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Research Paper

The impact of macroeconomic variables on stock market performance in Ghana

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ABSTRACT

The study used monthly data from 2010 to 2021 to consider the impact of macroeconomic variables on stock market performance in Ghana. Inflation rates, interest rates, exchange rates, and global economic policy uncertainty were the macroeconomic variables studied. Because the study was based on numerical secondary data, the study used a quantitative research approach. The study employed a correlation test to determine the relationship between variables. Only two of the four macroeconomic variables studied (interest rates and global economic policy uncertainty) had an impact on Ghanaian stock performance, according to the study. The study revealed that Ghana's stock market performance is unaffected by inflation or the exchange rate. Global Economic Policy Uncertainty, Interest Rate, and Inflation had a negative relationship with stock returns and were not statistically significant, however, Exchange Rate was statistically significant and positively correlated with stock returns. The study recommends maintenance and implementation of conservative macroeconomic policies, as changes in macroeconomic variables have an impact on stock returns, to strengthen support from stock actions.

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1. INTRODUCTION

Because macroeconomic variables can control the growth pattern of every country's economy, numerous scholars have utilized various theories to examine macroeconomic variables [1]. Inflation, the balance of payments, economic growth, and unemployment are all significant macroeconomic variables that have a positive or negative impact on the stock market, according to [2]. [3] Indicated that when businesses acquire international competitiveness and exports improve, exchange rates have an impact on stock market performance. The exchange rate has a beneficial impact on stock prices, but rising expenses as a result of the depreciation in the exchange rate are likely to have a negative impact on stock prices [3]. When looking to invest in shares, stock investors look at macroeconomic variables [3]. [4] Found that when inflation rates rise, the stock market falls, and vice versa. He indicated that higher inflation is bad for equities since it raises borrowing costs, and input costs, and lowers living standards, but a large drop in interest rates allows stock values to rise due to business spending. According to research by [1], macroeconomic variables co-integrate, indicating a long-run equilibrium relationship. It was identified that a 1% increase in inflation boosts stock returns by 0.54 percent, whereas a 1% increase in the exchange rate boosts stock returns by 0.052 percent. Numerous studies have been conducted on macroeconomic variables and their impact on Ghana's economy. Interest rates, inflation rates, currency rates, Gross Domestic Product (GDP), and unemployment rates can all influence stock market performance [5]. Therefore, it is important to study the relationship between macroeconomic variables, as it may reveal hidden relationships that other studies did not consider.

2. RELATED WORK

2.1 Theoretical Review

The theories that support this study are the Efficient Market Hypothesis [6]. The Efficient Market Hypothesis (EMH) is based on the assumption that information is universally communicated and that stock prices follow an exponential distribution, meaning they are driven by recent news rather than previous trends [7]. More often than not, stock investors make rational and good investment selections to prevent financial losses due to a lack of knowledge. The efficient market hypothesis posits that the market is efficient, which means that stock investors already have most of the information they need to make good stock trading decisions [8]. As a result, dominating the market is unlikely because stocks are already valued appropriately under market efficiency.

2.2 Impact of Macroeconomic Variables on Stock Market Performance

The exchange rate has been identified as one of the macroeconomic variables that influence the stock market performance of several economies. Currency depreciation affects stock, and when the currency appreciates exports become less competitive, impacting the national stock market. In this situation, the listed firms on the stock market become less productive and less desirable to stock investors, affecting the stock market [9]. Interest rate affects the stock market's performance as well as the economy's efficiency. A high-interest rate boosts borrowing costs while lowering business operating cash flows, and reducing company stock prices [10]. Investment returns on interest rates should reflect the pressure on the financial system created by a stock market collapse. Revenue drops greatly, as well as stock values. People and corporations will boost spending when interest rates fall considerably, leading stock prices to rise [11]. Levels of inflation for every market affect all areas, distorts pricing, and adversely affect the essential relationship that must exist between stock worth and its price [9]. Inflation is generally negative for stock since it raises prices, increases costs of production, and lowers standards of living. In situations of high inflation, stock prices behave differently, while value stocks perform much better in periods of low inflation. When inflation rises, stock prices for rising businesses tend to fall. Stocks appear to be more unpredictable in general during periods of high inflation [12].

