Examining Cryptocurrency Dynamics with Asian Equity Indices and Commodities: A Wavelet Coherence Analysis

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Abstract

A wide range of interest has been shown in this field by investors and decision-makers due to the correlation between cryptocurrencies, Asian stock indexes, and commodities in the global financial market through partitioning the data and applying the wavelet analysis approach to analyze the described movement of various variables. Moreover, this study seeks to provide information to fintech financiers and policymakers as well about the examined variables. Time-series data was obtained from 01st January 2019 to 31st December 2023 and analyzed from multiple internet sources about commodities, Asian Stock indices, and cryptocurrency prices. To find specific patterns and trends in a certain area, research used the wavelet approach to analyze the data and separate each series into a separate frequency band. The findings showed that there is a highly significant relationship among commodities, Asian stock indexes, and cryptocurrency in different frequency bands. On the other hand, a negative correlation was found in low frequency bands between the prices of commodities and cryptocurrency, whilst a positive correlation was found in high frequency bands between cryptocurrency and Asian Stock indices.

Key Words*: Crypto, Asian Stock, Commodities, Wavelet, Lagging, FinTech.*

Introduction

The digital revolution has been sparked by innovations across multiple industries and scientific and technological advancements. Financial technology has also been greatly impacted by this change. The growing acceptance of cryptocurrencies has led to a significant increase in their market value in recent times. The stock market's instability distribution and return act like an indicator of inter market interaction, providing current knowledge and understanding of international finance and having significant effects on portfolio and hedging decision-making. Professionals and scholars are very interested in the varying correlations between the values of equity stocks and the variations in crypto currency prices (Abdul Hamid & Talib, 2019). However, it is uncertain how crypto currencies relate to more established financial assets like commodities, and stock market indices. This study aims for investigating the correlational of crypto currency, Asian stock indices and commodities using the wavelet analysis technique. The global economy and traditional financial markets are being affected by the rise of FinTechs, cryptocurrencies, internet money transfers, and other technology advancements. Cryptocurrencies are a prime example of how technology improvements have affected both the global economy and traditional financial markets. They are safeguarded by encryption (Ha & Moon, 2018).

International financial markets have been dramatically impacted by the emergence of FinTech, cryptocurrency, and online financial transfers (Yang et al., 2019). Electronic financial transfer services were expensive and slow before Bitcoin. Digital currency, in its digital form, is equivalent to electronic money, according to the International Monetary Fund. According to Najeeb, Laraib & Ammar (2023) the issuer is the main distinction between virtual and electronic money virtual currency is produced in discrete units by private developers, whereas electronic money is governed and regulated by central banks using national currencies like PayPal. When virtual currency is frequently utilized in electronic transactions, it becomes more valuable and well-known; Habermeier (2016), the Fourth Industrial Revolution in finance is being accelerated by Bitcoin and its block chain technology, which is revolutionizing established financial systems (Su et al., 2020). Investments in gold provide consistent returns and are a wise choice for emergency savings, hedging against currency depreciation, and savings accounts. Gold, like Bitcoin, is a useful hedge in times of financial instability. Ibrahim & Basah (2022) With West Texas Intermediate (WTI) serving as a crucial pricing benchmark, the highly sought-after

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commodity known as crude oil which is produced from organic elements that date back millions of years has seen significant increases in prices.

The primary purpose of this research is the understanding the relationship between different financial assets especially the correlation of cryptocurrencies, stock index and conventional assets like gold, silver etc. With the goal of understanding investors in the digital currency market, this study intends to investigate the relationship between Cryptocurrency and other variables. In difficult economic times, there may be short- and medium-term difficulties, but long-term prospects for Bitcoin are bright, Ibrahim & Basah (2022). Once cryptocurrency gets acceptance as a secure investment with higher returns than traditional investments like securities, it has the potential to expand quickly and become one of the greatest asset classes in the world. Using the wavelet technique, this study aims to investigate the correlation of commodities, Asian stock indices, and cryptocurrencies. Data for the study was gathered from a variety of sources, including cryptocurrency exchanges, Asian stock markets, and commodities exchanges. The wavelet approach was subsequently applied on the data, and the resulting interpretation provided investors and policymakers in the fintech sector with innovative viewpoints.

Problem Statement

As cryptocurrency gains recognition, concerns about its potential to move in combination with other assets like commodities and the Asian stock indices are also growing. Fintech investors and policy makers find it challenging to develop a viable investment plan or to decide how to regulate these correlations due to always lack of understanding regarding them. This study investigates relationship among the movements of Asian stock indices, commodities and crypto currencies using the wavelet analysis technique. This study attempts to fill the absence in the literature by determining the correlation of different kinds of financial assets and offering beneficial knowledge for fintech investors and policy makers.

As compared to earlier studies that examined the correlation among crypto-currencies and other financial securities but had trouble correlation over a range of time scales, this technique was able to identify correlation across a variety of time scale and provides an extensive appreciation correlation of cryptocurrencies with other financial assets.

Research Question

- How does the wavelet analysis show that the correlation between commodities and the Asian stock indices changes over different time scales?
- What significant correlations were found by using wavelet analysis between

commodities, Asian stock indices, and cryptocurrency prices?

