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Abstract: *This study empirically examined the impact of some macroeconomic variables on stock price volatility in the Ghana Stock Exchange (GSE) using annual time series data over the period of 1990-2014. Secondary data on the performance of the stock exchange: GSE-All Shares was obtained from the Ghana stock exchange website whiles that of macroeconomic variables was obtained from the Bank of Ghana website. The macroeconomic variables used in this study are inflation rate, real gross domestic product growth rate and interest rate. The Granger causality test was employed to determine the causal link between stock prices and macroeconomic variables in Ghana. The results of the Granger causality test shows that at 10% significance level, real domestic product rate granger causes stock price but stock price does not granger cause real domestic product rate. There is, therefore, a unidirectional causality running from Real Gross Domestic Product growth rate to stock price The other variables: inflation rate and interest rate do not granger cause stock prices. This shows that a shock in real domestic product growth rate affects stock price volatility in Ghana. The Ghana Stock Exchange should track likely factors that are responsible for stock price volatility. Also, to stabilize stock price movement, real gross domestic product growth rate should be one of the main factors to be addressed apart from other internal factors that affect liquidity such as stock market liquidity and volume of shares. Laws and regulations governing the operations of the stock exchange should be strengthened to protect the interest of buyers and sellers on the stock market. This will increase the confidence of investors as well as boost domestic investor participation and enlarge stock ownership base in the economy.*

Keywords: GSE-All Share Index, inflation, interest rate, Real Gross Domestic Product growth rate, Ghana

1.0 INTRODUCTION

Stock market is a market that deals with the exchange of securities issued by publicly-quoted companies and the government. The market is a crucial institution in an economy which greatly determines and indicates the performance of an economy. The nature and the state of a stock market is of great concern to the government, investors, and generally, all the stake holders. As an economic institution, stock market plays a major role of enhancing the efficiency of capital formation and allocation. Thus the overall development of the economy is a function of how well the stock market performs. Stock prices are generally believed to be determined by some fundamental macroeconomic variables such as interest rates, Real Gross Domestic Product (GDP) growth, inflation, exchange rate, and Gross Domestic Product. Changes in stock prices are linked with macroeconomic behavior in advanced countries (Muradoglu *et al.,* 2000).

In an efficient market, stock prices react quickly to news release. This means that stock price volatility reflects robust information about the market condition and can be used as a major indicator for measuring the economic condition of a country. Consequently, the dynamic relationship between stock price oscillation and macro-economic variables can be used to gauge economic activities of countries.

The relationship between stock prices and macroeconomic variables is well illustrated by the theoretical stock valuation models. According to the models, the current prices of an equity share is approximately equal to the present value of all future cash flows, hence any macroeconomic variable that affects cash flow and the required rate of return will in turn influence the share value as well. Stock returns are generally believed to be determined by some fundamental macroeconomic variables. The volatility of stock returns represents the variability of stock price changes during a particular period of time. Despite being a measure of risk, excessive stock returns volatility or "noise" according to investors undermines the usefulness of the

stock prices which is an indicator about the true intrinsic value of the firm (Karolyi, 2001). Growing inflation, fluctuations in exchange rates, Real Gross Domestic Product (GDP) growth and interest rate will increase volatility of stock returns leading to rise in risk, and the investors may think of switching their investment to less risky portfolios like bonds.

Most of research works on macroeconomic variables and stock volatility mainly focused on developed economies. Such investigation has not been carried out in emerging countries like Ghana. The little work done concentrated on the impact of financial variables (i.e. exchange rate and interest rate on the volatility of stock prices). Therefore, this research work seeks to investigate the impact of macro-economic variables: inflation, gross domestic product (GDP) interest rate, and exchange rate on stock price volatility in Ghana.

2.0 LITERATURE REVIEW

Financial asset – pricing theories try to understand why certain capital assets have higher expected returns than others and why the expected returns are different at different points in time. There are different financial asset pricing theories, based on different sets of assumptions. Two such asset pricing theories are Capital Asset Pricing Model and Arbitrage Pricing Model. Capital Asset Pricing Model is the most basic asset pricing theory.

