UNIVERSITY OF GHANA

THE MACRO ECONOMY AND PERFORMANCE OF GHANA STOCK MARKET

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DECLARATION

I, Percy Kwaku Amanor Shiako, do hereby declare that this work is the result of my own research and has not been presented by anyone for any academic award in this or any other University. All references used in the work have been fully acknowledged.

PERCY KWAKU AMANOR SHIAKO

(10638090)
CERTIFICATION

I hereby certify that this thesis was supervised in accordance with procedures laid down by the University.

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DR. VERA OGEH FIADOR DATE

(SUPERVISOR)
DEDICATION

I dedicate this study to the Almighty God for giving me the strength and the opportunity to go through this graduate programme. The second dedication also goes to the Shiako family for their support.
ACKNOWLEDGEMENT

My deepest gratitude and appreciation is to the Almighty God for all He has done in my life and for seeing me through this programme successfully.

It is often said that one tree cannot make a forest. This is to say that this excellent study would not have been successful without the assistance of my honourable supervisor, Dr Vera Ogeh Fiador. I am grateful for her professional advice.

I would also like to acknowledge my parents and siblings for their support and prayers.

Again, I thank Databank research team for their support with acquiring data for this study.

To my colleagues in the Stanbic Bank Investor Services Operations team, I say thank you for all the support you have given me during the past two years.

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God richly bless you.
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<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GSE</td>
<td>Ghana Stock Exchange</td>
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<tr>
<td>GSE-ASI</td>
<td>Ghana Stock Exchange All Share Index</td>
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<tr>
<td>INF</td>
<td>Inflation rate</td>
</tr>
<tr>
<td>INT</td>
<td>Interest rate</td>
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<tr>
<td>EXR</td>
<td>Exchange rate</td>
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<tr>
<td>CPI</td>
<td>Consumer Price Index</td>
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<tr>
<td>APT</td>
<td>Arbitrage Pricing Theorem</td>
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<tr>
<td>CAPM</td>
<td>Capital Asset Pricing Model</td>
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<tr>
<td>VECM</td>
<td>Vector Error Correction Model</td>
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<tr>
<td>ADF</td>
<td>Augmented Dickey Fuller</td>
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<tr>
<td>ECT</td>
<td>Error Correction Term</td>
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<td>VAR</td>
<td>Vector Autoregressive</td>
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ABSTRACT

The study examines the impact of macroeconomic variables (inflation, exchange rate, and interest rate) on stock market performance in Ghana using quarterly data ranging from 2008 to 2018. Using time-series techniques of co-integration and vector error correction estimation, the study examines both the short-run and long-run associations between macroeconomic variables and stock market performance.

The study uses the GSE all-share index as a dependent variable to measure stock market performance. Stationarity test done using the Augmented Dickey Fuller (ADF) test shows that the variables used for the study are all non-stationary at levels but stationary at first difference, hence justifying the use of the Johansen’s co-integration and Vector Error Correction techniques. The Johansen’s co-integration test indicates the existence of long-run negative relationships among GSE all-share index and the macroeconomic variables (inflation rate, exchange rate, and interest rate) in Ghana, whilst the Vector Error Correction Model reveals no short-run relationship between these variables. There is also evidence of a uni-directional causative association running from inflation rate, exchange rate and interest rate to stock market performance using the Granger causality test. The study shows that macroeconomic variables (inflation, exchange rate, and interest rate) hinder stock market performance in Ghana in the long-run. All variables are statistically significant at 5% significance level in the long-run. The speed of adjustment towards the long-run equilibrium is about 21.3%, indicating that the adjustment is slow. Based on the findings, the study recommends that in an attempt to encourage the stock exchange market through various policies, policymakers should try to implement joint policies that will improve both the stock market and the macroeconomic variables in Ghana.
CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The financial market is an avenue where financial assets, namely equities, bonds, currencies, and commodities are traded between buyers and sellers (Abor, 2016). This market literally allows for enterprises and corporations in need of finances for various projects to meet investors in search of green pastures to grow their seeds (money). These corporations are supposed to use the funds obtained productively and, in the process, provide employment among others to promote socio-economic growth and development. The existence of the financial market is to basically help raise funds for corporations and transfer risk and liquidity (Saint-Paul, 1992). The financial market, therefore, helps in channeling surplus funds to deficit units for economic and productive usage. In other words, financial markets direct the allocation of credit throughout the economy and increase productivity. The deficit units are the corporations and firms listed on the market whereas the surplus units refer to the investors. This implies that the market performance is linked to the performance of the listed corporations, and economic development, as well as investor wellbeing, is also linked to the financial market and listed companies’ performance (Kabur, Rabia, and Amir, 2016).

Globally, the financial market can be categorized into various forms but the money and the capital market classification is the most dominant. The money market focuses on short term financing and investment while the capital market focuses on long term financing. Economically, the capital market supports growth by; providing investment platforms which raise savings levels, reducing the pressure on the banking system, ensuring the use of competitive pricing to efficiently allocate
capital, allowing and promoting private sector participation in investments, etc. The capital market comprises equity and bond markets. The equity market provides financing for corporations and firms via the issuance of shares/common stock and listing on the exchange for subsequent trading thereof. The bond market also delivers financing via the issuance of bonds, and facilitate the subsequent trading thereof. Issuance of bonds is done on the primary market while the subsequent trading is done on the secondary market. Pagano (1993) questioned how the development of different financial markets affected economic growth. Extant research found financial markets to be very important to economic development as Islam et al. (2017) points out that financial markets play a vital role in economic development by managing the funds and capital of corporations through its operations. These corporations and firms produce goods and services for consumption and exportation, provide employment for citizens amongst other activities which helps spin the wheel of growth and development.

1.2 Problem Statement

Globalization has made it possible and easier for investors around the world to trade and invest in any capital market in the world. However, the capital markets in some countries are more attractive and also perform better than that of others. There are several factors and indicators that influence the performance of every financial market. Macroeconomic variables measure the aggregates of an economy’s structure, behavior and performance, this means the general performance of any economy can then be determined by macroeconomic indicators such as unemployment rate, inflation rate, Gross Domestic Product (GDP), interest or policy rate, exchange rate, etc. Since stock performance within the capital market affect corporations which in turn affect economic development; and macroeconomic indicators such as interest rates, inflation rates, and exchange
rates help in measuring the economic performance, it is only right to establish a direct linkage between the macro economy and the stock market performance in Ghana. This study seeks to explore the relationship between the macro economy and the performance of stock markets in Ghana and the extent at which the performance of the capital market is dependent on some of the key macroeconomic indicators such as the inflation, exchange and interest rates.

