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IMPACT OF CRYPTOCURRENCY VOLATILITY ON STOCK MARKET PERFORMANCE

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DECLARATION

Student's Declaration

I, JOHN OBENG, declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE:…………………………….

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SUPERVISOR'S DECLARATION

We hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of thesis as laid down by the University of Education, Winneba.

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DATE:…………………….…………

DEDICATION

I dedicate this thesis to my family for their prayers and support.

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I owe a great debt of gratitude to professor Braimah Imurana Awiasu and Dr. Emmanuel Okofo Dartey for supervising my work for me.

My heart felt appreciation goes to my entire family and friends for supporting me both prayers and financially.

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TABLE OF CONTENTS

Content **Page**

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

The purpose of this study is to investigate the impact of cryptocurrency price volatility on the stock market performance. Guided by the positivist philosophy, the study adopted an explanatory research design and a quantitative approach. The study used 5-year data of daily closing prices of Bitcoin, Ethereum and Cardano as well as stock market indices such as Ghana Stock Exchange-Composite Index, Nigeria Stock Exchange All-share Index, and Johannesburg Stock Exchange All-Share Index. Having employed Autoregressive Distributed Lag (ARDL) and Fixed Effect panel regression models, the study found that Cryptocurrency price volatility significantly affects stock market performance, with Bitcoin showing a positive effect at the country level but negative effects at the group level. Ethereum price volatility also recorded a significant positive impact on both group and country levels, while Cardano has a significant negative impact at both levels, except for Ghana, which reports insignificant effects in both short and long runs and South Africa which recorded insignificant impacts in the long run. It was concluded that both the cryptocurrency market and the conventional stock market are not only interconnected but also interdependent. The study, therefore, calls for clear and consistent regulatory frameworks for cryptocurrencies, advocates for investor awareness and financial literacy, recommends portfolio diversification to mitigate volatility and calls for strengthened market surveillance and the exploration of market stability mechanisms and enhanced cybersecurity measures to address risks associated with cryptocurrency markets.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The study of the relationship between cryptocurrency volatility and its impact on the stock market is an important field of research, given the rapid growth and increasing popularity of cryptocurrencies. Cryptocurrencies have become a significant investment opportunity for individuals and institutions, resulting in a greater interest in understanding the market's dynamics. Bitcoin, which was created in 2008 by Nakamoto, was the first decentralized cryptocurrency based on blockchain technology. It has significantly facilitated electronic payments between individuals without the need for a third-party intermediary, making it the first digital currency devised and still the leading cryptocurrency based on stock market capitalization.

The volatility of cryptocurrencies is a significant concern for investors and regulators because it can lead to substantial gains or losses in a brief period. The unpredictability in price movements may also influence the stock market since investors might shift their investments from traditional stocks to cryptocurrencies to look for higher returns. Furthermore, the largely unregulated crypto market operates outside of traditional financial systems, increasing market uncertainty and unpredictability. This lack of regulation might also contribute to the volatility of cryptocurrencies, making it difficult for investors to accurately forecast price movements.

To discuss the impact of regulation on cryptocurrency value, it is necessary to investigate the extent to which government action can influence blockchain payment systems. As cryptocurrencies use various security solutions to make transaction tracking and the association between physical, legal, and digital individuals prohibitively difficult, the question of whether state regulation can effectively restrain blockchain payment systems is a valid and non-trivial topic to explore. Moreover, cryptocurrencies are necessarily exterritorial, while regulation is a predominantly national matter, as noted by Auer and Claessens (2018). For example, since multiple exchanges contribute to cryptocurrency price discovery with the same pairs traded in different jurisdictions, national exchange regulation may be extremely ineffective, as mentioned by Brandvold et al. (2015). According to Hendrickson and Luther (2017), banning cryptocurrencies is feasible by implementing transaction policies and sufficiently harsh punishments for their use. Therefore, at least theoretically, regulation can have a significant impact on the consumer value of blockchain payment systems and, consequently, on the market prices of cryptocurrencies. Auer and Claessens (2018) similarly speculate that cryptocurrency regulation can be effective, particularly if it is enforced internationally.

Given the growing importance of cryptocurrencies as an investment opportunity, more research is necessary to examine the relationship between cryptocurrency volatility and its impact on the stock market. This research can aid in better understanding the dynamics of the crypto market and the potential risks and benefits of investing in cryptocurrencies. The study aims to provide a comprehensive analysis of the relationship between cryptocurrency volatility and its impact on the stock market to inform investment decisions and help mitigate potential risks.

1.2 Statement of the Problem

The emergence of cryptocurrencies has sparked a global phenomenon, attracting the attention of investors, regulators, and academics alike. Bitcoin, the first cryptocurrency, was introduced in 2009, and since the market has exploded, with thousands of different cryptocurrencies now available for trading. The market capitalization of the cryptocurrency market was around $2.5 trillion in April 2021

(CoinMarketCap, 2021). Cryptocurrencies are digital or virtual currencies that use cryptography for security and operate independently of a central bank. They have gained popularity among investors due to their potential for high returns, decentralization, and lack of government control. However, cryptocurrencies are also highly volatile, with prices fluctuating widely over short periods. The volatility of the cryptocurrency market has raised concerns about its potential impact on traditional stock markets. Despite the increasing popularity of cryptocurrencies, the extent to which their volatility affects stock markets remains unclear.

A growing body of literature has explored the relationship between the cryptocurrency market and the stock market (Toma & Sandu, 2020; Mokni et al., 2021; Bouri et al., 2017; Chen et al., 2020). However, these studies yielded mixed, fragmented, and inconclusive results. Some studies have found a positive relationship between the two markets (Toma & Sandu, 2020; Bouri et al., 2017; Chen et al., 2020), while others have found a negative (Mokni et al., 2021;) or no relationship (Katsiampa, 2017). For example, Toma and Sandu (2020) found a positive relationship between Bitcoin and the S&P 500, while Mokni et al. (2021) found a negative relationship. Similarly, Bouri et al. (2017) found a positive relationship between Bitcoin and the VIX, while Katsiampa (2017) found no relationship between Bitcoin and the stock market. Again, Chen et al. (2020) found that Bitcoin's volatility was positively correlated with that of the stock market, suggesting a spillover effect between the two markets. Li et al. (2020) also found that a positive shock to Bitcoin's price leads to an increase in stock market returns. Todorova and Pashev (2021) also argue that while cryptocurrency market volatility may have a short-term impact on the stock market, it may not have a significant long-term effect.

One possible explanation for the mixed findings is that the impact of cryptocurrency market volatility on the stock market may vary depending on the type of cryptocurrency and the characteristics of the stock market. For example, Bitcoin, the largest cryptocurrency by market capitalization, may have a different impact on the stock market than smaller cryptocurrencies such as Ethereum or Ripple. Similarly, the impact of cryptocurrency market volatility on the stock market may vary across different industries or countries.

Despite the growing interest in cryptocurrencies and the significant research effort, there is a lack of consensus on the relationship between cryptocurrency market volatility and the stock market. Additionally, most of the studies used stock indices such as S&P 500 and cryptocurrencies such as Bitcoin. Again, the researcher has not sighted any known study in Ghana that investigates the effect of cryptocurrency volatility on the Ghana Stock Market. This research gap presents a problem for investors and policymakers, as they need to understand the potential risks and opportunities associated with investing in cryptocurrencies and traditional stocks. This study, therefore, seeks to investigate the extent to which the fluctuations in the cryptocurrency market affect the Ghana Stock Exchange, Nigeria Stock Market, and South Africa Stock Market with a specific focus on Ghana Stock Exchange-Composite Index (GSE-CI), Nigeria Stock Exchange All-share Index (NSE-ASI) and Johannesburg Stock Exchange All-Share Index (JSE-ASI) as the stock indices, and Bitcoin (BTC), Ethereum (ETH) and Cardano (ADA) as the cryptocurrencies. By doing so, this study will contribute to the growing body of literature on the impact of cryptocurrencies on traditional financial markets. The study will enrich literature by serving as a reference point to future studies. Again, the study will bring new insight into growing literature on cryptocurrencies in the studied jurisdiction. Also, the findings of the study will inform policy decisions in monitoring and controlling the infiltration of cryptocurrencies in the mainstream financial sector.

1.3 Purpose of the Study

The purpose of the study is to investigate the extent to which cryptocurrency market volatility affects the stock market.

1.4 Objectives of the Study

To satisfactorily address the purpose of the study, the study, thus, seeks to achieve the following specific objectives:

1. To investigate the effect of Bitcoin price volatility on the stock market at a country level.
2. To ascertain the effect of Ethereum price volatility on the stock market at the country level.
3. To assess the effect of Cardano price volatility on the stock market at the country level.
4. To examine the group effect of cryptocurrency on stock market performance

1.5 Research Hypotheses

Drawing from the research objectives, the following hypotheses are formulated:

H_1: Bitcoin price volatility has a significant and positive effect on the stock market both at a country level.

H_2: Ethereum (ETH) price volatility significantly and positively affects the stock market both at a country level.

H_3: Cardano (ADA) price volatility has a significant positive effect on the stock market both at a country level.

H_4: Cryptocurrencies have positive significant effect on stock market performance.

1.6 Significance of the Study

This study will contribute significantly to the body of literature, inform policy, and shape practice. The findings of this study will help gain a better understanding of how financial markets are interconnected. This knowledge will help investors and policymakers make informed decisions on how to diversify their portfolios and manage risks. As more investors look to diversify their portfolios with cryptocurrencies, understanding how these currencies interact with traditional markets can provide valuable insights into investment strategies.

These findings will assist investors optimize their portfolios and maximize returns while minimizing risks. Also, the findings of this study will help identify the factors that drive volatility in these markets and how it affects the stock market. This information can be used to mitigate risks and reduce the potential for losses.

Finally, the findings of the study will also help identify regulatory policies that can help stabilize these markets and reduce systemic risks.

1.7 Research Delimitation

Even though the study seeks to investigate the effect of cryptocurrency market volatility on the stock market, the study is delimited to using three (3) cryptocurrencies, which are Bitcoin (BTC), Ethereum (ETH), and Cardano (ADA) despite thousands of cryptocurrencies. Also, the stock market indices are delimited to Ghana Stock Exchange-Composite Index (GSE-CI), Nigerian Stock Exchange All-share Index (NSE-ASI) and Johannesburg Stock Exchange All-Share Index (JSE-ALSI) despite the numerous stock market indices, an indication that the study is delimited to Ghana. Additionally, the study is delimited to a five-year cryptocurrency market and Ghana Stock Market data for the analysis (2018-2022).

1.8 Definition of Terms

Cryptocurrency: A cryptocurrency is a digital or virtual currency that uses cryptography for security and operates independently of a central bank (Farell, 2015). Cryptocurrencies are decentralized, meaning they are not controlled by a single entity or government, and they use blockchain technology to facilitate secure and transparent transactions.

Cryptocurrency volatility: Cryptocurrency volatility refers to the degree of variation in the price of a particular cryptocurrency over a period (Yen & Cheng, 2021). Cryptocurrencies are known for their high volatility, with prices often fluctuating significantly in short periods of time.

Bitcoin: Bitcoin is the first and most well-known cryptocurrency which operates on a decentralized peer-to-peer network and uses a technology called blockchain to maintain a secure and transparent ledger of transactions (Nakamoto & Bitcoin, 2008).

Ethereum: Ethereum is a decentralized platform that enables the creation of smart contracts and decentralized applications (DApps) (Wood, 2014). Ethereum has its own cryptocurrency, called Ether (ETH), which is used to pay for transactions on the network.

Cardano: Cardano is a decentralized platform for building and running smart contracts and DApps (Lyu, 2022). It was created by Charles Hoskinson, one of the co-founders of Ethereum, and aims to provide a more secure and scalable platform for decentralized applications.

Stock market: A stock market is a public marketplace where stocks, bonds, and other securities are bought and sold (De Bondt & Thaler, 1985). Stock markets provide a platform for companies to raise capital and for investors to buy and sell securities.

Ghana Stock Exchange-Composite Index: The Ghana Stock Exchange-Composite Index is a stock market index that tracks the performance of companies listed on the Ghana Stock Exchange (Idun et al., 2022). The index is weighted by market capitalization and includes companies from various sectors, such as financial services, manufacturing, and telecommunications.

1.10 Organization of the Study

There are five chapters in this research work. The background of the study, the statement of the problem, the study's objectives, research questions, significance, delimitation, limitation, and definition of terms are all covered in chapter one. Chapter two examines current relevant literature on the effect of cryptocurrency market volatility and the stock market in order to gain a thorough understanding of the subject. In this chapter, relevant theories and empirical literature were reviewed and a conceptual framework was developed accordingly. The third chapter outlines the research methods. In effect, thematic areas such as research design, population, sample and sampling procedure, data collection instrument, data collection procedures, and data processing and analysis are considered. The fourth chapter bothers on results and discussion. In this chapter, research findings are presented in APA-styled tables, interpreted, and discussed accordingly. Finally, chapter five centres on summary, conclusions and recommendations. In this chapter, the various research findings are summarized, and relevant conclusions and recommendations are made.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter of the study focuses on the review of theoretical framework that underpins the concepts under study. Again, the chapter reviews empirical studies that have focused on the effect of cryptocurrency market volatility on stock exchange performance to know the extent the topic has been explored in contemporary times and the approaches adopted for its exploration. The final aspect of the chapter highlights on the conceptual framework and hypothesis development.

2.2 Theoretical Review

This section reviews theoretical frameworks that underpin the concept under discussion.

2.2.1 Arbitrage Asset Pricing Theory

The Arbitrage Pricing Theory (APT) focuses on the short run relationship between the stock market movement and the macroeconomic fundamentals as propounded by Ross in (1976). Ross' (1976) theoretical framework links the stock returns to several variables that characterize several sources of income volatility. The general idea behind this framework is that changes caused in macroeconomic variables and asset sensitivity and responses to those changes can explain the expected return on a financial asset. In accordance with CAPM, APT acknowledges that firm specific risk can be fully diversified, leaving only non-diversifiable risks. However, APT includes multi factors in determining the return on a stock, unlike CAPM that only takes into consideration market risk. APT therefore presumes that each stock depends partially on prevalent macroeconomic indicators as well as probable factors that can exert significant impact on the performance of the stock market. APT presents more advantages over other traditional theories in terms of the number of factors to consider and the less rigorous assumptions (Adu, 2012). Considering the fact that most African economies are very fragile and more likely to be hit by macroeconomic factors, the APT provides an ideal framework for measuring the impact of macroeconomic and other trading factors on the stock prices in African countries (Adu, 2012). A major shortcoming of the APT is that it does not stipulate the type and the number of macroeconomic factors to consider in measuring returns to an asset. This, however, might be viewed as strength since it gives room for the researcher to choose the macroeconomic factors that are peculiar to the country of study in order to present more relevant results (Adu, 2012). The APT is by far regarded as it provides better explanatory model of stock index than other theories since it gives room for the use of multi factors in the analysis. APT is subsequently a generalized form of CAPM.

In line with this study, the APT would allow stakeholders and cryptocurrency traders to know the impact cryptocurrency price volatility has on the stock market. The impact of cryptocurrency volatility on the stock market can be analyzed using the Arbitrage Pricing Theory (APT) framework, which considers the short-run relationship between stock market movements and macroeconomic fundamentals. Ross' APT model suggests that changes in macroeconomic variables and asset sensitivity can explain the expected return on a financial asset. The inclusion of cryptocurrency volatility in such a model could help identify additional sources of income volatility that might influence stock returns, accounting for both diversifiable and non-diversifiable risks, as acknowledged by CAPM. Empirical studies see Bhattacharyya and Bholanath (2019), Fatima and Ahmed (2021) as well as Cong and

Zhiguo (2019) applied the arbitrage asset pricing theory in their study relating to cryptocurrencies and stock market.

2.2.2 Efficient Market Hypothesis (EMH)

The efficient market hypothesis theory as introduced by Fama argues that in an efficient market, all available information about an asset is already reflected in its price, and that it is impossible to consistently earn excess returns by analyzing past prices or other information (Fama, 1960; Eakins & Mishkin, 2012). In such a case, the market value of the company changes in a way very similar to that of the intrinsic value of a company. Market is said to be efficient when it is not possible to earn a return higher than the market return (Brealey et al., 2011; Allen et al., 2011). In other words, the value of shares reflects the fair value of the company and is equal to the future cash flows discounted by an alternative cost of capital. Generally, the essence of an efficient market is built on two pillars: 1) in efficient markets, available information is already incorporated in stock prices; 2) in efficient markets, investors cannot earn a risk-weighted excess return. Considering the information reflected in market prices, market efficiency is usually categorized into three levels. Weak, semi-strong, and strong forms of market efficiency are distinguished. In weakly-efficient stock markets, the current stock price reflects all information related to the stock price changes in the past. Such information includes data on previous prices, trading volume, etc. Based on the above-mentioned information, it becomes then impossible to make excess profit in a stock market. Thus, if the market is weakly efficient, technical analysis yields no excess return. In semi-strongly efficient markets, current stock prices reflect not only information about historical prices but also all current publicly available information, e. g., announcements of acquisitions, dividend pay-outs, changes in accounting policy etc.

Finally, in strongly efficient markets, current stock prices reflect all possible information that does not necessarily have to be public. Many empirical studies have confirmed the weak form of market efficiency in different capital markets including Gadzo et al. (2021) who found Ghana's market as semi-strong. In the context of this study, the EMH could suggest that the impact of cryptocurrency price volatility on stock exchange performance may already be reflected in stock prices. Alternatively, if the EMH is not supported, it may indicate that there are opportunities for investors to profit from cryptocurrency price movements, which could impact stock exchange performance. The impact of cryptocurrency volatility on the stock market would justify the efficient market hypothesis by unveiling whether traditional stock prices may be influenced by movements in the cryptocurrency market. If stock prices are affected by cryptocurrency fluctuations, it could indicate that not all available information is fully reflected in stock prices, contradicting the hypothesis. This potential connection implies that there might be opportunities for investors to earn excess returns by analyzing both cryptocurrency and stock market data, contrary to the principles of the efficient market hypothesis. Empirical studies see (Bouri et al., 2018; Koutmos & Martzoukos, 2018; Wang et al., 2020; Al-Yahyaee et al., 2018; Azzi & Chohan, 2020; Koutmos & Lucey, 2019) have applied the efficient market hypothesis in their study of the cryptocurrency market and stock exchange performance.

2.2.3 Prospect Theory

Prospect theory is a behavioral finance theory that suggests that investors do not always make rational decisions when it comes to financial matters. According to prospect theory, individuals tend to overweigh small probabilities and underweight large probabilities when making decisions under uncertainty (Kahneman & Tversky, 1979). This can lead to risk-seeking behavior in the face of losses and risk-averse behavior in the face of gains.

In the context of the effect of cryptocurrency market volatility on the stock market performance, Prospect Theory explains how investors react to changes in market conditions. For example, if the price of a cryptocurrency experiences a sharp decline, investors may become more risk-averse and sell off their holdings in other riskier assets, such as stocks. Conversely, if the price of a cryptocurrency experiences a significant increase, investors may become more risk-seeking and invest more heavily in riskier assets, such as stocks.

Furthermore, prospect theory suggests that investors may be more sensitive to losses than to gains, which may exacerbate the impact of cryptocurrency market volatility on the stock market. For example, if the price of a cryptocurrency experiences a sudden and large drop, investors may panic and sell off their holdings in stocks as well, even if the impact of the cryptocurrency market volatility on the stock market is relatively small. The framework is not without drawback, one criticism is that it may be too simplistic in its assumptions about human behavior and decision-making. For example, the theory assumes that individuals are always rational in their assessment of probabilities and that their decisions are based solely on their attitudes towards gains and losses. Another weakness of prospect theory is that it may not fully account for the complex and dynamic nature of financial markets. Cryptocurrencies and stocks are influenced by a wide range of factors, including economic conditions, government policies, and geopolitical events, that are not always predictable. This may make it difficult to predict the behavior of investors with certainty, even when taking into account the principles of prospect theory.

Notwithstanding, the following strengths of the framework make it applicable to the study. One, the prospect theory provides a more accurate and comprehensive view of how individuals make decisions in uncertain situations. By recognizing the role of cognitive biases and heuristics, the theory offers a more realistic perspective on human behavior than the traditional economic theory that assumes individuals always make rational decisions. Another strength of prospect theory is that it can help to explain why some investors may be more willing to invest in cryptocurrencies than in traditional assets, such as stocks. According to prospect theory, individuals tend to be more risk-seeking when faced with potential losses. This may make cryptocurrencies, which are often perceived as high-risk investments, more attractive to some investors who are seeking to maximize their returns. The impact of cryptocurrency volatility on the stock market aligns with prospect theory as investors may react irrationally to uncertain market conditions. During periods of high cryptocurrency volatility, investors may overreact to small probabilities of significant gains, leading to risk-seeking behavior in the stock market. Conversely, during times of crypto market losses, investors may become overly risk-averse, potentially impacting their decisions and the overall stock market dynamics. Previous studies like Chen et al. (2020); Auer and Claessens (2018) applied the prospect theory in their stock exchange and cryptocurrencies volatility study.

2.3 Performance

In finance, performance generally refers to the effectiveness with which a firm, fund, or investment achieves its intended financial objectives (Yaya, 2020). Performance is a critical metric for stakeholders, including investors, managers, and analysts, to assess the economic health and efficiency of various financial entities. These performance evaluations often guide investment decisions, strategic business adjustments, and portfolio management (Osubgeui (2018). Performance in finance can be broadly categorized into two main dimensions: absolute performance and relative performance.

Absolute Performance considers the return on an investment without comparison to any benchmark or standard. It is typically measured through metrics like Return on Investment (ROI), Net Profit, Earnings per Share (EPS), and Total Shareholder Return (TSR) (Mmari, 2019; Wagana, 2016). Relative Performance assesses how well a firm or investment performs in relation to a benchmark or a peer group. This is often measured through ratios such as Return on Equity (ROE), Return on Assets (ROA), or through indices that compare performance against market or specific sector indices (Dzingai & Fokaya, 2017; Okaro, 2016).