The theoretical linkage between the macroeconomic factors and the stock price volatility can be obtained from the Present Value Model (PVM), Capital Asset Pricing Models (CAPM), and the Arbitrage Pricing Theory (APT). The present value model focused on the long-run relationship whereas the arbitrage pricing theory focused on short-run relationship between the stock market movement and the macroeconomic fundamentals. According to these models, any new information about the fundamental macroeconomic factors such as real output, inflation, Real Gross Domestic Product (GDP) growth, interest rate and so on, may influence the stock price/return through the impact of expected dividends, the discount rate or both Charkravarty (2005). A simple discount model shows that the fundamental value of corporate stock equals the present value of expected future dividends. The future dividends must ultimately reflect real economic activity. If all currently available information is taken into account, there could be a close relationship between stock prices and expected future economic activity.

According to Fleming & Remolona (1999), the one-factor capital asset pricing models (CAPM) is seen in certain quarters as the dominant asset pricing model. However, the CAPM model is based on the assumption that the expected return for any asset is a positive function of only one variable. Therefore, its market beta is defined as the covariance of asset return and market return. This single factor assumption of the CAPM is often cited to be its fundamental weak point. Consequently, the need for a more embracing and multi-factor model to account for stock returns led to the development of the Arbitrage pricing theory (APT).

The APT model as formulated by Ross, rests on the assumption that stock price is influenced by limited and non-correlated common factors and by a specific factor totally independent of the other factors. By using the arbitrage reasoning, it can be shown that in an efficient market where stock prices respond appropriately to various variants and sources of information, the expected return is a linear combination of each factor's beta (Morel, 2001). The risk associated with holding a particular security comes from two sources. The first source of risk is the macroeconomic factor that affect all securities. The whole asset market is influenced by these factors and cannot be diversified away. The second source of risk is the characteristic constituent. This constituent is unique to each security and according to the APT, in a broadly diversified portfolio, it can be diversified away.

Boyd and Jagannathan (2001) opine that Arbitrage Pricing theory comes from an entirely different set of assumptions as it is not primarily concerned about the efficiency of portfolios. Instead, it starts by taking a position on a line of causality between each equity's return and the prevailing and pervasive macroeconomic influences or factors as well as partly on random disturbances. Generally, the APT implies that the return of an asset can be broken down into an expected return and an unexpected or surprise component. Thus, the

APT predicts that "general news" will affect the rate of return on all stocks but by different amounts. In this way, the APT is more general than the CAPM, as it allows larger number of factors to affect the rate of return. Azeez and Yonezawa (2003) suggests that the primary advantages of using macroeconomic factors are that firstly, the factors and their APT prices in principle can be given economic interpretations, and that secondly, rather than only using asset-prices to explain asset-prices, observed macroeconomic factors introduce additional information, linking asset-price behaviour to macroeconomic events.

Since Ghana is one of the emerging economies in Africa, its stock market performance is highly dependent on the nature of the macroeconomic variables. These variables are considered to be causes of stock return volatility existing in NSE and may lead to stock market crisis. According to the International Finance Corporation (IFC), all markets in the developing countries are treated as emerging. Ghana's capital market, the Ghana Stock Exchange (GSE), is thus one of the emerging markets of the world. The market is characterized by; low trading volume, low turnover ratios, few listed companies, and inefficient information delivery.

The relationship between stock prices and macroeconomic variables is well illustrated by the theoretical stock valuation models. According to the models, the current prices of an equity share is approximately equal to the present value of all future cash flows, hence any macroeconomic variable that affects cash flow and the required rate of return will in turn influence the share value as well. Stock returns are generally believed to be determined by some fundamental macroeconomic variables. The volatility of stock returns represents the variability of stock price changes during a particular period of time. Despite being a measure of risk, excessive stock returns volatility or "noise" according to investors undermines the usefulness of the stock prices which is an indicator about the true intrinsic value of the firm (Karolyi, 2001). Growing inflation, fluctuations in exchange rates, Real Gross Domestic Product (GDP) growth and interest rate will increase volatility of stock returns leading to a rise in risk and the investors may think of switching their investment to less risky portfolios like bonds.

