CAN CRYPTOCURRENCIES BE A NEW SAFE HAVEN?

NATHAPHAT NA CHIANGMAI

MASTER OF SCIENCE
IN DIGITAL INNOVATION AND FINANCIAL TECHNOLOGY

GRADUATE SCHOOL
CHIANG MAI UNIVERSITY
NOVEMBER 2022

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A THESIS SUBMITTED TO CHIANG MAI UNIVERSITY IN PARTIAL
FULFILLMENT OF THE REQUREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE
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Examination Committee:

…………………………. Chairman

(Lect.Dr. Pongsutti Phuensane)
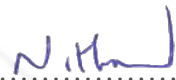
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(Lect.Dr. Nathee Naktnasukanjn)

…………………………. Member

(Lect.Dr. Piyachat Udomwong)

…………………………. Member

(Lect.Dr. Siva Shankar Ramasamy)

…………………………. Member

(Lect.Dr. Somsak Chanaim)

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…………………………. Advisor

(Lect.Dr. Nathee Naktnasukanjn)

…………………………. Co-advisor

(Lect.Dr. Piyachat Udomwong)

…………………………. Co-advisor

(Lect.Dr. Siva Shankar Ramasamy)

16 November 2022

b

To

Dr.Nathee Naktnasukanjn

Dr.Piyachat Udomwong

Dr.Nopasit Chakpitak

Dr.Anukul Tamprasirt

Dr.Pichayalak Pichayakul

Dr.Piang-or Laohavilai

Ms.Kanya Hirunwattanapong

Dr.Siva Shankar Ramasamy

**For my supervisors and mentors who were the guiding light
every step of the way as I researched for this thesis.**

c

ACKNOWLEDGEMENT

I have met a lot of mentors and friends during my two years of graduate study at ICDI Chiang Mai University.

First off, I want to convey my sincere gratitude to Dr. Nathee Naktnasukanjn, who oversaw my thesis, for his expertise and counsel. He gave me a lot of advice while I was writing my thesis and taught me a lot about finances and other topics, like assets and other things. I've been motivated to consider the subject more carefully by the advice.

Second, I want to thank my thesis co-supervisors, Dr. Piyachat Udomwong and Dr. Siva Shankar Ramasamy, who taught me data science and helped me understand the approach of this subject. The two mentors' insights into my writing will be a really beneficial asset.

Last but not least, I'd want to thank the instructors who helped me with a variety of subjects over my two years of study as well as the ICDI personnel. Your diligence will help me fully understand all the information in the fields of financial technology, the Internet of Things, data analysis, and finance. The creation of this paper laid a strong foundation, which also assisted me in conducting extensive research and revealing a wealth of information.

<div align="right">Nathaphat Na Chiangmai</div>

หัวข้อวิทยานิพนธ์	ฤๅเงินตราเข้ารหัสลับจะเป็นสินทรัพย์ที่หลบภัยในการลงทุนใหม่
ผู้เขียน	นาย ฉัฐภัทร ณ เชียงใหม่
ปริญญา	วิทยาศาสตรมหาบัณฑิต (นวัตกรรมดิจิทัลและเทคโนโลยีการเงิน)
คณะกรรมการที่ปรึกษา	อาจารย์ ดร.นที นาคธนสุกาญจน์ อาจารย์ที่ปรึกษาหลัก
	อาจารย์ ดร.ปิยะฉัตร อุดมวงษ์ อาจารย์ที่ปรึกษาร่วม
	อาจารย์ ดร.ศิวะ ศังกร รามาซาหมิ อาจารย์ที่ปรึกษาร่วม

บทคัดย่อ

ในปัจจุบันยุคดิจิทัลนั้น ได้มีสินทรัพย์หลายประเภทที่สามารถทำกำไรได้อย่างดีแต่เนื่องจากการลงทุน
ในสินทรัพย์ทั้งหลายเหล่านั้นมีความเสี่ยงนักลงทุนจึงต้องมีการค้นหาสินทรัพย์ที่จะสามารถคงคุณค่า
รวมถึงสามารถเพิ่มมูลค่าของตัวสินทรัพย์เองในช่วงเวลาของการเกิดวิกฤตเศรษฐกิจโดยสินทรัพย์ที่มี
คุณสมบัติดังกล่าว จะถูกเรียกว่า สินทรัพย์ที่หลบภัยในการลงทุน อย่างไรก็ตาม สกุลเงินดิจิทัล นั้นเป็น
สินทรัพย์ที่ถูกมองว่าเป็นทองแห่งยุคดิจิทัลเนื่องจากตัวเลือกของสินทรัพย์ที่หลบภัยในการลงทุนที่นัก
ลงทุนนั้นจะสามารถพึ่งได้ในช่วงเวลาของการเกิดวิกฤตเศรษฐกิจนั้นยังมีอยู่ไม่มากและอาจเสื่อม
คุณสมบัติที่สำคัญของสินทรัพย์ที่หลบภัยในการลงทุนได้ในอนาคต   นี่อาจจะเป็นโอกาสที่ดีในการ
ค้นพบสินทรัพย์ที่หลบภัยในการลงทุนตัวใหม่ที่จะมาทดแทนได้ในอนาคตด้วยเหตุนี้การศึกษาในครั้ง
นี้เพื่อหาคำตอบว่าสกุลเงินดิจิทัลสามารถเป็นสินทรัพย์ที่หลบภัยในการลงทุนได้หรือไม่

Thesis Title   Can Cryptocurrencies Be a New Safe Haven?