Performance measurement in finance literature revolves around various methodologies depending on the context corporate finance, personal investment portfolios, or institutional investment management. Here are several key studies and their methodologies for measuring financial performance:

Risk-Adjusted Returns: Sharpe’s (1966) introduction of the Sharpe Ratio revolutionized performance measurement by considering both the return and the riskiness of returns. This risk-adjusted return metric helps compare the performance of portfolios with differing risk characteristics.

Benchmarking Performance: Jensen's Alpha, developed by Michael Jensen in 1968, measures the abnormal return of a mutual fund or another investment type against its expected risk-adjusted return. This metric has been widely used in evaluating the performance of managed funds.

Value-based Measures: In corporate finance, value-based measures such as Economic Value Added (EVA), introduced by Stewart (1991), have been widely adopted. EVA measures a company's financial performance based on residual wealth calculated by deducting cost of capital from its operating profit.

Portfolio Performance: Fama and French (1992) developed a three-factor model expanding on the Capital Asset Pricing Model (CAPM). This model includes factors such as size, value, and market risk to evaluate the performance of investment portfolios, providing a more detailed analysis than CAPM.

Event Studies in Performance Measurement: Event studies, widely used to assess the impact of specific corporate events (like mergers, acquisitions, or earnings announcements) on the stock price, provide insights into the market's reaction and hence the performance influence of such events. Studies like MacKinlay (1997) have provided methodologies for calculating abnormal returns around event dates to gauge performance changes.

2.4 Contemporary Approaches and Challenges in measuring Performance

In recent years, the inclusion of non-financial measures of performance, such as environmental, social, and governance (ESG) criteria, has also become prominent, especially in the context of sustainable investing. Researchers like Friedman and Miles (2002) have begun to explore how these factors correlate with financial returns and overall company performance. However, measuring performance, especially in complex financial environments, poses challenges such as choosing appropriate benchmarks, adjusting for risk, and dealing with asymmetric information and market inefficiencies.

2.5 Empirical Review

This section of the chapter focuses on the review of extant literature to know the extent the topic cryptocurrencies prices and stock market nexus has been explored over the year. This gives room to identify the weakness in previous studies and synthesize various findings.

2.5.1 Bitcoin price volatility and stock market performance

Wang et al. (2020) focused on investigating the impact of Bitcoin price shocks on the stock market returns of the United States, China, Japan, and South Korea. The researchers aimed to explore the relationship between Bitcoin and stock market returns in these countries and examine whether the Efficient Market Hypothesis (EMH) holds true in this context. The investigation discovered that Bitcoin price shocks had a significant impact on stock market returns, providing further evidence that the EMH may not be fully supported in this context. This finding is consistent with the evidence provided by Koutmos and Martzoukos (2018) that Bitcoin price volatility significantly impact the stock market performance and the prepositions of the efficient market hypothesis does not hold in that jurisdiction.

Nevertheless, a number of limitations encountered by the study makes reliability if its conclusions questionable. The findings may be influenced by the specific time period analyzed and the sample of countries selected. The impact of Bitcoin price shocks on stock market returns may vary over time and across different countries due to variations in market structure, investor behavior, regulatory frameworks, or other country-specific factors. Therefore, the results may not be generalizable to other time periods or countries. Again, the study's findings of a significant impact of Bitcoin price shocks on stock market returns do not establish causation. While the study identifies a relationship, it does not provide a causal interpretation or delve into the underlying mechanisms driving the observed impact. Other unaccounted factors or common shocks that affect both Bitcoin prices and stock market returns could be influencing the observed relationship. Also, the study does not consider other potential factors that may influence stock market returns, such as macroeconomic variables, company-specific information, or market sentiment. The omission of these factors may limit the overall understanding of the relationship between Bitcoin price shocks and stock market returns. Lastly, the investigation concentrated on a specific set of countries, and the findings may not be applicable to other countries or regions. The impact of Bitcoin price shocks on stock market returns can be influenced by the specific characteristics and dynamics of each country's financial markets.

Al-Yahyaee et al. (2018) is one of several studies that have investigated the relationship between Bitcoin prices and stock market returns. Their study focused specifically on several emerging economies, including Brazil, China, India, Russia, and South Africa, and analyzed data from January 2014 to December 2016. The enquiry discovered a significant association between bitcoin prices volatility and stock market performance which suggest that stock markets are not fully efficient. The investigation focused on only emerging economies, which have become an increasingly important market for cryptocurrencies in recent years. Again, the crypto currency taken into consideration was only Bitcoin prices whilst there are Ethereum among others. Again, the analysis was limited to a relatively short time of period, which may not fully capture the long-term relationship between Bitcoin prices and stock market returns. Additionally, the study did not control for other factors that may affect stock market returns, such as macroeconomic conditions or political instability.

Cheah and Fry’s (2015) study on stock exchange is an important contribution to the literature on the relationship between Bitcoin prices and stock market returns. The study specifically focused on the US market and examined the relationship between Bitcoin prices and stock market returns during the period from 2010 to 2014. The research provides evidence that Bitcoin may serve as a hedge against market volatility, which has important implications for investors looking to diversify their portfolios. This confirms the findings of Al-Yahyaee et al. (2018) who concluded that trading in Bitcoin can serve as a hedge for investors from shading away from the risk inherent in conventional stock trade.

One of the strengths of the study is its use of a comprehensive dataset that includes both daily Bitcoin prices and stock market returns, allowing for a detailed analysis of the relationship between the two variables. However, the study also has some limitations that is the analysis only covers a relatively short time period, which may not capture the long-term relationship between Bitcoin prices and stock market returns. Additionally, the study does not control for other factors that may affect stock market returns, such as macroeconomic conditions or political instability. Just as found in the investigation by other studies, there was the use of only Bitcoin prices in place of the numerous cryptocurrencies whose price volatility could equally exert debilitating impact on the performance of stock exchange.

Azzi and Chohan (2020) investigated the impact of Bitcoin on the efficiency of stock markets in the United States, Canada, and Europe. Their findings indicated that Bitcoin had a positive effect on stock market efficiency, implying that markets were becoming more informationally efficient as a result of cryptocurrency integration. This is in contrast to the conclusion of Koutmos and Martzoukos (2018); Al-Yahyaee et al. (2108) who argued that the stock market may not be efficient as put forward by the efficient market hypothesis (Fama, 1990).

The study by Koutmos and Lucey (2019) elicit important contribution to the literature on the relationship between cryptocurrency price volatility and stock exchange returns. The exploration specifically aimed to establish the co-movement between Bitcoin and stock market returns in several countries, including the US, Japan, and several European countries, through the efficient market hypothesis (EMH) framework. The study used a number of data analysis techniques, including the Johansen cointegration test and vector error correction models, to examine the co-movement between Bitcoin and stock market returns. The results showed that there was significant co-movement between Bitcoin and stock market returns in all countries examined, suggesting that Bitcoin was becoming more integrated into global financial markets. In terms of related studies in the Nigerian, Ghanaian, and South African perspectives, there have been a number of studies examining the relationship between Bitcoin and stock market returns in these countries.

The study by Osuji and Ogbuehi (2018) investigated the relationship between Bitcoin and stock market returns in Nigeria. The researchers used daily data from January 2013 to December 2017 to analyze the relationship between the two variables. To examine the anticipated relationship between Bitcoin and stock market returns, the researchers used a multivariate Granger causality test which is a statistical test that examines the causal relationship between two or more time series variables.

The study found evidence of a positive relationship between Bitcoin and stock market returns in Nigeria. Thus, there was a bi-directional causal relationship between Bitcoin returns and stock market returns. This suggests that changes in Bitcoin returns could be used to predict changes in stock market returns, and vice versa. The study's contribution to the prevailing discussion on the association between cryptocurrency price volatility and stock market return is clear conversely, the study is not without limitation. Firstly, the study only focused on one country (Nigeria) and did not examine the relationship between Bitcoin and stock market returns in other countries. On that note, generalizing its findings to other emerging economies becomes problematic. Secondly, the study did not consider other important factors that could affect the relationship between Bitcoin and stock market returns, such as macroeconomic variables, political events, and investor sentiment. Lastly, the study only used one statistical method (Granger causality test) to analyze the relationship between Bitcoin and stock market returns. Future studies could consider using other econometric methods to examine the relationship between the two variables.

In a similar vein, Agyapong and Adjei (2018) investigated the relationship between Bitcoin and stock market returns in Ghana. Daily data from January 2014 to June 2017 was collected to examine the relationship between the two variables through the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model. The GARCH model enabled the researchers to examine the conditional variance and volatility spillovers between Bitcoin returns and stock market returns over time.

The study found evidence of a positive relationship between Bitcoin returns and stock market returns in Ghana, particularly during periods of market turmoil. Specifically, the researchers found that during periods of high stock market volatility, Bitcoin returns tended to be positively correlated with stock market returns. This suggests that Bitcoin may serve as a potential safe-haven asset during market turbulence in Ghana. This result confirms the findings of (Cheah & Fry, 2015) who discovered that bitcoin could be a hedge to volatility in traditional stock. However, the following limitations demean the findings of the study.

Firstly, the enquiry only covers a relatively short period (January 2014 to June 2017) which may not be sufficient to fully capture the long-term relationship between Bitcoin and stock market returns. Again, the study only focused on one country (Ghana) and did not examine the relationship between Bitcoin and stock market returns in other countries. Therefore, it is justifiable to generalize the results to other countries where bitcoin is traded. Also, Agyapong and Adjei (2018) did not consider other important factors that could affect the relationship between Bitcoin and stock market returns, such as macroeconomic variables, political events, and investor sentiment.

Gwadabe and Ezeaku (2018) investigated the relationship between Bitcoin and stock market returns in South Africa. The researchers used daily data from January 2013 to December 2017 to analyze the relationship between the two variables. To examine the relationship between Bitcoin and stock market returns, the researchers used a vector autoregressive (VAR) model. The study found evidence of a significant relationship between Bitcoin returns and stock market returns in South Africa. Specifically, the researchers found that a positive shock to Bitcoin returns led to an increase in stock market returns in the short run. The study also found that a positive shock to stock market returns led to an increase in Bitcoin returns in the short run. These findings suggest that Bitcoin and the stock market are interrelated in South Africa. This finding is consistent with the result of Osuji and Ogbuehi (2018) who established that cryptocurrency price shocks affect stock prices while stock price shocks also affect cryptocurrency prices.

Though the study provides valuable insight into the ongoing discussion on Bitcoin price volatility and stock market performance, it is nevertheless implicated with the following limitations. Firstly, just as found in the investigation of Adjei & Agyapong

(2018), this study only focused on one country (South Africa) and did not examine the relationship between Bitcoin and stock market returns in other countries. Therefore, it is unclear whether the results of the study can be generalized to other countries. Secondly, the study only used a VAR model to analyze the relationship between Bitcoin and stock market returns. While the VAR model is a useful statistical tool, it is not the only method for examining the relationship between variables. Future studies could consider using other econometric methods to examine the relationship between Bitcoin and stock market returns. The studies provide important insights into the relationship between Bitcoin and stock market returns in these countries. However, it is important to note that the data analysis approaches used in these studies may differ from those used by Koutmos and Lucey (2019), and therefore, the results may not be directly comparable.

In a similar vein, Amankwah-Amoah and Zhang (2019) investigated the effect of Bitcoin on the stock market in Ghana with the use of daily data from 2014-2018. The GARCH-M model which is a multivariate extension of the GARCH model that enables researchers to examine the conditional covariance and volatility spillovers between Bitcoin and the stock market was deployed. The study revealed a significant positive relationship between Bitcoin and the stock market in Ghana. Precisely, the it was found that Bitcoin had a positive effect on the stock market returns in Ghana. This suggests that Bitcoin could serve as a hedge against market volatility in Ghana. The result confirms the conclusion of Gwadabe and Ezeaku (2018), Osubgeui (2018) as well as Agyapong and Adjei (2018). The addition of the study's findings to extant literature is well acknowledged. However, the study is inflicted with some limitations. In the first place, the study covers a short spectrum of data period thus from 2014 to 2018 which may not be sufficient to fully capture the long-term relationship between

Bitcoin and the stock market in Ghana. The 4 years data period is considered as a limitation because Anarfo (2015) posited that using a data period of 10 years and above is necessary for arriving at accurate results. Secondly, the study only focused on one country (Ghana) and did not examine the effect of Bitcoin on the stock market in other countries. Therefore, it is unclear whether the results of the study can be generalized to other countries. Lastly, the study did not consider other important factors that could affect the relationship between Bitcoin and the stock market, such as macroeconomic variables, political events, and investor sentiment just as found with other studies Gwadabe and Ezeaku (2018), Agyapong and Adjei (2018).

Yaya et al. (2020) focused on analyzing the impact of Bitcoin on stock market volatility in South Africa. The researchers employed a Vector Autoregression (VAR) model to examine the relationship between Bitcoin and stock market volatility. The study found a significant positive relationship between Bitcoin and stock market volatility in South Africa. This suggests that changes in Bitcoin prices have an impact on stock market volatility, indicating a potential destabilizing effect of Bitcoin on the stock market. The result confirms agrees with the account t of Agyapong and Adjei (2018); Gwadabe and Ezeaku (2018), Osubgeui (2018) who found significant positive effect of Bitcoin market volatility and stock market volatility. Notwithstanding the same result deviates from the findings of Li et al. (2020); Corbet et al. (2018) who provided evidence that Bitcoin price volatility negatively affect the volatility of conventional stocks.

Nonetheless, it is important to consider the limitations of the study. Firstly, the study focused on a specific country, South Africa, and the findings may not be directly applicable to other countries or regions. Different market dynamics and regulatory environments in other countries may yield different results. Secondly, the study employed a VAR model, which captures the short-term dynamics between variables. While this approach provides valuable insights, it may not fully capture long-term relationships or account for potential time lags between Bitcoin and stock market volatility. Additionally, the study focused solely on the impact of Bitcoin on stock market volatility and did not consider other factors that could contribute to stock market volatility, such as macroeconomic indicators, political events, or investor sentiment. Failure to account for these factors may limit the comprehensive understanding of stock market volatility in relation to Bitcoin. Moreover, the study's findings are based on historical data and may not account for potential changes in market conditions or the evolving nature of the cryptocurrency market. The cryptocurrency landscape is highly volatile and subject to regulatory changes, technological advancements, and market sentiments, which could influence the relationship between Bitcoin and stock market volatility.

Boako and Alagidede (2021) examined the relationship between Bitcoin and stock market volatility in Ghana using a GARCH model. They found evidence of a bidirectional relationship between Bitcoin and stock market volatility, suggesting that changes in Bitcoin prices could affect stock market volatility, and vice versa. This result affirms the findings of Toma and Sandu (2020) who provided evidence that there is a bidirectional causality between Bitcoin price volatility and stock market volatility. Also, the possibility of Bitcoin price volatility on stock market volatility supports the account of Agyapong and Adjei (2018); Amankwah-Amoah and Zhang (2019) who established cryptocurrency price changes have direct significant positive effect on stock market returns. It is worthy of note that there are some potential shortcomings of Boako and Alagidede's (2016) study.

One limitation is the use of a single GARCH model, which assumes a symmetric relationship between Bitcoin and stock market volatility, whereas the relationship may be asymmetric. Additionally, the study only analyzed the relationship between Bitcoin and stock market volatility, without considering the impact of other factors that may affect stock market volatility in Ghana, such as macroeconomic variables or political events. Furthermore, the study focused only on the Ghanaian market, and the findings may not necessarily apply to other markets. Finally, the study used data up to 2019, and the relationship between Bitcoin and stock market volatility may have changed in the more recent period, especially given the impact of the COVID-19 pandemic on financial markets.

Conversely, Akinboade et al. (2020) examined the effect of Bitcoin on stock market performance in Nigeria using monthly data from January 2010 to September 2019 and employed the ARDL bounds testing approach. The findings of the study revealed a significant negative effect of Bitcoin on the Nigerian stock market. Notwithstanding the study's laudable contribution to extant literature, the presence of the underlisted limitations makes the veracity of its results questionable. One, the study exclusively investigates the impact of Bitcoin on the Nigerian stock market and does not consider the potential influence of other cryptocurrencies or external factors. The cryptocurrency market consists of various digital assets, and their combined effects on the Nigerian stock market could provide a more comprehensive understanding. Again, while the ARDL bounds testing approach is a useful econometric technique, it assumes a linear relationship between Bitcoin and the Nigerian stock market. However, the relationship may be nonlinear or subject to structural breaks, which could affect the accuracy of the results. Employing additional econometric methods that capture potential nonlinearity could enhance the analysis. Also, the study does not delve into the underlying mechanisms or factors driving the negative relationship between Bitcoin and the Nigerian stock market. Factors such as market sentiment, regulatory changes, or investor behavior could play a role in shaping this relationship. Future research could investigate these factors to provide a more nuanced understanding of the dynamics between Bitcoin and the Nigerian stock market.

Sackey and Wiredu (2020) investigated the impact of Bitcoin on the stock market in Ghana. By utilizing monthly data from 2014 to 2019 and employing the ARDL bounds testing approach, the researchers found a significant positive effect of Bitcoin on the Ghanaian stock market. The positive relationship supports the account of Agyapong and Adjei (2018) who similar study in the Ghanaian perspective found positive association between Bitcoin prices and conventional stock market returns. Nevertheless, it is important to acknowledge that the study is made up of certain weaknesses. First, the study focuses on a relatively short time period, spanning from 2014 to 2019 which do not satisfy the argument that using a data for ten and more years in statistical research is capable of yielding dependable results as put forward by Anarfo (2015) and confirmed by Forson *et al.* (2021), Gadzo and Asiamah (2018), Oduro *et al*. (2021) and Asiamah (2023). It would be valuable to assess the robustness of the findings over a longer time horizon to determine if the observed relationship remains consistent.

Second, the study exclusively examines the impact of Bitcoin on the Ghanaian stock market and does not consider the influence of other cryptocurrencies or external factors. Given the dynamic nature of the cryptocurrency market and the potential presence of multiple digital assets, an analysis encompassing a broader range of cryptocurrencies could provide a more comprehensive understanding of their impact on the Ghanaian stock market. Third, the study's use of the ARDL bounds testing approach assumes a linear relationship between Bitcoin and the Ghanaian stock market. However, the relationship between these variables may be nonlinear or subject to structural breaks, which could affect the accuracy of the results. Employing additional econometric techniques that account for potential nonlinearity could strengthen the analysis. Lastly, the study does not address potential endogeneity issues or address the direction of causality between Bitcoin and the stock market in Ghana. It is possible that there may be reverse causality or the presence of omitted variable bias, which could impact the observed relationship.

In the South African perspective, Mawira and Gwanyanya (2020) examined the impact of Bitcoin on the Johannesburg Stock Exchange (JSE) using daily data from 2013 to 2019 and employing the GARCH-BEKK model. The study found a positive relationship between Bitcoin and JSE returns, indicating that Bitcoin could potentially serve as a diversification tool for investors.

However, certain shortcomings of the study may demean the reliability of its findings. Thus, the study focuses on a specific time period from 2013 to 2019 which does not meet the expectation of the data period required for time serious analysis as argued by Anarfo (2015), and the cryptocurrency market is known for its high volatility and rapid changes. The findings may not be applicable or hold true for different time periods, particularly given the substantial fluctuations and developments in the cryptocurrency market in recent years. Second, the study solely examines the relationship between Bitcoin and JSE returns, neglecting the potential influence of other factors that may impact the JSE. The omission of other important variables, such as macroeconomic indicators, investor sentiment, or market-specific factors, may limit the comprehensive understanding of the relationship between Bitcoin and the JSE.

Additionally, the study relies on the GARCH-BEKK model, which assumes linear relationships and symmetric effects of shocks on volatility. However, in reality, the relationship between Bitcoin and JSE returns may be nonlinear or exhibit asymmetric effects. Alternative models or methodologies that account for potential nonlinearities and asymmetries could provide a more accurate assessment of the relationship.

Moreso, the study does not address potential endogeneity concerns, such as the potential for simultaneous causality or omitted variable bias. The relationship between Bitcoin and JSE returns may be subject to reverse causality, where JSE returns also influence Bitcoin prices. Failing to account for endogeneity may impact the validity of the results.

Additionally, Chen et al. (2020) investigated the volatility spillover effects between Cardano and the stock market in the US and China, finding that the two markets are interdependent and that cardano can transmit its volatility to the stock market. These studies suggest that there could be a link between cryptocurrency and stock market volatility, but more research is needed to explore this relationship in the context of the Ghana Stock Exchange.

Brandvold et al. (2015) studied the role of Bitcoin exchanges in price discovery, finding that the price discovery process is efficient and that exchanges are well integrated with each other. This study provides important insights into how the Bitcoin market functions and how its exchanges interact with each other. However, it only focuses on Bitcoin, and more research is needed on other cryptocurrencies and how their exchanges function.

Bouri et al. (2017) investigated the hedge and safe haven properties of Bitcoin, examining whether it can act as a diversifier for investors. The authors found that

Bitcoin has a weak diversification effect, and that it behaves more like a risky asset than a safe haven. This study provides important insights into how investors view Bitcoin and how it may fit into a diversified investment portfolio. While Cheah and Fry (2015) focused on the US market during a specific time period, Bouri et al. (2017) analyzed a wider range of markets over a longer time period. This suggests that the relationship between Bitcoin prices and stock market returns may be influenced by a variety of factors, including market conditions and regulatory environments.

Bouri et al. (2018) examined the effect of regulatory changes on Bitcoin returns and volatility. The authors found that regulatory changes have a significant impact on Bitcoin returns and volatility, and that markets react differently to positive and negative regulatory news. This study sheds light on the importance of regulatory changes in shaping the cryptocurrency market, and highlights the need for regulatory clarity and consistency.