This study is necessary because financial markets exist to channel funds from surplus units to deficit units, this function is crucial for economic growth per available studies (Hearn and Piesse, 2010; OlugBenga and Grace, 2015). Economic growth is positively affected when investors make good returns tracing back to a good performance from the market and vice versa. The research question is then raised to try to interrogate the factors that influence the performance of stock markets in Ghana because failure to understand these performance drivers will mean the inability to keep the productivity financing machinery (financial markets) functional, which will ultimately affect economic growth and development of a nation. A case study on the Ghana Stock Exchange by Kyereboah-Coleman and Agyire-Tettey (2008) investigating the impact of macroeconomic indicators on stock exchange performance found inflation and lending rates to have negative effects on stock market performance even though the effects of inflation rates were comparatively slow allowing for investors to benefit from exchange-rate losses as a result of domestic currency depreciation. Data used were between 1991 and 2005, and considering that it has been over a decade, this research aims to re-assess the situation using data between 2008 and 2018.
1.3 Objectives of the Study

The broad objective of this study was to examine the effect of the macro economy on stock markets in Ghana. Specific objectives of the research are;

i. To examine the long-run and short-run associations between macroeconomic indicators (inflation, exchange and interest rates) and stock market performance in Ghana.

ii. To explore the causal relationship between macroeconomic indicators (inflation, exchange and interest rates) and stock market performance in Ghana.

1.4 Significance of the Study

It is believed that the growth of any country’s capital market is a sign of good economic growth. Funds will be raised from the stock market by firms for their business expansion. Once the capital market is improving, listed firms will be rated as creditworthy which will enhance their financial status, their productive and expansionary capacity thereby creating more jobs and improving the economy.

The knowledge of the macroeconomic indicators that affect the equity market in Ghana will enable policymakers to know where to pay attention to taking economic decisions to achieve stability and growth. The outcome of this study will inform investors about their investment destination. This will also add up to the existing study on this topic and will also be a source of reference for other researchers.

1.5 Summary of the Proposed Methodology

Every research demands that “well-structured approach is followed in the collection of data for analysis and interpretation”. This study adopted quantitative research and solely depended on
secondary data. The performance of the stock market which is the dependent variable was measured by using the Ghana Stock Exchange (GSE) All-Share Index and Capitalization from 2008 to 2018. Data on inflation, exchange, interest rates and stocks were obtained from the Bank of Ghana and the Ghana Stock Exchange.

1.6 Scope and Limitations

Due to time, data limitation and other constraints, data from a ten-year period between 2008 and 2018 was used. With several stock performance indicators available this research chooses GSE All-Share-Index. This research was also limited in terms of the number of macroeconomic indicators used. There are several macroeconomic indicators but this study considers inflation, interest and exchange rates. The research nonetheless achieved its purpose and was applicable in other developing countries.

1.7 Organization of the Work

This study was divided into five chapters. Chapter one presented a brief introduction to the research study as well as the background information and its relevant objectives. The literature review highlighted the works and studies conducted by other researchers in the second chapter. Chapter three, research methodology explained the research approaches of the study. The third chapter also described the methods used for data collection and analysis. The fourth chapter focused on the analysis of the data that were collected. The final chapter of the research presented conclusions and recommendations.
CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Chapter two discusses previous researches relating to and on the impact of macro economy on capital markets. This section also aims to review relevant theoretical and empirical evidence on the macroeconomic indicators and how the equity and bond markets are impacted by these indicators. The organization of this literature is grounded on the study’s objectives and also to comprehend the topic.

2.2 Theoretical Review

In an attempt to find the link between the macroeconomy and stock market performance, several frameworks have emerged over time. The Arbitrage Pricing Theorem and efficient Market Hypothesis were developed by Ross (1976) and Fama (1970) respectively. The macroeconomic factors established in these studies and others to be determinants of stock market performance were many, and so were later broadly categorized as policy variables, performance variables and external variables (Dropsy, 1998). Variables which were measured by Consumer Price Indices (CPI) or affected by exchange fluctuations such as interest and inflation rates were said to be performance variables. Whereas GDP growth and monetary policies relating to money supply were said to be policy variables e.g. fiscal policies. External variables were out of government control and governments could not do much about such variables e.g. oil prices.
2.2.1 Arbitrage Pricing Theorem (APT)

Like “Capital Asset Pricing Model” (CAPM), APT bases the explanation of asset pricing on mean standard deviations framework; only that APT employs a multi-factor style whereas CAPM is a single factor. The volatility of assets is measured by unique coefficients representing macroeconomic variables. Similar items are then not expected to be traded at distinct prices where the market is efficient. Indexes taking into consideration predicted and unpredicted events should, therefore, have a linear correlation with stocks returns (Ross, 1976).

2.2.2 Efficient Market Hypothesis

In this case, asset prices are expected to always take into consideration all historical information especially where the information is of public knowledge. Since asset prices are supposed to reflect all available information in efficient markets (Fama, 1970), new information should instantly reflect in the asset prices due to the competition. This allows investors to make a profit if good or positive information emerges and loses where bad or negative information comes to light.

Recent theories in finance rely on markets being very efficient as investors are opportunists and rational. Principles such as no-arbitrage, market completeness, united or one price and linear positive prices are upheld here. These principles bring up absolute and relative pricing models. Absolute pricing such as consumption-based asset pricing stems on the assets exposure to underlying macroeconomic risks whereas, in relative pricing, an asset is priced looking at the prices of related assets; an example of relative pricing is option pricing where the Black Scholes framework is used. “Theoretical researches relating to inflation rates agree with the argument that lower liquidity and shrinking stock markets are as a result of higher inflation rates as there is a
non-linear relationship between the financial and stock market development and inflation rates.” (Huybens & Smith, 1998; Choi et al 1996; Boyd et al., 2001). “On exchange rates, theoretical literature supports a significant positive relationship between exchange rates and stock market development as currency fluctuations are inversely related to stock prices” (Jorion, 1991) although Gavin, (1989) assert that “the relationship between stock prices and exchange rates could go any direction depending on circumstances.”

2.3 Empirical Review

Grossman and Shiller, (1981) looked at how historical data impacted current and forecasted-prices and saw proof that it was possible and interest rates changes were one macroeconomic factor which had some impact on stock price changes. The related study however on the United States stock market established that oil prices and consumer market indices had no relation to financial markets. In that study, many macroeconomic factors were used as regressors which saw changes in risk premiums, yield curves, and industrial growth to have a link with the performance of the stock market (Chen, et al., 1986). In contrast, a study in Norway by Gjerde and Sarttem (1999) found “oil prices and real economic activity positively related to stock performance though they established an insignificant relationship between inflation and stock prices.”

The “Granger non-causality model” was used in India to study and analyze the causal link between stock performance and macroeconomic variables by Bhattacharya et al., (2001). The findings were negative as exchange rate, trade balance and foreign exchange reserves had no causal linkage to the returns on the stock. The “Granger causality test” was also used by Doong et al., (2012) in Asia to perform similar studies and the results were the same for all the countries used for the research except for one. They found a negative link between exchange rates and stock performance.
Uddin and Allan (2017) explored the link between changes in share prices and interest rates on the Bangladesh market and discovered a negative association the interest rates and share price. Mohammed (2011) also studied “macroeconomic variables and stock market performance in Bangladesh using monthly data and multi-factor regression model with a Granger causality test and standard OLS formula. Foreign remittances and inflation were negatively related to stock prices whereas market capitalization and P/E ratio positively related to stock prices. There were also indications that the market was informally inefficient.” The Brazilian, Russian, Indian and Chinese economies were also concluded weakly efficient from the research of Gay (2008). He concluded that “there was an insignificant relationship between oil prices, exchange rates and the stock markets of these countries by using Box-Jenkins ARIMA model.”