2.3 Objectives

The study assessed the influence of exchange rate, interest rate, inflation rate, and Global Economic Policy Uncertainty on stock market performance.

3. METHODOLOGY

3.1 Research Design

The study used a quantitative research design. This is because the study is based on numerical secondary data and is analyzed using statistical techniques.

3.2 Data and Sources

The empirical study was carried out with the use of monthly data. The GSE All Share Index was used in the study. The macroeconomic data was obtained from the Bank of Ghana (BoG) and Ghana Statistical Services at monthly intervals, similar to the study done by [13]. The exchange rate, interest rate, inflation, and global economic policy uncertainty are macroeconomic variables that were captured in the study. The study's data was collected every month from 2010 to 2021. The Ghana Stock Exchange will provide the GSE All Share Index (GSE). All the macroeconomic variables were normalized to natural logarithms to simplify the data. The GEPU was obtained from the news-based measure of global economic policy uncertainty developed by [14]. For this research, three macroeconomic variables, namely inflation, interest rate, global economic policy uncertainty, and exchange rate, have been chosen as major elements.

3.3 Model Specification

In terms of the research objectives, the study simulates the "GSE all share index" as a function of macroeconomic variables such as interest rate, inflation rate, global economic policy uncertainty, and exchange rate. Each dataset was verified for stationarity before the statistical models were used. The Augmented Dickey-Fuller (ADF) test for stationarity is used to verify this. Every non-stationary dataset was compared until it was found to be stationary. The statistical models employed and the technique for testing for stationarity are explained further down.

3.4 Quantile Regression Model

$$GSE_t = B_0^{\circ} + B_1^{\circ}(INF_t) + B_2^{\circ}(EXR_t) + B_3^{\circ}(IR_t) + B_4^{\circ}(GEPU_t) + \mu_t^{\circ} \quad (1)$$

GSE represents the Ghana Stock Exchange
INF represents Inflation from Bank of Ghana economic indicators
EXR represents the Exchange rate
IR represents the Interest rates – 91-day Treasury bill rate
GEPU represents the Global Economic Policy Uncertainty

The relationship between a set of predictor (independent) variables and particular percentiles of a target (dependent) variable, most frequently the median, is modelled using quantile regression. Quantile regression makes no assumptions about the target variable's distribution. Due to the characteristics of this data, quantile regression can be employed as an alternative to ARDL. The quantile regression approach, which is a reliable statistical tool, offers information on the link between predictor factors and outliers.
The equation that describes the quantile regression model in general is as follows:

$$Y_t = X^i_{t\beta\theta +} \mu_\varepsilon \quad (2)$$

Where $_{\beta\theta}$ represents the vector of unknown parameters associated with the Θth quantile. The regression minimizes Σt Θ |μt| + Σt (1-Θ) |μt|, thus the sum that offers the asymmetric penalties Θ |μt| for under prediction and (1-Θ) |μt| for overprediction.
Y_t is the dependent variable (Exchange rate, interest rate and inflation) To calculate the coefficient or the quantile estimator can be solved using the optimisation problem stated as;

$$\min \sum^{n}_{te}(Y_{t \geq X_{t\theta}^{i}})\,\theta \left| Y_t - X^i_t\beta \right| + \sum^{n}_{te}(Y_{t \geq X_{t\theta}^{i}})\,(1-\theta) \left| Y_t - X^i_t\beta \right| \quad (3)$$

Where Y_t is the dependent variable and X_t is a K by 1 vector of regressors. The relationship between exchange rate and commodities prices were examined across 19 different quantiles, thus from the 0.05th quantile to 0.95th quantile. These quantities were chosen to assess whether the variations in the commodities market conditions would have the same impact on exchange rate movements.

