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Effect of Interest Rate on Stock Prices in Ghana

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Abstract: The paper assesses the effect of interest rate on stock prices, with emphases on Ghana Stock Exchange; using monthly time series data from July 2007 to December 2019. The Augmented Dickey-Fuller (ADF) test was employed to establish the stationarity properties of the data or otherwise. Using the Ordinary Least Squares (OLS) estimation technique of Multiple Regression, the results ($\beta = -0.891$, $p < 0.05$) revealed an indirect association between interest rates and stock prices in the Ghanaian context; which is consistent with the theoretical conclusion that an increase in interest rate results in a decrease in stock prices. Thus, in the light of this finding, it was recommended that policymakers should consider the stock market dynamics due to the significant relationship that exists between the two macroeconomic variables.

Keywords: *Interest Rates, Stock Prices, Ordinary Least Squares, Augmented Dickey-Fuller Test, Ghana.*

1. Introduction

Interest rates and stock prices nexus has been the subject of several empirical and theoretical research works among academics, policymakers, economists and investment analysts in recent years. Economic theory postulates a negative correlation between these two macroeconomic variables (interest rates and stock prices); which implies that a rise in interest rate results in a fall in stock prices and vice versa. Higher interest rates as a contractionary monetary policy instrument, negatively affect stock prices owing to the fact that it brings about a fall in the value of stocks, making fixed-income assets more lucrative than keeping alternative stocks. This, therefore, reduces the likelihood for investors to take loans and invest in stocks and thereby decreasing demand for stocks (Teitey, 2019). In addition, a negative relationship has been hypothesized, in economic theory because interest rates affect the operations of business firms and companies. All other things being equal, a rise in interest rate brings about a rise in capital cost. As a result, a firm must put in extra effort to acquire higher earnings if interest rates are high; otherwise, the extra expenses on the additional interest will absorb a higher proportion of the profit.

The lower the profit, therefore, the lower the cash flow and hence, the larger the required rate of return for people which invariably affects the company's stock price. Furthermore, in a situation where interest rates increase to a level that a company might find it hard to honor its financial obligations, the survival of the company would certainly be threatened and for that matter, higher risk premiums would be demanded by investors. This will cause the company's stock price to decrease further (Stowe et al., 2007). Moreover, the inverse relationship between stock prices and interest rates is explained from the viewpoint that a rise in interest rates raises the interest expenditures of highly geared firms and companies. This reduces cash flows that can be distributed as dividends to shareholders in the future period. Changes in interest rates ultimately influence the extent to which financial assets and liabilities of non-financial firms are estimated on the market. In other words, a higher rate of interest affects the opportunity cost of investing in shares, which makes bonds more attractive. Hence, investors are motivated to substitute share investments with bonds and consequently, causing stock prices to fall (Mwaanga, 2017).

Furthermore, the negative association between interest rates and stock prices is explained from the perspective either through the rate of discount or the effect of inflation. According to Choi and Jen (1991), the expected returns on stocks are sturdily linked to the interest rate risk, as well as the market risk. Their findings indicated that the risk of the interest rate for smaller businesses is one of the main sources of portfolio risk for investors; the risk of the interest rate for bigger companies is negative or inverse. Also, the findings indicate that the risk premium of interest rate explains a significant proportion of the difference in projected earnings between the topmost five and the bottom five companies of the New York Stock Exchange. The above notwithstanding, the results of Humpe and Macmillan (2007) also revealed that Japan and United States stock prices are equally related to interest rates indirectly in the long run. Irrespective of the fact that

several academicians, policymakers and financial economists have attempted to establish the dynamic interactions between interest rates and stock prices, it appears only a few studies have been undertaken in the Ghanaian context. In addition, there have been mixed results in terms of the strength and nature of the relationship (Teitey, 2019).

Thus, undertaking a study to verify the linkage between the two macroeconomic variables in Ghana becomes imperative. In short, this study aims at contributing to the literature on interest rate and stock price nexus, by employing the OLS estimation technique of multiple regression. In the light of the objective, the study is guided by the question: What is the degree of strength of the association between interest rate and stock prices in Ghana, as well as the direction? To answer this question, the following hypothesis was formulated:
H_0: There is no degree of association between interest rate and stock price in Ghana (H_0: $\beta_1 = 0$).

The null hypothesis was tested against the alternative hypothesis:
H1: There is an inverse association between interest rates and stock prices in Ghana (H_1: $\beta_1 < 0$).

