Macroeconomic Variables and Stock Market Returns:

Full Information Maximum Likelihood Estimation

John K. M. Kuwornu (Corresponding author)

Department of Agricultural Economics and Agribusiness,

P. O. Box LG 68, University of Ghana,

Legon, Accra, Ghana

Tel: +233 245 131 807 E-mail: jkuwornu@ug.edu.gh / jkuwornu@gmail.com

Owusu-Nantwi, Victor

Ghana Institute of Management and Public Administration,

P. O. Box AH 50, Achimota, Accra, Ghana

Tel: + 233 245 131 807 E-mail: owuvic@yahoo.co.uk

Abstract

This study examines the relationship between macroeconomic variables and stock market returns using monthly data over period 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). Full Information Maximum Likelihood Estimation procedure was used in establishing the relationship between macroeconomic variables and stock market returns in Ghana. The empirical results reveal that there is a significant relationship between stock market returns and three macroeconomic variables; consumer price index (inflation rate), exchange rate and Treasury bill rate seem to affect stock market returns. Consumer price index (Inflation rate) had a positive significant effect, while exchange rate and Treasury bill rate had negative significant influence on stock market returns. On the other hand, crude oil prices 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 rate, crude oil price, exchange rate, interest rate, Ghana

1. Introduction

In recent years financial sector developments in emerging economies aimed at shifting their financial systems from one of bank-based to security market-based has orchestrated the establishment of many stock markets. 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 academicians, financial analysts, and policy makers of the increasing impact of macroeconomic variables on these markets. However, the relationship between stock prices and fundamental economic activities in the less developed markets like Ghana has received little attention. 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 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 taken 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 (e.g., 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, (see Ushad et al., (2008) and 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 (December 2007). The growing interest and the performance of emerging markets have been attributed to the conduct of sound macroeconomic policies, privatization, stock market reforms and financial liberalization (Adams and Anokye, 2008). 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 above 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.

Investor interest in the stock market is increasing as a result of the current stable economic and political climate prevailing in Ghana. Private sector investment being the engine of growth of our economy is becoming a major part of Ghana's developmental drive. Both government and private owned companies (e.g., UT financial services Limited) are converting into public companies and listed on the Ghana Stock Exchange (GSE). The GSE is becoming the heart of the economy and an institution that provides long term funding to companies in the country. As a result of these developments, understanding how the macroeconomics variables impact the performance of   the stock market is very necessary. The study of the impact of macroeconomic variables on stock market returns has become an important exercise in the security market industry. This study is carried out to determine how the stable economic climate has impacted the stock prices of financial and non-financial companies listed on the GSE. This study, hopefully, would be the reference point for individuals and institutional investors, policy makers, government agencies and academicians in their investment decision making. From a policy 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). Companies that intend to go public through listing on the GSE may also use the result of this study to determine the timing of their floatation.

The rest of the paper is organized as follows: section two focuses on the review of existing literature including empirical evidence on the nature of the relationship between macroeconomic variables and stock market returns; Section three presents the theoretical framework and methodology; section four presents and discusses the result of the study while section five provides the conclusions.

2. Literature review

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, 2000). 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. 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) finds a strong relationship between inflation and stock prices of China stocks. Omran and Pointon (2001) studied the how the inflation rate affect the performance of the market of Egypt and they found a negative relationship between them.

Contrary to these studies, Choudhry (2000) finds 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. Mohamed et al., (2007) studied the effect of macroeconomic variables on stock prices in Malaysia using error correctional model. The results indicate that there is a positive relationship between inflation rate and stock price. This is in line with other studies conducted on the Malaysian equity market for the period before economic crisis (i.e., Ibrahim and Yussof (1999), Ibrahim and Aziz (2003)). Engsted and Tanggaard (2002) find 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 (eg., 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) find 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 as 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 1973-1983 to examine the relation between real stock returns, exchange rates and reports a negative relation among variables. Employing monthly data, Aggarwal (1981) examines the relationship between stock market indexes and a trade weighted value of the dollar for the period 1974-1978 and finds that the stock prices and exchange rates are positively correlated. In contrast, Soenen and 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 1980-1986. 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 1985-1997. The results indicate that the exchange rate variable is clearly the most influential macroeconomic variables.