2.1 Stock Price and Macroeconomic Variables

2.1.1 GDP Growth Rate

Majority of the studies have found that the current stock levels are positively related to future levels of real economic activity, as measured by Gross Domestic Product (GDP) (Geske & Roll, 1983; Chen et al., 1986; Sharma, 2002). The levels of Gross Domestic Product (GDP) will likely influence stock returns through its impact on corporate profitability. An increase in output may increase expected future cash and, hence, raise stock prices, while the opposite effect would be valid in a recession.

2.1.2 Inflation Rate

A high inflation rate raises the cost of living and results to a shift of resources from investments to consumption. The demand for market instruments falls leading to reduction in the volume of stock traded. This will force the monetary policy authorities to respond to the increased rate of inflation with economic tightening policies, which in turn increases the nominal risk-free rate and hence raises the discount rate in the valuation model (Adam & Twenoboah, 2008). Nominal contracts that disallow the immediate adjustment of the firm's revenues and costs prevent cash flow to grow at the same rate as inflation.

Economic theory indicates that inflation decreases the purchasing power of business cash flow. Changes in inflation expectation therefore affect the purchasing power of businesses, hence it is expected that inflation will correlate negatively with stock returns. Ayadi (1991) and Ekpenyong and Obieke (1994) provide conflicting results. While Ayadi (1991), provide evidence that inflation has a positive explanatory power, Ekpenyong and Obieke conclude that inflation was not priced in Nigeria. Chen et al., (1986) records a negative association while Beenstock and Chan (1988) and Hamao (1988) report a positive relationship with stock returns.

2.1.3 Interest Rate

First, if an investor considers interest rate as cost of capital, an increase or a decrease in interest rate may affect the investment decision of the investors. For example, when there is a rise in interest rate and the opportunity cost goes up, individual investors would prefer to invest in non-fixed income securities such as bonds (Adam & Tweneboah, 2008). This may result either in profit or loss which is reflected in the firm's balance sheet. When the profit or loss of a firm is immediately announced, the stock price of a firm will increase or decrease. This implies that the valuation of a firm would either increase or decrease its stock price hence stock returns.

The level of interest rates influences economic activity through the capital investment process. Low interest rates encourage capital expenditures by individuals and businesses. These expenditures provide additional employment, increased output of goods and services, and overall increases in GDP. Interest rates have been closely correlated with economic activity because they closely move with the business cycle. Accordingly, the proposition is that it should negatively correlate stock returns. 91- day Treasury bill is used as proxy for interest rate since Treasury bill serves as the opportunity cost for of holding shares. Similarly, Chan et al., (1985), Chen *et.al*., (1986), Beenstock and Chan (1988), Ayadi (1991), Karamustafa and Kucukkale (2003) provide evidence on their relationship.

2.2 Empirical review

In Ghana Adjasi, Harvey and Agyepong (2008), studied the relationship between Ghana Stock Market and Foreign Exchange Market, and determined whether movement in exchange rates have an effect on stock market in Ghana. It was found out that there is a negative relationship between exchange rate volatility and stock returns- a depreciation in the local currency leads to an increase in stock markets in the long run, where as in the short runit reduces stock market returns. Additionally, they realised that the consumer price index has a strong relationship with stock market volatility. This means that an increase in consumer price would lead to in stock market volatility.

Adam and Tweneboah (2008), applied multivariate cointegration through error correction model to examine the impact of Foreign Direct Investment (FDI) on the stock market development in Ghana. Their results indicated that there exists a long-run relationship between FDI, nominal exchange rate and stock market development in Ghana. They concluded that a shock in FDI significantly influences the development of stock market in Ghana. They also employed cointegration test and vector error correction models (VECM) to examine both long-run and short- run dynamic relationships between the stock market index and economic variables. Their paper established that there is a cointegration between macroeconomic variables and stock prices in Ghana. The VECM analysis shows that the lagged values of interest rate and inflation have a significant influence on the stock market.

Kyereboah and Agyire-Tetteh (2008) examined the effect of macroeconmic indicators on the performance of Ghana Stock markets covering the period 1991-2005. The research findings revealed that lending rates from deposit money banks and inflation rate had an adverse effect on stock market performance and particularly served as a major hindrance to business growth in Ghana but investors benefited from exchange- rate losses as a result of domestic currency depreciation.