Literature Review

Recently, cryptocurrency has become extremely popular with investors, the public, scholars, and policymakers. Specifically, Bitcoin is not governed by any government or authority and has no intrinsic value yet having features of both commodity and fiat money. This study investigated the question of considering bitcoin present applications and usage it is possible to determine that bitcoin is an asset or just a tool for trading, possible uses of bitcoin in the future given its unique features Laraib, Ammar & Najeeb (2023).

Bitcoin has shown to be a successful alternative investment with high profit margins and superior performance. However, additional investigation is required because there is a great deal of danger involved with the enormous payoff. Investors are impacted by this elevated risk, which could potentially have an impact on the global economy. Kurihara and Fukushima (2018) suggest same as Liaquat & Siddiqui (2021) that fluctuations in the value of Bitcoin could influence the effective distribution of resources in the economy, hence influencing the prices of stocks, gold, silver, and crude oil.

The analysis of Bitcoin's price movement is convincing as, despite the cryptocurrency's lack of a tangible asset backing, one factor affecting price fluctuation is the forecast of future market demand. According to Kristoufek (2015), Bitcoin's transaction mechanism makes it interesting to estimate its future price. Furthermore, as these new commodities and investment options are developed so this research direction is examining the connections between Cryptocurrency and other commodities like gold, Brentoil and silver. There has been a noticeable increase in the amount of research conduct on block chain innovation and cryptocurrency over time. Many academics have used a variety of statistical computation techniques to determine the effects of including cryptocurrencies into various investing portfolios.

The independent position of block chain cryptocurrency in the global investment market indicates that it is an independent kind of digital money that functions independently of traditional financial instruments and has no effect on stock market indexes (Peltomäki, 2022). Reoboredo (2013) analyzed the price volatility of bitcoin and gold. Using the GARCH model, he demonstrated that over time, bitcoin and gold act as simultaneously unstable shelters and hedges. Bitcoin functions as an unstable haven in the near term but serves as an excellent hedge asset in the long term. Other research, especially in the Chinese market, was done by Kristoufek (2015) on the response of bitcoin to various economic factors. The study

discovered that the money supply and fundamental economic variables like GDP, interest rates, and price index have a long-term impact on the price of bitcoin. In the other studies, Sariannidis et al. (2009), Wong (2017), and Baur et al. (2018) GARCH volatility analysis was used to examine the changes in price of Asian stock indices, commodities and bitcoin. The study found that the correlated qualities that return over time and volatility of bitcoin set it apart from Asian stock indices and commodities.

In conclusion, a lot of investors now recognize cryptocurrencies as their primary option for investing. Several studies have been done on the relationship between bitcoin and other commodities or economic indicators as a new investment option. The currently available body of research highlights the importance it is to understand how cryptocurrencies, the Asian stock indices, and commodities function within the global financial system. One approach that shows promising for stripping down and examining the complex relationships between these variables is wavelet analysis.

Empirical Review

The past study has examined the relationship between cryptocurrency and equity markets; however, not much has been discovered about the co-movement of blockchain in cryptocurrency and stock markets of major global indices. A study done by Briere et al. (2015) examined the effect of cryptocurrency returns on equity market returns and discovered a significant correlation. According to Trabelsi's (2018) research, there is a strong correlation between Bitcoin and stock market volatility. Analyzed the relationship between Bitcoin and Asian stock markets, demonstrating that Bitcoin significantly affects Asian stock markets (Yaya, 2018).

Past research has examined the correlation between different financial factors, including commodities, Asian Stock Indices and crypto currencies. However, wavelet analysis is not applied much for investigating this issue. By breaking out the link between of this variable into distinct frequency bands using wavelet analysis, our study knowledge gap in the field of offering regulators and fintech investor's insightful information. By analyzing the relationship between these variables, our research adds a significant body in already existing literature. This study clarifies the spectral and temporal capabilities of these variables's correlation, which has important implications for investments and policy. This research also emphasizes the importance of considering different frequency bands when analyzing the co-movement of financial indicators. According to this research, wavelet analysis can be used to examine the relationship between financial factors. Policymakers and investors will find this

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research information helpful when making decisions about investments in these variables and economic policies in general.

Hypothesis:

- H1: There is a significant correlation between crypto-currencies prices and Asian stock markets indexes

- H2: There is a significant price correlation of crypto-currencies and commodities

Figure 1
Research Framework
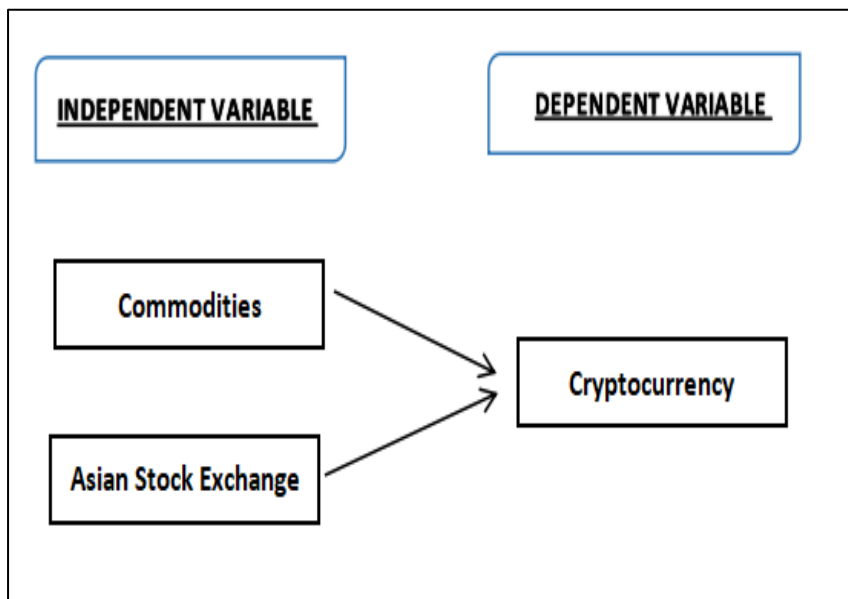
Research Methodology