Author   Mr. Nathaphat Na Chiangmai

Degree   Master of Science

                                               (Digital Innovation and Financial Technology)

Advisory Committee   Lect.Dr.Nathee Naktnasukanjn   Advisor

                                             Lect.Dr.Piyachat Udomwong   Co-advisor

                                             Lect.Dr.Siva Shankar Ramasamy   Co-advisor

Abstract

There are various assets that can be invested in and profited from in the digital age. Finding investments that are anticipated to maintain or improve in value during times of market turmoil allows investors to lower their risk because investments are always subject to risk. Assets that have a high probability of maintaining or appreciating in value are referred to be safe haven assets. Gold has been known as the safe haven asset, however cryptocurrency is a class of digital assets that was a part of a world new transaction security system call Blockchain. Blockchain is a system of recording information in a way that makes it difficult or impossible to change, hack, or cheat the system. Moreover, a blockchain is essentially a digital ledger of transactions that is duplicated and distributed across the entire network of computer systems on the blockchain. cryptocurrency is claimed as the new gold in the digital era. For a long investing history there only a few safe haven asset investors can rely on it, also there a chance that these old safe haven assets performance might be drop in the near future. This might be a good opportunity to study the new asset that might be a new safe haven for an investor in the near future. Consequently, this study aims to answer a question "Can cryptocurrency be a new safe haven?".

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LIST OF ABBREVIATION

COVID-19   Coronavirus disease 2019

VaR   Value at risk

CVaR   Conditional Value at Risk

BTC   Bitcoin

ETH   Ethereum

BNB   Binance

ADA   Cardano

USDT   Tether

NDX   Nasdaq-100

HSI   Hang Seng Index

DJI   Dow Jones Index

DAX   Deutscher Aktien Index

ERC   Ethereum request for comment

TRC   TRON request for comment

IoT   Internet of Thing

GFC   Global financial crisis

MBS   Mortgage-backed security

ICO   Initial Coin Offering

NFTs   Non-fungible tokens

USD   United States dollar

CHAPTER 1

INTRODUCTION

The definition of safe haven assets is the assets provide hedging benefit during periods of market turbulence which is the basic concept of the safe haven assets. Gold is one example of many safe haven assets that can store value for centuries and be safe haven for the investors in the several decades. However, Dirk G. Baur & Kristoffer J. Glover [1] said that the duration of the safe haven effect during the subprime crisis in 2008 was reduced significantly. It can be explained that there is a chance that the old safe haven asset cannot retain its own value.

This results in finding the digital asset such as cryptocurrency to be a new safe haven. In 2008, there was a spur of creating many cryptocurrencies known as altcoins by Satoshi Nakamoto [2]. One of the most popular altcoins is bitcoin which has the largest volume in the market. The cryptocurrencies are now becoming a focal point of the investors for several years [3]. These cryptocurrencies are currently becoming easier to exchange with real money or to trade with other cryptocurrencies on digital assets exchange platforms. For this reason, cryptocurrency is probably considered to be a new safe haven.

The purpose of this study is to find a conclusion on the cryptocurrency can be the new safe haven asset.

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1.1 Research background and significance

Investors have historically looked for safe haven assets to lower their portfolio risk during financial crises. The majority of investors were familiar with safe haven assets including gold, treasury bills, defensive stocks, currencies, etc. Over the previous century, these safe haven assets have been useful. The financial crises of today are very different from those of the past, thus the safe havens of the past may no longer be as effective. Given that the COVID-19 situation affects every nation on the planet, it may be a good time to investigate potential new safe haven assets. We can now more easily identify the assets that act as safe haven assets during the COVID-19 crisis.

1.1.1 Problem to be solve

According to data from numerous articles from the past, it appears that traditional safe haven assets like gold and others are beginning to lose some of their value during economic downturns. Future financial crises could cause these safe havens to completely lose their impact. This is why it's important to determine whether cryptocurrencies can serve as a reliable new safe haven asset for investors.

1.1.2 Benefit expected from this research

With the findings of this study, investors will have much more information to use when deciding whether to invest in cryptocurrencies in the future as safe haven assets or not. Additionally, the researcher who want to go deeply into this kind of subject may be used as a source for the fundamental analysis.

1.2   Objectives

The goal of this study is to examine five samples of cryptocurrencies from various angles, including cumulative return, correlation, risk, and portfolio performance. Then, by comparing these samples to gold, the traditional safe haven asset, we can determine whether cryptocurrencies can be considered new safe haven assets for investors.