Gazi and Hisham (2010) studied the relationship between macroeconomic variables and stock market returns in the Jordian Stock Market.   Using cointegration analysis, they find that the trade surplus, foreign exchange reserves, the money supply and oil prices are important macroeconomic variables which have long run effects on the Jordanian stock market. There is a negative relationship between crude oil price and stock market returns. This is also expected as increase in the price of oil will depress real economic activity, so a negative sign is justified. Interest rate does not affect the stock market.

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 above variables from 1991 to 2006 using Johansen's multivariate cointegration test and innovation accounting techniques. They established 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.

3.   Theoretical framework and methodology

3.1 *Theoretical framework*

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 in equation (1) as;

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

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).

3.1.1 *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.

3.1.1.1 *Capital Assets Pricing Model (CAPM)*

The Capital Assets Pricing Model (CAPM) was proposed as a model of risk and return by Sharpe (1964), Treynor (1962), Lintner (1965) and Mossin (1966). 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 in equation (2) as;

$$E(R_i) = R_f + \beta * E(R_m - R_f) \tag{2}$$

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.

3.1.1.2 *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 in equation (3) as;

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

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.

3.2 *Methodology*

3.2.1 *Data*

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) as a 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). The data for the study are monthly from 1992 to 2008. 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 below. In order to smooth the data all variables were converted to natural logarithm. 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.

Table 1: Data Description and Source

Variable	Concept	Description	Units	Source
LASI	Natural logarithm of Ghana Stock Exchange Index	Ghana Stock Exchange All Share Index	1990 = 77.65points	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

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 decreases in expected return of stocks cause 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, 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 & 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 interest rate is calculated as natural logarithms of three month T-bill rate at month t.

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.

3. 2. 2 *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.

Table 2: Descriptive Statistics of the variables

Statistic	Variables				
	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

3.3 *The APT Model*

The APT model in equation (3) can be re-written as;

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

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;

The first consist of an algorithmic analysis of the estimated covariance matrix of asset returns

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.

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 above 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 system estimation approach (Full Information Maximum Likelihood Estimation Procedure) is used to examine the effects of four macroeconomic variables on the stock portfolio returns. The three APT models used in this study are expressed as follow;

$$r_t = \mu_t + \beta f_t + \varepsilon_t \tag{5}$$

$$In\ ASI_{it} = \beta_0 + \beta_{1t}\ In\ CPI_{it} + \beta_{2t}\ In\ EXR_{it} + \beta_{3t}\ InTBR_{it} + \beta_{4t}\ InCRO_{it} + \varepsilon_{it} \tag{6}$$

$$ResidLASI = \alpha_0 + \alpha_{1t}\ ResidLCPI_{it} + \alpha_{2t}\ ResidEXR_{it} + \alpha_{3t}\ ResidTBR_{it} + \alpha_{4t}\ ResidCRO_{it} + v_{it} \tag{7}$$

Where In is the natural logarithm, *ASI* is the GSE All share Index (return on stock portfolio i), CPI_{is} the 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 and α_0 are the intercepts of the regression and are the constant terms representing risk free rate, β_1, $\beta2$, $\beta3$, β_4; α_1 α_2 α_3 α_4, are the coefficient of variables, *Resid* is the residual values of the variables, ε_t and v_t are the residual errors 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. The second model (equation 7) measures the movement in asset values or returns resulting from the surprise component or the unexpected portion of the shock. This is particularly important because finance theory argues that security prices change in response to the unexpected components.

The procedure followed in this study is as follows. First, four macroeconomic variables were selected and the GSE All share Index and their monthly logarithmic returns over the period of study are computed. Descriptive statistics for the variables are derived after which the stationarity of the variables are checked using the Augmented Dickey Fuller test. Finally, Full Information Maximum Likelihood Estimation was done for the two models (equations 6, and 7) simultaneously using EVIEWS Statistical package.