This research methodology is meant to provide an in-depth explanation of the techniques that have been used to gather and manage the data for this study. The purpose of this research topic is to identify geographical trends and patterns in the co moments of cryptocurrency, Asian stock indices and commodities. It is very important to select a research methodology which is aligning with the research question and objectives. The primary objective of this study is to uncover the potential volatility effects of both commodity and Asian stock indices on cryptocurrency and this research used wavelet analysis statistical software R studio and Python libraries to find specific patterns and trends in their movement. To ensure the study's validity and reliability a stringent and systematic method was taken. Time series data on cryptocurrency, Asian stock indices and commodities were obtained from verified resource investing.com. The wavelet techniques were applied to breakdown each series of data into individual frequency data and successfully identifying patterns and trend in their co-moments.

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Data Collection Procedure

This portion covers the methods adopted to collect the study's data "A comparative analysis of cryptocurrencies and their interaction with Asian stock indices and commodities; a wavelet coherence based multi resolution study". The following information is discussed for data collection: -

Study Population

The following factors were part of the study's data collection process:

1. Crypto currencies
2. Commodities
3. Asian Stock Indices

The study gathered data from two sources:

a) **Official Data**: www.investing.com provides official data from multiple types of marketplaces. Data for commodities, cryptocurrencies, and currency pairs were gathered from this source.

b) **Survey Data:** There was no survey data collected for this study because its goal was to assess official data that was already available on website

c) For categories of the countries this study used website msci.com emerging markets index region and country allocation.

Overall, the data collection method involved compiling official data from these two sites and analyzing it with wavelet analysis to look at how cryptocurrencies, Asian stock indices and commodities moved together.

Secondary Data Analysis

Analyzing secondary data involves utilizing Pre-existing data and information acquired from a different source. Investing.com, which offered pre-existing data on cryptocurrencies, Asian stock indices and commodities over a five-year period (2019 till 2023), were the data sources that were used. Access to these appropriate sources was necessary to collect data and do secondary data analysis. Once the data was gathered, the co-movement of cryptocurrencies, Asian stock indices and commodities was broken down using the wavelet analysis approach.

A time series may be broken down into unique frequency bands using wavelet analysis, which finally made it possible to identify patterns and correlations between various variables. The data were analyzed using statistical software R studio and Python. The software allows for the import of data and the subsequent wavelet analysis, which separates the data into

several frequency bands. Insight on the correlation of crypto-currencies, commodities and Asian stock indices can be obtained by analyzing the patterns and relationships between various variables. In general, secondary data analysis is the best technique for gathering information for this research.

The already existing information from investing.com and wavelet analysis approach applied to breakdown this data, the volatile movements of commodities, Asian stock indices and crypto-currency values could yield an extensive amount of information.

The Continuous Morelt Wavelet Transform (CMWT)

The research investigates the correlation and co movement of investment market using the Continuous Morelt Wavelet Transform CMWT. To identify periodic signals precisely in the temporal and frequency domains, CWT uses wavelet coherence cross correlations and variance analysis to detect spatial co-movement. This method offers insightful information about the changing patterns and synchronicity of investment markets.

In and Kim (2013) state that CMWT is obtained by multiplying the signal with scaled, shifted copies of wavelet function φ:

C (scale, position) = $\int X_t(scale, position, t) \ dt$ **(1)**

Using scale and location function Xt, the CMWT generates a set of wavelet coefficients C that represent different values of a time series data. Burrus et al. (1998), Grossman and Morlet (1984), and Gabor (1946) have defined the CMWT for two continuous variables as follows:

F (a, b) = $\int X_t \varphi\left(\frac{t-a}{b}\right) \ dt$ **(2)**

It is possible to simplify the Morlet wavelet.

$$\varphi(\omega) = \pi^{\frac{-1}{4}} \ e^{i\omega\psi} \ e^{-\frac{\omega^2}{2}}$$