Katsiampa (2017) investigated the volatility of Bitcoin and compared different GARCH models. The study found that GARCH (1,1) and EGARCH (1,1) are the most appropriate models for Bitcoin volatility estimation. Li et al. (2020) used wavelet analysis to examine the relationship between Bitcoin price and stock market returns. The study found that Bitcoin and stock market returns are positively related in the short term, but negatively related in the long term, indicating that Bitcoin may be used as a hedge against stock market volatility. Mokni et al. (2021) investigated whether Bitcoin can hedge global uncertainty using wavelet coherence analysis. The study found that Bitcoin has a significant hedging effect on global uncertainty, indicating that it may serve as a safe haven asset during times of uncertainty. CoinMarketCap (2021) provides data on the market capitalization of various cryptocurrencies. This data can be used to analyze the performance of the cryptocurrency market and its impact on traditional stock markets.

Hendrickson and Luther (2017) studied the competition in the cryptocurrency market and whether the winner in such a market with network effects can be predicted. The study found that the winner in the cryptocurrency market is difficult to predict due to the strong network effects and the highly volatile nature of the market.

The study conducted by Naeem et al. (2021) aimed to investigate whether Bitcoin can act as a hedge against stock market anomalies caused by the COVID-19 pandemic. The researchers employed a quantile regression approach to analyze the relationship between Bitcoin and stock market anomalies across different quantiles. The data analysis approach of quantile regression allowed the researchers to examine the relationship between Bitcoin and stock market anomalies at different points in the distribution, providing a more comprehensive understanding of the potential hedging effect. The study found that Bitcoin can serve as a hedge against stock market anomalies in certain quantiles, but not in others. This result is consistent with the conclusion drawn by Mawira and Gwanyanya (2020); Li et al. (2020) who provided evidence that Bitcoin can serve as a hedge against stock market anomalies and refutes the assertion of Bouri et al. (2017) who documented that Bitcoin has a weak diversification effect. The study just as other preceding studies is made up of some shortcomings.

These limitations are; firstly, the study focuses specifically on the impact of the COVID-19 pandemic on stock market anomalies, and the findings may not be generalizable to other periods or market conditions. The unique circumstances surrounding the pandemic, such as global lockdowns and market disruptions, could have influenced the relationship between Bitcoin and stock market anomalies during that specific period. Secondly, the study solely focuses on Bitcoin and does not consider the potential hedging capabilities of other cryptocurrencies or traditional assets. It would be valuable to compare Bitcoin's hedging properties with other digital assets or safe-haven assets to provide a more comprehensive analysis. Additionally, the study's findings are based on historical data, and the relationship between Bitcoin and stock market anomalies may vary in the future. The cryptocurrency market is highly volatile and subject to various factors, including regulatory changes, technological developments, and market sentiment, which could impact the effectiveness of Bitcoin as a hedge against stock market anomalies. Furthermore, the study's quantile regression approach provides insights into the relationship between Bitcoin and stock market anomalies at different quantiles, but it may not capture the full dynamics and underlying mechanisms driving the observed relationships. Other econometric techniques or models could be employed to further explore the dynamics and potential causal relationships.

Nakamoto (2008) proposed the idea of Bitcoin as a decentralized digital currency that operates on a peer-to-peer network. This paper laid the foundation for the development of the cryptocurrency market and has been widely cited in subsequent research. On the other hand, Todorova and Pashev (2021) conducted a review of empirical research on the impact of cryptocurrencies on the stock market. The study found mixed evidence on the relationship between cryptocurrencies and the stock market, with some studies suggesting a positive relationship and others suggesting a negative relationship.

2.5.2 Ethereum price volatility and stock market performance

Ogunwale and Sanni (2019) examined the impact of cryptocurrency on stock market performance in Nigeria using an ARDL model with a focus on Ethereum. Through the use of time series econometric model ARDL and its associated diagnostics the researchers found that there was a positive relationship between Ethereum and stock market returns, indicating that Ethereum can serve as an alternative investment opportunity for investors. The research has the following shortcoming, one the study concentrated on only Nigeria making generalization of its findings problematic. Again, the unique characteristics inherent in the Nigerian financial market that can impact the result of the study were not accounted for. Also, the duration within which the study collected data is short for yielding robust results. Moreover, since the cryptocurrency market keeps and the study considered specific years the results may not be applicable to years outside the study's frame.

Auer and Claessens (2018) found that regulatory announcements regarding cryptocurrencies could affect their prices and trading volumes, indicating a link between regulatory measures and market volatility. While the study by Auer and Claessens (2018) provides valuable insights into the impact of regulatory measures on the cryptocurrency market, it has some limitations that must be considered. First, the study focused solely on regulatory announcements related to cryptocurrencies, and did not consider other factors that may contribute to market volatility, such as economic indicators or political events. This narrow focus may limit the generalizability of the findings to other contexts. Again, the study relied on publicly available data sources for cryptocurrency prices and trading volumes, which may be subject to measurement error or manipulation. Additionally, the study did not provide a detailed methodology for how the data were collected and analyzed, which may make it difficult for other researchers to replicate the study or build upon its findings. Also, the study did not address the potential impact of regulatory measures on the broader financial system or on other markets, such as the stock market. While the study suggests that regulatory measures can affect cryptocurrency prices and trading volumes, it remains unclear whether these effects spill over into other markets or have broader macroeconomic implications.

Comparably, Toma and Sandu (2020) focused on investigating the spillover dynamics and causality between cryptocurrencies and stock market returns. The researchers aimed to understand the relationship and interdependence between these two markets. To achieve this, they employed a data analysis technique that explored bidirectional causality. The enquiry found evidence of bidirectional causality between cryptocurrencies and stock market returns, indicating that the two markets are interdependent. This result coincides with the findings of Chen et al. (2018) who posited that there is spillover effect of cryptocurrency volatility unto stock market during high volatility period. Nevertheless, notable limitations that engulfed the study cannot be underestimated. Firstly, the study does not provide details about the specific cryptocurrencies and stock market indices used in the analysis. Different cryptocurrencies and stock markets may exhibit varying degrees of interdependence and spillover effects. Therefore, the findings may not be applicable to all cryptocurrencies and stock markets in general. Secondly, the study focuses on a specific time period, and the relationship between cryptocurrencies and stock market returns may vary over time. Given the dynamic nature of both markets, the results may not hold true for different time periods or during periods of market volatility or regulatory changes.

Moreover, the study's findings of bidirectional causality do not necessarily imply a cause-and-effect relationship. The observed relationship may be influenced by various factors, such as investor sentiment, market liquidity, or macroeconomic conditions. Therefore, due caution should be exercised in applying the causality results and understanding the underlying mechanisms driving the interdependence between cryptocurrencies and stock market returns. Lastly, like any empirical study, there may be limitations in data quality, accuracy, or availability. The accuracy of the findings relies on the quality and reliability of the data used in the analysis. Any shortcomings or biases in the data could impact the robustness and generalizability of the study's conclusions.

A Comparison to Stocks, Forex, and Gold by Kristoufek and Vosvrda (2018) found that cryptocurrency market volatility is positively correlated with stock market volatility. They used data from Bitcoin, Ethereum, Ripple, and Litecoin, and compared them to the S&P 500, the NASDAQ composite index, gold, and several currency exchange rates.

"Cryptocurrency and Stock Market Co-movement" by Bouri et al. (2018) examined the co-movement between cryptocurrency and stock markets by analyzing daily data from Bitcoin, Ethereum, and Ripple, and the stock markets of the US, UK, Germany, France, Japan, and China. They found that there is a significant positive correlation between the cryptocurrency and stock markets, and that the relationship is stronger during periods of high market volatility. Arbitrage Opportunities and Efficiency of Bitcoin, a Study of the Arbitrage Opportunities in the Bitcoin Market using APT by Bholanath and Bhattacharyya (2019) used the APT to analyze the efficiency of the Bitcoin market and identify any potential arbitrage opportunities. They found that Bitcoin returns are influenced by market risk factors, such as stock market returns and oil prices, and that there are some profitable arbitrage opportunities in the Bitcoin market.

Cryptocurrencies and Stock Market Indices Relationship: A Comprehensive Analysis Using APT by Fatima and Ahmed (2021) examined the relationship between cryptocurrencies and stock market indices using the APT. They found evidence of a positive relationship between cryptocurrencies and stock market indices, and that cryptocurrencies provide diversification benefits to traditional stock portfolios. An Arbitrage Pricing Analysis of Cryptocurrencies" by Cong and Zhiguo (2019) used the APT to analyze the pricing of cryptocurrencies, including Bitcoin, Ethereum, and Litecoin. They found that the returns of cryptocurrencies are significantly influenced by market factors, such as exchange rate fluctuations and macroeconomic news, and that the APT provides a useful framework for understanding the risk and return characteristics of cryptocurrencies.

2.5.3 Cardano price volatility and stock market performance

Koutmos and Martzoukos (2018) focused on examining the impact of cryptocurrency market volatility on stock market volatility in the United States, Europe, and China. The researchers aimed to explore the relationship between these two markets and investigate whether the Efficient Market Hypothesis (EMH) holds true in this context through empirical estimation. They discovered that cryptocurrency volatility had a statistically significant impact on stock market volatility, suggesting that the EMH may not hold true in this context. In as much as the study's contribution is laudable, it is inflicted with the following shortcomings. Firstly, the study focused on a specific time period, and the relationship between cryptocurrency market volatility and stock market volatility may evolve over time. The volatility of cryptocurrency markets is known for its high fluctuations, and these dynamics may change in response to various factors, such as regulatory developments or market sentiment.

Secondly, the findings of Koutmos and Martzoukos (2018) may be influenced by the specific sample of countries analyzed (US, Europe, and China). The impact of cryptocurrency market volatility on stock market volatility may vary across different countries or regions due to variations in market structure, regulatory frameworks, or investor behavior. Therefore, the results may not be generalizable to other countries or regions. Additionally, the study does not account for other potential factors that may affect stock market volatility, such as macroeconomic variables, geopolitical events, or market-specific characteristics. These factors could influence stock market volatility independently of cryptocurrency market volatility, and their omission may limit the overall understanding of the relationship. Lastly, the study's findings of a statistically significant impact of cryptocurrency market volatility on stock market volatility do not necessarily imply causation. While the study establishes a relationship, it does not delve into the underlying mechanisms or directionality of the relationship. The impact of cryptocurrency market volatility on stock market volatility may be influenced by various complex and intertwined factors that require further investigation.

Corbet et al. (2018) conducted a systematic review of the empirical research surrounding the major themes linked to the emergence and growth of cryptocurrencies as a financial asset since their inception in 2009. It focuses on understanding the dynamics of their rapid price increases and the challenges they face, which include regulatory scrutiny, potential for illegal activities, and vulnerabilities due to cybercriminal activities. The methodology of the study involved a comprehensive search and analysis of empirical studies related to cryptocurrencies from various academic databases and financial journals starting from 2009. The review specifically targeted studies that discussed the pricing, regulatory issues, market development, and security challenges of cryptocurrencies. The review revealed that despite significant price appreciations, cryptocurrencies are often viewed skeptically due to recurring market bubbles. The primary concerns highlighted include: Cryptocurrencies operate in a space that lacks robust regulatory frameworks, making them prone to market manipulation and other fraudulent activities. The anonymity provided by digital currencies has been exploited for illegal purposes, casting doubts on their legitimacy as an investment. As a nascent market, the cryptocurrency exchange systems are often underdeveloped and have become targets for cybercriminal activities, leading to significant breaches and loss of funds.

The review identified several weaknesses in the current literature. Many studies suffer from inadequate data availability, as the cryptocurrency market is relatively new and highly volatile. There is a noticeable focus on the negative aspects of cryptocurrencies in existing research, which could overshadow potential benefits and developments in this sector. Due to the rapid evolution of cryptocurrencies, there is a scarcity of long-term studies that track their development and maturation over extended periods. Based on the findings and identified gaps, the following recommendations were made by the study. There is a need for clearer and more comprehensive regulations that can provide stability to the cryptocurrency markets and protect investors. Investment in technology and infrastructure to secure cryptocurrency exchanges is critical to mitigate risks associated with cyber threats. Future research should aim to provide a balanced view that considers both the potential risks and opportunities presented by cryptocurrencies. Encourage the initiation of long-term empirical studies that can provide insights into the trends and long-term viability of cryptocurrencies as an asset class.

Elsayed and Fakoya (2017) explored the causality relationships between the three primary cryptocurrencies Cardano, Litecoin, Ripple and nine significant foreign currencies. The research seeks to understand how these cryptocurrencies interact with each other and with major global currencies in terms of returns and volatility spillovers. Two analytical methods were employed in this research: Diebold-Yilmaz Technique: This method was used to calculate the spillover index, assessing the return and volatility spillovers between the cryptocurrencies and the currency markets and the Bayesian Graphical Structural Vector Autoregression (SVAR): This approach helped in determining the dependency of the cryptocurrencies on each other and on major foreign currencies over time. The findings from the two methods are as follows: there was a notable return spillover effect observed between Bitcoin and Litecoin during the first three quarters of 2017, indicating a significant interaction between these two cryptocurrencies. For Cardano and Ripple, such return spillovers were significant only in the first three quarters of 2015.

The total volatility spillover index among the studied cryptocurrencies and currencies declined in the last quarter of 2017, suggesting a decrease in systemic volatility. Cardano's value changes were found to be influenced primarily by the prior levels of the Chinese Yuan. Ripple's levels depended considerably on the previous values of Cardano and to a lesser extent on Litecoin. Litecoin's value was mainly affected by prior Ripple levels and the Chinese Yuan. Except for the Chinese Yuan, the impact of other major traditional currencies on the cryptocurrencies was not significant, which may limit the understanding of global economic influences on these digital assets. The analysis was confined to specific periods, and thus the findings may not necessarily reflect longer-term trends or emerging dynamics after 2017 and these serve as weakness of the study. Future research should extend the analysis to more recent periods to capture the latest dynamics and potentially evolving relationships between these assets. Including more foreign currencies could provide a broader view of the economic factors influencing cryptocurrencies. Additional studies focusing on the sources and impacts of volatility in cryptocurrency markets could provide deeper insights, especially in relation to global economic conditions.

In conclusion, the literature suggests that the relationship between cryptocurrencies and traditional stock markets is complex and multifaceted, with factors such as network effects, regulatory changes, and spillover effects contributing to the performance and volatility of both markets. Further research is needed in the Ghanaian, Nigerian and South African perspective to fully understand these relationships and their potential implications for investors and policymakers because chunk of the studies was carried out outside the developing countries. Again, further study is needed because majority of the studies on the concept considered only Bitcoin price volatility whilst there are other trading cryptocurrencies.

2.6 Conceptual Framework and Hypothesis Development

This section of the study focuses on the interconnectedness among the independent and dependent variables under consideration. According to Imenda (2014), a conceptual framework delineates the main elements to be examined within a study such as key factors, constructs, or variables and hypothesizes potential relationships among them either through diagrams or narrative. Essentially, a conceptual framework serves as a sophisticated intellectual map of experience, as proposed by Chin & Kramer (1999). It reflects the researcher's perspective on the topic at hand and provides clear, albeit unmarked, guidance for investigation. The conceptual framework can originate from innovative work or may refine existing theories to better suit new research aims, or it might simply utilize an established framework (Chin & Kramer, 1999). Thus, a conceptual framework is instrumental in defining and organizing the research process, illustrating the researcher's understanding of how the variables of interest might interrelate. It plays a vital role in guiding the direction and coherence of the study.

A considerable body of literature has emerged, examining the effect of cryptocurrency market volatility on the stock market. Several studies have observed a significant impact of Bitcoin price volatility on the performance of the stock market. Al-Yahyaee et al. (2018), Agyapong & Adjei (2018), Osuji & Ogbuehi (2018), and Gwadabe & Ezeaku (2018) are among the researchers who support this viewpoint. These studies suggest that fluctuations in the price of Bitcoin can influence stock market movements and lead to notable changes in market performance. Another perspective put forth in the literature indicates a direct association between changes in cryptocurrency prices and the movements in the prices of conventional stocks. Koutmos & Matzoukos (2018) and Koutmos & Lucey (2019) have contributed to this line of research. According to their findings, shifts in the cryptocurrency market can have a direct impact on the traditional stock market, suggesting a link between the two financial domains.

However, some studies have yielded mixed results when exploring the relationship between cryptocurrency price volatility and stock market performance. Todorova and Pashev (2021) found conflicting evidence, with both positive and negative associations between these two variables. This suggests that the relationship between cryptocurrency market volatility and stock market behavior may be more complex and context-dependent.

In contrast, certain researchers have exclusively identified a negative relationship between Bitcoin price volatility and stock market volatility. Corbet et al. (2018) and Li et al. (2020) have reported findings supporting this view, suggesting that increased volatility in the cryptocurrency market may lead to reduced stock market volatility. On the other hand, some authors argue that volatility in the price of Bitcoin has a significant positive effect on the volatility of traditional stocks. Unfortunately, the specific references for these authors were not provided in the initial account, and further investigation is necessary to explore their findings.

A dive into literature on various studies concerning effect of cryptocurrency market volatility and stock market co-movement has presented myriad of accounts. According to a strand of literature Bitcoin price volatility have significant impact on the performance of stock market (Al-Yahyaee et al., 2018; Agyapong & Adjei, 2018; Osuji & Ogbuehi, 2018; Gwadabe & Ezeaku, 2018). Similarly, another account has it that changes in the price of cryptocurrencies has a direct association with movement in the price of conventional stock (Koutmos & Matzoukos, 2018; Koutmos & Lucey, 2019). Todorova and Pashev (2021) found mixed relationship between cryptocurrencies price volatility and performance of stock market with both positive and negative relationships. Corbet et al. (2018), Li et al. (2020) exclusively found negative relationship between Bitcoin price volatility and stock market volatility. To some authors volatility in the price of Bitcoin has significant positive effect on the volatility of price of traditional stocks.

Additionally, another strand of literature has it that changes in the price of cryptocurrencies directly reflect in the performance of stock exchange. The authors credited with this assertion furthered that stock market is not as efficient as put forward by the efficient market hypothesis (Wang et al., 2020; Al-Yahyaee, 2018;

Martzoukos, 2018). Notwithstanding, Azzi and Chohan (2020) argued that stock market is informationally efficient. The reviewed studies above demonstrate that a plethora of studies have been conducted on stock market performance and development in the cryptocurrency trade. Nonetheless, chunk of the studies concentrated on only bitcoin price sand made generalization of their findings to other cryptocurrencies. Again, considerable number of these studies found incoherent results regarding the association that prevails between cryptocurrencies pries and stock market performance. With this being said the current study therefore hypothesize that;

H_1: *Bitcoin (BTC) price volatility has significant positive effect on Stock Market Index (SMI).*

H_2: *Ethereum (ETH) price volatility has significant positive effect on Stock Market Index (SMI).*

H_3: *Cardano (ADA) price volatility has significant positive effect on Stock Market Index (SMI).*

H_4: *Cryptocurrencies price volatility has significant positive impact on stock market performance.*

The proxied relationships between the various variables used in the study are displayed on the Figure 2.1 below. The framework represents the interrelationships that is proxied to prevail between the various dependent variables Bitcoin Coin (BTC), Etherum (ETH), Cardano (ADA) and the dependent variable Stock Market Index (SMI). According to Figure to 2.1, the independent variable BTC is proxied to cause a positive significant effect on SMI. Again, variations in the prices of Etherum is assumed to cause a positive significant effect on the level of movement in the stock market index of the sampled countries. Also, with Cardano as independent variable, the study proxy that the changes in the price of the coin would trigger a significant impact on the level of stock market index. The acronyms INF represent inflation, GDPG represent gross domestic product growth whist INT denote interest rate.

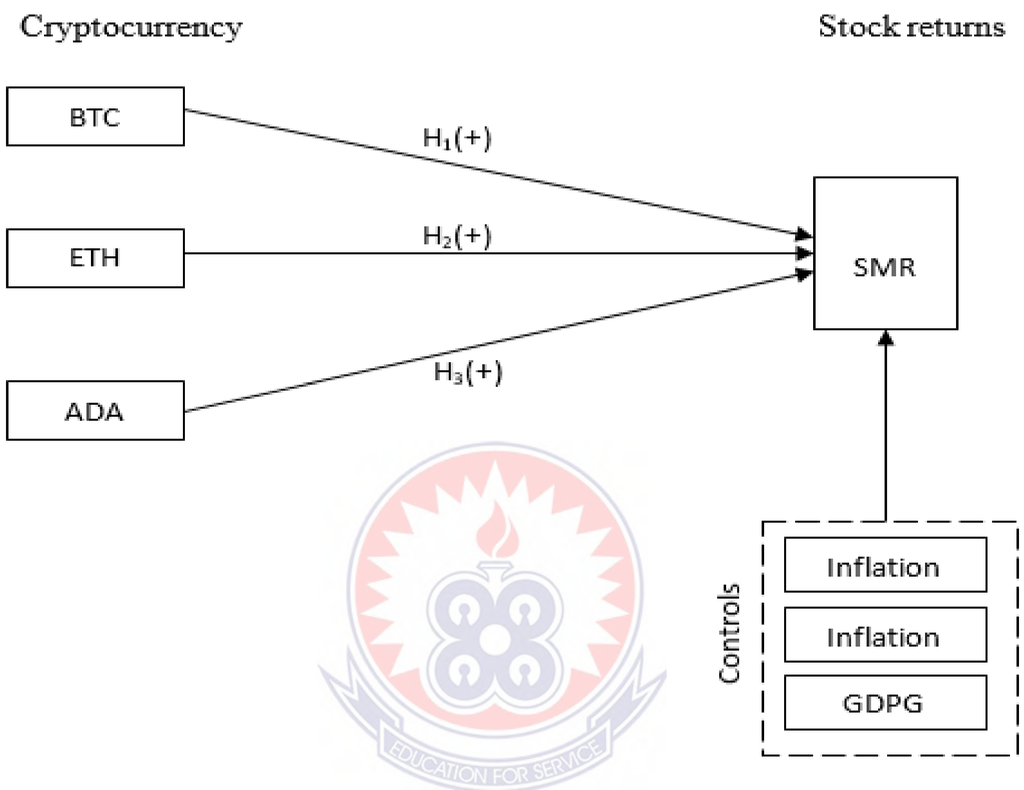


Figure 2. 1: Conceptual framework

Source: Authors construct (2023).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The study seeks to assess the effect of cryptocurrency market volatility on the stock market. This chapter discusses the methodology suitable for addressing this objective. The chapter discusses the methodology under thematic areas which include, the philosophical underpinning, research approach, research design, population of the study, sample and sampling technique, data and data collection technique, data analytical techniques, and ethical considerations. This methodology, therefore, provides a robust framework for investigating the effect of cryptocurrency market volatility on the stock market.