3.0 METHODOLOGY

The study employed annual time series data from 1990 to 2014 to examine the effect of macroeconomic variables on stock price volatility on the Ghanaian Stock Exchange. The macroeconomic variables are Real Gross Domestic Product (GDP) growth, inflation, and interest rate. Annual data sourced for this study were from the Bank of Ghana statistical data and Ghana Stock Exchange (GSE) publications. The techniques employed to analyze the data include descriptive statistic and the unit root Augmented Dickey- Fuller (ADF). The data was tested for stationarity using the Augmented Dickey Fuller method. Time series data are generally assumed to be non-stationary at level forms and so running a regression without controlling the problem of non-stationarity will yield spurious regression results. Spurious regression results exist when the

test statistics show a significant relationship between variables under study in the regression model, even though no such relationship exists between the variables (Patterson, 2000). To address this problem, the study undertook a preliminary examination of the annual data by using the unit root test. Failure to properly account for the dynamics in the time series data set may harm the estimation results. As a result, the ADF test, developed by Dickey and Fuller (1979) was employed to examine the presence of unit root. This is because the ADF is simple and offers a more convenient procedure for examining properties of time series data set. The ADF approach controls for higher-order correlation by adding lagged difference terms of the dependent variable to the right-hand side of the regression. The ADF test is specified as follows:

$$\Delta Yt = \_\_bo + \_\_\beta Yt-1\_ + \_\_\mu 1\_Yt-1\_ + \_\_\mu 2\_Yt-2\_ + \_\_\ldots\ldots + \_\_\mu pYt-p + \_\_\varepsilon t$$

Where Y_t represents time series data on stock prices, Real Gross Domestic Product (GDP) growth, inflation and interest rate to be tested, b_0 is the intercept term, β is the coefficient of interest in the unit root test, μ_i is the parameter of the augmented lagged first difference of Y_t to represent the p_{th}-order autoregressive process, and ε_t is the error term. In carrying out the unit root test, the study seeks to test the hypothesis that:

Ho: β=0 , Non stationary (there is unit root)
H_1: $\beta \neq 0$, Stationary (no unit root)

The decision rule involves comparing the computed ADF value with the MacKinnon critical values for the rejection of a hypothesis for a unit root. If the computed tau (ADF) statistic is less negative (that is, lies to the right of the MacKinnon critical values) relative to the critical values, the null hypothesis of non-stationarity in time series variables is not rejected. If the null hypothesis is rejected, then the time series data is stationary, hence no unit root. Finally, the Granger causality statistic, developed by Granger (1969), was applied to test the statistical causality between stock exchange performance indicator and economic growth (GDP) in Ghana. According to Granger (1969) in causality approach, a variable Y, is caused by another variable X if Y can be predicted better from past values of variables Y and X than from past values of variable Y alone. The causality test helps to ascertain whether a uni-directional or bi-directional (feedback) relationship exists between the two variables. The choice for the granger procedure is based on the fact that it is the more powerful and simpler way of testing causal relationship (Olweny and Kimani, 2011).

3.1 Variable Description

The overall measure of stock market performance is captured by the Variable GSE All-Share-Index which is the dependent variable in this study. This is a composite index which reflects the average price movements in all equities listed on the stock market. The use of this composite index is justified since it captures all other performance measures such as market capitalization, liquidity and turn over ration. Inflation rate was proxied by Non-food inflation while 91-day Treasury bill rate was used as a proxy for interest rate. Real Gross Domestic Product growth rate was used as proxy for Gross Domestic Product.

3.2 Specification of the Operational Model

The study employed the Granger causality approach to determine effect of macro-economic variables on stock price volatility in Ghana during the period 1990-2014. This study specifies the following augmented functional model of the stock market performance for Ghana which is based on the theoretical and empirical literature on asset valuation:

$$GSE_t = \alpha_0 + \alpha_1 INFL_t + \alpha_2 RGDP_t + \alpha_3 INTR_t + \epsilon_t \qquad (1)$$

Where GSE All- Share Index which serves as a proxy for stock market performance; *INFL* is the rate of inflation*; INTR* is the interest rate *RGDP* is a measure of economic activity; *t is* time and ϵ is the usual white noise error term.