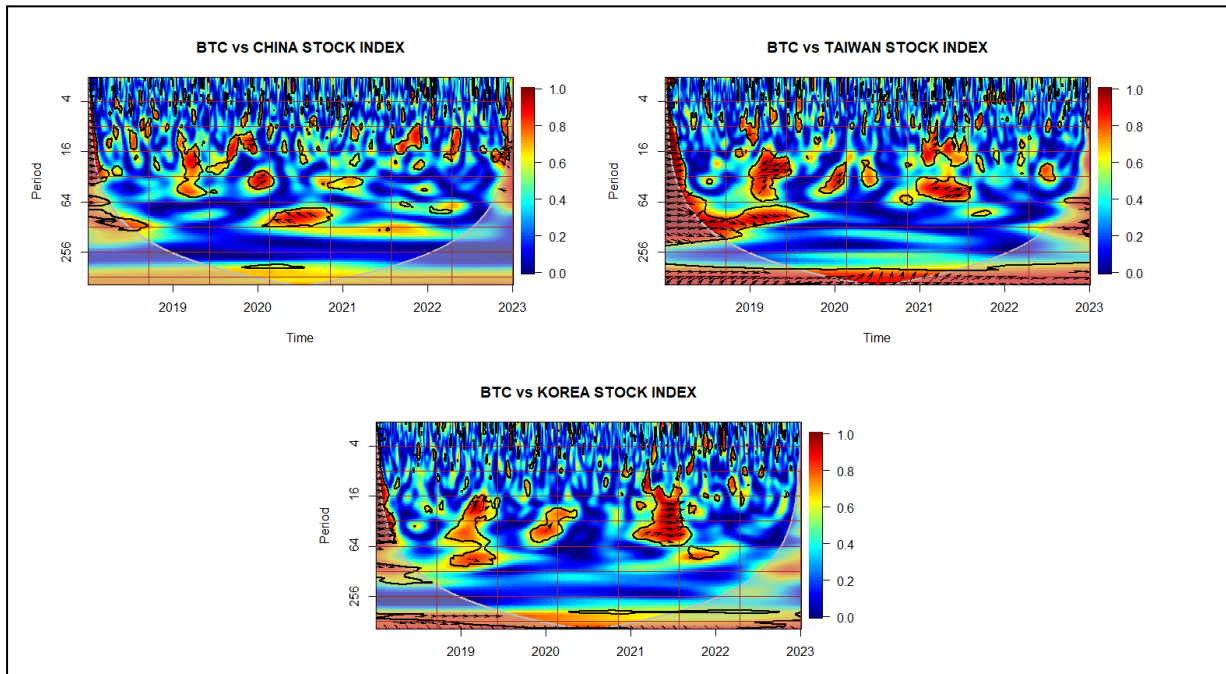Where the parameter for "time" (ω) is non-dimensional.

Results and Discussion

**The Continuous Morelt Wavelet Transform (CMWT) Analysis and Result**

Figure 2
Bitcoin and Asian Stock Indices

correlation between 2019 and 2020, especially from 16 to 64, when the vector arrows pointing diagonally downward to the right indicate a slowdown in the crypto currency market. Then in year 2020 to 2021 the China stock index is leading crypto currency returns, as seen by the negative correlation that appears around period 64, vector arrow in this correlation point upward to the left. In picture 2 (BTC vs. Taiwan Stock Index) a positive correlation can be observed prior to 2019, about between periods 16 and 64, vector arrows point diagonally upward and to the right, signifying the market leadership of crypto currencies. Another positive correlation, with arrows pointing diagonally downward to the right appears in 2019 at frequency 64, indicating a decline in the market presence of crypto currency. Vector arrows point diagonally downward to the right from 2019 to 2022, during periods 16 to 64, reviving a positive correlation and demonstrating the market leadership of crypto currency. In picture 3 (BTC vs. Korea Stock Index) at the start of 2019, there was no discernible relationship between the Korea stock index and bitcoin. A positive correlation appears between 2019 and 2020, during periods 16 and 64, by vector arrows pointing diagonally upward right side, demonstrating that crypto currency has boosted the market. The vector arrows point straight to the right with no upward or downward movement, indicating that