3.5 Description of Variables

- **Ghana Stock Exchange All Share Index (GSE-ASI):** The GSE All Share index was used in the study as a measure for Ghana Stock Exchange. The GSE-ASI was the dependent variable for the study analysis, evaluating the performance of the stock market and relating it to the independent variables of interest, inflation, and exchange rates.
- **Inflation Rate:** Ghana Consumer Price Index (GCPI) was used as a proxy for inflation. The natural logarithm of the consumer price index at month t was used to calculate monthly inflation.
- **Interest Rate:** The 91-day Treasury bill rate is utilized as a measure for interest rate. The interest rate is computed as the natural logarithm of the three-month T-bill rate at month.
- **Exchange Rate:** The change in exchange rate is computed by taking the natural logarithms of the month's exchange rate.
- **Global Economic Policy Uncertainty:** Stock returns are skewed by global economic policy uncertainty (EPU), which focuses on long-term and short-term investments.
- **Quantile Regression:** Quantile regression was necessary because it tends to help in finding relevant aspects by adopting the hypothesis that macroeconomic variables operate the same at the upper tails of the distribution as they do at the mean, considering different market conditions [15]. Quantile regression is employed to uncover more meaningful predictive correlations between macroeconomic variables [16]. The intricacy of relationships between different macroeconomic variables resulting in data with an uneven variation of one variable for distinct ranges of another variable has been ascribed to the necessity for and effectiveness of Quantile regression [17].
- **Data Processing and Analysis:** The major software used for data processing and analysis were R statistical computing software, Python, and Microsoft Excel. Microsoft Excel was used to collect all of the time series and to estimate the log returns of all of the data collected. The quantile regression method was used to estimate the link between macroeconomic variables and stock performance using the R software. The correlation tests were carried out using the Python software.

3.6 Findings

3.6.1 Descriptive Statistics

This section presents a brief discussion of the descriptive statistics of the macroeconomic variables used in the model over the period 2010 to 2021. These variables are GSE all-share index (GSE-ASI), Inflation rate (INF), Interest rate (INT), Exchange Rate (EXR), and Global economic policy uncertainty (GEPU). Among the summary statistics examined are the standard deviation, mean, maximum, and minimum values. GSE-ASI, INF, INT, EXR, and GEPU had mean values of 0.0064, 0.0027, 0.0004, 0.0110, and 0.0040 respectively. The standard deviation for the GSE-ASI was 0.0466, with a minimum of -0.0968 and a maximum of 0.1763. The standard deviation for INF was 0.0457, with a minimum of -0.1466 and a maximum of 0.3067. The standard deviation for INT was 0.0509, with a minimum of -0.2163 and a maximum of 0.2488. The standard deviation for EXR was 0.5901, with a minimum of -4.6017 and a maximum of 4.6719. The standard deviation for GEPU was 0.1890, with a minimum of -0.4972 and a maximum of 0.6236. Table 1 shows the details of the descriptive statistics of the macroeconomic variables.

Table 1. Summary Statistics of the Variables, 2010-2021

Variables	Observations	Mean	Standard Deviation	Minimum	Maximum
GSE-ASI	124	0.0064	0.0466	-0.0968	0.1763
INF	124	0.0027	0.0457	-0.1466	0.3067
INT	124	0.0004	0.0509	-0.2163	0.2488