4. Empirical results and discussions

ADF test indicates that the series are not stationary at levels but stationary at first differences. The fact that the series are stationary at first difference requires the use of Cointegration and Vector Error Correction Modeling (Johansen and Juselius, 1990, 1992). However, the limitation Vector Error Correction Model is that it analyses the results of the variables in first differences which will make little economic sense in this study. In this respect, the use of the Full Information Maximum Likelihood Regression procedure has become necessary because of the relevance and practicability of the results. The Full Information Maximum Likelihood regression estimates are efficient and consistent. Furthermore, this estimation procedure assumes that the error terms across the equations are jointly normally distributed.

The full information maximum likelihood estimates are presented in table 3 below.

Table 3: Full Information Maximum Likelihood Estimates of Arbitrage Pricing Theory (APT) Models obtained from equation (6) and (7)

	Coefficient	Std. Error	z-Statistic	Prob.

β_0	0.686948	0.850115	0.808065	0.4191
β_1	1.608613	0.179850	8.944208	0.0000
β_2	-0.386302	0.163873	-2.357326	0.0184
β_3	-0.225814	0.092396	-2.443973	0.0145
β_4	-0.005231	0.117961	-0.044344	0.9646
α_0	-8.39E-09	2.04E-07	-0.041207	0.9671
α_1	2.40E-06	6.05E-06	0.397046	0.6913
α_2	-2.93E-07	1.95E-06	-0.150231	0.8806
α_3	1.000000	4.19E-07	2384122.	0.0000
α_4	-7.29E-08	3.80E-07	-0.191675	0.8480

Log Likelihood	2251.172
Determinant residual covariance	8.91E-13

Equation: LASI=C(1)+C(2)*LCPI+C(3)*LEXC+C(4)*LTBR+C(5)*LCRO
Observations: 204

R-squared	0.948095	Mean dependent var	6.903503
Adjusted R-squared	0.947052	S.D. dependent var	1.451560
S.E. of regression	0.334011	Sum squared resid	22.20112
Durbin-Watson stat	1.981452		

Equation: RESID=C(6)+C(7)*RESIDCPI+C(8)*RESIDEXR+C(9)
    *RESIDTBR+C(10)*RESIDCRO
Observations: 204

R-squared	0.952308	Mean dependent var	-1.57E-16
Adjusted R-squared	1.000000	S.D. dependent var	1.139379
S.E. of regression	3.13E-06	Sum squared resid	1.95E-09
Durbin-Watson stat	1.978217		

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 the findings of Choudhry (2001), Maysami et al., (2004), Mohammed et al., (2007), Ibrahim and Aziz (2003). 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 rate. This is not consistent with the bulk of empirical evidence (e.g., Chatrath et al., (1997), Zhao (1999), Omran and Pointon (2001)) that inflation rate negatively affects stock returns.

Crude oil price is negatively related to stock returns. Though they are negatively correlated, crude oil price does not seem to be a significant factor in determining the stock returns. This finding is surprising, since Ghana is a net importer of oil. For oil importing countries, crude oil price is hypothesized to impact stock returns negatively. For such countries, increases in oil prices would cause a rise in production costs and a subsequent fall in aggregate economic activity. This would cause lower stock market returns. Chen et al., (1986) and Clare and Thomas (1994) also does not specify oil price as an important pricing factor for British and American firms. Since UK and USA are other net importers of oil, this finding is also confusing. These findings imply that in Ghana, USA and the UK,

some other factors rather than oil are more important in determining the production costs of the firms. Our empirical result shows a negative link between stock returns and exchange rate and this is consistent with Bilson et al., (2001) conclusion that a devaluation of the domestic currency has a negative relationship with returns. Soenen and 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 1980-1986. This finding is consistent with the argument that exchange rate depreciation leads to declines in stock returns, at least from the international investors' perspective. The link between exchange rates and equity returns is based on a simple and intuitive financial theory. The appreciation of a country's currency lowers the cost of imported goods, which in most cases constitute a large part of 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.