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there is no valuable connection among the variables from 2021 to 2022 during the same periods 16 to 64.
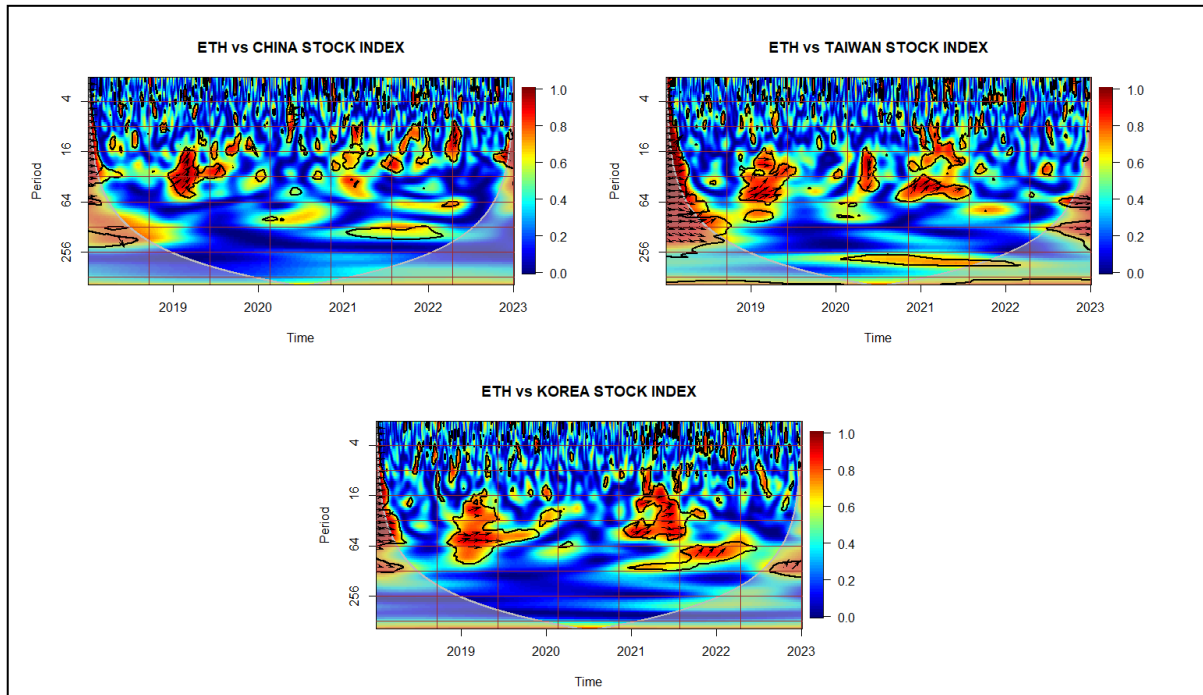
Figure 3
Bitcoin and Commodities
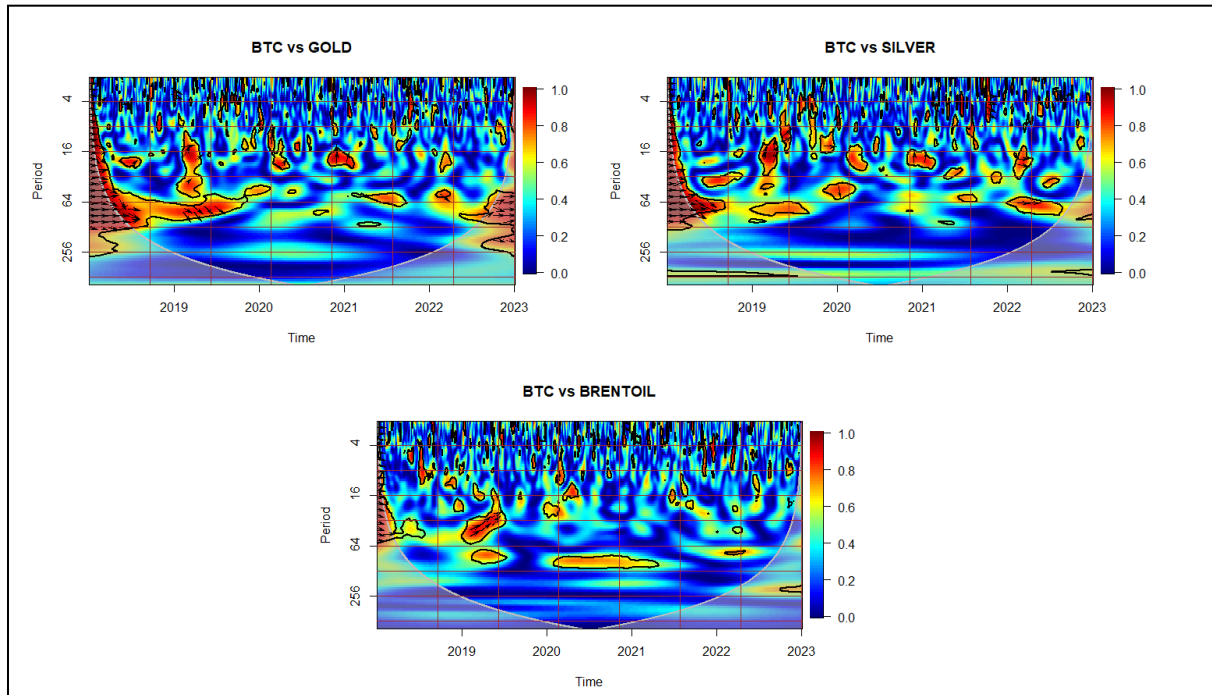
In Figure 3, (BTC vs Gold) show a clear positive link around period 64 just before 2019, with vector arrows moving diagonally downward right side, that crypto currency is declining in the market. A positive connection is seen from 2019 to 2020 in period 64, with decreasing trends and vector arrows point downward slope on right side which is revealing a decrease in the crypto currency market. With vector arrows point upward sloped in right side in 2019 at period 16, there is a brief upward trend that suggests crypto currencies are driving market. At around period 16, a positive correlation returns in 2021, suggesting that both assets are growing in importance. In picture 2 (BTC vs. Silver) just before 2019, there was a decrease in the variables and the vector arrows pointed diagonally downward and to the right, signifying that the crypto current market is trailing. The variables show a minor increase between 2019 and 2020, at period 16 and the vector arrows go diagonally downward right, explaining that crypto currencies are leading market. The two variables show a slight increase in 2021 at period 16, and the diagonal arrows pointing right direction on upward side, showing that crypto currency is dominating. With vector arrows pointing straight to the right, there is no obvious correlation among the variables from 2021 to 2023. In picture 3 (BTC vs. Brent oil) prior until mid-year of 2019 and 2020 around period 64, the variables do not appear to be