EXR	124	0.0110	0.5901	-4.6017	4.6719
GEPU	124	0.0040	0.1890	-0.4972	0.6236

Based On Research Data, 2021

3.6.2 Time Series Plot of Inflation, Exchange, Interest Rates and Global Economic Policy Uncertainty from 2012 to 2020

The following plots depict the prices and return of stocks at various points throughout time. The stock price exchange rate time plot displays a periodic time series with regular fluctuations. The series has just a vertical variation in 2020, suggesting that the means are not constant but are changing over time, indicating that it is not stationary. The GEPU price time series plot demonstrates an upward trend. Because the growth in data values appears to accelerate over time, the time series has a slight curve. After 2018, the interest rate time series for price reveals a significant movement in the price. The upward trend is visible in the GSE time series plot. The data has a mild curve because the increase in data values appears to accelerate over time, but then dips in 2018 and 2020. From 2012 to 2016, the inflation rate time series plot for price shows a slight upward trend, but a declining trend from 2016 to 2020.

In 2020, the exchange rate plot for returns looks to have an upward or downward trend, which is similarly characterized by a non-constant mean concerning time, indicating that the returns are non-stationary. Returns indicate random fluctuation in the GEPU time series plot. In 2014, there was a downward trend, while in 2016, there was a downward and upward trend. The returns plot, in contrast to the GSE price time series, shows rising and downward trends. From 2012 to 2014, there was a downward trend with a sharp rise in 2014, followed by a downward trend from 2014 to 2018, with a steep fall till 2020. The interest rate time series plot shows a seasonal trend, with a significant spike in 2012 and a significant decline between 2016 and 2018. The plot of the inflation time series shows an obvious upward trend in 2013 and a significant increase in 2020. The rate of increase and decrease in data values appears to be slightly accelerating and declining with time.



Figure 1. Plot of Prices and Returns

4. RESULTS AND DISCUSSION

The association between macroeconomic variables and stock market performance was investigated in 19 quantiles, ranging from 0.05th to 0.95th. These quantiles were chosen to see if changes in macroeconomic variables impacted stock performance in the same way.

4.1 Macroeconomic Variables and Stock Performance

The impact of macroeconomic variables on stock performance was measured using the intercept, which measures the linear relationship between variables. At the 5%, 10%, 15%, 20%, 25%, 30%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, and 95% quantile, the macroeconomic variables were statistically significant at 0.1 significance level. The macroeconomic variables are statistically significant at the 0.05 significance level at the 35% quantile. Also, there was no statistical significance at any of the significance levels at the 45%, 50%, and 55% quantiles. This shows that there is a significant association between macroeconomic variables and stock market performance at a significant majority of quantiles. The findings are consistent with [18] findings, which claim that macroeconomic variables such as interest rates and inflation, as well as Foreign Direct Investment (LFDI), have an impact on the stock performance of companies listed on the GSE.

4.2 Interest Rates and Stock Performance

At the 0.01 significance level, interest rates were only statistically significant (p=0.06106) at the 50th quantile. Interest rates have a considerable impact on stock market performance, according to the research, though it was minimal at most quantiles. This suggests that interest rates have a minor impact on stock market performance. This conclusion contradicts the findings of [19], who found that interest rates had a significant impact on stock market development. As a result, lowering the interest rate will have a significant negative influence on the performance of Ghana's stock market.

4.3 Inflation Rates and Stock Performance

At any of the significance levels, inflation rates at all quantiles were not statistically significant. According to the data, the rate of inflation has no substantial impact on stock market performance. This contradicts the findings of [20], who discovered a relationship or influence of inflation on stock returns using bootstrapped data. There is a substantial relationship between GSE market returns and inflation, according to [20].

The data rejected the theory that GSE market performance is linked to exchange rates. These variables have such a property, making it a desirable trait for investors to take advantage of. There is a relationship between inflation and stock return, according to [21]. They argued that when inflation rises, the rate of interest rises. This study also contradicts the findings of [22], who discovered that macroeconomic variables like the interest rate might influence stock prices.

4.4 Exchange Rate and Stock Performance

At any of the significance levels, exchange rates at all quantiles were not statistically significant. This means that at all significance levels, there is no significant relationship between GSE and EXR. The exchange rate does not affect Ghana's stock performance, according to the findings. This is clear that the exchange rate and stock returns have no obvious relationship. This contradicts [13] results, which said that as the cedi appreciates, prices drop. It also leads to an increase in the money supply and a reduction in interest rates.