3.2 Philosophical Underpinning

This section discusses the research paradigm, ontology, and epistemology that underpin the study. The study takes the positivist paradigm (also known as the scientific paradigm), which posits that knowledge is best gained through observable and measurable facts (Creswell, 2013). The positivist paradigm focuses on quantifiable observations to make predictions about the phenomena under study. By implication, this paradigm is grounded in the realist ontology. Realism is the view that objects have an existence independent of the knower (Cohen et al., 2007). Thus, a discoverable reality exists independently of the researcher (Pring, 2000a). Most positivists assume that reality is not mediated by our senses. The study is, thus, based on objectivist epistemology. Positivists go forth into the world impartially, discovering absolute knowledge about objective reality. The researcher and the researched are independent entities. Meaning solely resides in objects, not in the conscience of the researcher, and it is the aim of the researcher to obtain this meaning.

Positivistic statements are descriptive and factual. The scientific paradigm is foundational as scientific propositions are founded on data and facts (House, 1991). The knowledge derived through this paradigm is seen as absolute and devoid of bias; it is not influenced by political or historical contexts. The objective of the positivist paradigm is to delineate relationships and ascertain causal factors that drive outcomes (Creswell, 2009). Positivists aim to establish laws, thereby creating a platform for prediction and generalization. They rely on tangible evidence collected through direct experiences and observations, typically encompassing empirical testing, randomized sampling, and the control of variables (independent, dependent, and moderating) and control groups. Since the scientific paradigm seeks predictions and generalizations, the methods often generate quantitative data. Examples include standardized tests, closed-ended questionnaires, and descriptions of phenomena using standardized observation tools (Pring, 2000a). The analysis involves descriptive and inferential statistics. Inferential statistics allow sample results to be generalized to populations.

By focusing on objective measurements and statistical analysis, the positivist paradigm enables the study to identify clear patterns and relationships between cryptocurrency volatility and stock market performance.

3.3 Research Approach

A research approach, according to Creswell (2013), is a plan and procedure that consists of the steps of broad assumptions to detailed methods of data collection, analysis, and interpretation. It is therefore based on the nature of the research problem being addressed. A research approach could be quantitative, qualitative, or mixed approach (Jebreen, 2012). This study employs the quantitative approach for data collection and analysis. Quantitative research can be defined as a research strategy that emphasises quantification in data collection and analysis (Bryman & Bell, 2011).

This approach of research mainly highlights the use of measurement to describe underlying phenomena and relationships (Saunders et al., 2007). Quantitative research methods encompass survey modelling and statistical analysis (Nyame-Asiamah & Patel, 2009). Therefore, the quantitative approach systemically studies phenomena through mathematical calculations to confirm hypotheses developed from theory (Saunders et al., 2007). This definition is corroborated by Creswell (2013) who accentuated that the quantitative approach is rooted in the positivist paradigm and is typically associated with objective, numerical data. According to Creswell, this approach is generally used when the research aims to measure the incidence of various views and opinions in a chosen sample, often through surveys and experiments. It was also argued that this approach is best suited when the research question calls for quantifiable data related to cause and effect, relationships among variables, or predictions. The quantitative approach is well suited for this study since the study seeks to use statistical models to assess the effect of cryptocurrency market volatility on the stock market which will provide the platform for future prediction and generalization.

3.4 Research Design

A research design serves as an ideal roadmap connecting the research questions with the data to be collected and its subsequent analysis (Yin, 2018). It can, therefore, be regarded as a step-by-step plan outlining how to execute planned research. It makes elements measurable and provides a framework for interpreting the outcomes from empirical testing. A research design may be descriptive, correlational, experimental, quasi-experimental, explanatory, or exploratory.

This study employed an explanatory design because the study seeks to assess the effect of cryptocurrency market volatility on the stock market; an indication of a cause-and-effect analysis which is the foundation of this design. Babbie (2010) defines explanatory research as research in which the major emphasis is on the discovery of true causal relationships among variables. This type of research design explains the causes and effects of variables in a situation and usually involves hypothesis testing.

3.5 Population of the Study

A population is an entire group of individuals, events, or elements that possess an interested characteristic (Weeks, 2020). A study's interested population is the number of respondents in the entire environment of interest to the researcher (Yin, 2018). The population of this study is the top 20 crypto-trader countries (Mohsin et al., 2023).

3.6 Sample and Sampling Technique

A sample is a set of respondents selected in some manner from a population (Fowler, 2013). Fowler notes that the way the sample is selected is crucial for ensuring that the conclusions drawn from the sample can be generalized to the broader population. Sampling is therefore the selection of the elements in the population to form the sample. This study employs the purposive sampling technique to select three countries for the study. These countries are Ghana, Nigeria and South Africa. The choice of these countries is informed by the volume of trading of cryptocurrency.

3.7 Data and Data Collection Instrument

Secondary data was collected from financial databases such as Bloomberg, Yahoo Finance, and CoinMarketCap and the stock markets of the selected countries. These databases are commonly used in financial research due to their extensive historical data and reliability (Schmidt, 2011). This data includes daily closing prices of Bitcoin, Ethereum, and Cardano, as well as the stock market indices of Ghana, Nigeria, and

South Africa over the past 5 years such as the Ghana Stock Exchange-Composite Index, Nigeria Stock Exchange All-share Index, and Johannesburg Stock Exchange All-Share Index.

3.8 Data Analytical Techniques

Considering the objectives of the study, Autoregressive Distributed Lag (ARDL) regression model (Pesaran et al., 2001) and fixed effect panel regression model (Brüderl & Ludwig, 2015) were used to analyse the collected data. The ARDL model was used to estimate the effect at the country level whereas the fixed effect panel regression model was used to ascertain the effect at the group level since it comprised of data from one than one country's stock exchange.

The Autoregressive Distributed Lag (ARDL) is a time series econometric tool that is used to analyze time series data since it includes various methods for bound testing to cointegration, long run and short run relationship between variables of interest through the Error Correction Model. The choice of the Autoregressive Distributed Lag (ARDL) estimation technique is based on the strength of the technique as compared to other conventional estimation tools. These strengths are; the Autoregressive technique is a robust and consistent estimator with small and large data samples. Again, the Autoregressive technique is efficient in estimating both long and short-run effects by combining the lag and substituting the error lag terms. This feature has been proven to examine the intended association by Saungweme and Odhiambo (2021). The robustness of the ARDL tool to accurately reveal the causal relationship between study variables has been affirmed by empirical studies (Aimola et al., 2021; Adjei et al., 2018; Saungweme & Odhiambo, 2021). In carrying out the ARDL model, preliminary tests such as stationary tests (Augmented Dickey-Fuller-Unit Root Test and Philip-Perron test), cointegration tests (Long form and Bounds

Tests), and heteroscedasticity (Breusch-Pagan-Godfrey Test) were run to ascertain the suitability of the data and robustness of the model. Furthermore, stability diagnostics such as Recursive Estimation using the CUSUM of Squares Test was also run to ensure that the time series data is stable for the conduct of ARDL analysis.

Furthermore, fixed effect model was employed to estimate the effect of cryptocurrency volatility on stock market indices. The choice of this analytical technique was informed by the result of Correlated Random Effects - Hausman Test. The result of this test provided enough evidence accept the alternative hypothesis and conclude that fixed effect panel regression is most appropriate in estimating the effect of cryptocurrency volatility on stock market index. A fixed effect panel regression model is an econometric model used to analyze data from panel or longitudinal datasets, where the same individuals or entities are observed over multiple time periods (Bertrand et al., 2004). It aims to control for individual-specific heterogeneity by including fixed effects, which are individual-specific intercepts, in the regression equation. This approach allows researchers to examine the relationships between variables while accounting for unobserved individual-level characteristics that remain constant over time.

Apart from the statistical backing of the choice of the fixed effect regression model, it is important to note that this technique is most suitable because of its potency in controlling for unobserved heterogeneity, mitigating potential biases arising from omitted variables and unobservable confounding factors and its suitability for dealing with short term panel data (Wooldridge, 2010).

3.8.1 Stationarity tests

Stationarity is a critical assumption in time series analysis, as it allows us to make meaningful predictions and draw accurate conclusions from the data. A stationary time series is one where the statistical properties, such as the mean, variance, and autocorrelation, remain constant over time (Witt et al., 1998). In contrast, non-stationary time series exhibit trends, seasonality, or irregular patterns, making it challenging to model and analyze them (Baumohl & Lyocsa, 2009). By convention, a unit root test is conducted to ascertain whether the data is stationary or not. Different statistical tests are used in testing for the presence of stationarity in a dataset. Notable among them are Augmented Dickey-Fuller (ADF) Test (Dickey & Fuller,1979), Phillips-Perron (PP) Test (Phillips & Perron, 1988) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) Test (Kwiatkowski et al., 1992). This study dwells on Augmented Dickey-Fuller (ADF) Test and Phillips-Perron (PP) Test.

The ADF test is a modified version of the Dickey-Fuller test and takes into account lagged differences of the series to assess stationarity. The test is formulated as a hypothesis test, with the null hypothesis (H_0) stating that the time series is non-stationary (has a unit root), and the alternative hypothesis (H_1) stating that the time series is stationary. Suppose, we have a series yt for testing unit root. Then, ADF model tests the unit root as follows.

$$\Delta y_t = \mu + \delta y_{t-1} + \sum_{i=1}^{k} \beta_i \Delta y_{t-i} + \varepsilon_i$$

Where; $\delta = \alpha - 1, a = coefficient\ of\ y_{t-1}$ and

$\Delta y_t = first\ difference\ of\ y_t, i.e., y_t - y_{t-1}$. The null hypothesis of ADF is $\delta = 0$ against the alternative hypothesis of $\delta < 0$.

If we do not reject null, the series is non-stationary whereas rejection means the series is stationary

Additionally, The Phillips-Perron test is a non-parametric version of the Dickey-Fuller test, and it addresses some of the limitations associated with the Dickey-Fuller test. The test is based on the following autoregressive model:

$$\Delta y_t = \pi y_{t-1} + \beta_i D_{t-i} + \varepsilon_t$$

Where; ε_t is a I (0) with zero mean and D_{t-i} is a deterministic trend component. The hypothesis is tested for $\pi = 0$. Apart from the fact that PP is the non-parametric version of the ADF, it corrects the statistics to consider the autocorrelation and heteroscedasticity issues. Unlike the ADF test, the PP test does not require the selection of lag order, which can be a subjective decision and affect the test results. Due the statistical rigor of these tests, they find expression in a host of extant literature (Ajewole et al., 2020; Vural, 2019; Nakintu, 2022; Khan, 2021; Ariyo, 2022; Namazzi, 2022).

3.8.2 Cointegration tests

Cointegration is a statistical concept used in econometrics to describe the long-run relationship between non-stationary time series variables (Engle & Granger, 1987). In a time series context, two or more non-stationary variables are said to be cointegrated if there exists a stable and linear combination of these variables that is stationary. This implies that while individual time series may have trends or drifts, there is a common, shared trend that links them together in the long run. Cointegration is a powerful concept in econometrics, as it allows researchers to explore and analyze long-term relationships between non-stationary variables, helping to avoid spurious correlations (Johansen, 1988). For the purpose of this study, Long Form and Bounds Tests were used to test the existence of cointegration in the series. This approach of testing for cointegration court support in the empirical literature (Saungweme & Odhiambo, 2021; Ghildiyal et al., 2015; Lawal et al., 2016).

3.8.3 Heteroscedasticity tests

Heteroscedasticity, also known as heteroskedasticity, is a term used in statistics and econometrics to describe a specific type of non-constant variance in a dataset (Engle, 1982). In the context of regression analysis, heteroscedasticity refers to the situation where the variability of the residuals (the differences between observed and predicted values) changes systematically as the values of the independent variables (predictors) change (White, 1980). Heteroskedasticity can be tested using a number of methods including, ARCH/GARCH Models, Breusch-Pagan Godfrey Serial Correlation LM Test and White's Test. Breusch-Pagan-Godfrey Serial Correlation LM Test was deployed in this study. The choice of this test is informed by its ability to tests for both heteroscedasticity and serial correlation simultaneously. This test is used in a number of empirical studies (Ndiaya & Lv, 2018; Thirumagal & Vasantha, 2016; Verma & Bala, 2013; Beckul Wang, 2019; Kunwar, 2019).

3.8.4 Stability tests

Stability diagnostics in time series data analysis refer to the process of assessing whether the statistical properties and relationships within a time series model remain stable over time (Brockwell & Davis, 1991). Time series data often come from dynamic systems, and the underlying data-generating process might change over different time periods, leading to shifts in statistical properties or relationships. Identifying and addressing such changes is crucial for making reliable forecasts and drawing accurate conclusions from time series models (Kwiatkowski et al., 1992). Recursive Estimation using the CUSUM of Squares Test was employed to test stability of the dataset. Due to robustness of this test a number of empirical studies (Voumik & Ridwan, 2023; Noureen et al., 2022; Ali & Audi, 2018) employed it in their stability diagnostics.

3.8.5 Model Specification

The multivariate linear model is specified in the following equations. These equations are a derivative of the research objectives to be addressed. As inspired by the research objectives, two estimation techniques were used; the ARDL model and fixed effect panel regression model. The ARDL model was used to test the effect at country level whereas fixed effect panel regression model was used for testing the effect at the group level. The ARDL model is a useful estimation technique for studying the relationship between variables that may have different orders of integration, such as stationary and non-stationary variables. The ARDL model can also capture both the short-run and long-run effects of the explanatory variables on the dependent variable, and test for the existence of a cointegration relationship among them. Moreover, the ARDL model is more robust and performs better for small sample sizes than other cointegration methods (Haug, 2002).

Equation 1 indicates the simple model which clearly stipulates that the stock market index is a function of Bitcoin volatility, Ethereum volatility and Cardano volatility.

$$SMI = f(BTC, ETH, ADA) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (1)$$

Objective 1: To investigate the effect of Bitcoin volatility on the stock market index at both country level and group level. Equations 2, 3 and 4 stipulate the effect of Bitcoin volatility on stock market at country level whereas the Equation 5 indicates the effect at the group level.

$$GSECI_t = \gamma_1 \sum_{i=1}^{\rho} GSECI_{t-1} + \gamma_2 \sum_{i=0}^{k} BTC_{t-1} + \gamma_3 \sum_{i=0}^{k} INTR_{t-1} + \gamma_4 \sum_{i=0}^{K} GDP_{t-1} + \gamma_5 \sum_{i=0}^{K} INF_{t-1} + \propto_1 GSECI_{T-1} + \propto_2 BTC_{T-1} + \propto_3 INTR_{T-1} + \propto_4 GDP_{T-1} + \gamma_5 \sum_{i=0}^{K} INF_{t-1} + \varepsilon_t \dots\dots (2)$$

$$NSEASI_t = \gamma_1 \sum_{i=1}^{\rho} NSEASI_{t-1} + \gamma_2 \sum_{i=0}^{k} BTC_{t-1} + \gamma_3 \sum_{i=0}^{k} INTR_{t-1} + \gamma_4 \sum_{i=0}^{K} GDP_{t-1} + \gamma_5 \sum_{i=0}^{K} INF_{t-1} + \propto_1 NSEASI_{T-1} + \propto_2 BTC_{T-1} + \propto_3 INTR_{T-1} + \propto_4 GDP_{T-1} + \gamma_5 \sum_{i=0}^{K} INF_{t-1} + \varepsilon_t \dots\dots (3)$$

$$JSEASI_t = \gamma_1 \sum_{i=1}^{\rho} JSEASI_{t-1} + \gamma_2 \sum_{i=0}^{k} BTC_{t-1} + \gamma_3 \sum_{i=0}^{k} INTR_{t-1} + \gamma_4 \sum_{i=0}^{K} GDP_{t-1} + \gamma_5 \sum_{i=0}^{K} INF_{t-1} + \propto_1 JSEASI_{T-1} + \propto_2 BTC_{T-1} + \propto_3 INTR_{T-1} + \propto_4 GDP_{T-1} + \gamma_5 \sum_{i=0}^{K} INF_{t-1} + \varepsilon_t \dots\dots (4)$$

Effect of Bitcoin volatility on stock market index at group level

$$SMI_{it} = \beta_0 + \beta_1 BTC_{it} + \beta_2 INTR_{it} + \beta_3 GDP_{it} + \beta_4 INF_{it} + \varepsilon_{it} \dots\dots (5)$$

Objective 2: To ascertain the effect of Ethereum volatility on stock market index at both country level and group level. The Equations 6, 7 and 8 stipulate the effect at the country level whereas the Equation 9 indicates the effect at the group level.

$$GSECI_t = \gamma_1 \sum_{i=1}^{\rho} GSECI_{t-1} + \gamma_2 \sum_{i=0}^{k} ETH_{t-1} + \gamma_3 \sum_{i=0}^{k} INTR_{t-1} + \gamma_4 \sum_{i=0}^{K} GDP_{t-1} + \gamma_5 \sum_{i=0}^{K} INF_{t-1} + \propto_1 GSECI_{T-1} + \propto_2 ETH_{T-1} + \propto_3 INTR_{T-1} + \propto_4 GDP_{T-1} + \gamma_5 \sum_{i=0}^{K} INF_{t-1} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (6)$$

$$NSEASI_t = \gamma_1 \sum_{i=1}^{\rho} NSEASI_{t-1} + \gamma_2 \sum_{i=0}^{k} ETH_{t-1} + \gamma_3 \sum_{i=0}^{k} INTR_{t-1} + \gamma_4 \sum_{i=0}^{K} GDP_{t-1} + \gamma_5 \sum_{i=0}^{K} INF_{t-1} + \propto_1 NSEASI_{T-1} + \propto_2 BTC_{T-1} + \propto_3 INTR_{T-1} + \propto_4 GDP_{T-1} + \gamma_4 \sum_{i=0}^{K} INF_{t-1} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (7)$$

$$JSEASI_t = \gamma_1 \sum_{i=1}^{\rho} JSEASI_{t-1} + \gamma_2 \sum_{i=0}^{k} ETH_{t-1} + \gamma_3 \sum_{i=0}^{k} INTR_{t-1} + \gamma_4 \sum_{i=0}^{K} GDP_{t-1} + \gamma_5 \sum_{i=0}^{K} INF_{t-1} + \propto_1 JSEASI_{T-1} + \propto_2 BTC_{T-1} + \propto_3 INTR_{T-1} + \propto_4 GDP_{T-1} + \gamma_5 \sum_{i=0}^{K} INF_{t-1} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots. (8)$$

$$SMI_{it} = \beta_0 + \beta_1 ETH_{it} + \beta_2 INTR_{it} + \beta_3 GDP_{it} + \beta_4 INF_{it} + \varepsilon_{it} \dots\dots\dots. (9)$$

Objective 3: To assess the effect of Cardano volatility on stock market index at both country level and group level. Equations 10, 11 and 12 state the effect at the country level while the Equation 13 models the effect at the group level.

$$GSECI_t = \gamma_1 \sum_{i=1}^{\rho} GSECI_{t-1} + \gamma_2 \sum_{i=0}^{k} ADA_{t-1} + \gamma_3 \sum_{i=0}^{k} INTR_{t-1} + \gamma_4 \sum_{i=0}^{K} GDP_{t-1}$$

$$+ \gamma_5 \sum_{i=0}^{K} INF_{t-1} + \propto_1 GSECI_{T-1} + \propto_2 ADA_{T-1} + \propto_3 INTR_{T-1}$$

$$+ \propto_4 GDP_{T-1} + \gamma_5 \sum_{i=0}^{K} INF_{t-1} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots (10)$$

$$NSEASI_t = \gamma_1 \sum_{i=1}^{\rho} NSEASI_{t-1} + \gamma_2 \sum_{i=0}^{k} ADA_{t-1} + \gamma_3 \sum_{i=0}^{k} INTR_{t-1} + \gamma_4 \sum_{i=0}^{K} GDP_{t-1}$$

$$+ \gamma_5 \sum_{i=0}^{K} INF_{t-1} + \propto_1 NSEASI_{T-1} + \propto_2 ADA_{T-1} + \propto_3 INTR_{T-1}$$

$$+ \propto_4 GDP_{T-1} + \gamma_5 \sum_{i=0}^{K} INF_{t-1} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots.. (11)$$

$$JSEASI_t = \gamma_1 \sum_{i=1}^{\rho} JSEASI_{t-1} + \gamma_2 \sum_{i=0}^{k} ADA_{t-1} + \gamma_3 \sum_{i=0}^{k} INTR_{t-1} + \gamma_4 \sum_{i=0}^{K} GDP_{t-1}$$

$$+ \gamma_5 \sum_{i=0}^{K} INF_{t-1} + \propto_1 JSEASI_{T-1} + \propto_2 ADA_{T-1} + \propto_3 INTR_{T-1}$$

$$+ \propto_4 GDP_{T-1} + \gamma_5 \sum_{i=0}^{K} INF_{t-1} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots.. (12)$$

Effect of Cardano volatility on stock market indices at group level

$$SMI_{it} = \beta_0 + \beta_1 ADA_{it} + \beta_2 INTR_{it} + \beta_3 GDP_{it} + \beta_4 INF_{it} + \varepsilon_{it} \dots\dots (13)$$

Where:

t =time series dimension

i=cross sectional dimension

GSECE=Ghana Stock Exchange-Composite Index

NSEASI=Nigeria Stock Exchange All-Share Index

JSEASI=Johannesburg Stock Exchange All-Share Index

BTC=Bitcoin

ETH=Ethereum

ADA=Cardano

INF=Inflation

INTR=Interest rate

GDP=Gross Domestic Product

SMI=Stock market index

3.9 Ethical Considerations

Since this research uses publicly available secondary data, there are minimal ethical considerations. However, the researcher ensured that the data is used responsibly and that any analysis or conclusions drawn did not misrepresent the data or its source. Finally, all the documents and prior studies that were used were duly acknowledged and referenced in both the text and the final references to avoid plagiarism.