The relationship between stock returns and Treasury bill rate is found to be negative. French et al., (1987), Fama and Schwert (1997) also reports that negative relationship exists between Treasury bill rate and stock returns. This indicates that interest rates represent alternative investment opportunities. As the interest rate rises, investors tend to invest less in stocks causing stock prices to fall. When Treasury bill rate is high, rational investors tend to invest in less risky asset with high returns and vice versa. This was the case in Ghana between 1995 and 1999. This affected the performance of the Ghana Stock Exchange.

5. Conclusions and recommendations

This paper investigates the effects of macroeconomic variables on the stock market returns in Ghana. It estimates three multivariate APT models with the dependent variables as GSE All share returns, excess return and unexpected return respectively.

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.

Full Information Maximum Likelihood Estimation procedure was used in establishing the relationship between macroeconomic variables and stock market returns. The empirical results reveal that there is a significant relationship between stock market returns and three macroeconomic variables; consumer price index (inflation rate), exchange rate and Treasury bill rate seem to affect stock market returns.

The results of the study show that there is a significant positive relationship between consumer price index (inflation) and stock market return. 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.

Our empirical result shows a negative link between stock returns and exchange rate and this is consistent with Bilson et al., (2001) conclusion that a devaluation of the domestic currency has a negative relationship with returns. For developing economies like Ghana that depend heavily on imports, currency depreciation may lead to higher import prices causing a fall in firms' profit and in turn the price of stocks. The net effect of currency depreciation will depend on which of these factors is more dominant. In addition, currency depreciation may also create expectations in future increase in the exchange rate which consequently leads to a fall in the investment flows to the country (Ibrahim and Yusoff, 2001).

The relationship between stock returns and Treasury bill rate is found to be negative. French et al., (1987), Fama and Schwert (1997) also reports that negative relationship exists between Treasury bill rate and stock returns. This indicates that interest rates represent alternative investment opportunities. As the interest rate rises, investors tend to invest less in stocks causing stock prices to fall. When Treasury bill rate is high, rational investors tend to invest in less risky asset with high returns and vice versa. This was the case in Ghana between 1995 and 1999. This affected the performance of the Ghana

Stock Exchange.

The contributions of this paper are two-fold:

First, this paper makes an empirical contribution to the ongoing debate on the effect of macroeconomic variables on stock market returns.

Second, to the best of our knowledge this paper makes a theoretical contribution to the existing literature. Thus, on unlike other studies this paper simultaneously estimates the effect of macroeconomic variables on stock market returns in a system of equations (using Full Information Maximum Likelihood Estimation Procedure) involving the raw stock market returns and the macroeconomic variables on one hand; and the residual of the returns and the residuals of each of the macroeconomic variables (obtained through a univariate Ordinary Least Squares regression of each of the macroeconomic variables on the stock market returns) on the other hand.

In view of the findings from the study, we provide following recommendations:

Returns from investment in Ghana Stock Exchange should be made more attractive than the rate of return from Treasury bill. This is so because investors see treasury bills as alternative assets to stocks and would switch to the Treasury bill if the rate of returns from the GSE is lower. This requires instituting prudent measures that will bring about cost minimization and increase productivity for the listed companies. Once operational expenses are less, all other things being equal, more in terms of returns on equity can be given to the shareholders.

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.

At the policy level, 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.

Furthermore, 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 return - economic activity relationship.

Finally, 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.

References

Abdullah D. A. & Hayworth, S. C. (1983). Macroeconometrics of Stock Price Fluctuations. *Journal of Business and Economics*, 32 (1), 49-63.

Abugri, B. A. (2008). Empirical Relationship between Macroeconomic Volatility and Stock Returns: Evidence from Latin American markets. *International Review of Financial Analysis*, 17, 396–410.

Aggarwal, R. 1981. Exchange Rate and Stock Prices. A Study of US Capital Markets Under Floating Exchange Rates, *Akron Business and Economic Review* 12(2), 7-12.

Altay, E., 2003. The Effect of Macroeconomic Factors on Asset Returns: A Comparative Analysis of the German and the Turkish Stock Markets in an APT Framework, *Martin-Luther-Universität Halle,*

Betriebswirtschaftliche Diskussionsbeiträge, Nr. 48/2003.