4.5 Global Economic Policy Uncertainty and Stock Performance

GEPU was statistically significant at the 0.05 significance level at the 5%, 10%, 80%, and 85% quantiles, with p-values of 0.02840, 0.01169, 0.03216, and 0.04116, respectively. GEPU was also statistically significant at the 0.01 significance level at the 15%, 30%, and 90% quantile, with p-values of 0.08165, 0.09361, and 0.09426, respectively. GEPU is statistically significant, indicating that it has an

impact on stock performance. This conclusion is consistent with [19] findings, which revealed that in all scenarios, GEPU had a positive impact on the long-run relationship between oil and industrial returns.

Table 2. Quantile Regression Estimation Results

Quantiles	Intercept	Interest	Inflation	Exchange	GEPU
		Macroeconomic Variables			
0.05	0.00000***	0.34917	0.19299	0.72313	0.02840**
0.1	0.00000***	0.33809	0.48453	0.82892	0.01169**
0.15	0.00002***	0.68779	0.54248	0.89443	0.08165*
0.2	0.00003***	0.38070	0.94777	0.96394	0.35487
0.25	0.00029***	0.52412	0.96734	0.97207	0.21410
0.3	0.00128***	0.53555	0.91272	0.97176	0.09361*
0.35	0.03135**	0.29008	0.68854	0.99685	0.11236
0.4	0.06989*	0.37161	0.63511	0.99097	0.20246
0.45	0.51562	0.13742	0.71710	0.97726	0.48897
0.5	0.48417	0.06106*	0.93236	0.92203	0.89380
0.55	0.11518	0.26833	0.70577	0.93721	0.93333
0.6	0.00837***	0.57069	0.73514	0.93523	0.46384
0.65	0.00002***	0.34903	0.47347	0.95405	0.27356
0.7	0.00000***	0.95112	0.57240	0.93138	0.31692
0.75	0.00000***	0.69399	0.80052	0.87534	0.18429
0.8	0.00000***	0.68408	0.82947	0.79032	0.03216**
0.85	0.00000***	0.48946	0.74254	0.85594	0.04116**
0.9	0.00000***	0.85445	0.87984	0.83235	0.09426*
0.95	0.00058***	0.77426	0.77283	0.96133	0.23498
		Stock Returns			

*, ** and *** signifies significant levels at 10%, 5% and 1% respectively.

4.6 Correlation between Macroeconomic Variables and Stock Performance

The impact of macroeconomic variables (INT, INF, EXR, and GEPU) on stock performance (GSE-ASI) was investigated in this section.

4.7 Correlation between Ghana Stock Exchange and Exchange Rate

The correlation test between GSE and EXR revealed a p-value of 0.0078. This means that at a significance level of 0.01 there is a positive and significant relationship between GSE and EXR. The exchange rate has an impact on Ghana's stock performance, according to the findings. The fact that the exchange rate and stock returns have a positive relationship is predictable. This corresponds to [13]. Prices fall when the cedi appreciates. It also leads to an increase in the money supply and a reduction in interest rates.