3.10 Summary of the Chapter

This chapter discussed the research methodology employed to address the research objectives. The study took the positivist paradigm predicated on realist ontology and objectivist epistemology. Additionally, a quantitative research approach and longitudinal descriptive and explanatory research designs were used. The study also considered a population of all countries trading in cryptocurrency and purposively selected three countries that were considered high-volume trading countries to form the sample. A 5-year secondary data on cryptocurrencies such as Bitcoin, Ethereum and Cardano as well as stock market indices such as Ghana Stock Exchange-Composite Index, Nigeria Stock Exchange All-share Index, and Johannesburg Stock Exchange All-Share Index were used in this study. The collected data was analysed using Autoregressive Distributed Lag (ARDL) regression model and Random Effect Panel regression model.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

The overriding purpose of this study was to investigate the impact of cryptocurrency price volatility on the stock market performance. To satisfactorily achieve this purpose, three objectives were developed; (i) to investigate the impact of Bitcoin price volatility on stock market indices at both country level and group level, (ii) to examine the impact of Ethereum price volatility on stock market indices at both country and group level and (iii) to assess the impact of Cardano price volatility on the stock market indices at both country and group levels. To address these objectives, Autoregressive Distributed Lag (ARDL) was employed to address the objectives at country levels and fixed effect panel regression model was deployed to address the objectives at group level. As a prerequisite for conducting time series analysis, tests for stationarity, cointegration, autocorrection, heteroskedasticity and stability tests were conducted to assess the suitability of the data. Preliminarily, descriptive analysis was conducted to describe the profile of the collected data (averages, deviations and shape) after which the inferential tests were carried out.

4.2 Descriptive Statistics

Table 4.1 presents the descriptive analysis of the data used in the study. The table provides information on the mean, median, maximum, minimum, standard deviation, skewness, and kurtosis of the variables under consideration. The variables include SMI, ADA, BTC, ETH, GDPG, INFR, and INTR. From the results, it can be observed that the mean value of SMI is 2.06997. This indicates that the distribution of SMI is highly skewed to the left, as evidenced by the high negative skewness value of -0.269. The kurtosis value of 1.328022 indicates that the distribution of SMI is highly peaked, an indication that the dataset is characterized by extreme values (outliers). The standard deviation value of 6.381527 indicates that the values of SMI are widely spread out from the mean.

Additionally, the Cardano (ADA) recorded a mean value of 0.498572 and a median value of 0.159863. The maximum value is 11.12087, while the minimum value is 0.023961. The standard deviation is 0.63, indicating that the values of ADA are less widely spread out from the mean. The skewness value of 1.612309 indicates that the distribution of ADA is moderately skewed to the right, while the kurtosis value of 4.911084 indicates that the distribution is moderately peaked, an indication that the dataset contains fewer extreme values. These values suggest that the distribution of ADA is not normal and has a longer tail on the right side than a normal distribution. The Bitcoin (BTC) has a mean value of 9.580237 and a median value of 9.302061. The maximum value is 11.12087, while the minimum value is 8.082329. The standard deviation is 0.825447, indicating that the values of BTC are widely spread out from the mean. The skewness value of 0.25208 indicates that the distribution of BTC is moderately skewed to the right, while the kurtosis value of 1.852545 indicates that the distribution is less peaked than a normal distribution. These values suggest that the distribution of BTC is closer to a normal distribution than the distributions of SMI and ADA.

The ETH also recorded a mean value of 6.425482 and a median value of 6.251607. The maximum value is 8.478886 while the minimum value is 4.43448, with a standard deviation of 1.161753, indicating that the distribution is widely spread out from the mean value. The fact that the mean value outweighs the median value suggests that the data is positively skewed as validated by the skewness figure of 0.157968. The kurtosis figure of 1.584727 suggests that the dataset is moderately peaked, an indication that there are no serious issues with extreme values. In all, the table suggests that the dataset for all the variables is normally distributed as supported by high Jarque-Bera statistics with p-values greater than 0.05.

Table 4.1: Descriptive Statistics

Variable	LSMI	ADA	LETH	LBTC	INTR	INFR	LGDPG
Mean	2.06997	0.498572	6.425482	9.580237	17.59869	12.62916	25.01316
Median	2.084934	0.159863	6.251607	9.302061	15.9	9.89	25.02733
Maxi	11.12087	2.968239	8.478886	11.12087	27	31.23	25.09524
Mini	-6.10396	0.023961	4.43448	8.082329	14.5	7.14	24.93243
Std. Dev.	6.381527	0.63034	1.161753	0.825447	3.944628	6.632123	0.052189
Skew	-0.269	1.612309	0.157968	0.259208	1.266755	1.341023	-0.08196
Kurtosis	1.328022	4.911084	1.584727	1.852545	3.019947	3.352252	1.567535
Jarq-Bera	630.1033	3207.005	479.9672	361.8691	1465.153	1670.208	210.8274
Prob	0.0070	0.0001	0.0090	0.0003	0.0010	0.0040	0.0008
Sum	10146.99	2731.177	35198.79	52480.54	96405.6	69182.55	60882.03
Sq. Dev.	199587.8	2176.17	7392.144	3731.824	85222.61	240906.1	6.626646
Obs	4902	5478	5478	5478	5478	5478	2434

Source: Author's own construction.

4.3 Diagnostic Check

This section presents some test conducted to assess the suitability of the data for the study's analysis.

4.3.1 Correlation analysis and Multicollinearity

Table 4.2 presents the correlation analysis of the variables SMI, ADA, BTC, ETH, GDPG, INFR, and INTR. The table shows the pairwise correlation coefficients between each pair of variables. The correlation coefficient ranges from -1 to 1, where -1 indicates a perfect negative correlation, 0 indicates no correlation, and 1 indicates a perfect positive correlation. The correlation analysis reveals that SMI has a positive correlation with ADA (r = 0.309), BTC (r = 0.308) and ETH (r = 0.433). This suggests that as the values of ADA, BTC and ETH increase, stock market performance will also tend to increase, *ceteris paribus*. Additionally, SMI has a positive correlation with INTR (r = 0.304). ADA has a positive correlation with INFR (r = 0.800) and INTR (r = 0.562), indicating that as the value of ADA increases, the values of INFR and INTR also tend to increase. Like ADA, BTC has a positive correlation with ETH (r = 0.833) and GDPG (r = 0.590), indicating that as the value of BTC increases, the values of ETH and GDPG also tend to increase. ETH has a positive correlation with GDPG (r = 0.304), indicating that as the value of ETH increases, the value of GDPG also tends to increase. INFR has a positive correlation with INTR (r = 0.478), indicating that as the value of INFR increases, the value of INTR also tends to increase. Overall, the correlation analysis suggests that there are positive correlations between the variables under consideration. The strongest correlations are observed between BTC and ETH.

Bitcoin and Ethereum recorded a strong correlation coefficient(r=0.833) suggesting a possibility of the presence of multicollinearity problems among the variables. However, the result is not significant. Validating this position, the multicollinearity test reported a centered variance inflation factor (VIF) score below the threshold of 10, an indication that the model does not encounter multicollinearity issues (Aboagye-Otchere & Boateng, 2023).

Table 4.2: Pairwise Correlation

	SMI	ADA	BTC	ETH	GDPG	INFR	INTR	Centered VIF
SMI	1.000**							
ADA	0.309**	1.000**						6.891
BTC	0.308***	0.048**	1.000*					8.853
ETH	0.433**	0.291**	0.833	1.000**				9.430
GDPG	0.031*	0.264*	0.590**	0.304*	1.000**			4.804
INFR	0.404**	0.800	0.805	0.784*	0.412*	1.000**		1.626
INTR	0.304**	0.562*	0.386	0.603*	-0.050*	0.478**	1.000**	1.974

Source: Author's own construction. Note: Sig at 1%, 5% and 10% are denoted as ***, ** and *

4.3.2 Stationarity Analysis

Table 4.3 and Table presents the results of the ADF and PP test for stationarity for the different cryptocurrencies, the stock market and economic indicators studied in the research at level and at first difference respectively. The table shows the t-statistic and the associated p-value for the level and first difference of each variable. The null hypothesis of the ADF test is that the variable has a unit root, indicating that it is non-stationary with an alternative hypothesis which states that the variable is stationary. A variable is considered stationary if its mean, variance, and autocorrelation structure do not change over time. For instance, the t-statistic of SMI at level is -4.7456, with a p-value of 0.000, indicating that there is sufficient evidence to reject the null hypothesis at the 5% significance level and conclude that the data for SMI is stationary. In fact, the results indicated that data for SMI is stationary at both level and first difference. Similarly, the t-statistic of ADA at level is -2.6229, with a p-value of 0.0085, indicating that we can reject the null hypothesis of non-stationarity for ADA at the 1% significance level and conclude that the data is stationary. Ethereum also recorded a stationary data as supported by its t-statistics with the p-value. However, the t-statistic for the BTC at level showed a t-statistics of -1.5396 with a p-value of 0.1162, indicating that we cannot reject the null hypothesis of non-stationarity for ADA at the 10% significance level. However, enough evidence was observed to reject the null hypothesis at first difference. This result is essential for time series analysis, as non-stationary variables can lead to spurious regression results and unreliable forecasts.

Table 4.3: PP and ADF Stationarity test (Levels estimates)

	PP TEST		ADF TEST		
Variable	**t-Statistic**	**Prob.**	**t-Statistic**	**Prob.**	**Order**
LSMI	0.0001	0.0001***	-4.7456	0.0000***	I (1)
ADA	0.0031	0.0021***	-2.6229	0.0085***	I (1)
LETH	-9.0370	0.0006***	-1.5396	0.1162	I (1)
LBTC	-3.3300	0.0500**	-1.9724	0.0465**	I (1)
INTR	-0.3562	0.0015***	-0.0925	0.6518	I (1)
INFR	0.0001	0.0301**	-1.1947	0.213	I (1)
LGDPG	0.0380	0.0694**	-0.2154	0.6089	I (1)

Source: Author's own construction. Note: Sig at 1%, 5% and 10% are denoted as ***, ** and *.

Table 4.4: PP and ADF Stationarity test (1st Difference estimates)

	PP TEST		ADF TEST		
Variable	**t-Statistic**	**Prob.**	**t-Statistic**	**Prob.**	**Order**
d(LSMI)	0.0401	0.0001***	-74.7797	0.0001***	I (1)
d(ADA)	0.3001	0.0012***	-21.2372	0.000***	I (1)
d(LETH)	0.0821	0.0020***	-75.2812	0.0001***	I (1)
d(LBTC)	0.3401	0.0011***	-28.2612	0.000***	I (1)
d(INTR)	0.0911	0.000***	-74.1012	0.0001***	I (1)
d(INFR)	0.5301	0.0002***	-17.7132	0.000***	I (1)
d(LGDPG)	0.0201	0.0004***	-74.0914	0.0001***	I (1)

Source: Author's construction. Note: Sig at 1%, 5% and 10% are denoted as ***, ** and *.

Table 4.5: Zivot-Andrew Breakpoint Test

	GHANA			NIGERIA			SOUTH AFRICA		
Variable	**t-statistics**	**p-value**	**Breakpoint**	**t-statistics**	**p-value**	**Breakpoint**	**t-statistics**	**p-value**	**Breakpoint**
INFR	-4.718	0.002	6/5/2021	-6.051	0.001	31/12/2020	-4.906	0.003	31/12/2021
INTR	-4.492	0.004	1/2/2022	-8.878	0.000	1/1/2022	-5.546	0.002	1/1/2022
LGDP	-4.043	0.050	19/06/2020	-8.560	0.000	1/1/2021	-8.560	0.000	1/1/2021
SMI	41.927	0.111	19/01/2022	-5.252	0.020	30/03/2022	-5.887	0.003	31/12/2019
ETH							-4.837	0.000	20/07/2021
ADA							-5.124	0.000	2/1/2021
BTC							-3.924	0.000	13/12/2020

Source: Author's construct

Structural break is a phenomenon in time series data that occurs when there are abrupt changes in a series for a variable that makes it vary the normal movement in the series and makes it difficult to predict future outcomes using the underlying series (Ibrahim et al., 2022). The study adopted the Zivot-Andrews stationarity test with a breakpoint to assess the presence of structural breaks in the series Zivot and Andrews (1992) with results presented in Table 4.5. The results for the structural break as displayed in Table 4.5 show that Ghana recorded a structural break in its inflation rate, interest rate and gross domestic product for the period 06/05/2021, 01/02/2022, and 19/06/2020 respectively. This means that there were breakages in the interest rate, inflation and the rate at which the Ghanaian economy was growing.

Structural breaks in interest rates in Ghana coincide with shifts in monetary policy by the central bank. For instance, if the central bank adjusts its policy rate to control inflation or stimulate economic growth, it could lead to changes in lending rates and subsequently impact interest rates. Similarly, fluctuations in global financial markets, such as changes in the Federal Reserve's interest rate or shifts in investor sentiment towards emerging markets, can influence domestic interest rates. Economic events like the COVID-19 pandemic or changes in global trade dynamics may prompt investors to reassess risk, leading to changes in interest rates. Again, structural breaks in interest rates may also reflect changes in domestic economic conditions, such as shifts in consumer spending, investment patterns, or fiscal policy decisions. For example, the Ghanaian government’s excessive borrowing to finance infrastructure projects such as the Accra Obitsebi interchange and Pawlugu multipurpose dam or stimulus packages can affect demand for credit and influence interest rates. Moreover, the Ghanaian government's quest to increase healthcare facilities across the length and breath of the country through the construction of new state-of-the-art district hospitals themed as agenda 111 shot the country’s loan stock and partly contributed to the observed break.

Structural breaks in inflation could result from supply chain disruptions, such as shortages of essential goods or disruptions in global trade routes. Events like natural disasters, geopolitical tensions, or pandemics can disrupt production and distribution channels, leading to price volatility. Similarly, changes in central bank policies, including adjustments to interest rates, reserve requirements, or quantitative easing measures, can impact inflation dynamics. For instance, expansionary monetary policies aimed at stimulating economic activity may lead to higher inflation, while contractionary policies may have the opposite effect. Also, the sharp fluctuations in the exchange rate experienced by Ghana with consistent devaluing of the Ghanaian cedi influenced domestic inflation by affecting the prices of imported goods and raw materials.

Structural breaks in GDP may reflect significant economic shocks, such as recessions, financial crises, or external shocks like changes in global commodity prices. For instance, a sudden drop in oil prices, a key export for Ghana, could lead to a contraction in GDP growth. Again, structural breaks in GDP growth may coincide with changes in government policies, including fiscal stimulus measures, tax reforms, or regulatory changes. Government spending on infrastructure projects or social programs can have multiplier effects on economic growth, influencing GDP dynamics. Also, changes in the composition of GDP across sectors, such as shifts from agriculture to services or increased investment in manufacturing, can contribute to structural breaks in GDP growth. Technological advancements, changes in consumer preferences, or shifts in global demand can drive these sectoral changes. The break in the stock market performance experienced on 19.01.2022 is attributed to global economic conditions. Events like changes in global commodity prices, shifts in investor sentiment and overconfidence bias from the aftermath of the novel covid-19 pandemic as confirmed by Kuranchie-Pong and Forson (2022), or geopolitical tensions can impact stock market performance.

In the case of Nigeria, the study witnessed a break in the inflation series on 31 December 2021, structural breaks in inflation resulted from changes in Nigeria's monetary policy. Adjustments to the Central Bank of Nigeria's policy rate or reserve requirements can impact inflation dynamics. Also, the break in the inflation rate is attributed to the hikes in the price of oil and other tradable commodities on the world market. Interest rates experienced a break on 1ST January 2022, fluctuations in global financial markets, such as changes in US interest rates or investor sentiment towards emerging markets, can influence Nigeria's interest rates. Economic events like the COVID-19 pandemic can prompt changes in monetary policy to destabilise the economy. Again, the build-up pressure to the elections in Nigeria partly played a role in the abrupt changes in its interest rate as political influencers would prefer a decline in interest rate to score a political point to attract votes from the business community and the citizenry as a whole. Stock market performance witnessed an abrupt change on 30/03/2022, the structural breaks in the stock market may be influenced by political factors in Nigeria, such as elections, policy uncertainty, or security concerns. Also, political uncertainty in the build-up to the general elections might have wet investors’ confidence, have increased investors' overconfidence bias which affected market volatility as revealed by Musah et al. (2023) whilst the gross domestic product for Nigeria recorded a break on 1ST January 2022 as a result of changes in global oil prices. Variations in oil prices can have significant implications for Nigeria's GDP, as oil exports account for a significant portion of government revenue. Structural breaks in GDP growth may occur in response to fluctuations in oil prices and production levels.

Similarly, South Africa just like Ghana and Nigeria, experienced some notable abrupt variations in its inflation, interest rate, stock market performance and GDP. The structural break for the inflation rate on 31/12/2021 coincides with the fluctuations in South Africa's Rand to major trading currencies rate. Depreciation of the South African rand relative to major currencies could lead to higher import prices and inflationary pressures. Again, the resultant effect of the covid-19 protocols which led to a soar in global commodity prices accounted for the break in the South African inflation rate. A series of breaks in interest rates took place on 01/01/2022 as a result of adjustments to the repo rate. Policy decisions aimed at controlling inflation and supporting economic growth implemented by the South African government to revive its economy from the repercussions of the covid-19 pandemic impacted borrowing costs and lending rates.

The South African stock market performance experienced a hiatus on 31/12/2019, this break resulted from the shifts in South Africa's domestic economic conditions. Changes in consumer confidence, business sentiment, or corporate earnings could affect investor behaviour and stock prices. Also, the decline in corporate earnings in the aftermath of the covid-19 pandemic fuelled investors' fears and induced them to sell their stake in listed companies leading to a decline in the stock market value (Azam et al., 2022). Finally, structural breaks in GDP growth in South Africa which happened on 01/01/2021 may be linked to changes in South Africa's fiscal policies pursued to improve the business-friendliness of the economy. Government spending initiatives, tax reforms, or infrastructure projects can influence economic activity and GDP growth rates. Additionally, the hiatus in GDP was a result of the stand still in global economic activities when the novel covid-19 was at its apogee.

Structural breaks in the cryptocurrencies under review took place on 20/07/2021, 02/01/2021, and 13/12/2020 for Ethereum, Cardano, and Bitcoin respectively. These breaks as witnessed in the digital currencies prices are primarily attributed to the outbreak of the novel covid-19 pandemic that engulfed the world and disrupted normal business operations. Again, the rising security concerns raised by several central banks made some investors curious about the security of digital currencies. Moreover, the increasing number of money laundering cases recorded around the world led to structural breaks in the stability of the prices of cryptocurrencies.