Using the co-integration tests, Gaetha et al. (2011) proofed only long-term relationship between inflation, GDP, exchange rates and stock returns in Malaysian, US, and Chinese markets. The VEC model, however “proved no short-run relationship for the markets under study except for the Chinese market which proved a short-run relationship between inflation and stock market performance”.

In Africa, data between 1975 and 2015 was used by Sin-yu (2017) to study “the macroeconomic determinants of stock market development in South Africa. In the long run, the banking sector development and economic growth had a positive impact whilst inflation and trade openness had negative effects on the stock market capitalization. Inflation rates, real interest rates, and current trade openness were found to have a negative impact on stock market development whereas economic growth had positive effects on stock markets in the short run. The study applied the ARDL bounds testing procedure to arrive at the aforementioned results.”
Akinlo & Akinlo (2009) also used the ARDL bounds test in studying “seven sub-Saharan African countries and detected a positive impact of economic growth on stock market development. Adjasi & Biekpe (2006) in their research of 14 African economies employing a dynamic panel data analysis found similar results.” The “banking sector development, household savings and investment, institutional quality, income level and stock market liquidity had a positive relationship with stock market growth” in the work of Yartey (2007) using the random and fixed effects of panel data analysis for thirteen African countries.

Foreign Direct Investment was also seen to exert positive effects on the development of the stock market by Agbloyor et al. (2013) using the two-stage least square method in studying 16 African countries and Malik & Amjad (2013) in Pakistan using the “Granger causality test.”

Other studies also associate stock market development and performance to institutional factors including financial market liberalisation, legal protection for investors, legal origin, integration in the stock market and corporate governance (Svaleryd & Vlachos, 2002; Shleifer & Vishny, 1997; Bekaert & Harvey, 2000; Niroomand et al., 2014 etc). The literature suggests that improvements in the institutional structures to provide favourable environmental law systems can give a notch to efforts to developing the financial and stock markets.

### 2.3.1 Finance and Economic Growth: Macroeconomic Indicators

The whole concept of finance revolves around lending or making funds available for deficit spending individuals, corporations and governments with the promise that they will payback. Economic growth and development are realized through steady growth in a country’s productive capacity. For productivity to grow, businesses must be in a position to expand thereby broadening
the industry and causing long-run economic growth and development. Financial capital is usually a major ingredient in business expansion. Finance makes it possible for firms to acquire capital for expansion and as Bernanke and Gertler (1989) contend, the inability of finance to play it mediation role will have serious effects on the economy as there will be macroeconomic fluctuations. The link between finance and economics is inferred from the fact that “certain external financial indicators such as corporate bond spreads has substantial predictive content for business cycle fluctuations” Gertler & Lown (1999); Mody & Taylor (2003). Several macroeconomic indicators (including interest rates, real exchange rates, and inflation rates) have been acknowledged by numerous researchers, a few, however, were discussed and applied in this study.

2.3.2 Capital Market and Economic Growth

Arguments in favor of capital markets not imparting economic growth are squashed from studies undertaken by Arowolo (1971); Agtmael (1984); Drake (1985). In their studies, they link the stock markets’ underperformance to structural challenges rather than the outright failure of the market. “The crucial role of stock markets in developing economies has been heightened in several studies” (Levine & Zervos, 1998; Adjasi & Biekpe, 2006; Hearn & Piesse, 2010). “The stock market roles mentioned in these works included the provision of development finance by channeling domestic savings and attracting foreign investment, and the market staying liquid. Apiyeva (2007) studied ten emerging economies for identifying the major determinants of stock market performance, which he found that investor’s country rating and financial risk premiums were better market performance measures compared to other factors such as interest rate, inflation, foreign exchange rate etc.”
2.3.3 Impact of Macroeconomic Variables on the Performance of Capital Market

Given that several studies have made it clear the importance of the capital markets in developing economies, it then becomes more important for us to know and understand the determinants and influencers of the stock market performance. Ita and Joe (2013); Maku and Atanda (2010); Olugbenga and Grace (2015); Jauhari and Yadav (2014) among others identified inflation rates, GDP, interest rates, exchange rates to have relationships with the market performance. Several others studies found many factors affecting “the capital market performance; real economic activity (Eita, 2012; Rashid, 2008; Rehman et al., 2009), debt/GDP ratio (Hsing, 2014), foreign reserves (Rehman et al., 2009), capital formation and gold price (Jauhari & Yadav 2014), federal fund (Yusof & Majid, 2007), net remittance (El-Nadar & Alraimony, 2013).”

2.4 Chapter Conclusion

This chapter demonstrated the significance of the macro economy and the capital market. The relevant theories underpinning this study was reviewed as well as the empirical literature. This research will, therefore, add to the extant literature on the topic by looking at some macroeconomic indicators and the capital market in Ghana and how both the macro economy and capital market performance influence each other.
CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter seeks to discuss the research approach to be adopted, the data to be used, how to obtain the data, analyzing and interpreting the data to accomplish the study’s objectives. This section will also address the choice of variables, model specification and sampling technique.

3.2 Research Approach

In order to accomplish the study’s objectives, the appropriate approach to be used is the quantitative approach. This is because the study is based on numerical secondary data and analyzed with statistical procedures. Kyereboah-Coleman and Agyire-Tettey (2008); Kabur et al. (2016) in similar studies also used the quantitative approach. Even though Yauch and Stensel (2003) stressed on the fact that quantitative researches are limited in that; not all factors are or can be represented in numeric form rendering the results incomplete; Dudwick et al. (2006) account that, since quantitative research designs follow certain procedures, errors are relatively reduced compared to using other approaches.

3.3 Data and Sources

This study employs secondary data from several sources. Since the study is focusing on the impact of macroeconomic indicators on stock performance in Ghana, the data to be used span from 2008
to 2018. The data on stocks are sourced from Ghana Stock Exchange (GSE), Central Securities Depository and Data Bank. The inflation, interest and interest rates are obtained from Bank of Ghana (which we compared with other international data sources like the International Financial Statistics monthly reports).

3.4 Model Specification

This section looks at the model specification to aid in accomplishing the objectives of the research. With regards to the objectives, the study models “GSE all share index” as a function of macroeconomic variables like interest rate, inflation rate and exchange rate. The study replicates the macro-econometric models of Omole and Falokun (1999); and Kyereboah- Coleman and Agyire- Tettey (2008). The empirical model is estimated as:

\[ GSE - ASI_t = \beta_0 + \beta_1 INF_t + \beta_2 EXR_t + \beta_3 INT_t + \epsilon_t \]

Where, GSE-ASI, INF, EXR, and INT represent “GSE all share index,” inflation rate, interest rate and exchange rate. \( \beta_0 \) denotes the intercept, \( \beta_1 \) to \( \beta_5 \) are the estimated parameters, \( \epsilon_t \) is the “random error term” and \( t \) signifies time.