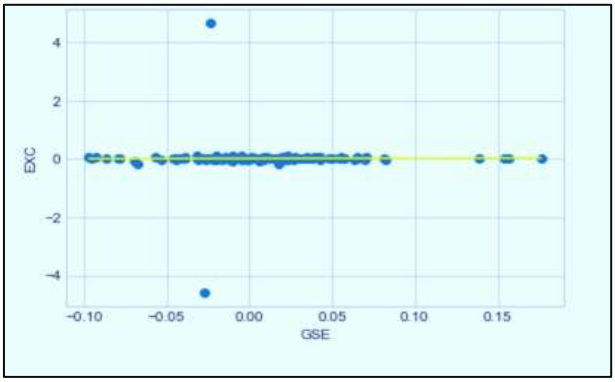


Figure 2. A Plot to Show the Correlation between GSE and EXR

4.8 Correlation between Ghana Stock Exchange and Global Economic Policy Uncertainty

The correlation test indicated a p-value of -0.2089 between GSE and GEPU. This implies that there is a negative and no significant relationship between GSE and GEPU at all significance levels. Global Economic Policy Uncertainty, according to the research, has no impact on Ghana's stock performance. This disagrees with the findings of [19], who found that GEPU had a favorable effect on the long-run correlation between oil and industrial returns in all scenarios.

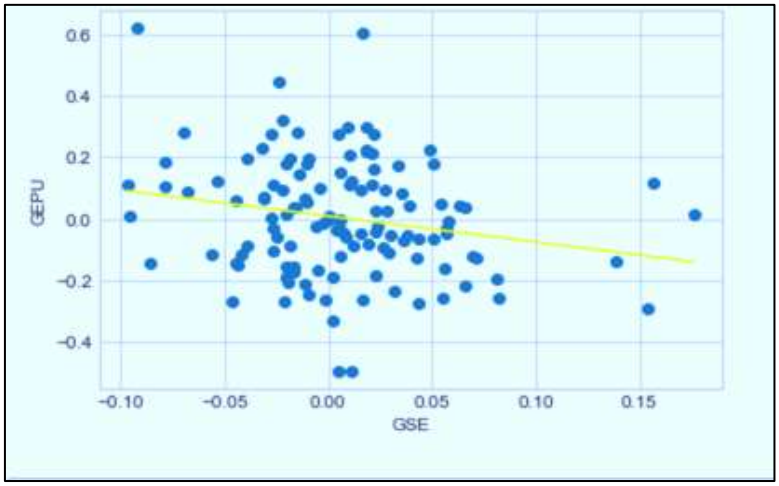


Figure 3. A Plot to Show the Correlation between GSE and GEPU

4.9 Correlation between Ghana Stock Exchange and Interest Rate

The correlation test between GSE and INT revealed a p-value of -0.0770. At a significance level of 0.1, this means that there is a negative and significant relationship between GSE and INT. Interest rates, according to the data, have a negative impact on Ghana's stock performance. This conclusion is consistent with [19] findings for South Africa, which found that interest rates had a significant negative impact on stock market development. This suggests that lower interest rate will have a negative influence on the performance of Ghana's stock market.

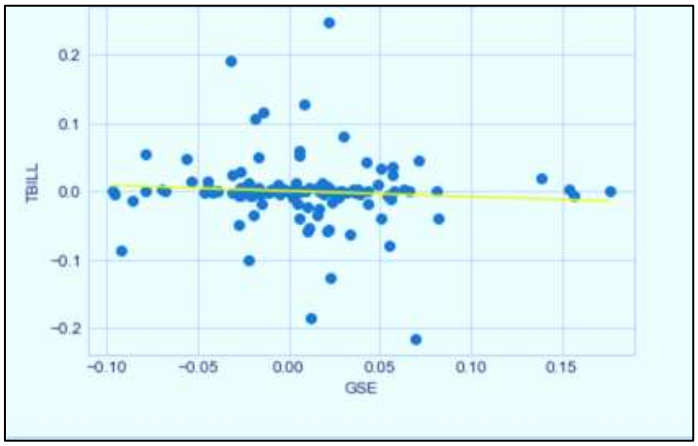


Figure 4. A Plot to Show the Correlation between GSE and INR

4.10 Correlation between Ghana Stock Exchange and Inflation Rates

The correlation test between GSE and INR revealed a p-value of -0.0772. This means that at the 0.1 significance level, there is a negative and significant association between GSE and INR. According to the data, the rate of inflation has a negative impact on stock performance. This supports the findings of [23], which discovered a statistically significant relationship between exchange rate and stock market

performance in Malaysia, the United States, and China, but also indicated a negative effect on stock market performance.