ZIVOT-ANDREW BREAKPOINTS

GHANA

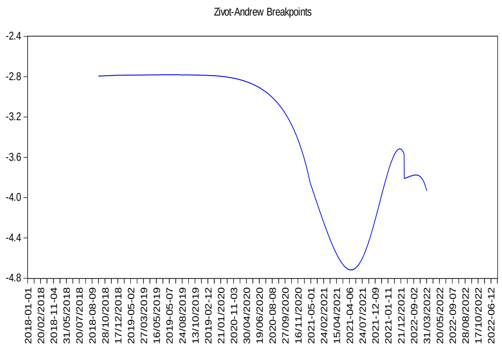


Figure 4.1: Inflation rate(Ghana)

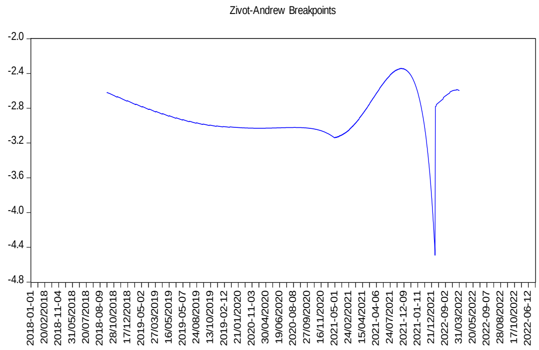


Figure 4.2: Interest rate(Ghana)

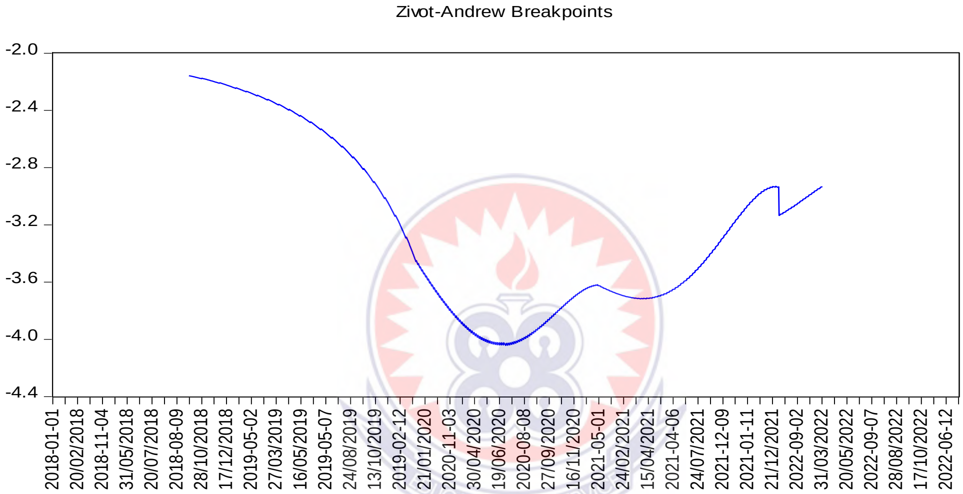


Figure 4.3: GDP (Ghana)

NIGERIA

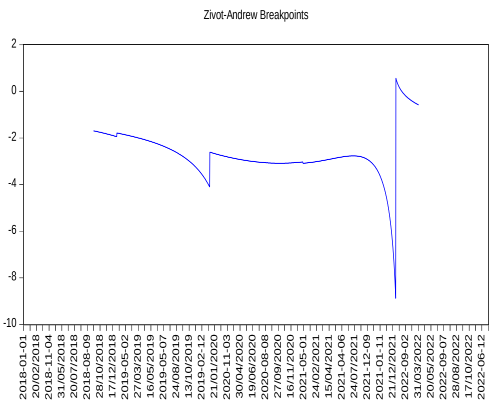


Figure 4.4: Interest rate(Nigeria)

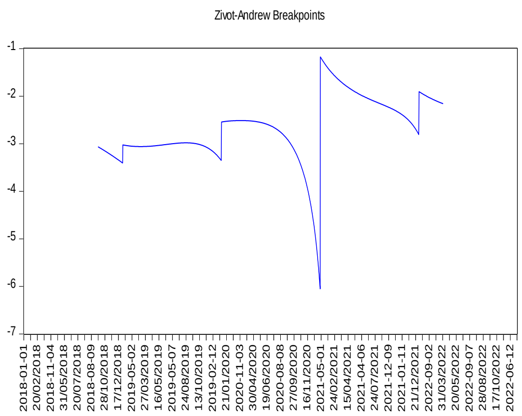


Figure 4.5: Inflation rate(Nigeria)

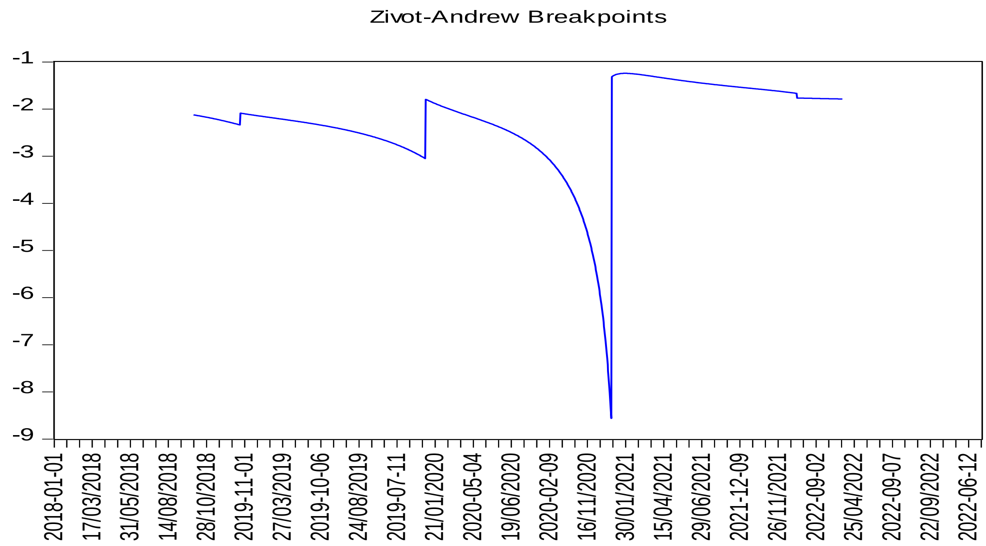
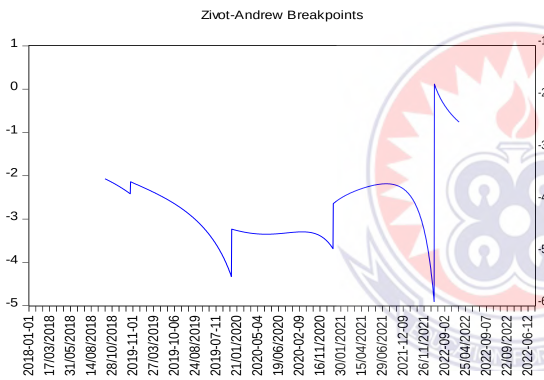


Figure 4.6: GDP(Nigeria)

SOUTH AFRICA



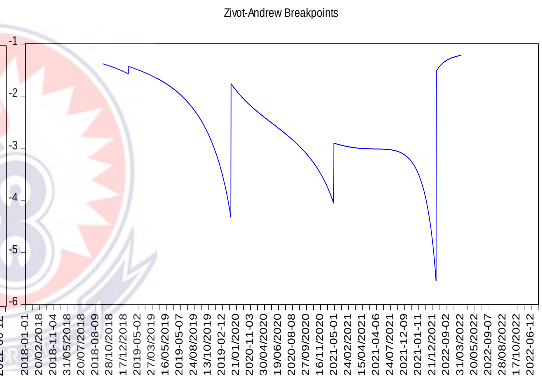


Figure 4.7: Interest rate(South Africa) ***Figure 4.8: Inflation rate (South Africa)***

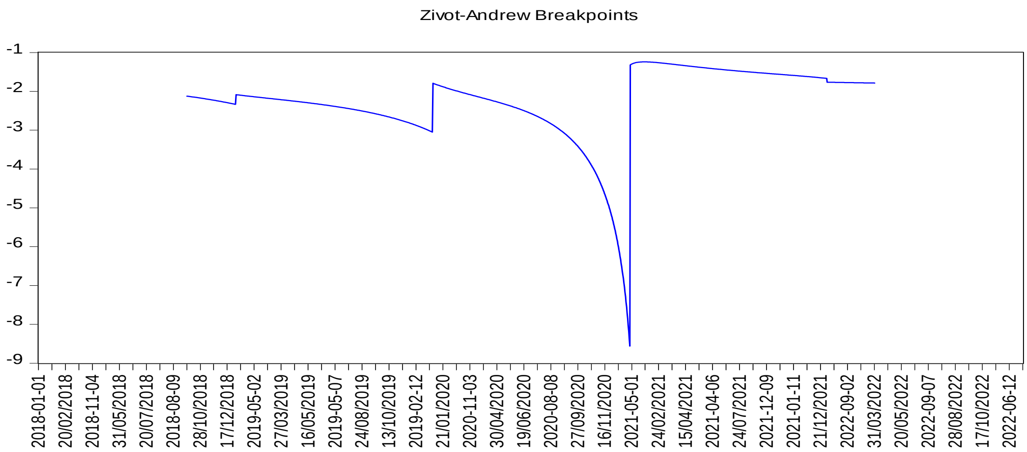


Figure 4.9: GDP(South Africa)

Stock Market Indices

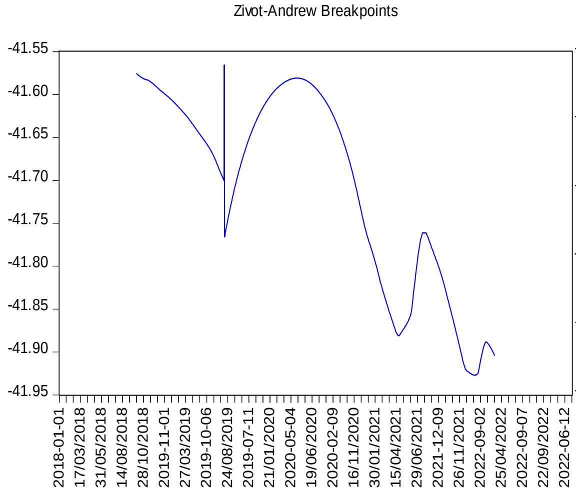


Figure 4.10 GSECI

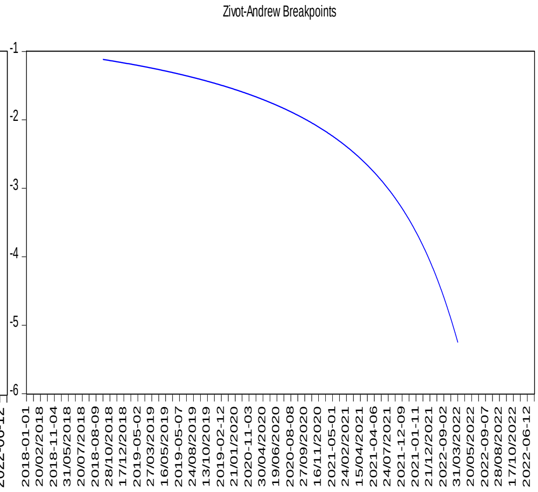


Figure 4.11: NSECI

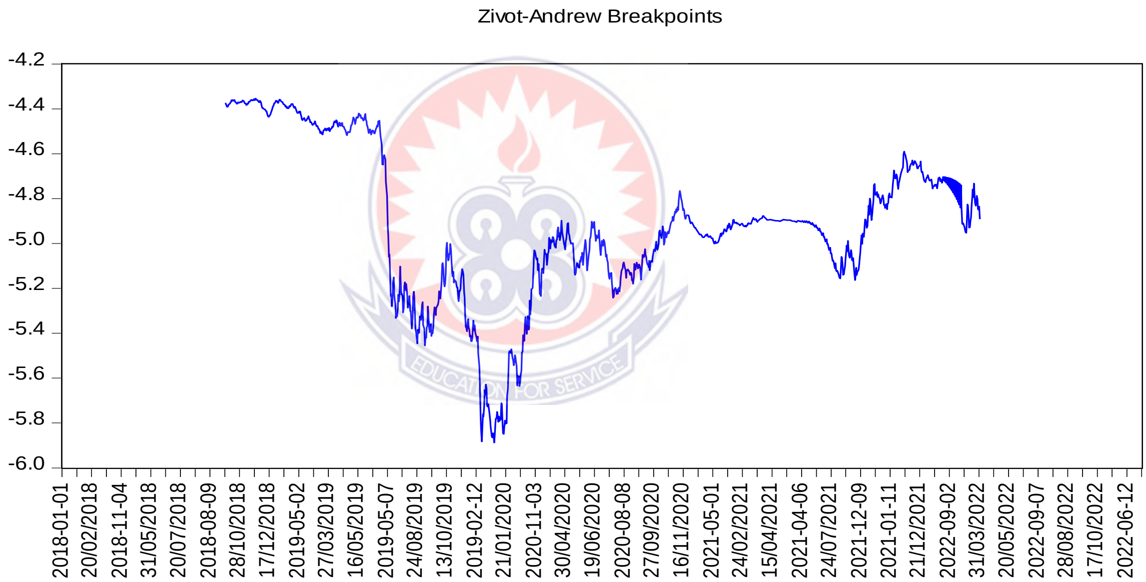


Figure 4.12: JSECI

Cryptocurrency Indices

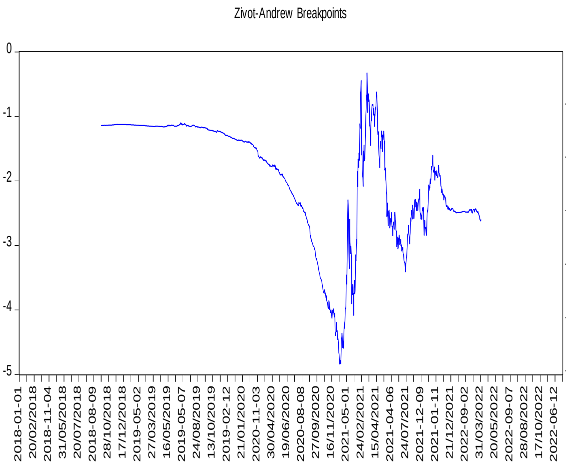


Figure 4.13: Bitcoin

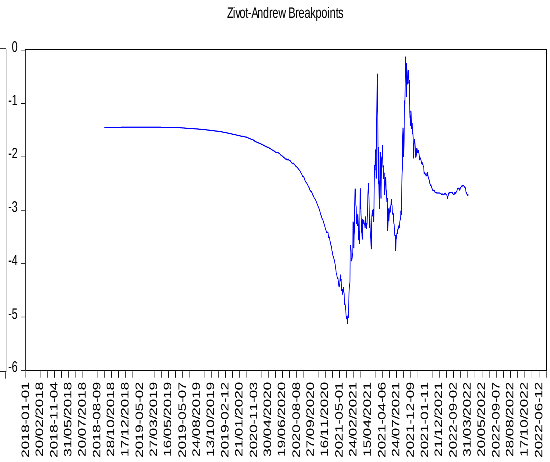


Figure 4.14: Cardano

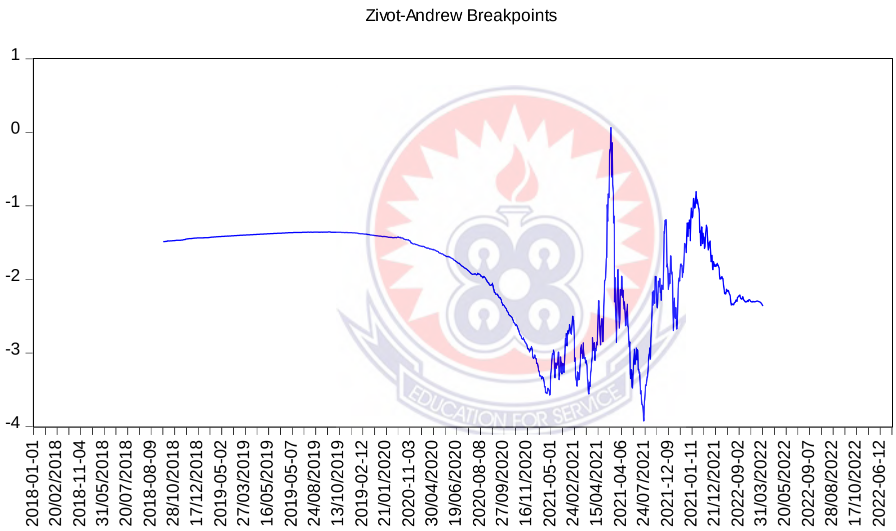


Figure 4.15: Bitcoin

Source: Author's construct

4.3.3 Lag Length Selection

Table 4.5 presents the results of the Vector Autoregression (VAR) lag length selection for the different cryptocurrencies, stock market index and economic indicators studied in the research. The table shows the log-likelihood (LogL) value, the likelihood ratio (LR) statistic, the final prediction error (FPE), and the Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SC), and Hannan-Quinn Criterion (HQ) for different lag lengths. The VAR model is a statistical model used to analyze the interdependence among multiple time series variables. The lag length of the VAR model determines the number of past observations that can significantly predict the current value of the variables. From the results, the significance of lag length of 2 years garnered the most support from the results, as it was significant under FPE, AIC, and HQ criteria. Hence, this model includes a lag length of 2. Overall, Table 4.4 provides information about the optimal lag length for the VAR model for the different variables studied. The results suggest that a lag length of 2 is the optimal choice for most of the variables, based on the information criteria values.

Table 4.6:**Lag length selection**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-94653.02	NA	3.29e+38	108.5551	108.5770	108.5632
1	-70173.11	48735.24	2.24e+26	80.53797	80.71342*	80.60284
2	-70065.72	212.9295	2.09e+26*	80.47101*	80.79998	80.59264*
3	-70026.55	77.34938	2.12e+26	80.48229	80.96477	80.66067
4	-69985.84	80.06759	2.14e+26	80.49179	81.12779	80.72694
5	-69944.99	80.03019	2.16e+26	80.50113	81.29064	80.79303
6	-69896.82	93.94656	2.16e+26	80.50209	81.44512	80.85076
7	-69834.70	120.6872	2.13e+26	80.48704	81.58359	80.89246
8	-69786.36	93.51583*	2.13e+26	80.48780	81.73786	80.94998

Source: Author's own construction.

4.3.4 Cointegration Analysis

This section presents the results of the bound testing to cointegration for the different stock market models studied in the research. Table 4.6 shows the model, the bound test F-statistic, the 5% critical value, and the remarks for each model. Cointegration is a statistical property that indicates a long-term relationship between two or more non-stationary time series variables. The bound testing approach is a method used to test for cointegration between variables by comparing the F-statistic of the model to the critical values of the F-distribution. For instance, the model for the South African stock market (SMI) includes the variables ADA, BTC, ETH, GDPG, INFR, and INTR.

Table 4 7: Bound testing to cointegration

Model	Bound test F-stat	5% Critical value	Remarks
Stock market for South Africa model smi = f (ada, btc, eth, gdpg, infr, intr)	6	Upper (3.28) Lower (2.27)	Cointegration Exist
Stock market for Nigeria model smi = f (ada, btc, eth, gdpg, infr, intr)	6	Upper (3.28) Lower (2.27)	Cointegration Exist
Stock market for Ghana model smi = f (ada, btc, eth, gdpg, infr, intr)	6	Upper (3.23) Lower (2.27)	Cointegration Exist

Source: Author's own construction.

As reported in Table 4.6, the bound test F-statistic for the South Africa model is 6, which is greater than the upper 5% critical value of 3.28. Therefore, it is concluded that there is cointegration between the variables in this model. Similarly, the models for the Nigerian and Ghanaian stock markets also show evidence of the existence of cointegration between the variables. The results suggest that there is cointegration between the variables in the stock market models for South Africa, Nigeria, and Ghana.

4.4 Analysis of Regression Results at the Country Level

Table 4.7 presents the results of the Autoregressive Distributed Lag (ARDL) model for the stock market index (SMI) in South Africa, Nigeria, and Ghana. The table shows the short-run and long-run coefficients for each variable in the model. The ARDL model is a statistical model used to analyze both the short-run and long-run relationships between variables that may have different orders of integration. The short-run coefficients represent the immediate impact of a change in the independent variable on the dependent variable, while the long-run coefficients represent the long-term impact of a change in the independent variable on the dependent variable.

Table 4.8: ARDL Result

Dependent Variable: Stock market Index							
	Long Run				Short Run		
Variables	**S.A Model**	**NIG Model**	**GHA Model**	**Variables**	**S.A Model**	**NIG Model**	**GHA Model**
SMI (-1)					0.932	0.978	-0.003
					(0.00***)	(0.012**)	(0.002***)
SMI (-2)					0.048	0.078	0.158
					(0.046**)	-0.87	-0.52
ADA	-33.28	-17.3	-0.424	d(ADA)	-6.741	-38.24	-0.426
	-0.46	(0.01***)	-0.94		(0.04**)	(0.02**)	-0.93
BTC	0.002	0.289	0.003	d(BTC)	2.47	0.006	0.003
	(0.09*)	(0.04**)	(0.01**)		(0.09*)	(0.04**)	(0.01**)
ETH	0.26	8.15	-0.002	d(ETH)	0.005	-0.179	-0.003
	(0.05*)	-0.16	-0.47		(0.05*)	-0.19	-0.47
GDPG	5.57	-1.17	-4.63	d(GDPG)	1.113	-2.57	-4.64
	-0.15	(0.06*)	(0.05*)		-0.17	(0.06*)	(0.06*)
INFR	-30.2	544.36	-0.86	d(INFR)	-0.611	11.94	-0.869
	-0.41	-0.33	-0.36		-0.396	-0.33	-0.355
INTR	24.84	112.75	-1.764	d(INTR)	0.502	24.68	-1.769
	-0.49	(0.05**)	(0.02**)		-0.48	(0.04**)	-0.243
ECM					-0.02	-0.022	-1.003
					(0.00***)	(0.00***)	(0.00***)
R-sq					0.969	0.98	0.782
Adj					0.969	0.98	0.761
Dur-W.					2.014	2.021	2.001
P(F-St)					0.000**	0.000**	0.020**

Source: Author's own construction. Note: Sig at 1%, 5% and 10% are denoted as ***, **, and *.

Table 4.7 reveals that the first and second lagged values of the Stock market index (SMI) have significant impact on the current value of SMI for all three countries, an indication that changes in the past values of SMI (Ghana Stock Exchange Composite Index, Nigeria Stock Exchange-All Share Index & Johannesburg Stock Exchange All-Share Index) will affect their present values. For instance, the short-run coefficients for SMI (-1) are 0.932, 0.978, and -0.003 for South Africa, Nigeria, and Ghana, respectively, with p-values less than 0.07. However, considering the second lag of SMI, apart from the South Africa model, both Ghana and Nigeria models recorded insignificant effect of SMI (-2) on the current values of SMI. Again, Cardano was found to have negative and significant effect on the current stock market performance for South Africa (β=-6.741, p-value=0.04) and Nigeria (β=-38.24, p-value=0.02) but insignificant effect for Ghana (β=-0.426, p-value=0.93) in the short run. However, in the long-run, even though negative effect was recorded in all the models, only Nigeria recorded a significant effect. This result suggests that there is no sufficient evidence to assert that cryptocurrency volatility has a long-run effect on stock market performance in the case of Ghana and South Africa. This result further implies that uncertainties in the cryptocurrency market may not significantly influence the investment decisions of market participants in the long-run.

Contrastingly, Bitcoin price volatility was recorded to have positive effect on the current stock market index for South Africa (β=2.470, p-value=0.09, Nigeria (β=0.006, p-value=0.04) and Ghana (β=0.003, p-value=0.01) in the short-run. Same direction of effect was recorded in the long run. These results suggest that once a unit increase in the price of Bitcoin is recorded, the stock market index will also see an appreciation in value in both the short-run and long-run, holding all other factors constant.

However, apart from Nigeria model that recorded positive and significant long-term effect of Ethereum (ETH) on stock market index, other models recorded insignificant effect at both the short-run and long-run. This is not surprising because Ethereum does not experience high volume of trading as compared to Bitcoin so the volatility in the price of this market may not have the tendency to influence the performance of the mainstream market. The coefficients of ECM indicate how much the dependent variable adjusts to the deviation from the long-term equilibrium in the previous period. In this case, the coefficients are negative and significant, which means that there is a negative feedback mechanism that corrects the disequilibrium. The magnitude of the coefficients implies how fast the adjustment is. For example, the coefficient of -1.003 for the Ghana model means that about 100% of the deviation from the long-term disequilibrium is corrected in one period. However, considering the ECT for South Africa and Nigeria, the speed of disequilibrium correction is low as compared to Ghana's model, hence, a substantial amount of time is required to correct the disequilibrium in those models.