related to one another. Afterwards this, a positive correlation appears the crypto currency is leading the market is shown by diagonal arrows pointing right direction on upward side.
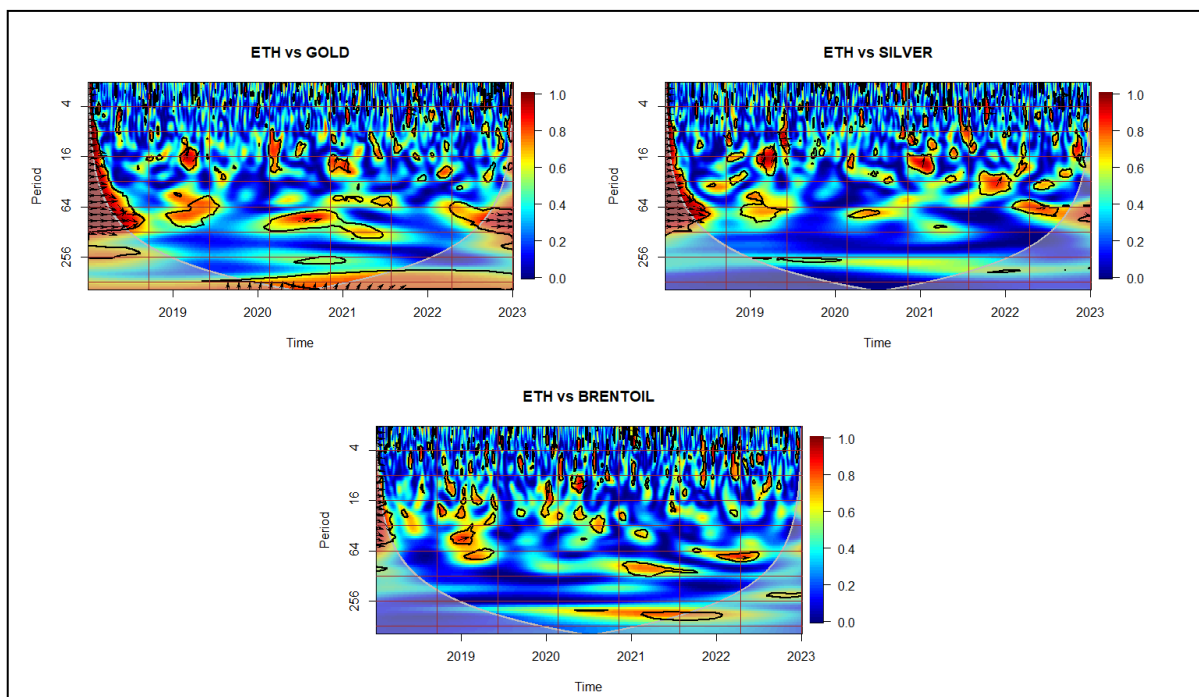
Figure 4
Etherem vs Asian Stock Indices

In Figure 4, there was not an apparent connection between ETH and China stock index before 2019. The China stock index and Eth have a positive relationship in year 2019 to 2020 from time frame 16 to 64. This correlation is shown by diagonal arrows pointing right direction on upward side. Demonstrating the crypto currency is influencing the market. A positive relationship is also seen between 2020 and 2021 approximately period 4, where vector arrows move diagonally upward right side, suggesting that crypto currency is pushing the market. Around periods 16 in 2022, there is another positive relationship shows that crypto currencies dominate the stock market, with diagonal arrows pointing right direction on upward side. In picture 2 (Eth vs. Taiwan Stock Index) showed a positive connection just before 2019, between periods 16 and 64. The vector arrows point diagonally upward and to the right side, suggesting that crypto currency is heading the market. Vector arrows moving diagonally upward right indicate the continuation of this positive correlation from 2019 to 2020. But between periods 16 and 64 in 2020 and 2021, a negative connection that shows diagonal arrows pointing left direction on downward side, suggesting that the Taiwan stock index is leading the market while crypto currency is trailing behind. A positive connection reappears from 2021 to 2022, roughly around periods 64, with vector arrows moving diagonally upward

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and to the right, suggesting that crypto currency is driving the market. In picture 3 (ETH vs. Korea Stock Index) were not thought to be correlated prior to 2019. Both variables demonstrate an improvement in 2019 between periods 16 and 64, with diagonal arrows pointing right direction on upward side, suggesting the fact that crypto currency is boosting in the market. This favorable relationship continues in 2022 between periods 16 and 64, with diagonal arrows pointing right direction on upward side suggesting that crypto currency is regulating the marketplace.
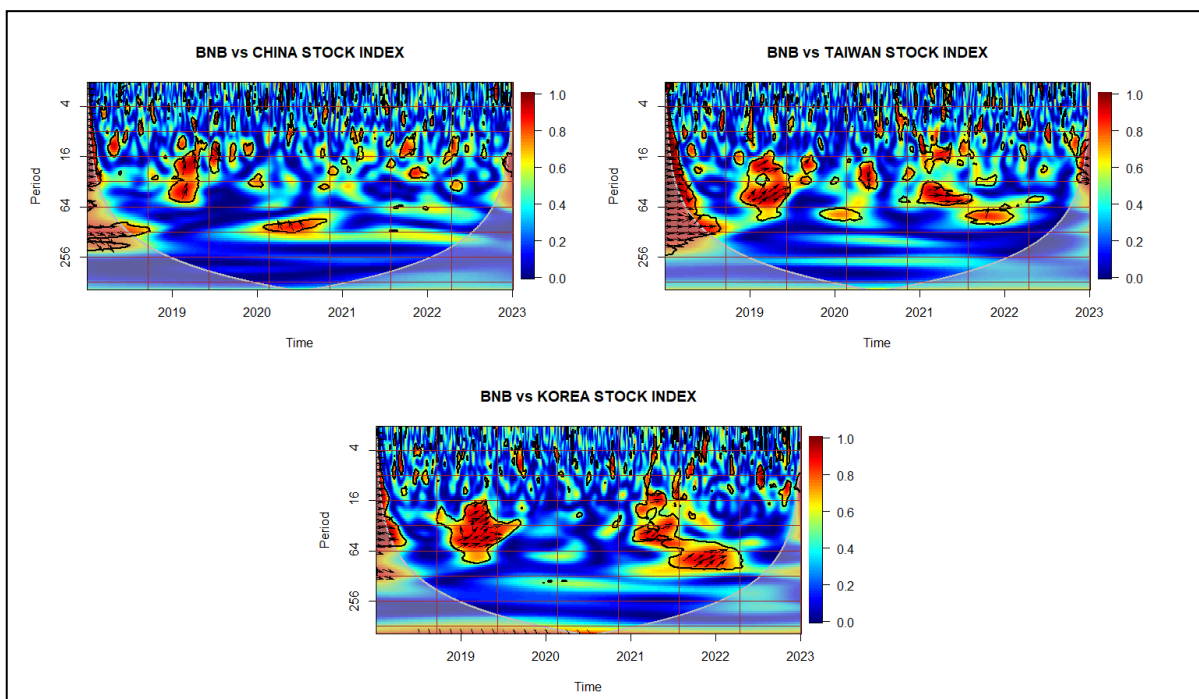
Figure 5
Etherem and Commodities