2. Related Literature

In literature, several researchers have reported that there is an inverse relationship between interest rates and prices of stocks (Kandir, 2008; Somoye et al., 2009; 2017; Teitey, 2019; Flannery & James, 1984; Gan et al., 2006; Madura & Schnusenberg, 2000). In addition, the results of Abugri (2008) indicated an inverse association between stock prices and interest rate; and significant in both Chile and Argentina as well as Brazil. However, the results indicated an insignificant relationship between the two variables in Mexico. Muradoglu and Metin (2001) also found that a rise in interest rates impacts stock prices in Turkey. Yildirtan (2007) also reported a negative connection between interest rates and stock prices. However, the results revealed that the degree of association was very weak. Employing monthly time series data from January 2007 to December 2013 from Colombo Stock Exchange, the results of Amarasinghe (2015) showed a negative relationship between interest rate and stock prices in Sri Lanka. Using the heteroscedastic cointegration technique, Liu and Shrestha (2008) investigated the short-run relationships between interest rates and stock prices in China. Their results indicated that interest rates are negatively related to stock prices in the short run. To conclude, analysis of interest rate and stock price nexus by various researchers has revealed mixed results.

Using stock portfolios rather than individual stocks, Kandir (2008) indicated that interest rates appear to impact negatively on the prices of stocks. On the other hand, the regression analysis of Tursoy et al. (2008) on interest rate and stock price nexus revealed no significant degree of association between interest rates and stock prices. It is important to emphasize that almost all the results obtained from the various research works undertaken on both emerging and developed stock markets showed a negative relationship between the two macroeconomic variables under consideration. Kganyago and Gumbo (2015) assessed the interest rate and stock price relationship in Zimbabwe for the period; April 2009 to December 2013 by employing the Johansen cointegration techniques. Their results revealed a strong and statistically significant negative association between the two variables. Osamwonyi and Evbayiro-Osagie (2012), attempted to establish the strength and direction of the relationship between these two macroeconomic variables in Nigeria. Employing annual time series data on both the explained and explanatory variables from 1975 to 2005; the results indicated that interest rates, exchange rates inflation impact significantly on stock prices in Nigeria. This result is consistent with the results obtained by Nkoro Uko (2013).

Studies on interest rate and stock price nexus have been undertaken on emerging stock markets as well. Studies were undertaken by Al-Sharkas (2004) in Jordan on one hand, and Adam and Tweneboah (2008) in Ghana, on the other hand, indicated an indirect association between interest rates and stock prices; and statistically significant at five percent error level. Furthermore, the results obtained from the study undertaken by Maysami et al. (2004) showed that both short-term and long-term rates of interest have a strong negative relationship with stock prices in Singapore. In contrast, some authors have reported a direct or positive relationship between stock prices and interest rates. Some of these authors and researchers include: Premawardane (1997) and Geske & Roll (1983). These researchers explain that the positive relationship between stock prices and interest rates could be attributed to the fact that a change in interest

rate can positively influence the investment decisions of potential stockholders about future changes in dividends. In addition, Alam and Uddin (2009) examined the link between interest rates and stock market returns and found a direct correlation between interest rates and stock prices although the results were only significant at a 10 percent error level. This could be attributed to differences in analytical tools and research methodologies employed.

3. Data and Methodology

In literature, interest rate money supply, inflation and exchange rate the key determinants of stock prices. Thus, to establish the strength and direction of the relationship between interest rates and stock prices in Ghana, we develop a model in which stock price is a function of interest rate (monetary policy rate), money supply, nominal exchange rate and inflation rate as follows: GSE = f (MPR, MS, NER, INF); where GSE = Stock Price of Ghana Exchange; MPR = Monetary Policy Rate (Official Interest Rate or Bank Rate); MS = Money Supply; NER = Nominal Exchange Rate; INF = Inflation Rate. Average monthly time-series data from the period July 2007 to December 2019 were employed to establish the relationship. The data for the study were therefore obtained primarily from secondary sources: The Ghana Stock Exchange, Bank of Ghana and Ghana Statistical Service. Data on inflation rate were specifically accessed from Ghana Statistical Service while data on money supply, interest rate and exchange rate were obtained from the Bank of Ghana. Nonetheless, the data on the All-share index (Proxy for the explained variable, i.e., stock prices) of the Ghana Stock Exchange have been obtained from the Ghana Stock Exchange website. The Ordinary Least Squares (OLS) estimation technique of multiple regression was employed to estimate all the regression coefficients using Views statistical software. In order to avoid spurious regressions, various statistical diagnostic tests were conducted vis-à-vis the Ordinary Least Squares (OLS) assumptions.