The result also indicates that the models have high explanatory power, an indication that a greater portion of the variability in SMI for all the models can be explained by the regressors under consideration. This is evident as the result indicated Adjusted R^2 of 0.969, 0.981 and 0.761 for South Africa, Nigeria and Ghana respectively. Additionally, the Dubin-Watson statistic also indicated that there are no issues of autocorrelations in the dataset. Durbin-Watson statistics is a test for autocorrelation in the residuals of a regression model. Autocorrelation means that the residuals are correlated with each other, which violates one of the assumptions of regression analysis. The Durbin-Watson statistic ranges from 0 to 4, with values around 2 indicating no autocorrelation. In this case, the Durbin-Watson values are close to 2, which means that there is no evidence of autocorrelation in the residuals. This is a desirable property for a regression model, as it implies that the model is not missing any important variables or dynamics that could affect the dependent variable. The results also revealed that the combined effect of Cardono, Bitcoin and Ethereum is significant at 1% level of significance, since the p-value of the F-statistic was less than 0.01.

4.5 Other Model Diagnostic Checks

This section presents other assessment checks that were conducted to assess the robustness of the study's estimations.

4.5.1 Autocorrelation and Heteroskedasticity

This section presents the results of the autocorrelation and heteroskedasticity in the dataset. The correlogram test is a statistical method used to analyze the autocorrelation and partial autocorrelation of a time series. The autocorrelation coefficient measures the correlation between the values of a time series at different lags, while the partial autocorrelation coefficient measures the correlation between the values of a time series at different lags, controlling for the effects of the intermediate lags. Table 4.8 shows the autocorrelation and partial autocorrelation coefficients for the SMI at different lags. The Q-statistic measures the overall significance of the autocorrelation and partial autocorrelation coefficients, and the p-value measures the probability of obtaining a test statistic as extreme as the one observed, assuming that the null hypothesis of no autocorrelation is true. On the other hand, heteroskedasticity is a statistical property that indicates that the variance of the errors in a regression model is not constant across the range of values of the independent variables. Table 4.8 presents the results of the Breusch-Pagan-Godfrey (BPG) test for heteroske dasticity for the different stock market models studied in the research. The BPG test is a method used to test for heteroskedasticity in a regression model by comparing the F-statistic of the model to the critical values of the F-distribution. The table shows the F-statistic and the p-value for the BPG test for each of the stock market models. The F-statistic measures the ratio of the explained variance to the unexplained variance in the model. The p-value measures the probability of obtaining a test statistic as extreme as the one observed, assuming that the null hypothesis is true. This test is premised on a null hypothesis, which states that error variances across the observations in the model are constant(homoscedastic), and an alternative hypothesis that error variances across the observations are not constant(heteroscedastic).

Table 4.9: Autocorrelation and Heteroskedasticity

Correlogram Test							Breusch-Pagan-	
Autocorrelation	**Partial Correlation**		**AC**	**PAC**	**Q-Stat**	**Prob**	**F-stat**	**Prob**
						1	0.000	0.000	0.000	0.986	0.895	0.510
						2	-0.003	-0.003	0.020	0.990		
						3	-0.003	-0.003	0.037	0.998		
						4	-0.002	-0.002	0.048	1.000		
						5	-0.003	-0.003	0.066	1.000		
						6	-0.003	-0.003	0.080	1.000		

Source: Author's own construction. Note: Sig at 1%, 5% and 10% are denoted as ***, ** and *.

The result from the Breusch-Pagan-Godfrey test showed F-statistic of 0.895 with a p-value of 0.509. The p-value being greater than 0.05 suggests enough evidence to accept the null hypothesis of homoskedasticity and to conclude that error variances across the observations are constant. This result suggests that the variance of the errors in the model is constant across the range of values of the independent variables. This result makes it possible for the conduct of ARDL analysis. This result is critical because a model with heteroscedastic error variance has the tendency to produce unreliable T and F values thereby leading to unreliable predictions. The test is essential because, without ascertaining this condition, there is the tendency to commit a type I error of rejecting a true null hypothesis, hence misleading policymakers and practitioners. In terms of autocorrelation, the results of the correlogram test suggest that there is no evidence of autocorrelation or partial autocorrelation in the SMI time series. The autocorrelation and partial autocorrelation coefficients are not statistically significant at any lag, and the Q-statistic is not significant at any lag. This means that the values of the SMI are not dependent on their past values, and there is no pattern of correlation between the values of the SMI at different lags.

4.5.2 Model stability analysis

Stability diagnostics are very relevant to ARDL analysis, as they help to verify the validity and robustness of the estimated model. According to Bahmani-Oskooee and Saha (2016), stability diagnostics test whether the parameters of the model are constant over time, or whether there are structural breaks or regime shifts that affect the relationship between the variables. If the model is unstable, then the estimates may be biased or inconsistent, and the inference may be unreliable.

In a model's stability diagnostics using the CUSUM of squares approach, the x-axis of the graph represents the time period whereas the y-axis represents the CUSUM of squares, which measures the cumulative sum of the squared residuals. The blue line represents the CUSUM values and the red dashed lines represent the 5% significance level. To assess the stability of the dataset, there is the need to examine whether or not the CUSUM values stay within the 5% significance bounds. If the CUSUM values remain within these bounds, it indicates that the model is stable over time. The opposite is true for unstable models.

Considering the results of stability diagnostics as shown in Figure 4.1, 4.2 and 4.3 indicates that the models for South Africa, Nigeria and Ghana are all stable. This is because, the CUSUM values remain within the 5% significance bounds. These results offer credibility to the ARDL analysis since the stability of the dataset is critical in making sound and unbiased inferences and predictions from the model.

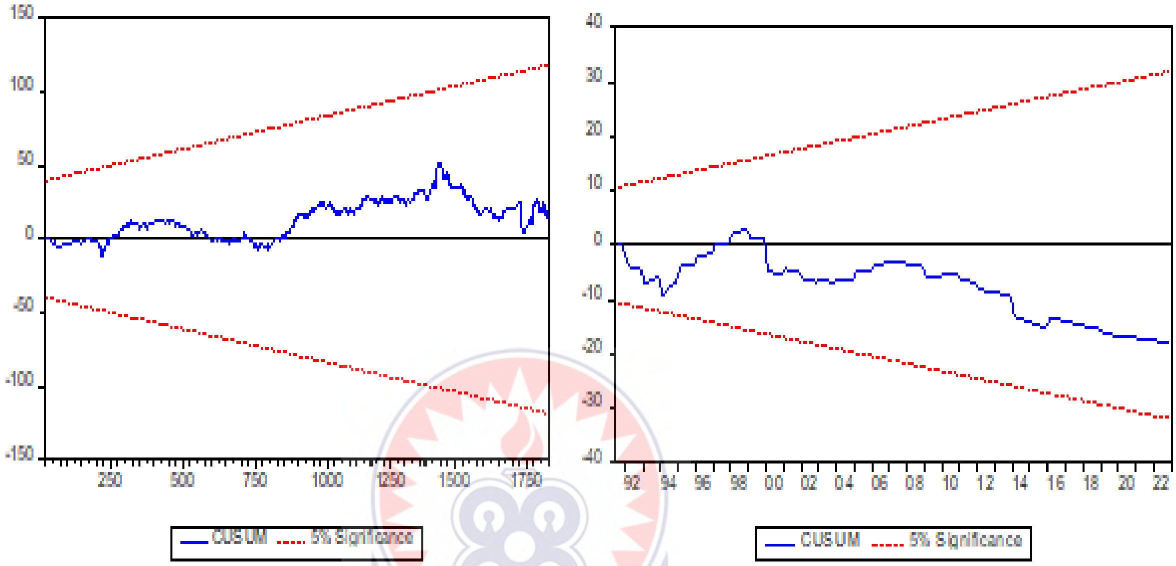


Figure 4. 16: Stability of S.A model

Source: Author's own construction.

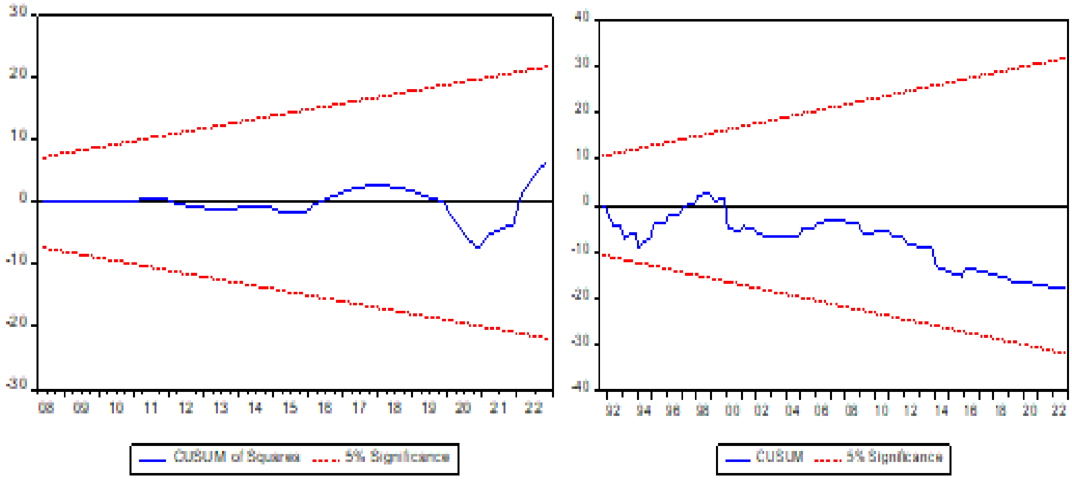


Figure 4.17: Stability of NIG model

Source: Author's own construction.

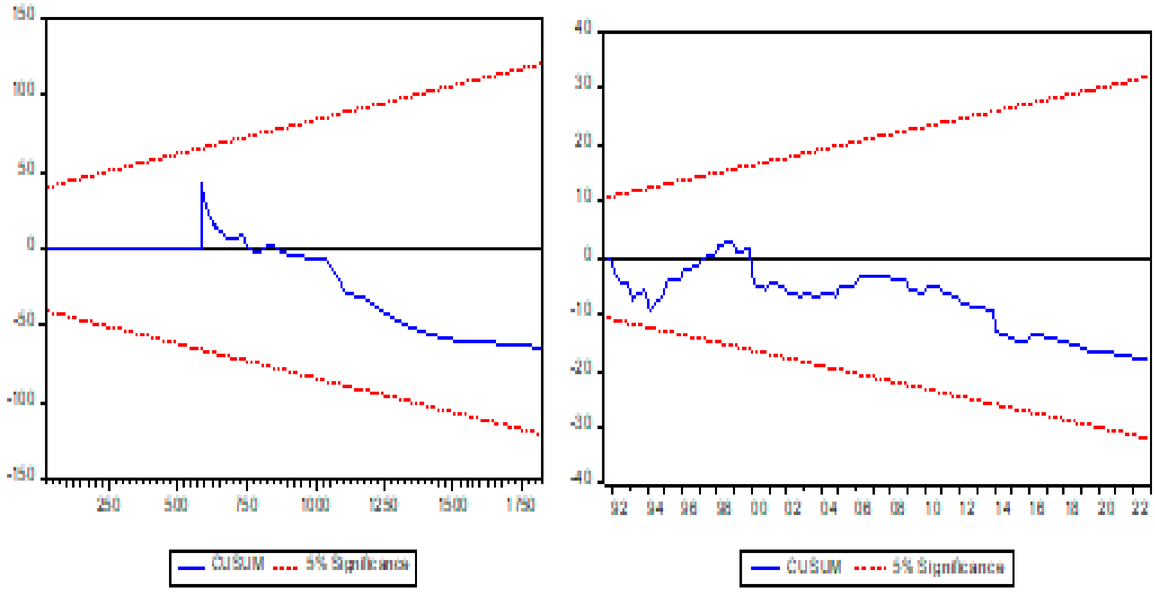


Figure 4.18: Stability of GHA model

Source: Author's own construction.

4.6 Objective Four: Analysis of Regression Result at the Group Level

This section presents the results of the group effect of cryptocurrency volatility on the stock market performance. Table 4.9 shows the coefficients, standard errors, t-statistics, and probabilities for each variable.

Table 4.10: Group effect of cryptocurrencies on stock market index

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LBTC	0.209765	0.143959	1.457124	0.0451
INTR	0.114673	0.016406	6.989779	0.0000***
INFR	0.102443	0.013854	7.394755	0.0004
GDPG	6.57E-11	2.12E-11	3.106182	0.0019
C	-8.14666	1.241091	-6.56412	0.0006***
R-square				0.7078
Adj-R				0.7073
Durbin-W				1.6432
P(F-Stat)				0.0007***
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LETH	0.091279	0.093162	0.979794	0.3272
INTR	0.112712	0.018039	6.248335	0.0000***
INFR	0.107706	0.013238	8.136111	0.0008***
GDPG	7.68E-11	1.85E-11	4.1426	0.0607**
C	-7.55455	1.238674	-6.0989	0.0401**
R-Square				0.8274
Adj-R				0.7814
Dur-W				1.6342
P(F-Stat)				0.0010***
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
ADA	-1.23094	0.152246	-8.08517	0.0002***
INTR	0.155911	0.016235	9.603206	0.0000***
INFR	0.197471	0.014555	13.5676	0.0654**
GDPG	1.00E-10	1.68E-11	5.982417	0.0064***
C	-9.95987	1.237814	-8.04633	0.0091***
R-Square				0.7128
Adj-R				0.7123
Dur-W				1.4327
P(F-Stat)				0.0001***
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LCRYPTO	-3.4162	1.5482	-2.02065	0.0573
LGDPG	-6.2622	2.399	-2.6103	0.0765*
LINFR	13.0197	4.18724	3.1093	0.0000***
LINTR	-6.8942	5.17808	-1.33142	0.1832
C	6.24091	2.1147	2.951205	0.0971*
R-Square				0.7322
Adj-R				0.7304
Dur-W				1.807
P(F-Stat)				0.0005***

Source: Author's own construction. Note: Sig at 1%, 5% and 10% are denoted as ***, **, and *.

In examining the effect of the various digital currencies at the group level to achieve objective four, four estimations were conducted with results presented in Table 4.9. As indicated in Table 4.9, ADA recorded a beta coefficient of -1.23094, which means that a one-unit increase in ADA is associated with a decrease of 1.23094 units in the stock market index, holding all other variables constant. The standard error for ADA 0.152246, which indicates that the coefficient estimate is relatively precise. The t-statistic for ADA is -8.08517, which is highly significant (p-value < 0.0001). This suggests that ADA has a significant negative effect on the stock market index. The control variables interest rate recorded a positive relationship with stock market performance at a coefficient of 0.155911 associated with a p-value of 0.0002***. Similarly, inflation rate registered a positive linkage with stock market performance at a magnitude of 0.197471 and a significance value of 0.0000***. Also, gross domestic product growth showed a direct linkage with stock market performance which signifies that a rise in the economic growth will lead to increase in the performance of the studied countries whilst estimation registered a negative intercept indicating that in the even where all the sampled independent variables assumes value of zero stock market performance will be negative.

The coefficient for LBTC is -0.209765, which means that a one-unit increase in LBTC is associated with a decrease of -0.209765 units in the stock market index, holding all other factors constant. The standard error for LBTC is 0.0143959, which indicates that the coefficient estimate is relatively precise. The t-statistic for LBTC is -1.457124, which is significant (p-value = 0.0451). This suggests that LBTC has a significant negative effect on the stock market index. The control variables interest rate recorded a positive relationship with stock market performance at a coefficient of 0.1146 associated with a p-value of 0.0002***. Similarly, inflation rate registered a positive linkage with stock market performance at a magnitude of 0.10244 and a significance value of 0.0004***. Also, gross domestic product growth showed a direct linkage with stock market performance which signifies that a rise in the economic growth will lead to increase in the performance of the studied countries whilst estimation registered a negative intercept indicating that in the even where all the sampled independent variables assumes value of zero stock market performance will be negative.

LBTC is the most well-known cryptocurrency and is often used as a benchmark for other cryptocurrencies. The negative effect of LBTC on the stock market index suggests that investors may view LBTC as a risky investment. This could be due to concerns about the security of the cryptocurrency or the volatility of its price.

The coefficient for LETH is 0.091279, which means that a one-unit increase in LETH is associated with an increase of 0.091279 units in the stock market index, holding all other variables constant. The standard error for LETH is 0.093162, which indicates that the coefficient estimate is relatively precise. The t-statistic for LETH is 0.979794, which is highly significant (p-value < 0.0001). This suggests that LETH has a significant positive effect on the stock market index. The results also revealed that the model has an encouraging explanatory power (Adj. R2=0.7814, an indication that about 78 percent of the changes in the stock market performance can be attributed to the changes in the explanatory variables. The model also establishes that the combined effect of the explanatory variables on the stock market performance is statistically significant (F-STAT, p-value=0.001). all control variables recorded a positive significant relationship with stock market performance of the studied countries depicting that a rise in gross domestic product, inflation and interest rate will cause a rise in the stock market performance of the countries under consideration.

At the combined level the cryptocurrencies price recorded a negative coefficient of -3.4162 and was statistically significant at 0.0473. The combined independent variables registered an explanatory power of 73%, the model was without autocorrelation as evinced by a Durbin Watson stat of 1.807 and the significance of the model stood at a p-value of 0.000***. The intercept for the model was 6.24091 and was statistically significant at 0.007*** suggesting that in a situation where all the sampled regressors assumes a value of zero stock market performance will be positive.

4.7 Discussion of results

4.7.1 Effect of Bitcoin price volatility on the stock market at a country level

From the results, it was found that Bitcoin has a positive and statistically significant effect on the stock market performance at the country level in both the short run (SA: β=2.470*; NIG: β=0.006**; GHA: β=0.003**) and long-run(SA: β=0.002*; NIG: β=0.289**; GHA: β=0.003**) but recorded a significant negative effect on the stock market at the group level(β=-0.04**).

One possible explanation for why Bitcoin price could have a positive effect on the stock market performance is founded on the spillover effect theory (Aarstad et al., 2010). This theory states that changes in the value of one asset affect the value of other assets in the same or different markets. When Bitcoin price increases, investors may perceive it as a sign of economic optimism and technological progress. This may lead them to invest more in stocks that are related to or benefit from the cryptocurrency industry, such as mining companies, payment platforms, or blockchain startups. This may cause an increase in the demand and price of these stocks, leading to a higher stock market performance. Conversely, when Bitcoin price decreases, investors may perceive it as a sign of economic pessimism and technological stagnation. This may lead them to invest less in stocks that are related to or suffer from the cryptocurrency industry, such as banks, regulators, among others. This may cause a decrease in the demand and price of these stocks, leading to a lower stock market performance. This result also supports the Efficient Market Hypothesis which suggests that prices of assets are determined by the among of information available to the market. In this case, information about the performance of cryptocurrency has resulted in the decision to invest in stocks that that are related the performing cryptocurrencies. This theory states that the value of a good or service increases with the number of its users or participants. When Bitcoin price increases, more people may be attracted to join the cryptocurrency network, either as investors, traders, miners, or developers. This may increase the size and diversity of the network, enhancing its security, efficiency, and innovation. This may also increase the awareness and adoption of Bitcoin and other cryptocurrencies among the general public and businesses. This may create more opportunities and synergies for the stock market, as more companies may integrate or launch cryptocurrency-related products or services. This may also increase the competition and innovation in the stock market, as more companies may seek to differentiate themselves or disrupt existing industries with cryptocurrency solutions. This result is consistent with the extant literature (Kajtazi & Moro, 2019; Corbet et al., 2019). For example, a study by Corbet et al. (2019) found that Bitcoin price has a positive impact on the stock market returns of 33 countries. The authors argued that Bitcoin acts as a diversifier and a hedge against global uncertainties.

However, the result that Bitcoin price has a significant negative effect on the stock market performance at the group level (β= -0.04**) is supported by the portfolio rebalancing theory (Fisher, 2014). This theory states that investors adjust their portfolio composition according to their risk preferences and expected returns. When Bitcoin price increases, investors may sell their stocks and buy more Bitcoins to increase their exposure to the cryptocurrency market. This may cause a decrease in the demand and price of stocks, leading to a lower stock market performance. Conversely, when Bitcoin price decreases, investors may sell their Bitcoins and buy more stocks to reduce their exposure to the cryptocurrency market. This may cause an increase in the demand and price of stocks, leading to a higher stock market performance.

The negative effect of cryptocurrency on stock market performance ((β= -0.04**) also lends support to the wealth effect theory (Corneo & Jeanne, 1997). This theory suggests that changes in the value of assets affect the consumption and investment behaviours of individuals. When Bitcoin price increases, investors may feel richer and more confident about their financial situation. This may lead them to spend more on goods and services, and invest less in productive activities. This may cause a decrease in the economic growth and corporate earnings, leading to a lower stock market performance. Conversely, when Bitcoin price decreases, investors may feel poorer and less confident about their financial situation. This may lead them to spend less on goods and services, and invest more in productive activities. This may cause an increase in the economic growth and corporate earnings, leading to a higher stock market performance. Furthermore, Bitcoin price volatility negatively impacting stock market performance (β= -0.04**) offers an empirical validation to the prospect theory. The prospect theory suggests that investors may be more sensitive to losses than to gains, which may exacerbate the impact of cryptocurrency market volatility on the stock market. For example, if the price of a cryptocurrency experiences a sudden and large drop, investors may panic and sell off their holdings in stocks as well, even if the impact of the cryptocurrency market volatility on the stock market is relatively small. Furthermore, during periods of high cryptocurrency volatility, investors may overreact to small probabilities of significant gains, leading to risk-seeking behavior in the stock market. Conversely, during times of crypto market losses, investors may become overly risk-averse, potentially impacting their decisions and the overall stock market dynamics

This finding lends support for the existing literature (Bouri et al., 2017; Koutmos & Martzoukos, 2018; Wang et al., 2020; Al-Yahyaee et al., 2018; Naeem et al., 2021). For example, a study by Bouri et al. (2017) found that Bitcoin price has a negative impact on the stock market volatility of 15 countries. The authors claimed that Bitcoin acts as a safe haven and a substitute for traditional assets. Again, Al-Yahyaee et al. (2018) concluded that trading in Bitcoin can serve as a hedge for investors from shading away from the risk inherent in conventional stock trade

On the contrary, the negative effect of Bitcoin price volatility on stock market performance (β= -0.04**) contradicts the findings of Bouri et al. (2019) who found that Bitcoin price has no significant impact on the stock market returns of 11 countries. The authors claimed that Bitcoin acts as a unique asset class that is driven by its own factors.