In Figure 5, (ETH vs. Gold) Even before 2019, there exists an uptrend between Eth and Gold, as demonstrated by vector arrows heading diagonally right upward. This suggests that the crypto currency market us expanding. Vector arrows heading diagonally upward to the right indicate that crypto currency will continue to lead the market from 2019 to 2021 specifically during periods 16 to 64. In picture 2 (Eth vs. Silver) the relationship between Eth and Silver shows a positive association but a fall earlier in 2019, at around period 64. Diagonal arrows pointing right direction on upward side indicate a slowdown in the crypto currency market. On the other hand, a positive correlation between the variables reappears around the middle of 2019 and 2020 about period 16 with diagonal arrows pointing right direction on upward side suggesting that crypto currency is leading in the market. Vector arrows heading

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diagonally upward to the right represent a minor climb in both from 2021 to 2022 probably representing periods 16 to 64 demonstrating that crypto currency continues to lead the market. In picture 3 (ETH vs. Brent Oil) there was no apparent connection between Eth and Brent oil before 2019. There is a favorable relationship at period 64, suggesting that both variables have increased over the time. In year 2020 period 16 shows the same positive relationship with vector arrows moving diagonally upward right side suggesting that crypto currency is driving the market. The variables no longer show any noticeable correlation after this.
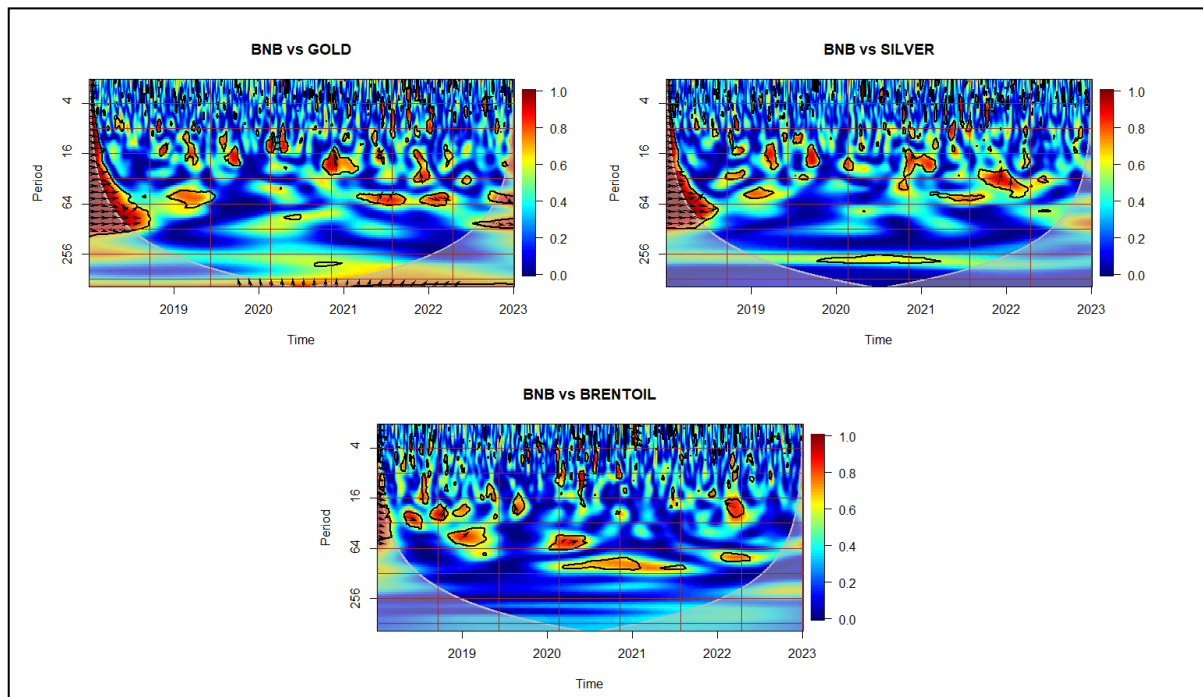
Figure 6
BNB vs Asian Stock Indices