Thus, all the relevant residual and specification tests were rigorously conducted to ascertain the robustness of the model. Firstly, since the presence of serial correlation between the residuals limits the efficiency and predictive powers of the regression coefficients of OLS-based estimates, the Durbin-Watson (DW) test for first-order serial correlation between the residuals was conducted to ensure that there was no autocorrelation between the error terms. The Variance Inflation Factors (VIF) test for determining the extent of multicollinearity between the independent variables was conducted to ascertain that the extent of collinearity between the independent variable is not a serious problem. This is because, if the correlation between the independent variables is high, the estimates are indeterminate and the standard errors of these estimates become extremely large (Koutsoyiansnis, 1973). Moreover, White's test for determining the existence of heteroscedasticity was also carried out. This test was motivated by the fact that in several economic time series, the variances of the residuals appear to correlate with each other. The presence of heteroscedasticity itself does not invalidate standards least squares. Nevertheless, ignoring it may result in a loss of efficiency in the estimated parameters. The null hypothesis is that heteroscedasticity is not present. In short, the addition of a non-stationary variable can nullify the tests for statistical significance.

The Ramsey RESET test is a general test for model specification errors resulting from the omitted variables, incorrect functional form and correlation between the independent variables and the residuals, which sometimes occur due to measurement errors, simultaneity bias and serially correlated disturbances. Under such specification errors, the estimates of least squares regression tend to be biased and inconsistent, and therefore, conventional inference procedures become invalidated. Thus, the model is correctly specified when the F-statistic is not significant at a 5 percent error level. Also, The Jarque-Bera statistic for establishing whether the residuals are normally distributed or not was performed. In this case, if the residuals are normally distributed, the Jarque-Bera statistic, which has a chi-square distribution under the null hypothesis of normally distributed errors, should be insignificant. In order to establish the time series properties or stationarity properties of the data, a unit root test was conducted. Stationarity simply implies that the mean and covariance of the distribution do not change over time. Thus, the concept of stationarity implies that the future will be the same as the past, at least in probability terms. Regression estimates involving non-stationary data; lead to spurious results and hence, render the t and F statistics invalid. The Augmented Dickey-Fuller (ADF) and Phillips-Perron Tests were conducted to establish the stationarity or non-stationarity properties of the data set.

4. Results and Discussion

In order to avoid spurious regressions, a unit root test was conducted on all the variables to establish the stationarity properties of the data or otherwise. Two different methods namely; Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) Tests were conducted to establish the stationary of the series. Both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests specify the null hypothesis (H_0) that the time series has a unit root and hence, the times series is non-stationary. This is tested against the alternative hypothesis (H_1) that the time series has no unit root and hence, the time series is a stationary time one. The decision rule as to whether to accept or reject the null is as follows:
(i) Reject the Null Hypothesis if the absolute ADF / PP test statistic < critical value.
(ii) Do not reject the Null Hypothesis if the absolute ADF / PP test statistic > critical value. In this study, the researcher carried out unit root tests using the log of the various variables and first difference levels to establish their stationarity properties. Table 1 presents the results.

Table 1: ADF and PP Unit Root Results for All Variables (GSE, MPR, MS, NER, INF)

Test Type	Deterministic Trend	Test Statistic	Critical Values		
			1%	5%	10%
ADF	None	-0.543955	-2.591204	-1.944487	-1.614367
	Intercept	-1.249565	-3.505595	-2.894332	-2.58435
	Intercept and trend	-1.534887	-4.064453	-3.461094	-3.156776
PP	None	-0.543955	-2.591204	-1.944487	-1.614367
	Intercept	-1.274675	-3.505595	-2.894332	-2.584325
	Intercept and trend	-1.617713	-4.064453	-3.461094	-3.156776

*Stationarity of series at 1% level. **Source:** Views Output, 2020.

The results indicate that none of the series were significant at a 1% significance level for all the tests (Both ADF and PP). The results further indicate that none of the series were significant at 5% and 10% in all cases. Thus, in order to ensure stationarity, the researchers took the first difference of the data. Table 2 presents the first difference results.

Table 2: ADF and PP Unit Root Results after First Difference (GSE, MPR, MS, NER, INF)

Test Type	Deterministic Trend	Test Statistic	Critical Values		
			1%	5%	10%
ADF	None	-9.019844	-2.591505*	-1.944530**	-1.614341***
	Intercept	-8.986600	-3.506484*	-2.894716**	-2.584529***
	Intercept and trend	-8.942510	-4.065702*	-3.461686**	-3.157121***
PP	None	-9.019844	-2.591505*	-1.944530**	-1.614341***
	Intercept	-8.986600	-3.506484*	-2.894716**	-2.584529***
	Intercept and trend	-8.942510	-4.065702*	-3.461686**	-3.157121***

Note: The asterisks (*), (**), (***) indicate how significant the coefficients are, at 1%, 5% and 10% levels of significance respectively. *stationarity of series at 1% level, **stationarity of series at 5% level ***stationarity of series at 10% level.
Source: Views Output, 2020.