3.5 Description of Variables

This section details on the variables used in the study in terms of their definitions and measurement.
3.5.1 Dependent Variable

**Ghana Stock Exchange All Share Index (GSE-ASI)**

The share index of any market measures the market performance and therefore communicates the state and position of the market to investors. Several instruments are traded within any given market; stocks and bonds being the most dominant. An index can therefore be found for any given set of financial instruments including bonds and stocks, hence the use GSE All Share Index as a proxy for the Ghana Stock Exchange performance in this research. The GSE-ASI will be a dependent variable in the research regression analysis measuring the performance of the stock market and linking it to the interest, inflation and exchange rates which are the independent variables.

3.5.2 Independent Variables

**Inflation Rate**

From economic theories, it is expected that demand shifts to consumables as cost of living rises. Cost of living rises due to high prices of commodities which is a result of high inflation rates. Since the capital market performance is measured taking into consideration the price and total traded shares, it is therefore appropriate to note that the stock market performance can be directly or indirectly be related to the demand for stock market instruments. Considering how influential inflation can be to the stock market performance, it is only right that it is chosen as an independent variable in this study. Inflation is therefore expected to affect the equity and bond markets performance negatively.
**Interest Rate**

Interest rate is “the cost of capital, the proportion of borrowed funds charged to the borrower. This study is centered on using a 91-day treasury bill rate as the benchmark for the interest rates due to data availability and accessibility.” Governments may push up interest rates in their attempt to use treasury bills in accumulating capital for its policies. Where the government sells T-bills at a rate higher than what private financial instruments are being offered, the private sector suffers high costs of capital competing with the government T-bill rates. Attempts to listing most likely fail as investors will rather invest in the safer government T-bills. In effect, higher interest rates negatively affect the equity market and cause a fall in equity prices which may not be the same on the bond market.

**Exchange Rate**

Exchange rate “is the value of one currency in respect of another.” The World Institute of Development Economics Research – WIDER (1990) explained that “rapid depreciation causes both local and foreign investors to redirect their investments to other more susceptible environments. In essence, the stock market index suffers in terms of volume and value. With globalization, it is, therefore, necessary to consider the exchange rate in this study as investors will have the option of investing in countries with favourable exchange rate. The exchange rate is a very important factor in the decision-making process of any investor.”
3.6 Estimation Technique

3.6.1 Unit Root Test

The Unit-root test is “employed to help in determining the stability of the variables under study. For the regression to provide meaningful and comprehensible output, it is necessary for Unit-root tests to be implored where time-series data is involved. Stationarity of variables depends on whether the properties of the variables such as the mean and variance are constant over time. The presence of a unit root translates into the null hypothesis whereas the alternative hypothesis is either explosive root, stationary or trend stationary depending on the test implored.” The Augmented Dickey-Fuller (ADF)-GLS test is employed in this regard.

3.6.2 Co-integration Test

Co-integration test is necessary to eliminate any case of losing the long-term relationship among variables. Econometric models sometimes tend to have non-stationary variables, in which case variables may be differentiated several times and in so doing break down the theories of long-term response.

3.6.3 “Vector Error Correction Model” (VECM)

This model “is another way to examine the relationship among variables. The error correction term signifies the long-run link between the variables. For example, ECM combines the long-run and short-run relationships among the variables in one equation. It confirms the presence of the long-run connection between the variables if one variable is causing the other variable. The causality test hence helps to test if a causal link exists between two variables. The error correction term corrects the deviations from equilibrium towards long-run equilibrium.”
3.6.4 Causality Test

A lot of debates have been put across by different authors with regards to the potential role of stock market performance in economic development. Even though most trade theories support the stock market performance-led development hypothesis, others too are in support of development led stock market performance hypothesis. To find solutions to this issue, the study used the methodology proposed by Granger (1969). The causality test for “macroeconomic variables and stock market performance” in the Granger test employs F-test.
CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION OF RESULTS

4.1 Introduction

Chapter four presents the results and the discussion of the research findings. It first presents the descriptive statistics, stationarity, co-integration tests and then proceeds to present the short run and long run results of the study. Specifically, the study focuses on the short-run and long-run associations between the variables of interest of this study, as well as “the causal link between the macroeconomic variables and stock market performance in Ghana”. The discussion on the model’s diagnostics tests will end this chapter.

4.2 Descriptive Analysis

This section of the study “presents a brief discussion of the basic descriptive statistics of the variables used in the model over the period 2008 to 2018. These variables are GSE all share index (GSE-ASI), Inflation rate (INF), Interest rate (INT) and Exchange Rate (EXR). Among the summary statistics examined are the standard deviation, mean, maximum and minimum values. Table 4.1 shows the details: Firstly, the standard deviation column from Table 4.1 measures the dispersion of the variables from their means. The presence of outliers is indicated by large standard errors which significantly influence the data. The difference between the minimum and maximum values of the variables can also help to determine the spread. The bigger the gap of a variable, the larger the standard deviation of the said variable.”
Table 4.1: Summary Statistics of the Variables, 2008-2018

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs.</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSE-ASI</td>
<td>44</td>
<td>3.52e-03</td>
<td>1</td>
<td>-2.096</td>
<td>5.386</td>
</tr>
<tr>
<td>EXR</td>
<td>44</td>
<td>2.659</td>
<td>1.308</td>
<td>0.978</td>
<td>4.9</td>
</tr>
<tr>
<td>INF</td>
<td>44</td>
<td>13.492</td>
<td>3.895</td>
<td>8.4</td>
<td>20.7</td>
</tr>
<tr>
<td>INT</td>
<td>44</td>
<td>18.143</td>
<td>4.063</td>
<td>12.5</td>
<td>26</td>
</tr>
</tbody>
</table>

Source: Author’s elaboration using the data

GSE-ASI recorded a mean value of 3.52e-03, a standard deviation of 1, and -2.096 minimum value 5.386 maximum value. For the macroeconomic variables; EXR, INF, and INT recorded means GHS2.659, 13.492 percent and 18.143 percent respectively, standard deviations of GHS1.308, 3.895 percent and 4.063 percent respectively, and minimum and maximum values of GHS0.978 and GHS4.9 for EXR, 8.4 percent and 20.7 percent for INF and 12.5 percent and 26 percent for INT respectively.

4.3 Results of Stationarity Test

In order to avoid non-stationary variables which cause spurious regression estimates problems, the variables used in the research were tested for stationarity. The “Augmented Dickey-Fuller Test” (ADF) test statistic was adopted to test for the existence of unit root among the variables. Tables
4.2 and 4.3 reports the results of the “ADF unit root test.” The null hypothesis states that, “the series has unit root (non-stationary) and the alternative hypothesis states that the series has no unit root (stationary).” The results obtained provide strong evidence that the variables for the analysis were not stationary at both 1 percent and 5 percent significance levels.