A log-linear specification of the relationship between variables in Equation (1) would be an innocuous

assumption. First, there could be non-linear relationship between the variables and also taking the natural logarithms of variables reduces their scale from a ten-fold to a two-fold which has the potential of reducing heteroscedasticity (Gujarati, 1995). Second, estimating the log-linear relationship will aid the interpretation of the estimated coefficients as partial elasticities (i.e., the independent variables would measure the relative changes in the dependent variables). Thus, the stochastic relationship between the variables in its estimable form is specified as follows:

$$\ln GSE_t = \alpha_0 + \alpha_1 \ln INFL_t + \alpha_2 \ln RGDP_t + \alpha_3 \ln INTR_t + \epsilon_t \qquad (2)$$

Where all the variables have been defined already except *ln* which is the natural logarithm.

4.0 RESULTS AND DISCUSSION

4.1 Descriptive Statistics and Bivariate Correlation of Variables

The summary statistics and bivariate correlations between the variables are presented in Table 1 and Table 2 respectively. In Ghana, between 1990 and 2014, the GSE- All share index averaged 2533.27 points. Within the same period, the inflation rate averaged 23.54% whilst Real Gross Domestic Product growth rate averaged 5.65% and recording its highest at 14.03%. This suggests a relatively slow pace of economic growth of the economy. Much effort needs to be made by government to accelerate the pace of economic growth of the country. Interest rate (91 Day Treasury Bill rate) within the same period averaged 26.16% with minimum interest rate being 9.60%. The descriptive statistics shows that all variables have return distributions that are positively skewed. The descriptive statistics presented in Table 4.1 provides sufficient grounds to carry on with any kind of analysis since the data shows enough variability. The descriptive statistics presented in Table 1 provides sufficient grounds to carry on with any kind of analysis since the data shows enough variability.

Table 1: Descriptive statistics of GSE All-Share Index, Inflation, Real Gross Domestic Product (GDP) growth and Interest Rate

Statistics	GSE All-Share Index	Inflation (%)	Real Gross Domestic Product (GDP) growth	Interest rate (%)
Mean	2533.27	23.54	5.65	26.16
Median	969.03	18.80	5.04	25.79
Maximum	10431.64	72.80	14.03	47.88
Minimum	62.17	10.30	3.34	9.60
Standard deviation	2899.60	14.81	2.28	11.50
Skewness	1.26	1.97	2.38	0.39
Kurtois	0.73	4.43	6.97	-5.84
Shapiro-Wilk	0.81***	0.79***	0.75***	0.95
Probability	0.00	0.00	0.00	0.21
Variance	8407692.54	219.19	5.21	132.29
Observation	25	25	25	25

Source: Survey Data, 2016. NB: *significant at 10% **significant at 5% *** significant at 1%

Table 2: Bivariate Correlation of the Variables

	GSE	***INF***	***GDP***	***INT***
GSE	1.000			
INFL	-0.340	1.000		
RGDP	0.329	-0.420*	1.000	
INTR	-0.577**	0.704**	-0.489*	1.000

Source: Survey Data, 2016. NB: * significant at 5%, ** significant at 1%

The pairwise correlation of the variables also presented in Table 2 ascertains the degree of collinearity of variables. This is also to determine potentially which variables can cause multicollinearity in the estimated models to be presented subsequently. The results of bivariate correlation indicate that the Ghana Stock Exchange variable (*GSE)*, is positively correlated with all the other variables except inflation which also happens to have a weak correlation. The *GSE* variable also has a weak correlation with Real Gross Domestic Product (GDP) growth rate. A higher correlation of the *GSE* variable with the other variables is not a matter of concern since it is used mainly as the dependent variable in this study, though the other variables are endogenised. Thus, a higher correlation amongst the other variables (mainly the independent variables for the purpose of this study) is rather a matter of concern which can cause the variances of the estimated parameters to be unduly large resulting in the statistical insignificance of most of them. The results indicate that interest rate and inflation rate are highly correlated. The question that naturally arises is" should I drop a variable if it is found to be highly correlated with the other variables in the model as in an attempt to solve the problem of multicollinearity?"Since all variables are deemed relevant explanatory variables, dropping a variable might cause serious consequences to the estimates than keeping it. As expressed by Blanchard,
"…When students run their first ordinary least squares (OLS) regression, the first problem that they usually encounter is multicollinearity. Many of them conclude that there is something wrong with OLS; some resort to new and often creative techniques to get around the problem. But, we tell them, this is wrong. Multicollinearity is God's will, not a problem with OLS or statistical technique in general".