From Table 2, the ADF and PP unit root test for the first difference of the log of the variables (GSE, MPR, MS, NER, INF) indicated that all the series were significant at 1%, 5% and 10% significance level for all the tests since in all cases the value for the absolute value of the test statistic was greater than the critical level. The results, therefore, provide evidence for the stationarity of the series. The results of the stock price equation estimated with OLS at first difference are presented in Table 3. The results of all the diagnostic tests performed are very satisfactory. The results of the F- test indicate that the F-statistic (89.249) is statistically significant at a 1% error level. The R^2 of 0.831 indicates that about 83 percent of the variations in stock prices are caused by the inflation rate, interest rate, money supply and stock prices. The high R^2 value implies that the explanatory variables correctly explain the dependent variable and hence the model is correctly specified.

Table 3: OLS Regression Estimates at First Difference

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.801	1.705	4.315	0.000
DLINF	0.762	0.489	1.685	0.029
DLMPR	-0.891	0.973	0.923	0.037
DLMS	-1.351	0.364	-4.247	0.000
DLNER	-1.104	0.667	1.943	0.048
R-squared	0.831	Mean dependent var		3.824
Adjusted R-squared	0.782	S.D. dependent var		0.376
S.E. of regression	0.157	Akaike info criterion		-0.625
Sum squared resid	2.291	Schwarz criterion		-0.524
Log-likelihood	35.652	Hannan-Quinn criteria.		-0.617
F-statistic	89.249	Durbin-Watson stat		0.358
Prob (F-statistic)	0.000			

Source: Views Output, 2020.

It can be deduced from Table 3 that the R-square value was 0.831 which indicates that 83.1% of the variation in the dependent variable LGSE has been explained by the independent variables LINF, LMPR, LMS, and LNER. The correlation coefficient between the dependent and independent variables was 0.9112 which implies that there is a strong positive correlation between the independent variables and dependent variables. That is to say, about 91 percent of the variations in stock prices can be explained by the inflation rate, interest rate, money supply and exchange rate. This high value of the R^2 shows that the overall model is statistically significant. The adjusted R-squared compares the explanatory power of the regression model that contains a different number of predictors. It accurately gives you the actual and unadulterated percentage of variability in the dependent variable that is accounted for by the four (4) independent variables.

In this case, it is 0.782 which implies that exactly 78.2% of the variability in the dependent variable is accounted for by the independent variables. The negative coefficient of interest rate ($\beta = -0.891$, $p < 0.05$) indicates a significant negative correlation between interest rates and stock prices in Ghana. This result confirms the theoretical conclusion of an inverse correlation between interest rates and stock prices. This is because a rise in interest rates, caused by a fall in money supply (holding demand for money constant), raises the opportunity cost of holding cash and stocks. To this effect, people will be attracted by the higher interest earnings and hence, change their stock holdings and cash into interest-earning securities and assets which invariably results in a decrease in stock prices. In specific terms, the coefficient of – 0.891 for the interest rate variable implies that a one percent rise in the interest rate will influence stock prices to decrease by 89 percent on average.

5. Conclusion and Recommendation

The results revealed that interest rates are negatively related to stock prices in Ghana. The inverse relationship can be explicated by the positive relationship between money supply and inflation as elucidated by Sellin (2001). Moreover, the negative coefficient of interest rate indicates that an increase in the 91-day treasury, bill rate will lead to a fall in stock prices. It will therefore be reasonable to expect a negative change in the attitude of Ghanaians towards investment in stocks when interest rates go up. This finding is consistent with both theory and evidence from other studies as a negative relation between the 91-day treasury bill rates and stock prices were expected (Somoye et al., 2009), Adam and Tweneboah (2008), Sellin (2001). However, this finding is in conflict with several studies on the correlation between monetary policy and stock prices (Sellin, 2001, Ioannidis & Kontonikas, 2008). It is also evident from the results that changes in interest rate as an aspect of monetary policy exerts a significant indirect effect on stock prices in Ghana while money supply reports a weak negative relationship with stock prices. Thus, all things being equal, any expansionary monetary policy that will aim at increasing interest rates would bring about a significant increase in stock prices in Ghana.

Thus, a surge in the 91-day Treasury bill rate would cause an appreciable decrease in stock prices. In the light of this finding, it is recommended that the dynamics of the stock market should be taken into consideration

by the monetary authorities when adjusting monetary policy or interest rates in view of the fact that variations in monetary policy rates impact significantly on stock prices. A decrease in interest rates, for instance, can lead to a rise in the prices of stocks and consequently increase the wealth of households (consumers), and thus, influence households to increase their expenditures – a phenomenon termed as the wealth effect. Also, higher stock prices in effect, lower the capital cost for firms which results in increased capital investments. Surges in both consumer and business spending have a propensity of stimulating the economy. To this effect, it becomes necessary for monetary authorities to take the stock market into account when adjusting monetary policies. Further work needs to be done to establish whether fiscal policies influence stock prices or not. This study can zoom in on which government expenditure has the highest impact on stock prices. The effect of diaspora remittances on stock prices is also an interesting area to be explored in Ghana.

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