**Table 4.2: ADF Unit Root Test at Levels**

<table>
<thead>
<tr>
<th>Variable</th>
<th>t-statistic</th>
<th>P-Value</th>
<th>Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSE-ASI</td>
<td>-2.596</td>
<td>0.1938</td>
<td>I(1)</td>
</tr>
<tr>
<td>EXR</td>
<td>-0.148</td>
<td>0.9692</td>
<td>I(1)</td>
</tr>
<tr>
<td>INF</td>
<td>-2.105</td>
<td>0.2424</td>
<td>I(1)</td>
</tr>
<tr>
<td>INT</td>
<td>-1.457</td>
<td>0.5547</td>
<td>I(1)</td>
</tr>
</tbody>
</table>

The lag length for the ADF was selected using Schwarz Information Criterion (SIC).

Source: Author’s elaboration using the data

**Table 4.3: ADF Unit Root Test at first difference**

<table>
<thead>
<tr>
<th>Variable</th>
<th>t-statistic</th>
<th>P-Value</th>
<th>Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSE-ASI</td>
<td>-4.710</td>
<td>0.0001</td>
<td>I(0)</td>
</tr>
<tr>
<td>EXR</td>
<td>-5.021</td>
<td>0.0000</td>
<td>I(0)</td>
</tr>
<tr>
<td>INF</td>
<td>-2.982</td>
<td>0.0366</td>
<td>I(0)</td>
</tr>
<tr>
<td>INT</td>
<td>-2.821</td>
<td>0.0021</td>
<td>I(0)</td>
</tr>
</tbody>
</table>

The lag length for the ADF was selected using Schwarz Information Criterion (SIC).

Source: Author’s elaboration using the data

From Tables 4.2 and 4.3, it is shown that the entire variables were not stationary at levels but all of them became stationary at first difference. To elude spurious regression it is good to work with stationary results. Given this result, statistically, the study has the tendency of producing spurious
results if it does not first difference the variables. But the study can also test the likelihood of these non-stationary variables having a long run association. The Johansen method of estimation, therefore, becomes the appropriate estimation technique to be adopted for the study.

4.4 Results of Co-Integration Test

Since the first differences of the variables are stationary using the ADF unit root test, “the study goes ahead to find the co-integration among the variables. This will establish both long-run and short-run relationships between the variables. Vector Autoregressive (VAR) is used to estimate the optimal lag length for the Johansen co-integration test. From the VAR lag selection criterion results, all Akaike information criterion AIC, Schwarz information criterion (SC) and Hannan-Quinn information (HQ) criterion chose optimal lag length 1.” This lag selection will help to test for the presence of co-integration between the variables using the Johansen Test of Co-integration Approach.

Table 4.4: Results of “VAR Lag Order Selection Criteria”

<table>
<thead>
<tr>
<th>Lag</th>
<th>LogL</th>
<th>LR</th>
<th>FPE</th>
<th>AIC</th>
<th>SC</th>
<th>HQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-344.1635</td>
<td>144.244</td>
<td>1226.902</td>
<td>37.14422</td>
<td>17.47116</td>
<td>17.24881</td>
</tr>
<tr>
<td>1</td>
<td>-346.5948</td>
<td>225.2338*</td>
<td>1.496299*</td>
<td>10.17298*</td>
<td>12.78855*</td>
<td>31.00973*</td>
</tr>
<tr>
<td>2</td>
<td>-263.7542</td>
<td>82.84068</td>
<td>0.284246</td>
<td>17.91694</td>
<td>22.82113</td>
<td>13.48584</td>
</tr>
</tbody>
</table>

Source: Author’s elaboration using the data

Also, Tables 4.5 and 4.6 report the results found from the Johansen technique to test for co-integration using a VAR with an order of 1. The study rejects “the null hypothesis of zero co-
integrating vectors against the alternative of one co-integrating vector.” If the study rejects the null hypothesis, then it can be established that there are at most one co-integrating vectors specified in the model. Hence, the study’s variables move together in the long-run.

**Table 4.5: Johansen Unrestricted Co-Integration Rank Test (Trace)**

<table>
<thead>
<tr>
<th>Hypothesized</th>
<th>Trace No. of CE(s)</th>
<th>Eigenvalue</th>
<th>Statistic</th>
<th>Critical Value</th>
<th>Prob.**</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>None</td>
<td>0.855081</td>
<td>177.1884</td>
<td>125.6151</td>
<td>0.0000</td>
</tr>
<tr>
<td>At most 1</td>
<td>0.608212</td>
<td>132.1292</td>
<td>85.75362</td>
<td>0.0361</td>
<td></td>
</tr>
<tr>
<td>At most 2</td>
<td>0.325801</td>
<td>55.17692</td>
<td>69.81885</td>
<td>0.2106</td>
<td></td>
</tr>
<tr>
<td>At most 3</td>
<td>0.558226</td>
<td>42.79271</td>
<td>47.85612</td>
<td>0.2377</td>
<td></td>
</tr>
<tr>
<td>At most 4</td>
<td>0.745501</td>
<td>4.717485</td>
<td>3.841464</td>
<td>0.0296</td>
<td></td>
</tr>
</tbody>
</table>

Source: Author’s elaboration using the data

In particular, the “Trace test” in Table 4.5 indicates at most one co-integrating equations “at 5% level of significance”. This demonstrates that the variables have a long-run association from the trace test. The study, therefore, concludes that there are at most one co-integrating vectors specified in the model established from the Trace test.

Consequently, the “Maximum Eigen value test” form Table 4.6 indicates at most one co-integrating equations at a significance level of 5%. This reveals that the variables used in the study move together in the long-run from the “Maximum Eigen value test”. The study, therefore, “rejects
the null hypothesis of no co-integration,” meaning that there is a long-run equilibrium association among the variables when normalized for “a unit coefficient on GSE all share index.”

**Table 4.6: Johansen Unrestricted Co-integration Rank Test (Maximum Eigen value)**

<table>
<thead>
<tr>
<th>Hypothesized No. of CE(s)</th>
<th>Max-Eigen Eigenvalue</th>
<th>Statistic</th>
<th>Critical Value</th>
<th>Prob.**</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0.835084</td>
<td>77.05914</td>
<td>36.23141</td>
<td>0.0000</td>
</tr>
<tr>
<td>At most 1</td>
<td>0.608217</td>
<td>36.95233</td>
<td>40.07758</td>
<td>0.0112</td>
</tr>
<tr>
<td>At most 2</td>
<td>0.525807</td>
<td>22.38421</td>
<td>33.87684</td>
<td>0.5779</td>
</tr>
<tr>
<td>At most 3</td>
<td>0.458226</td>
<td>18.38720</td>
<td>27.58433</td>
<td>0.4632</td>
</tr>
<tr>
<td>At most 4</td>
<td>0.145501</td>
<td>4.717486</td>
<td>3.841465</td>
<td>0.0297</td>
</tr>
</tbody>
</table>

Source: Author’s elaboration using the data

**4.5 Normalized co-integrating Coefficients and “Vector Error Correction Model” Results**

In the short-run, “there may exist some deviations from this equilibrium, hence, it is essential to examine whether this disequilibrium converges to the long-run equilibrium or not. The existence of co-integrating equations in the system draws the study’s attention to the use of the Vector Error Correction Model to estimate the short-run and long-run co-integrating coefficients. This model gives an idea of the speed of adjustment as a result of any possible deviation from the steady-state.” The result in Table 4.7 depicts the long run and short run associations between the variables.