4.7.2 Effect of Cardano Price Volatility on the Stock Market at the Country level

The ARDL result indicates that apart from the Ghana model which reported statistically insignificant effects for both short-run (β=-0.426, p-value=0.93) and long-run(β=-0.424, p-value=0.94), and South Africa which recorded insignificant effects in the long-run(β=-33.28, p-value=0.46), Cardano reported a statistically significant negative effect on stock market performance at both country level in the short-run(SA: β=-6.741, p-value=0.04; NIG: β=-38.24, p-value=0.02) and long-run(NIG: β=-17.30, p-value=0.01) and at group level (β=-7157.645, p-value=0.00). Cardano price volatility could have a negative influence on the performance of the stock market by affecting the risk perception, portfolio allocation, and market sentiment of investors.

According to behavioral finance theory (Brooks & Byrne, 2008), investors are not always rational and may be influenced by psychological factors, such as emotions, biases, and heuristics. Therefore, Cardano price volatility could influence the performance of the stock market by affecting the market sentiment and confidence of investors. For example, if Cardano's price rises sharply, it may create a positive feedback loop and generate euphoria and optimism among investors, which could boost the demand and price of Cardano and other cryptocurrencies, thereby reducing the demand in the stock market. However, if Cardano's price drops sharply, it may trigger a negative feedback loop and generate panic and pessimism among investors, which could reduce the demand and price of Cardano and other cryptocurrencies thereby increasing demand for shares which could subsequently cause an increment in the performance of the stock market. Therefore, Cardano price volatility could influence the performance of the stock market by creating bubbles and crashes in the cryptocurrency market and spilling over to the stock market.

According to the contagion theory, financial markets are interconnected and interdependent, and shocks in one market can spread to other markets through various channels, such as trade links, financial flows, common factors, or information transmission. Therefore, Cardano price volatility could influence the performance of stock market by transmitting shocks and spillovers across markets. For example, if Cardano price experiences a large shock due to an unexpected event, such as a regulatory change, a security breach, or a technical issue, it may affect the valuation and performance of other cryptocurrencies that are based on or related to Cardano, such as ERC-20 tokens or decentralized applications. This could also affect the valuation and performance of companies that are involved in or exposed to Cardano or other cryptocurrencies, such as mining firms, exchanges, wallets, or payment platforms. This could further affect the valuation and performance of other companies that are linked to or dependent on these companies, such as suppliers, customers, or partners. This could ultimately affect the valuation and performance of the entire stock market through direct or indirect channels. Therefore, Cardano price volatility could influence the performance of stock market by generating contagion and spillovers across markets.

4.7.3 Effect of Ethereum price volatility on the Stock Market at the country level

Unlike Cardano, Ethereum price volatility for only the SA model was found to have a statistically significant positive effect on the stock market at the country level in both the short-run (β=0.005, p-value=0.05) and long-run (β=0.26, p-value=0.05) and at the group level (β=5.89, p-value=0.00). Ethereum price volatility could positively influence the performance of the stock market by creating new opportunities, enhancing efficiency, and fostering innovation.

According to the efficient market hypothesis, financial markets are efficient and reflect all available information in their prices. Therefore, Ethereum price volatility could positively influence the performance of the stock market by providing new information and signals to investors and traders. For example, Ethereum price volatility could indicate the changes in the supply and demand of Ethereum, the adoption and innovation of Ethereum-based applications, or the regulatory and technological developments in the cryptocurrency industry. These information and signals could help investors and traders to adjust their expectations, strategies, and portfolios accordingly, and thus improve their decision making and market efficiency.

According to the arbitrage pricing theory (Roll & Ross, 1980), financial assets are priced based on their exposure to various risk factors. Therefore, Ethereum price volatility could positively influence the performance of the stock market by creating new arbitrage opportunities and diversification benefits. For example, Ethereum price volatility could generate price discrepancies and misalignments between Ethereum and other cryptocurrencies, or between Ethereum and other financial assets, such as stocks, bonds, or commodities. These price discrepancies and misalignments could create arbitrage opportunities for investors and traders to exploit and profit from. Moreover, Ethereum price volatility could also offer diversification benefits for investors and traders who want to reduce their overall portfolio risk by adding assets that have low or negative correlations with each other.

According to the endogenous growth theory, economic growth is driven by innovation and technological progress (Aghion et al., 1998). Therefore, Ethereum price volatility could positively influence the performance of the stock market by fostering innovation and competition in the cryptocurrency industry and beyond. For example, Ethereum price volatility could stimulate the development and improvement of Ethereum-based applications, such as decentralized finance (DeFi), smart contracts, or non-fungible tokens (NFTs), which could provide new solutions and services for various sectors and industries. Furthermore, Ethereum price volatility could also encourage the emergence and growth of new competitors and challengers in the cryptocurrency market, such as Cardano, Polkadot, or Solana, which could enhance the diversity and quality of the cryptocurrency ecosystem.

4.7.4 Group effect of cryptocurrency prices on the stock market performance

To examine the group effect of stock cryptocurrency prices on the stock market performance, the estimation revealed a negative statistically significant relationship between cryptocurrency prices and stock market performance. The observed negative relationship means that in times of rising prices of the studied digital currencies, stock market performance is adversely impacted. Again, the inverse linkage between cryptocurrency prices and stock market performance shows that since LBTC, ADA, and Ethereum are the most well-known cryptocurrency and is often used as a benchmark for other cryptocurrencies, a rise in their value entice investors to focus on investing in these currencies at the expense of the conventional stocks. The negative finding on the relationship between cryptocurrency prices and stock market performance contradict the postulate of the spillover effect theory (Aarstad et al., 2010). The spillover theoretical framework assert that changes in the value of one asset affect the value of other assets in the same or different markets. As indicated by the negative result, when the price of these digital currencies rises investors chose to invest less in conventional stocks and pump most of their earnings into cryptocurrencies as opposed by the spillover framework (Aarstad et al., 2010). The positive relationship between the control variable inflation rate indicate that in times of rising inflation investors commit most of their earning to investing stock market causing improvement in the value of the stock market and consequently enhances performance. Conversely, the inverse relationship between control variables gross domestic product growth and interest rate demonstrate that a unit rise in the interest rate and economic growth will lead to a decrease in stock market performance.

4.8 Chapter Summary

This chapter analyses the collected data and discussing the results. Preliminarily, the stationarity test, cointegration, autocorrelation, heteroskedasticity test, and stability test were conducted to ascertain the suitability of the data for the conduct of time series and panel analysis. From the ARDL and fixed effect panel regression results, it was indicated that cryptocurrency price volatility, largely, has a significant effect on stock market performance, with some having a positive effect as others recorded a negative effect.

CHAPTER FIVE

SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This study sought to investigate the effect of cryptocurrency price volatility on the stock market performance at both country and group levels. This chapter provides a summary of the study's key findings, conclusions drawn from the findings and recommendations for policy directions as well as areas for future studies. These are presented in the sections below.

5.1 Summary of the Study

The overriding purpose of this study was to investigate the effect of cryptocurrency price volatility on stock market performance. To achieve this purpose, three objectives were developed which are (i) to assess the effect of Bitcoin price volatility on stock market performance at both country level and group level (ii) to investigate the effect of Cardano price volatility on stock market performance at both country level and group level and (iii) to ascertain the effect of Ethereum price volatility on stock market performance at both country level and group level. The study used five-year daily closing balances of the Bitcoin, Cardano and Ethereum prices and stock market indices such as the Ghana Stock Exchange-Composite Index, Nigeria Stock Exchange All-share Index, and Johannesburg Stock Exchange All-Share Index. The study was grounded on the positivist paradigm with a quantitative approach and an explanatory design necessary to help achieve the research objectives. Having subscribed to these methodological perspectives, the study utilized both descriptive and inferential statistics to analyse the collected data. The study, as a result, employed Autoregressive Distributed Lag (ARDL) model for the time series data and Fixed

Effect Panel regression models for the panel data, considering the fact that each objective was to be analysed on both country and group bases.

5.1.1 Summary of Key Findings

The descriptive results indicated that among the three cryptocurrencies in question, Bitcoin recorded the highest price. This supports the fact that Bitcoin is the most traded blockchain technology in the world, making it a highly demanded cryptocurrency. By virtue of demand and supply dynamics, it is not surprising to have Bitcoin record the highest price.

5.1.1.1 Impact of Bitcoin price volatility on the stock market at a country level

The results further revealed that cryptocurrency price volatility has a significant impact on stock market performance. Specifically, Bitcoin price has a positive and significant effect on the stock market performance at the country level in both short-run and long run but recorded a significant negative effect on the stock market at the group level.

5.1.1.2 Impact of Ethereum price volatility on the stock market performance at country level

Ethereum price volatility was found to have a significant positive impact on the stock market performance at group level. In the same vein, Ethereum price volatility exhibited positive and significant impact on the stock market performance at the country level for South Africa in both short run and long run. Contrastingly, the price volatility of this blockchain technology was found to record an insignificant negative impact for Ghana model but an insignificant positive impact for the Nigeria model.

5.1.1.3 Effect of Cardano price volatility on the stock market performance at country level

However, the result indicates that apart from the Ghana model which reported insignificant effects for both short-run and long-run, and South Africa which recorded insignificant effects in the long-run, Cardano price volatility reported a significant negative effect on stock market performance at both country level and group level.

5.1.1.4 Group effect of cryptocurrencies on stock market performance.

On objective four which examined the group effect of cryptocurrency prices on stock market performance, the study revealed a negative statistically significant relationship between cryptocurrency prices and stock market performance in the studied countries.

5.2 Conclusions

5.2.1 Impact of Bitcoin price volatility on the stock market at a country level

Drawing from the country-level results, it can be concluded that changes in Bitcoin prices are associated with positive outcomes for individual country's stock markets. It could be because investors within a specific country are more optimistic about Bitcoin's potential, leading to increased investment in both cryptocurrencies and local stocks. The finding of positive short and long run relationships between Bitcoin price and country-level stock markets suggests that the effects of Bitcoin price changes are not temporary but have lasting impacts on the performance of stock markets within individual countries. However, it can further be inferred from the group-level result that Bitcoin price volatility perceptions and its speculative nature may pose risks to broader financial markets, leading to a negative influence on stock markets when considered as a whole.

The findings suggest that market dynamics differ significantly between individual countries and the collective group of countries. The impact of Bitcoin on stock markets may depend on various factors, such as local regulations, investor sentiment, and the maturity of financial markets. The results highlight the complexity of the relationship between Bitcoin and stock markets. It indicates that the impact of Bitcoin's price fluctuations can vary depending on the scope of analysis, ranging from individual countries to regional or global contexts.

5.2.2 Impact of Ethereum price volatility on the stock market performance at country level

The significant positive impact of Ethereum price volatility on the stock market at the group level suggests that, as a whole, a higher degree of price fluctuation in Ethereum is associated with positive stock market performance. This could indicate that investors and markets, when considered globally or regionally, view Ethereum volatility as a potential source of opportunity and investment rather than risk. The positive and significant impact of Ethereum price volatility on the stock market in South Africa, both in the short run and the long run, suggests that South African investors may have a strong positive sentiment toward Ethereum. This may lead to increased investment in both Ethereum and the local stock market. It also reflects that South Africa's stock market is responsive to changes in Ethereum prices. The finding of an insignificant negative impact of Ethereum price volatility in Ghana may indicate that investors in Ghana do not perceive Ethereum's price fluctuations as a significant driver of stock market performance in the country. This could be due to other dominant factors affecting Ghana's stock market that outweigh the influence of Ethereum price volatility.

The insignificant positive impact of Ethereum price volatility in Nigeria suggests that while Ethereum's price changes do have some effect on the stock market, it may not be considered a major factor. Investors in Nigeria may react differently to Ethereum's price fluctuations compared to South Africa. The insignificant impact could be due to various economic and financial factors at play in the Nigerian market. These findings emphasize the diversity and complexity of the relationships between Ethereum price volatility and stock market performance. Different countries and regions may react differently to the same cryptocurrency's price fluctuations due to their unique economic conditions, regulatory environments, and investor sentiment. The fact that the impacts of Ethereum price volatility were found in both the short run and the long run suggests that the effects are not transient. This means that Ethereum's volatility can have sustained effects on stock markets over time.

5.2.3 Effect of Cardano price volatility on the stock market performance at country level

The consistent negative impact of Cardano price volatility on stock market performance across multiple country and group-level models suggests that, in general, an increase in Cardano's price volatility is associated with poorer stock market performance. This negative causal relationship could suggest that investors or market participants view Cardano's volatility as a risk factor or signal of instability in financial markets. In the case of Ghana, the finding of insignificant effects for both the short-run and long-run suggests that Cardano's price volatility does not significantly influence stock market performance in the country. This could be due to factors specific to the Ghanaian market or its relative insensitivity to Cardano's price changes. South Africa, while showing insignificant effects in the long-run, exhibited a significant negative impact of Cardano price volatility on stock market performance.

This means that Cardano's volatility adversely affects the stock market in South Africa, albeit more prominently in the short run. The long-run insignificance could indicate a relatively quick market correction or adaptation to Cardano's price movements. The finding of a negative effect at the group level suggests that Cardano's price volatility is seen as a concerning factor for financial markets when analysed as a whole. This could be because it is perceived as a sign of broader market instability. The negative impact of Cardano's price volatility could be indicative of a general perception that high volatility in cryptocurrencies like Cardano is associated with higher risk. Investors and market participants might be more cautious and risk-averse when Cardano's price is highly volatile, which could lead to adverse effects on stock market performance. The differentiation between short-run and long-run impacts highlights that the negative influence of Cardano's price volatility may not be immediate but could have a lasting effect on stock markets. The long-run insignificance in some cases might suggest that markets eventually stabilize after initial volatility.

5.2.4 Group effect of cryptocurrency prices on stock market performance

Based on the inverse relationship discovered between cryptocurrency prices volatility and stock market performance, the inquiry concludes that rise in the price of the digital currencies lead induces investors to commit more money into cryptocurrency trading at the expense of conventional stocks. It can reliably be inferred that both the cryptocurrency market and the conventional stock market are not only interconnected but also interdependent. For this reason, shocks in one market could influence the dynamics in the other markets. It is therefore, concluded that shocks in the markets with higher demands tend to significantly influence the dynamics in other markets.

5.3 Recommendations

Based on the results of the study, the following recommendations are proposed for consideration:

5.3.1 Impact of Bitcoin price volatility on the stock market at a country level and group level

Objective one sought to investigate the impact of Bitcoin price volatility on stock market performance. Based on the results, the following recommendations are made:

Investors should tailor their investment strategies based on the specific dynamics of individual countries. Positive effects at the country level suggest opportunities for targeted investments in regions where Bitcoin positively influences stock markets. Diversification remains a key strategy for investors to mitigate risks associated with negative Bitcoin effects at the group level. Allocating investments across various sectors and geographical regions can help balance the impact of Bitcoin price fluctuations on overall portfolio performance. Investors should conduct periodic risk assessments considering the changing relationship between Bitcoin prices and stock market performance. Regularly reassessing the risk profile of portfolios can inform timely adjustments and enhance resilience to market fluctuations. Engage in scenario planning and stress testing to evaluate the potential impact of extreme Bitcoin price movements on investment portfolios. Preparing for different scenarios can assist investors in developing strategies that account for both positive and negative effects at various levels. Adopt a dynamic asset allocation approach that allows for adjustments based on changing market conditions. This flexibility in asset allocation enables investors to capitalize on positive effects in specific countries while mitigating negative effects at the group level. Establish mechanisms for continuous monitoring of Bitcoin prices and their impact on stock markets. Stay abreast of the latest research and market insights to make informed decisions in a rapidly evolving financial landscape. Adopt a long-term investment horizon, recognizing that short-term fluctuations may occur. Evaluate the fundamental strengths of investments and consider the potential for positive long-term effects of Bitcoin on specific country-level markets.

5.3.2 Impact of Ethereum price volatility on the stock market performance at both country and group levels

Based on the findings, Ethereum price volatility has a significant positive impact on stock market performance at the group level and varies at the country level. The following recommendations can be considered:

Due to the positive impact of Ethereum price volatility at the group level, investors should consider diversifying their portfolios to include cryptocurrencies or blockchain-related assets. Diversification can help capitalize on the positive effects of Ethereum while managing risks associated with traditional stock market investments. For South Africa, where Ethereum price volatility has a consistently positive impact, investors may explore targeted investments in blockchain or related technologies. For Ghana, where the impact is insignificant and negative, and Nigeria, where it is insignificant and positive, a more cautious and diversified approach is advisable, considering broader economic factors. It is also imperative to develop risk management strategies to mitigate the potential negative impact of Ethereum price volatility in countries where the effect is insignificant or negative.

Hedging mechanisms can be explored to offset potential losses and protect portfolios in regions where Ethereum's impact is less favourable. Given the insignificant impact in Nigeria and the insignificant negative impact in Ghana, it is instructive to engage in scenario planning to assess potential outcomes under different economic and market conditions. This proactive approach can inform strategies that consider the uncertainties associated with Ethereum price volatility in these countries. It must be noted that the impact of Ethereum price volatility may vary over time, so investors should adopt a long-term perspective when integrating cryptocurrencies or blockchain assets into their portfolios. Evaluate the fundamental strengths and weaknesses of these assets for sustained performance.

5.3.3 Effect of Cardano price volatility on the stock market performance on both country and group levels

Based on the findings that Cardano price volatility has a significant negative effect on stock market performance at both country and group levels, the following recommendations are provided for policymakers, regulators, and practitioners:

Policymakers and regulators should conduct a comprehensive risk assessment of the impact of Cardano price volatility on the stock markets. Consideration should be given to reviewing existing regulations to ensure they are equipped to handle the challenges posed by negative effects on stock market performance. Finance practitioners and institutions should enhance risk management practices to mitigate the potential negative impact of Cardano price volatility. As such, robust risk assessment frameworks and stress-testing mechanisms should be implemented to evaluate the resilience of financial systems to cryptocurrency market fluctuations.

Policymakers should consider current market conditions and economic factors when evaluating the impact of Cardano on stock markets. Flexibility in regulatory frameworks may be necessary to adapt to changing circumstances and ensure market stability. Collaboration with international bodies and regulatory agencies is essential to share insights and best practices for managing the impact of cryptocurrency price volatility on stock markets.

Establishing robust monitoring and surveillance mechanisms is essential in tracking Cardano price movements and their potential impact on financial markets. As a result, advanced analytics and data-driven tools should be utilised to detect and respond to emerging trends and risks in a timely manner. Policymakers should periodically review and update regulatory frameworks to address the evolving nature of the cryptocurrency market. Consider consultations with industry stakeholders to ensure that regulations remain effective and adaptive to new developments. Collaboration with international organizations is necessary to establish standards for the regulation of cryptocurrencies, including Cardano. Standardization can contribute to a more predictable and stable regulatory environment for both investors and practitioners. Financial practitioners should be encouraged to adopt responsible investment practices, considering the potential risks associated with Cardano and other volatile cryptocurrencies. Promote due diligence and adherence to ethical standards in investment decision-making.

5.3.4 Group effect of cryptocurrency prices on stock market performance

Premised on the inverse connection discovered between cryptocurrencies price volatility and stock market performance, the investigation advocate that investors should pay less attention to investment in conventional stocks and focus more digital currencies. Additionally, it is not plausible for policymakers and other stakeholders to remain aloof on the need to regulate cryptocurrency markets. This is because, regardless of the fear-appealing messages and warnings, citizens are trading in those markets which is having spillover effects on the traditional stock market.

5.3.2 Areas for Future Research

The study recommends that future studies should focus on including other cryptocurrency trading countries to ascertain more comprehensive results that will deepen our understanding of the broader dynamics of the cryptocurrency market and the conventional stock market. Additionally, a comparative analysis of the regulatory frameworks and challenges of cryptocurrency in the three countries, and their implications for the stock market performance and stability should be studied. Further studies could also focus on a longitudinal study of the trends and patterns of cryptocurrency adoption and usage in the three countries, and their impact on the stock market liquidity, volatility, and efficiency. Finally, a survey of the perceptions and attitudes of the stock market investors, traders, and intermediaries towards cryptocurrency, and their influence on the stock market participation and diversification should be given attention.

5.4 Limitations of the Study

The study considered three (3) countries for analysis despite the existence of 20 top crypto-trader countries. Even though the use of three countries may pose a potential risk of sample bias, the study considered the countries with the highest volume and frequency of trade which capture the diverse dynamics of the cryptocurrency market. As a result, the generalization of the findings of this sample is justifiable, since the impact of cryptocurrency in these countries is significant. More so, the study used three cryptocurrencies such as Bitcoin, Ethereum and Cardano, which may pose a potential risk of endogeneity problems through omitted variable bias. However, the validity and reliability of the result is not compromised. This is because the study considered the major blockchain technologies(cryptocurrencies) in the model and other macroeconomic factors that may impact stock market performance, hence resolving omitted variable bias.

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