		ADF	P-Value	
LASI	2.825817	0.9989	Not stationary	-8.579287	0.0000	1
LCPI	3.472291	0.9999	Not stationary	-3.535390	0.0005	1
LCRO	0.513189	0.8257	Not stationary	-12.21816	0.0000	1
LEXC	-4.353557	0.0000	Stationary, I(0)	-5.232998	0.0000	0
LTBR	-1.568882	0.4967	Not stationary	-10.28618	0.0000	1

MacKinnon critical value for the variables in levels at 5% is -2.9130; MacKinnon critical value for the variables in first differences at 5% is -2.914.

Table 4. Ordinary least squares regression results of the effect of macroeconomic variables on stock market returns.

Dependent variable: FDLASI				
Variable	Coefficient	Std. error	t-Statistic	Probability
FDLCPI	1.203324	0.275100	4.374130	0.0000
FDLCRO	-0.039732	0.047721	-0.832592	0.4061
FDLEXR	0.088845	0.220498	0.402926	0.6874
FDTBR	0.000259	0.002581	0.100189	0.9203
AR(1)	0.431236	0.064920	6.642619	0.0000
R^2	0.208615	Mean dependent variable		0.025025
Adjusted R^2	0.192546	S.D. dependent variable		0.070310
S.E. of regression	0.063179	Akaike info criterion		-2.661247
Sum squared residual	0.786343	Schwarz criterion		-2.579360
Log likelihood	273.7860	Durbin-Watson stat		2.005457

formulating regressions in which the variables were expressed in first difference. Their approach simply assumed that non-stationary data can be made stationary by repeated differencing until stationarity is achieved and then to perform the regression using these differenced variables. The results of the Augmented Dickey Fuller tests reveal that all the time series variables are integrated of order one, *I*(1), except exchange rate which is stationary at levels (Table 3). Consequently, this study employs Box and Jenkins' (1976) methodology to analyze the effect of macroeconomic variables on stock market returns in Ghana. The empirical model presented in Equation (7) includes an autoregressive term, *AR*(1). The regression results without the autoregressive term indicate some traces of autocorrelation in the residuals as evidence by the unsatisfactory Durbin Watson Statistic of 1.14. However, after introducing the autoregressive term, *AR* (1) the Durbin Watson Statistic became satisfactory (that is, value of 2.0) (Table 4).

$$FDLASI_t = \beta_0 + \beta_{1t}\, FDLCPI_t + \beta_{2t}\, FDLEXR_t + \beta_{3t}\, FDTBR_t + \beta_{4t}\, FDCRO_t + AR(1) + \varepsilon_t \quad (8)$$

Where *FDLASI* is the first difference of the logarithm of stock market returns; *FDLCPI* is the first difference of the logarithm consumer price index; *FDLEXR* is the first difference of the logarithm of the exchange rate; and *FDCRO* is the first difference of the logarithm of crude oil prices.

The regression results indicate that about 19.3% of the variations in the stock market returns is explained jointly by the four macroeconomic variables (consumer price index, exchange rate, crude oil prices, and Treasury bill rate), as shown by the value of the Adjusted R-squared. The actual, fitted, and residual plots in Figure 1 show that the model has a relatively good fit, as the residual are stationary around zero (that is, mean reverting). Further, the Durbin Watson Statistic (2.0) shows that there is no autocorrelation in the residuals.

The relationship between consumer price index and stock returns is positive. This means the beta coefficient for consumer price index (inflation) in the regression model is positive. These empirical results are consistent with previous research (Choudhry, 2001; Maysami et al., 2004). Their rationale for this pattern is related to the inadequacy of hedging role of stock against inflation. This rationale would be suggested for the Ghana stocks. That is, Ghana stocks cannot be used as a hedge against inflation, since the positive regression coefficient implies a higher expected return is required for higher inflation