Anokye M. A. and Tweneboah G. (2008). MPRA Paper No. 11256: *Macroeconomic Factors and Stock Market Movement: Evidence from Ghana*. Munich: Munich Personal RePEc Archives.

Beenstock, M. and Chan, K.F., 1988. Economic Forces in London Stock Market, *Oxford Bulletin of Economics and Statistics*, 50, 22-39.

Bilson, C. M., Brailsford, T. J., & Hooper, V. J. (2001). Selecting Macroeconomic Variables as Explanatory Factors of Emerging Stock Market Returns, *Pacific-Basin Finance Journal*, 9(4), 401–426.

Black, F., Jensen M. C. and Scholes M.(1972). The *Capital Asset Pricing Model: Some Empirical Tests in Studies in the Theory of Capital Markets.* Michael C. Jensen, ed. New York: Praeger, pp. 79–121.

Bulmash, S.B., Trivoli, G.W., 1991. Time-lagged Interactions between Stock Prices and Selected Economic Variables. *Journal of Portfolio Management* 17 (4), 61–67.

Burton, J.(1998). *Revisiting the Capital Asset Pricing Model*. [WWW] University of Stanford. Available from: http://www.stanford.edu/~wfsharpe/art/djam/djam.htm. [Accessed 25/10/2010].

Chatrath, A., Ramchander, S., & Song, F., (1997). Stock Prices, Inflation and Output: Evidence from India. *Applied Financial Economics*, 7, 439–445.

Chen, N. F., Roll, R, & Ross, S. A. (1986). Economic Forces and Stock Market. *Journal of Business*, 59, 383−404.

Choudhry, T. (2000). Inflation and Rates of Return on stocks: Evidence from high inflation countries. *Journal of International Financial Markets, Institutions, and Money*, 11, 75−96.

Elton E. J. and Gruber M. J. (1991). *Modern Portfolio Theory and Investment Analysis*. New York: John Wiley and Sons.

Engsted, T., and Tanggaard, C., 2002. The Relation between Asset Returns and Inflation at Short and Long Horizons. *Journal of International Financial Markets, Institutions & Money* 12, 101−118.

Fama, E. F. (1981). Stock Returns, Real Activity, Inflation and Money. *American Economic Review*, 71 (4), 545−565.

Fifield, S. G. M., Power, D. M. and Sinclair, C. D. (2002). Macroeconomic Factors and Share Returns: An Analysis using Emerging Market Data. *International Journal of Finance and Economics,* 33 (1), 51-62.

Fisher, I., (1930). *The Rate of Interest*. Macmillan, New York.

French, Kenneth R., Schwert, G., W. and Stambaugh, R., F., 1987. Expected Stock Returns and Variance. *Journal of Financial Economics* 19, 3-29.

Gangemi, M., Brooks, R., and Faff R., (2000). Modelling Australia's Country Risk: A County Beta Approach. *Journal of Economic and Business*, 52, 259-276.

Gazi Mainul Hassan and Hisham Al refai (2010). *Can Macroeconomic Factors Explain Equity Returns in the Long Run? The Case of Jordan.* Draft 4-15/05/2010. School of Economics and Finance, University of Western Sydney, Australia.

Ghana Statistical Service Monthly Report, January, 1992 – December 2008.

Ghana Stock Exchange Monthly Report, January 1992 – December, 2009.

GIPC (December, 2007). *Sector Profile of Ghana's Financial Service Industry.* Accra, Ghana: Ghana Investment Promotion Center.

Ibrahim, M and Aziz. (2003). Macroeconomic Variables and the Malaysian Equity Market. *Journal of Economic Studies,* 30, 6-27.

Ibrahim, M and Yusoff. (1999). Macroeconomics Variables and Stock Price in Malaysia: an Empirical Analysis. *Asian Economic Journal,* 13(2), 219-231.