In Figure 6, (BNB vs. China Stock Index) there was no apparent connections between BNB and the China Stock Index prior to 2019. Positive correlations with vector arrows moving diagonally upward the right side are seen between 2019 and 2020 in periods 16 and 64 this indicate that the crypto currency market is leading. Subsequently within the same time frame a positive correlation is observed implying that the stock market surpassing crypto currency returns. The diagonal arrows pointing right direction on downward side, indicating that crypto currency is trailing the market. The variables show a negative connection from 2020 to 2021 with vector arrows heading diagonally upward to the left suggesting that the stock market is leading, and crypto currency is lagging. In picture 2 (BNB vs. Taiwan Stock Index) have a positive correlation with one another just before 2019, between periods 16 and 64. This suggests that crypto currency controls the market's diagonal upward and rightward

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arrows. Comparable patterns are seen between 2019 and 2020 in the period range 16 to 64. While a negative connection between the variables diagonal arrows pointing left direction on downward side arises around period 64 in the middle of 2020 and 2021, indicating that the Taiwan stock index is dominating the market while crypto currency is slowing down. A positive connection between the variables diagonal arrows pointing right direction on upward side re-emerges between 2021 and 2022 between periods 16 and 64 suggesting that crypto currency is boosting the market. In picture 3 (BNB vs. Korea Stock Index) there is a small increasing trend between BNB and Korea stock index vector arrows heading diagonally upward to the right, just earlier in 2019 during periods 64. A favorable correlation with vector arrows moving diagonally upward right side is seen between mid of 2019 and 2020 at period 16 to 64, suggesting that cryptocurrency is leading the market. A positive connection remains between 2021 and 2023 about period 16 to 64, with vector arrows pointing diagonally upward to the right side indicating that the stock market lags while cryptocurrency leads.

Figure 7
BNB and Commodities

In Figure 7, (BNB vs. Gold) at period 64, which occurs just before 2019, shows a small increase in variables vector arrows heading diagonally upward right side, suggesting the crypto currency is dominating in the market. The vector arrows pointing straight left indicate that there is no meaningful link between the variables in 2021, at period 16. On the other

hand, a positive correlation appears in the middle of 2021 and 2022 around period 64, indicating that the stock market vector arrows are leading the cryptocurrency in a diagonal upward direction. Variable vector arrows circulating diagonally downward to the right show a slight decrease by 2022 around period 64. In picture (BNB vs. Silver) just before 2019 at period 64 vector arrows are positively correlated with arrows going diagonally upward to the right side. Between 2019 and 2021 no noteworthy correlation is observed. The stock market diagonal arrows pointing right direction on upward side in 2022 during period 64 a positive connection appears that suggests cryptocurrency is driving the stock market. In picture 3 (BNB vs. Brent oil) prior 2019 at period 64, there is a positive link between variables. At the middle of 2019, there is a positive correlation at around period 16 to 64 indicating that crypto currency is leading the market diagonal arrows pointing right direction on upward side. Yet there is a noticeable slight fall in both variables vector arrows pointing diagonally downward to the right. The positive correlation diagonal arrows pointing right direction on upward side from 2020 to 2021 in between periods 16 and 64 demonstrate that crypto currency is still leading the market. The variables vector arrows are slightly negatively correlated later in 2022, at period 64 and point diagonally upward to the left side implying that the crypto currency market is dragging.

Discussion and Conclusion

The wavelet analysis method was chosen for this study in order provides insight into how commodities, Asian stock indices, and cryptocurrencies are moving in tandem. The aim of this study is to aid investors and policymakers in the fintech sector, as well as significant information and insights that will help them make sensible decisions about regulatory frameworks and investment strategies. With the use of this technique, significant trends and correlations might be found by analyzing several wavelet plots with significant correlations and upward arrows observed across the majority of cryptocurrency and stock market index pairings, the data show a general affinity between stock market indices and cryptocurrencies, but these relationships can be change over time. These findings support the inter market correlations between cryptocurrencies, global stock and commodities stock performance as demonstrated by Ibrahim, J., & Basah, M. Y. A. (2022).

When exploring the relationship between cryptocurrencies and commodities, this study encountered periods of positive correlation between Bitcoin and gold, silver, and Brent oil. These times frames demonstrated when cryptocurrencies led or lagged the market. In this study's result shows where correlation and direction of arrows on right hand side indicate the

leading and lagging relationship between markets and crypto currencies. We examined these correlations among our variables using wavelet coherence. This wavelet analysis graphs reflected a strong to medium- and long-term relationship between cryptocurrencies and stock market indices of China, Taiwan and Korea. This study advice the investors and fintech policy makers to make short term strategies to manage the valuation of cryptocurrency and hedge the risk of stock market. The correlation between cryptocurrency and commodities also revealed both leading and lagging behavior. The results give investors more tools to uncover valuable possibilities in the financial technology sector and give policymakers more information about market dynamics to help them make judgments about regulations that will promote financial technology and economic growth. These findings aim to highlight the dynamic and complex interactions among cryptocurrencies, Asian stock indices, and commodities. It is important to keep in mind that the findings of study are dependent on specific time over a five-year period from 01st January 2019 to 31st December 2023 and this datasets analysis we used wavelet technique therefore, to provide a more thorough understanding of these relationships, future studies could consider expanding the analysis to cover longer time periods and with more different factors of the economy.

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