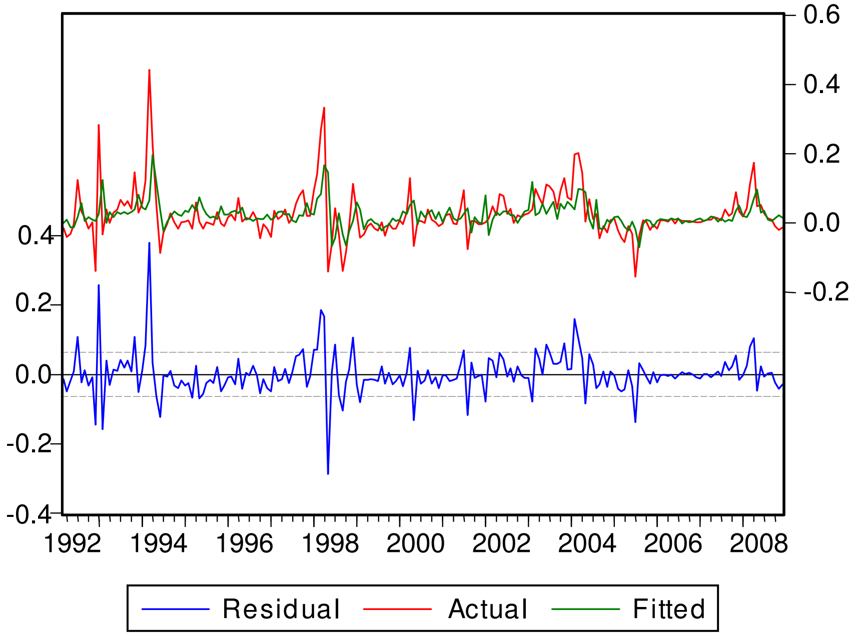

Figure 1. Actual, fitted and residual plots of the stock market returns.

rate. This is not consistent with the bulk of empirical evidence (Chatrath et al., 1997; Zhao, 1999; Omran and Pointon, 2001) that inflation rate negatively affects stock returns.

Contrary to expectations, crude oil prices, exchange rate, and Treasury bill rate do not significantly influence the stock market returns.

A result worth noting in this study is that crude oil price does not seem to be a significant factor in determining the stock returns, though the negative sign of the effect is consistent with expectations. This result is not surprising since Ghana is a net importer of oil. For oil importing countries, oil price is hypothesized to impact stock returns negatively. In this respect, increases in oil prices would cause a rise in production costs and a subsequent fall in aggregate economic activity. This would ultimately cause lower stock returns.

CONCLUSIONS AND RECOMMENDATIONS

This paper investigates the effects of macroeconomic variables on the stock market returns in Ghana. It estimates a multivariate APT model with the dependent variables as GSE All share returns.

In this study, a macroeconomic factor model is employed to test for the effects of macroeconomic factors on stock returns for the period from January 1992 to December 2008. Macroeconomic variables used in this study are consumer price index, exchange rate, crude oil price, 91 day Treasury bill rate and GSE All share index. Ordinary least squares regression model within the framework of Box and Jenkins'(1976) time series methodology was employed to establish the relationships between the stock market returns and the macroeconomic variables. In the regression model, stock market returns were used as dependent variables, while the macroeconomic variables were used as independent variables. Empirical findings reveal that only consumer price index (inflation) had a significant effect, while crude oil prices, exchange rate and Treasury bill rate do not appear to have any significant effect on stock market returns.

The results of the study show that there is a positive significant relationship between consumer price index (inflation) and stock market returns. This means that there is a tradeoff between risk and return by investors in holding stocks and also it serves as a guide for risk management. The findings also points out the inadequacy of hedging role of stock against inflation. That is, Ghana stocks cannot be used as a hedge against inflation, since the positive regression coefficient implies a higher expected return is required for higher inflation rate.

The listed firms should strive to make their stocks attractive to investors as the firms stocks seem to be a good hedge over a long period for investors. This means the firms should undertake projects that are viable to boost their performance over time, as investors are motivated to invest in companies with good financial performance. Once it is realized by investors that listed firms have a superior performance coupled with the fact that returns on their shares increases as inflation goes up, the shares may be preferred assets when investors have to hedge against the risk of inflation.

The effect of macroeconomic variables on stock market returns has attracted much attention in developed and emerging economies due to their implications in the financial markets. Investors may use this study as a guide in forecasting stock market viability and to decide whether it is worthwhile to invest in it.

This study may provide some insights on how the formulation and implementation of appropriate monetary and fiscal policies could help to stabilize the financial market. Furthermore, financial sector reform and the institution of a regulatory regime for the listed companies and the Ghana Stock Exchange will also be important.

Finally, although a rich set of macroeconomic variables are used in this study; the macroeconomic variable set employed is not exhaustive. Some other macroeconomic variables would provide more information about the stock market returns - economic activity relationship. The inclusion of other macroeconomic variables in the model provides an avenue for future research.

Further, a more robust and super-consistent estimates of the effects of macroeconomic variables on stock market returns could be obtained by employing the vector error correction and cointegration analysis. This methodology provides both the short run and long run estimates of the effects of macroeconomic variables on stock market returns. This provides another avenue for future research.

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