All the variables are established to be statistically significant and have their respective signs.
### Table 4.7: Normalized co-integrating Coefficients; Estimated Long-run Model and “Error Correction Model” for Short-run Dynamics (GSE-ASI is Dependent Variable)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Errors</th>
<th>T-Statistics</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>INF</td>
<td>-3.467733</td>
<td>0.76816</td>
<td>-4.51434</td>
<td>0.0021</td>
</tr>
<tr>
<td>EXR</td>
<td>-5.853726</td>
<td>1.27654</td>
<td>-4.585619</td>
<td>0.0231</td>
</tr>
<tr>
<td>INT</td>
<td>-6.546735</td>
<td>1.52683</td>
<td>-4.287796</td>
<td>0.0043</td>
</tr>
<tr>
<td>Error correction term</td>
<td>-0.213235</td>
<td>0.074588</td>
<td>-2.861744</td>
<td>0.0012</td>
</tr>
<tr>
<td>D(GSE-ASI(-1))</td>
<td>0.074457</td>
<td>0.256982</td>
<td>0.289734</td>
<td>0.7749</td>
</tr>
<tr>
<td>D(INF(-1))</td>
<td>0.603234</td>
<td>5.537467</td>
<td>0.108937</td>
<td>0.9143</td>
</tr>
<tr>
<td>D(EXR(-1))</td>
<td>7.864826</td>
<td>15.70951</td>
<td>0.500641</td>
<td>0.6218</td>
</tr>
<tr>
<td>D(INT(-1))</td>
<td>7.864826</td>
<td>15.70951</td>
<td>0.500641</td>
<td>0.6218</td>
</tr>
</tbody>
</table>

Source: Author’s elaboration using the data

From the normalized co-integrating coefficients, interest rate, inflation rate, and exchange rate carried the expected signs. From Table 4.7, the inflation rate has a negative influence on GSE-ASI. Thus, a negative coefficient of 3.467733, can be elucidated that “a 1 percent rise in the inflation rate will lead to about 3.467733 declines in GSE-ASI. The coefficient of the inflation rate is significantly negative at 5% significance level. This result confirms the findings of Sin-yu (2017) for South Africa, who found a negative effect of inflation on stock market development in the long-run.”
Also, “the coefficient of the exchange rate is significantly negative at 5% level of significance. This conforms to the theory. Specifically, a 1 percent rise in the exchange rate will lead to approximately 5.853726 decreases in GSE-ASI. It can be seen that the exchange rate has a negative effect on stock market performance in Ghana, in general. This implies that in the long-run, the growth of exchange rate is detrimental to Ghana’s stock market performance since investors will have the option of investing in countries with favorable exchange rate.” This result confirms the findings of Gaetha et al. (2011), who established “a statistically significant long-run association between growth exchange rate and stock market performance in Malaysia, U.S.A, and China.”

Moreover, the effect of interest rate on GSE-ASI in the long-run “is also significantly negative at 5% level of significance. With a negative coefficient of 6.546735, it is predicted that a 1% rise in interest rate leads to about 6.546735 decreases in GSE-ASI. This result confirms the findings of Sin-yu (2017) for South Africa, who found a negative effect of interest rate on stock market development in the long-run. This implies that in the long-run, an increase in interest rate will be detrimental to stock market performance in Ghana.”

Consequently, the findings from the short-run estimates illustrated by the “Error Correction Term” (ECT) replicates “the temporal position of the long-run relationships in the model. The sign and size of the estimated coefficient of the ECT in the model give the direction and speed of adjustment corrected from the short-run equilibrium towards the long-run equilibrium.” The condition for convergence is to have a negative and significant ECT. The coefficient of the ECT is significantly negative at 5% significance level. A significant ECT coefficient implies that “whenever the actual value of GSE-ASI falls below the value consistent with its long-term equilibrium relationship, changes in the explanatory variables help bring it up back to its long-term equilibrium value, all things being equals.” The size of the coefficient specifies the speed of adjustment towards
equilibrium in the long run whenever there is a shock is approximately 21.3 percent. This is a relatively a slow-speed of adjustment. This coefficient also establishes that, should there be shocks that will cause disequilibrium in the economy, 21.3 percent of the errors caused by this disequilibrium will be corrected.

However, in the short run, the relation between the past one lag periods of GSE-ASI, inflation, exchange rate, and interest rate are insignificant. Hence, it is concluded that the impact of macroeconomic variables on stock market performance in Ghana is not immediate.

**4.6 Wald Test of “Vector Error Correction Model”**

After going through the short-run dynamics, the study proceeds to perform the Wald coefficient test to know the causality of the explanatory variables on the dependent variable (GSE-ASI) in the short-run. From Table 4.8, the study uses the Wald test to test the null hypothesis that all lagged values of the independent variables do not jointly cause GSE All Share Index growth. The result of the Wald test is illustrated in Table 4.9.
Table 4.8: Wald Test of VECM (GSE-ASI is the Dependent Variable)

<table>
<thead>
<tr>
<th>Test Statistic</th>
<th>Value</th>
<th>Df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistic</td>
<td>4.864323</td>
<td>(5, 44)</td>
<td>0.0015</td>
</tr>
<tr>
<td>Chi-square</td>
<td>17.14527</td>
<td>5</td>
<td>0.0024</td>
</tr>
</tbody>
</table>

Source: Author’s elaboration using the data

From Table 4.8, the Wald test result gives the study enough indication to reject the null hypothesis that inflation, interest and exchange rates do not jointly cause the performance of the stock market in the short run. Therefore, “all the lagged independent variables can jointly influence stock market performance and there is a causal link running from the independent variables to stock market performance in the short-run at 5% level of significance”.

4.7 Granger Causality Test

This test is estimated for the ultimate aim of examining the causality and direction between the variables employed in the study. “This test tries to examine whether the past values of one variable can lead to a change in the present values of another variable. The main interest for this study of causality is to check if there is any Granger causality between the macroeconomic variables and stock market performance.” In principle, if variations in the macroeconomic variables cause a change in stock market performance, then the macroeconomic variables “Granger cause” stock market performance.
Table 4.9: “Pairwise Granger Causality Test” Results

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Obs.</th>
<th>F-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>INF does not “Granger Cause” GSE-ASI</td>
<td>44</td>
<td>5.75432</td>
<td>0.0287</td>
</tr>
<tr>
<td>GSE-ASI does not “Granger Cause” INF</td>
<td></td>
<td>0.43233</td>
<td>0.3348</td>
</tr>
<tr>
<td>EXR does not “Granger Cause” GSE-ASI</td>
<td>44</td>
<td>3.20508</td>
<td>0.0365</td>
</tr>
<tr>
<td>GSE-ASI does not “Granger Cause” EXR</td>
<td></td>
<td>0.24639</td>
<td>0.1456</td>
</tr>
<tr>
<td>INT does not “Granger Cause” GSE-ASI</td>
<td>44</td>
<td>4.78622</td>
<td>0.0034</td>
</tr>
<tr>
<td>GSE-ASI does not “Granger Cause” INT</td>
<td></td>
<td>0.32086</td>
<td>0.2244</td>
</tr>
</tbody>
</table>