Multicollinearity is a data deficiency problem and since I have no choice over the data I am using in this empirical analysis, nothing is done about the problem of multicollinearity.

4.2 Result of the unit root Augmented Dickey-Fuller (ADF) test

To prelude spurious regression (Granger and Newbold, 1975) and to ascertain that long-run relationship exist among the variables, the order of integration of each of the series is checked. Stated differently, for a VAR model, the series used in the model have to be stationary which is checked using Augmented Dickey-Fuller (ADF) unit root test. The null hypothesis is that the variable under investigation has a unit root against the alternative that it does not. The decision rule is to reject the null hypothesis if the ADF statistic value exceeds the critical value at a chosen level of significance. Table 3 presents the results of the ADF unit root for both levels and difference. The results from the ADF test indicate that almost all the variables are non-stationary at levels. The ADF test statistics for all the variables, with the exception of inflation and Real Gross Domestic Product (GDP) growth are greater than their respective critical values at 5% and 10% confidence levels respectively. Since the time series are non-stationary at levels, each of the variables was tested by differencing. Table 3 shows that after first difference, all variables become stationary. Thus, it can be concluded that the variables under investigation are integrated of order one. (i.e. I(1)). Since the variables are integrated of the same order. The researcher, therefore, examine their co-integrating relationship using Engle-Granger procedure

Table 3: Unit Roots Test Result

Variables	ADF STATISTICS		ADF STATISTICS		
	Level	Critical Values	1ST Difference	Critical Values	Lag Length
GSE	-1.945	1% -3.75 5% -3.00 10% -2.63	-3.153	1% -3.75 5% -3.00** 10% -2.63*	1
INFL	-3.425	1% 3.75 5% -3.00** 10% -2.63	-4.620	1% -3.75*** 5% -3.00** 10% -2.63*	1
RGDP	-2.985	1% -3.75 5% -3.00 10% -2.6*	-4.447	1% -3.75*** 5% -3.00** 10% -2.63*	1
INTR	-1.746	1% -3.70 5% -3.00 10% -2.63	-4.057	1% -3.75*** 5% -3.00** 10% -2.63*	1

Source: Survey Data, 2016. NB: *Significant at 10% ** significant at 5% *** significant at 1%

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4.3. Results from Co-Integration Test

Since the differenced series are stationary, the VAR model was estimated using the first difference of the variables in the model. Stated alternately, since VAR requires variables to be stationary, using the level form of the variables would not be appropriate because they have been found not to be stationary. Prior to the estimation of VAR, the optimal number of lags to be included in the model using some information criteria as a guide in the selection. The results of the lag selection are presented in Table 4 . The results indicate that, the Akaike Information Criterion (AIC), the LR Criterion and Hanna-Quinn information (HQ) criterion are selecting lag order of 3. The Final Prediction Error (FPE) criterion selects a lag of 4 whilst the SBIC is selecting a lag of 0. Adhering to the law of parsimony in modeling, the AIC, LR and HQ criterion was chosen and subsequently used a lag order of 3 in the estimation of the VAR model. Also considering the series used in the estimation, including a lag order of 4 is not out of place, although the FPE penalizes the model quite more in relation to the other information criteria. Again, though the SBIC penalize the model less, the lag selection of 0 is just out of place. Thus, at the 5% level of significance, a lag of 3 was used in the VAR estimation in conformity with the Law of Parsimony.