Johansen S. and Juselius K. (1992). Testing Structural Hypotheses in Multivariate Cointegration Analysis of the PPP and UIP for UK. *Journal of Econometrics*, 53: 211 – 244.

Johansen S. and Juselius K. (1990). Maximum Likelihood and Inference on Cointegration With Applications to the Demand for Money. *Oxford Bulletin of Economics and Statistics*, 52: 169 – 210.

Kaneko T, Lee B. S.   (1995). Relative Importance of Economic Factors in the U.S. and Japanese Stock Markets. *Journal of Japan International Economics*, 9, 290-307.

Maysami, R.C., Howe, L.C., & Hamzah, M.A. (2004). Relationship between Macroeconomic Variables and Stock Market Indices: Cointegration Evidence from Stock Exchange of Singapore's All-S sector Indices. *Jurnal Pengurusan,* 24, 47-77.

Miller M. H. and Modigliani F. (1961). Dividend Policy, Growth and Valuation of Shares. *Journal of Business*, 34 (4), 411-433.

Mohammed A. M. T., Wisam R., Hassama A, And Bin Amin F. M (2007), Effects Of Macroeconomic Variables on Stock Prices In Malaysia: An Approach Of Error Correction Model. *International Islamic University Malaysia, Jalan Gombak-53100,* Kuala Lumpur, Malaysia.

Mossin, J, (1966). Equilibrium in a Capital asset Market, *Econometrica*, 34 (4), 768 – 783.

Mukherjee, T. K. and Naka, A. (1995). Dynamic Relations between Macroeconomic Variables and the Japanese Stock Market: An Application of vector error correction model. *The Journal of Financial Research,* 18(2), 223-237.

Omran, M., & Pointon, J. (2001). Does the Inflation Rate affect the Performance of the Stock Market? The case of Egypt. *Emerging Markets Review*, 2, 263–279.

Osinubi, T. S. (2004). Does Stock Market Promote Economic Growth in Nigeria? The ICFAI *Journal of Applied Finance*, IJAF 10 (3), 17-35.

Ozcam, M., (1997). "An Analysis of the Macroeconomic Factors That Determine Stock Return in Turkey", *Capital Market Board of Turkey, Publication Number 75*.

Pebbles, G., and Wilson, P. (1996). *The Singapore Economy*. Cheltenham, UK: Edward Elgar.

Roll, R., (1977). A Critique of the Asset Pricing Theory's Tests' Part I: On Past and Potential Testability of the Theory. *Journal of Financial Economics*, 4 (2), 129 –176.

Ross, S. A., (1976). The Arbitrage Theory of Capital Asset Pricing, *Journal of Economic Theory*, 13, 341–360.

Sharpe, W., (1964), Capital Asset Prices: A Theory of Market Equilibrium under conditions of Risk, *Journal of Finance*, 19, 425 – 442.

Soenen L. A. and Henniger E. S. (1998). An Analysis of Exchange Rates and Stock Prices: the US Experience between 1980 and 1986. *Akron Business and Economic Review*, 19, 71-76.

Soenen L.A. and Aggarwal R. (1989). Financial Prices as *Determinants of Changes in Currency Values*, Paper Presented at the 25th Annual Meetings of Eastern finance Association, Philadelphia, United States.

Solnik, B.(1987). Using Financial Prices to Test Exchange Rate Models: A Note*, Journal of Finance*, 42, 141-149.

Tobin, J., (1965), "Money and Economic Growth"*, Econometrica*, 33(4), 671-84.

Treynor, J., (1999), *Toward a Theory of Market Value and Risky Assets*, Unpublished manuscript, Final version in Asset Pricing and Portfolio Performance; Robert A. Korajczyk, ed., London: Risk Books, pp. 15 – 22.

Ushad, S. A.; Fowdar, S.; Sannassee, R. V. and Jowaheer, M., (2008) "Return Distributions: Evidence from Emerging African Stock Exchanges" *The Icfai University Journal of Financial Economics,* VI (3), 41-52.

Zhao, X., (1999). Stock Prices, Inflation and Output: Evidence from China. *Applied Economics Letters*, 6, 509–511.