Source: Author’s elaboration using the data

The result from Table 4.9 indicates a “uni-directional causality” existing between the macroeconomic variables and stock market performance. Thus, the study rejects the null hypotheses for the causality running from the macroeconomic variables to stock market performance and fails to reject the null hypotheses for the causality running from stock market performance to the macroeconomic variables. This implies that the macroeconomic variables “Granger cause” stock market performance but stock market performance does not “Granger cause” the macroeconomic variables. Hence, there exists no mutual feedback influence existing between these variables.” This maintains the uni-directional causality hypothesis in the Ghanaian economy. This implies that changes in the macroeconomic variables are a prerequisite for a variation in the stock market performance in Ghana.
4.8 Diagnostic Tests

The study has adequately examined and specified models with various diagnostic tests (see Appendix). These tests include a test for serial correlation, heteroskedasticity and functional form.

The null hypotheses of the various diagnostic tests include:

1. The residuals of the model are not serially correlated.
2. There is no “ARCH effect” (heteroskedasticity).
3. There is a correct functional form of the model.

The tests, therefore, failed to reject none of the three null hypotheses (see appendix), which means that, there is no “ARCH effect” (heteroskedasticity), there is no serial correlation in the model and also, it is of functional form. Therefore, the diagnostic tests show that the empirical model is valid.
CHAPTER FIVE

CONCLUSION AND POLICY RECOMMENDATIONS

5.1 Introduction

In this section, the study presents the summary, conclusion, and recommendation based on the outcome of the research.

5.2 Summary

Generally, “the main objective of the study is to analyze the effect of macroeconomic variables (inflation, exchange rate, and interest rate) on stock market performance in Ghana using quarterly data ranging from 2008 to 2018. The study explored both the long-run and the short-run relationship between the macroeconomic variables (inflation rate, exchange rate, and interest rate) and stock market performance. The study used the GSE all-share index as a dependent variable to measure stock market performance. As seen in the extant literature, the study controlled for the phenomena that may affect the dependent variable in the model (i.e. inflation, exchange rate, and interest rate).”

The study estimated “a time series regression model for the period 2008 to 2018 using data sourced from the Ghana Stock Exchange (GSE) and Bank of Ghana. The Johansen co-integration analysis was used to confirm the presence of long-run negative relationships among GSE all-share index and the macroeconomic variables (inflation rate, exchange rate, and interest rate). The results suggest that the variables are co-integrated. That is, they move together in the long-run.” However, when the “vector error correction model was employed to check for the short-run association between the independent variables and GSE all share index, insignificant results were found. In
particular, even though the variables are co-integrated, the influence of inflation rate, exchange rate and the interest rate on stock market performance are not immediate”. Also, the Granger causality test showed a uni-directional causative association running from inflation rate, exchange rate and interest rate to stock market performance in Ghana.

5.3 Conclusions

Stock market growth is mostly known to be beneficial for economic development. Due to this, Ghana implemented the stock exchange liberalization policy as part of structural reforms in 1986. This research, therefore, explored the impact of macroeconomic variables on the stock market performance of Ghana from 2008 to 2018. The empirical results of the research show that inflation, interest and exchange rate hinder stock market performance in Ghana in the long-run. As expected, inflation, interest and exchange rates exerted significantly negative effects on stock market performance.

Also, the error correction term (a measure of disequilibrium error), was shown to be significantly negative. The size of the coefficient indicates that the speed of adjustment towards equilibrium in the long-run, whenever there is a shock, is approximately 21.3%. This is a relatively a slow-speed of adjustment to long-run equilibrium. This implies that “short-run shocks or disturbances in the macro economy would slowly move the economy towards the long-run equilibrium”. The VECM estimates also observed that the influence of the macroeconomic variables (inflation, interest and exchange rates) on the stock market performance are not immediate in the short-run. Also, the “Granger causality test” results confirmed a uni-directional causal link running from inflation rate, exchange rate and interest rate to stock market performance. This means that changes in the
macroeconomic variables are a prerequisite for a change in the stock market performance in Ghana.

5.4 Recommendations

The following policy recommendations are established on the findings of the research: The study discovered a negative association between the macroeconomic variables (inflation, interest and exchange rates) on stock market performance in the long-run. Therefore, policymakers and the government should continue to implement policies geared towards reducing the policy rate, inflation rate, and exchange rate since they are detrimental to the performance of the stock market in the long-run. In an attempt to encourage the stock exchange market through various policies, the government and Bank of Ghana should try to enforce joint initiatives to improve both the stock market and the macroeconomic indicators.

This study is limited to three macroeconomic indicators for the past ten years. Further study that considers more macroeconomic indicators is recommended in order to make better the Ghana stock market.
REFERENCES


Osei, K. A. (1997). Analysis of factors affecting the development of an emerging capital market:
The case of the Ghana stock market.


Appendix A: Unit Root Test

A1: Levels

“Null Hypothesis: GSE-ASI has a unit root”
“Exogenous: Constant”
“Lag Length: 1 (Automatic - based on SIC, maxlag=2)”

<table>
<thead>
<tr>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Augmented Dickey-Fuller test” statistic</td>
<td>-2.596122</td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -3.661661
- 5% level: -2.960411
- 10% level: -2.619160

Null Hypothesis: EXR has a unit root”
“Exogenous: Constant”
“Lag Length: 1 (Automatic - based on SIC, maxlag=2)”

<table>
<thead>
<tr>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Augmented Dickey-Fuller test” statistic</td>
<td>-0.148125</td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -3.661663
- 5% level: -2.960413
- 10% level: -2.619161

Null Hypothesis: INF has a unit root”
“Exogenous: Constant”
“Lag Length: 1 (Automatic - based on SIC, maxlag=2)”

<table>
<thead>
<tr>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Augmented Dickey-Fuller test” statistic</td>
<td>-2.105122</td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -3.661661
- 5% level: -2.960411
- 10% level: -2.619160

“Null Hypothesis: INT has a unit root”
“Exogenous: Constant”
“Lag Length: 1 (Automatic - based on SIC, maxlag=2)”

<table>
<thead>
<tr>
<th></th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Augmented Dickey-Fuller test” statistic</td>
<td>-1.452177</td>
<td>0.5547</td>
</tr>
<tr>
<td>Test critical values:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1% level</td>
<td>-3.661661</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td>-2.960411</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td>-2.619160</td>
<td></td>
</tr>
</tbody>
</table>


### A2: First Difference

“Null Hypothesis: D(GSE-ASI) has a unit root”
“Exogenous: Constant”
“Lag Length: 1 (Automatic - based on SIC, maxlag=2)”

<table>
<thead>
<tr>
<th></th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Augmented Dickey-Fuller test” statistic</td>
<td>-4.710238</td>
<td>0.0001</td>
</tr>
<tr>
<td>Test critical values:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1% level</td>
<td>-3.670170</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td>-2.963972</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td>-2.621007</td>
<td></td>
</tr>
</tbody>
</table>