Table 4: VAR Lag Order Selection Criteria

Lag	LL	LR	FPE	AIC	HQIC	SBIC
0	22.267		1.9e-06	-1.8267	-1.78783	-1.62755*
1	33.7988	23.064	3.1e-06	-1.37988	-1.18551	-0.384152
2	46.9632	26.329	5.2e-06	-1.09632	-0.746443	0.695996
3	90.1587	86.391*	7.1e-07	-3.81587*	-3.31049*	-1.22697
4			-1.6e-21*			

* Indicates lag order selected by the criterion (each test at 5% level of significance); LL: Log Likelihood; LR: sequential modified Likelihood Ratio test statistic; FPE: Final prediction error; AIC: Akaike information criterion; SBIC: Schwarz information criterion; and HQ: Hannan-Quinn information criterion. Exogenous variables: Constant Endogenous: ΔSP, ΔINF, ΔINTR ΔLnRGDP

4.3.1 Granger Causality Between Stock Prices and Macroeconomic Variables

The Granger Causality test was used to test the hypothesis of no causal relationship between stock prices

(GSE- All shares/ composite index) and macroeconomic variables. The Granger causality test was conducted to find out the direction of causality and possible feedback amongst the variables. The results are presented in Table 5. The results indicate that Real Gross Domestic Product growth rate causes stock price. Thus, past values of Real Gross Domestic Product growth rate can be used to predict the current stock prices. However, stock prices do not granger cause Real Gross Domestic Product growth rate. There is therefore a unidirectional causality running from Real Gross Domestic Product growth rate to stock price. The results indicate no causality between stock prices and the other macroeconomic variables (inflation and interest rate). The results of the Granger causality show that improvement in Real Gross Domestic Product growth rate leads to an improvement in the stock market performance.

Table 5: Results of the Granger Causality Test

Lags	Null Hypothesis	F-Statistics	Probability	Inference
3	ΔLnGSE does not Granger cause ΔLnINFL	0.49577	0.6953	Do not reject
3	ΔLnGSE does not Granger cause ΔLnRGDP	0.6415	0.6095	Do not reject
3	ΔLnGSE does not Granger cause ΔLnINTR	2.2797	0.1563	Do not reject
3	ΔLnINFLdoes not Granger cause ΔLnGSE	2.6918	0.1168	Do not reject
3	ΔLnRGDP does not Granger cause ΔLnGSE	3.8444	0.0567*	Reject
3	ΔLnINTR does not Granger cause ΔLnGSE	1.3525	0.3247	Do not reject

Source: Survey Data, 2016. NB: ***, **, * denotes rejection of null hypothesis at 1%, 5% and 10% significance levels respectively.

5.0 CONCLUSIONS AND RECCOMMENDATIONS

The relationship between macroeconomic variables and stock price volatility were investigated. Specifically, three macroeconomic variables were investigated: inflation rate, real gross domestic product growth rate and interest rate for the period of 1990 to 2004. The results of the Granger causality test shows that at 10% significance level, real domestic product rate granger causes stock price but stock price does not granger cause real domestic product rate. The other variables: inflation rate and interest rate does not granger cause stock prices. This shows that a shock in real domestic product rate affects stock price volatility in Ghana. There is, therefore, a unidirectional causality running from Real Gross Domestic Product growth rate to stock price. It is recommended that efforts will first promote the development of the stock exchange should be encouraged. Policies that would enhance macro-economic variables should be put in place in order to control stock price movement in Ghana. Policies that would bring about innovations in macroeconomic variables should be pursued in order to foster stock market price development. The Ghana Stock Exchange should track likely factors that are responsible for stock price volatility. Also, to stabilize stock price movement, real gross domestic product growth rate should be one of the main factors to be addressed apart from other internal factors that affect liquidity such as stock market liquidity and volume of shares. Laws and regulations governing the operations of the stock exchange should be strengthened to protect the interest of buyers and sellers on the stock market. This will increase the confidence of investors as well as boost domestic investor participation and enlarge stock ownership base in the economy. There is also the need for government to encourage private companies to list on the stock exchange through the provision of tax incentives so as to improve upon the liquidity of the market.

Future studies may be conducted to identify other macro-economic variables which were not captured in this study that significantly affect stock returns. Since a wide range of factors may be relevant in determining the stock market returns. Such variables may include but not limited to political uncertainties, unemployment/employment levels, export earnings, regional stock market indices, broadband internet penetration, regional retail sales, and bankruptcies among others.

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