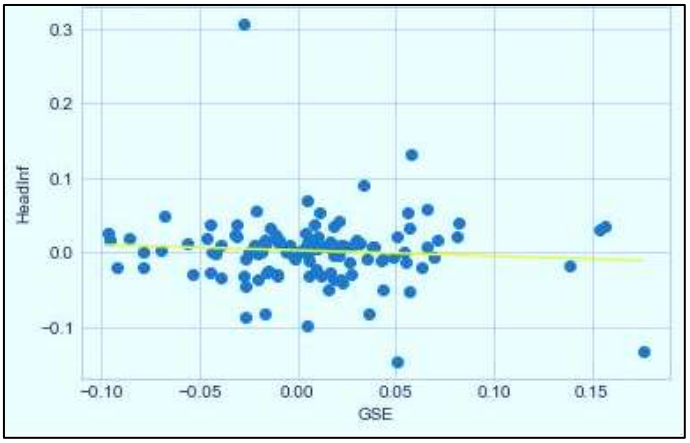


Figure 5. A Plot to Show the Correlation between GSE and INR

5. CONCLUSION

According to the quantile regression results, the exchange rate was not significant however the correlation test showed a positive correlation between exchange rates and GSE returns. Changes in exchange rates affect real economic costs, profitability, price stability, and even the stability of a country. When the exchange rate depreciates, it affects share prices. This makes the capital market less attractive to investors, therefore causing stock market performance to fall, and vice versa. Interest rates have a significant impact on stock market performance, however, for most quantiles, it is minimal. The negative correlation with GSE returns means that when there is an increase in interest rate, stock returns decrease due to fallen stock prices. As interest rate increases, investors will prefer to invest in fixed deposits and treasury bills than invest in the stock market because risk-free assets will give higher returns. The effect of interest rates on stock market returns was significant, demonstrating that increases in money supply cause stock prices to fall. The inflation rate at all quantiles had no significant relationship with GSE but had a negative and significant relationship with GSE according to the correlation. This indicates that inflation negatively affects the returns on the stock market. High inflation will decrease the value of stock returns. The value of stock returns moves in the opposite direction with inflation. When the correlation test was used, GEPU had a negative and insignificant effect on GSE. Quantile regression showed a significant relationship. Ups and downs of GEPU can cause stock market volatility. These findings show that policy uncertainty causes stock prices to rise. This work contributes to the growing literature on the implications of policy uncertainty on macroeconomics by helping to understand the effect of policy uncertainty on stock prices.

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Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Miss Rashidatu Abdullai	✓	✓	✓	✓		✓		✓	✓	✓	✓			
Oscar Twumasi		✓	✓	✓			✓	✓	✓		✓	✓	✓	

Amos Nana Addo	✓	✓	✓		✓	✓	✓	✓		✓		✓	✓	✓
Daniel Danso Tettey	✓	✓	✓	✓			✓	✓			✓	✓		✓

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Informed Consent

All participants were informed about the purpose of the study, and their voluntary consent was obtained prior to data collection.

Ethical Approval

Not Applicable.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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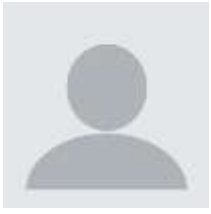
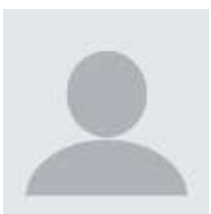
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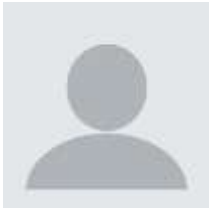
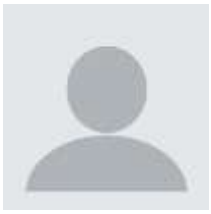
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