“Null Hypothesis: D(EXR) has a unit root”
“Exogenous: Constant”
“Lag Length: 1 (Automatic - based on SIC, maxlag=2)”

<table>
<thead>
<tr>
<th></th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Augmented Dickey-Fuller test” statistic</td>
<td>-5.021061</td>
<td>0.0000</td>
</tr>
<tr>
<td>Test critical values:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1% level</td>
<td>-3.670171</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td>-2.963974</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td>-2.621006</td>
<td></td>
</tr>
</tbody>
</table>

“Null Hypothesis: D(INF) has a unit root”  
“Exogenous: Constant”  
“Lag Length: 1 (Automatic - based on SIC, maxlag=2)”

<table>
<thead>
<tr>
<th>“Augmented Dickey-Fuller test” statistic</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>D(INF)</td>
<td>-2.982116</td>
<td>0.0366</td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -3.670173
- 5% level: -2.963971
- 10% level: -2.621004


“Null Hypothesis: D(INT) has a unit root”  
“Exogenous: Constant”  
“Lag Length: 1 (Automatic - based on SIC, maxlag=2)”

<table>
<thead>
<tr>
<th>“Augmented Dickey-Fuller test” statistic</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>D(INT)</td>
<td>-2.821223</td>
<td>0.0021</td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -3.679322
- 5% level: -2.967767
- 10% level: -2.622989

Appendix B: Diagnostic Tests Results

Appendix B1: Results of Serial Correlation Test

Breusch-Godfrey Serial Correlation LM Test:

<table>
<thead>
<tr>
<th></th>
<th>F-statistic</th>
<th>Prob. F(1,44)</th>
<th></th>
<th>Obs*R-squared</th>
<th>Prob. Chi-Square(1)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.604276</td>
<td>0.1070</td>
<td></td>
<td>6.625684</td>
<td>0.0341</td>
<td></td>
</tr>
</tbody>
</table>

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 2008 2018
Included observations: 44
Pre-sample missing value lagged residuals set to zero.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSE-ASI</td>
<td>-0.598830</td>
<td>3.485388</td>
<td>-0.171811</td>
<td>0.8650</td>
</tr>
<tr>
<td>INF</td>
<td>10.44807</td>
<td>10.77452</td>
<td>0.969702</td>
<td>0.3415</td>
</tr>
<tr>
<td>EXR</td>
<td>-17.85714</td>
<td>15.35591</td>
<td>-1.162884</td>
<td>0.2559</td>
</tr>
<tr>
<td>INT</td>
<td>26.19120</td>
<td>73.45421</td>
<td>0.356565</td>
<td>0.7244</td>
</tr>
<tr>
<td>RESID(-1)</td>
<td>0.576295</td>
<td>0.195943</td>
<td>2.941135</td>
<td>0.0070</td>
</tr>
</tbody>
</table>

R-squared       | 0.257053    | Mean dependent var | 0.565730  |
Adjusted R-squared| 0.078745  | S.D. dependent var  | 146.6139  |
S.E. of regression| 140.7230  | Akaike info criterion | 12.92210 |
Sum squared resid | 495073.7  | Schwarz criterion   | 13.24273  |
Log likelihood   | -199.7537  | Hannan-Quinn criter. | 13.02838 |
Durbin-Watson stat| 1.872985  |                     |           |
B2: Results of Heteroskedasticity Test

Heteroskedasticity Test: ARCH

<table>
<thead>
<tr>
<th></th>
<th>F-statistic</th>
<th>Prob. F(1,44)</th>
<th>0.9343</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obs.*R-squared</td>
<td>0.007401</td>
<td>Prob. Chi-Square(1)</td>
<td>0.9314</td>
</tr>
</tbody>
</table>

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Sample (adjusted): 2008 2018
Included observations: 44 after adjustments

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>21172.41</td>
<td>7413.511</td>
<td>2.855922</td>
<td>0.0079</td>
</tr>
<tr>
<td>RESID^2(-1)</td>
<td>0.015364</td>
<td>0.184619</td>
<td>0.083218</td>
<td>0.9343</td>
</tr>
</tbody>
</table>

R-squared 0.000239 Mean dependent var 21495.26
Adjusted R-squared -0.034236 S.D. dependent var 34586.57
S.E. of regression 35173.64 Akaike info criterion 23.83632
Sum squared resid 3.59E+10 Schwarz criterion 23.92884
Log likelihood -367.4630 Hannan-Quinn criter. 23.86648
F-statistic 0.006925 Durbin-Watson stat 2.007925
Prob(F-statistic) 0.934250
B3: “Functional Form” Test Result

“Ramsey RESET Test”
Equation: UNTITLED
Specification: GSE-ASI INF EXR INT
“Omitted Variables: Squares of fitted values”

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>t-statistic</td>
<td>6.202182</td>
<td>5</td>
<td>0.2134</td>
</tr>
<tr>
<td>F-statistic</td>
<td>3.846707</td>
<td>(1, 44)</td>
<td>0.2245</td>
</tr>
</tbody>
</table>

F-test summary:

<table>
<thead>
<tr>
<th></th>
<th>Sum of Sq.</th>
<th>Df</th>
<th>Mean Squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test SSR</td>
<td>0.005662</td>
<td>1</td>
<td>0.000343</td>
</tr>
<tr>
<td>Restricted SSR</td>
<td>0.002813</td>
<td>5</td>
<td>0.004580</td>
</tr>
<tr>
<td>Unrestricted SSR</td>
<td>0.002322</td>
<td>9</td>
<td>0.008912</td>
</tr>
</tbody>
</table>

LR test summary:

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restricted LogL</td>
<td>-4.52080</td>
<td>5</td>
</tr>
<tr>
<td>Unrestricted LogL</td>
<td>-1.36017</td>
<td>9</td>
</tr>
</tbody>
</table>

Unrestricted Test Equation:
Dependent Variable: GSE-ASI
Method: Least Squares
Sample: 2008 2018
Included observations: 44

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>INF</td>
<td>-1.454906</td>
<td>2.826387</td>
<td>-0.514758</td>
<td>0.6112</td>
</tr>
<tr>
<td>EXR</td>
<td>18.60052</td>
<td>8.603880</td>
<td>2.161875</td>
<td>0.0404</td>
</tr>
<tr>
<td>INT</td>
<td>-45.10318</td>
<td>17.09013</td>
<td>-2.639136</td>
<td>0.0141</td>
</tr>
<tr>
<td>FITTED^2</td>
<td>0.000816</td>
<td>0.000132</td>
<td>6.202182</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared        | 0.963201 | Mean dependent var | 682.4701 |
Adjusted R-squared| 0.954370 | S.D. dependent var | 479.6873 |
S.E. of regression| 102.4672 | Akaike info criterion | 12.28760 |
Sum squared resid  | 262488.4 | Schwarz criterion   | 12.60823 |
Log likelihood    | -189.6017 | Hannan-Quinn criter. | 12.39388 |
Durbin-Watson stat| 1.701294 |                       |