1.3 Conceptual Framework

1.3.1 Research methods

1.3.1.1 Data Collection

To achieve the purpose of this thesis, historical price data of different assets, which are cryptocurrencies, gold, and top stock index around the world, are collected. The time period of the collected data is from January 1, 2018, to November 25, 2021. The selected period covers the COVID-19 pandemic because the COVID-19 case was first reported in late December 2019.

1.3.1.2 Focused indices

The primary benchmark for this argument will be gold, an old-school safe haven that may be used to contrast with cryptocurrencies.

1.3.1.3 Methods

In this thesis, gold, the conventional safe haven asset, will be contrasted with cryptocurrencies. Using descriptive analysis to identify trends in the data, standard deviation, variance, and CVar to analyze risk, cumulative return calculation, simulation of a portfolio with equal weights of stocks and cryptocurrencies, and comparison of a portfolio with equal weights of stocks and gold, are the final step.

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1.3.1.4 Results

Var, CVar, Pearson correlation, and portfolio analysis of cryptocurrencies will be used to compare the results with gold in order to determine whether or not cryptocurrencies can replace gold for the safe haven asset.

1.3.2 Research content

The report has four chapters, the first chapter introduces the research background and relevance, conceptual framework, and research focuses. Review of existing literature on safe haven assets, safe haven asset analysis, and digital currencies is covered in the second chapter. The third chapter is methodology. We discussed the sample data we used and the methods we used to evaluate it, including the calculation of the cumulative return, risk analysis using VaR and CVaR, standard deviation, differencing, and finally Pearson correlation. The fourth chapter summarizes the analysis' findings, and the thesis' conclusion is presented in chapter five.

1.4 Research innovation and difficulties

Since the price of bitcoin has only been recorded over the past 8–10 years, it is difficult to draw a firm conclusion, even if the analysis's findings indicated that cryptocurrencies are a safe haven. More historical data will eventually be needed in order to confidently determine if cryptocurrencies may serve as a new form of safe haven or not.

CHAPTER 2

LITERATURE REVIEW

2.1 Safe haven Asset

The safe haven asset was a well-known investment that can retain or increase in value during the time of market turbulence. To qualify as a safe haven asset, an asset must be able to retain or increase in value during downturns of the market. Statistically, the returns from the safe haven asset should be uncorrelated or negatively correlated with the returns of other assets during a crisis period [4]. There is another concept of a safe asset by [5] who defined the safe asset as an asset whose value is insensitive to information can be clearly distinguished as the "Safe haven" asset. A typical example of safe haven asset is gold. However, There the article [6] which provides evidence that there is no such thing as a free lunch, not even for safe haven assets. Their in-crisis performance comes at a cost which is reflected in the underperformance in non-crisis periods. Importantly, the identified trade-off implies that safe haven assets do not automatically lose their property when they exhibit negative returns as sometimes claimed. This can be said that the safe haven asset might not always be the solution of rick management of the investors.

2.2 Safe haven Analysis

The article about safe-have analysis mostly consists of the methodology of applying the theory of safe haven asset with gold. Under such a notion, gold has typically been considered as the safe haven asset which has a long historical role as natural money or a store of value [7]. There is a large volume of literature investigation whether gold can act as the safe haven asset. Results from the previous literatures show both positive and negative results. For the positive example, the article of Gözde Gürgün [8] concluded that gold performed as a hedge and the safe haven asset most of the financial market. During times of extreme losses in equity markets, gold acts as a safe haven in more countries for

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both domestic and foreign investors. Finally, the results are mixed for major gold producing countries. Dirk G. Baur [9] found that gold offered the investors distinctive forms of "safety". Mohd Fahmi Ghazali pointed out that gold, at best, is a weak safe haven during the financial stress for stockholders. Rather than the studies that focused on gold being the safe haven assets. As for the negative example, the same Dirk G. Baur [1] performed the study showed that the duration of the safe -haven effect during the subprime crisis in 2008 was remarkably declined. Rather than the studies that focused on gold being the safe haven assets, there is a study that studied on the cryptocurrencies whether they can be safe haven. Thomas Conlon [10] discovered that Bitcoin and Ethereum are not, in general, found as the safe haven asset for the international equity markets. However, Tether is found to be the safe haven asset over the most recent period including the COVID-19 crisis. The studies performed various methods, but the most popular methods are downside risk analysis and correlation analysis.

2.3 Blockchain

The concepts of bitcoin and blockchain were first proposed in 2008 by someone using the pseudonym Satoshi Nakamoto, who described how cryptology and an open distributed ledger can be combined into a digital currency application [2], blockchain using peer-to-peer payment system for electronic transactions which allowed different financial actors to send payments to one another without the intermediation of a central agent (for example a central bank), preventing the double-spending problem. As shown in Figure 1, each block has a unique identification hash that refers to its preceding block. Any user with a public or private key can enter the network and have access to the information exchanged in the system network.
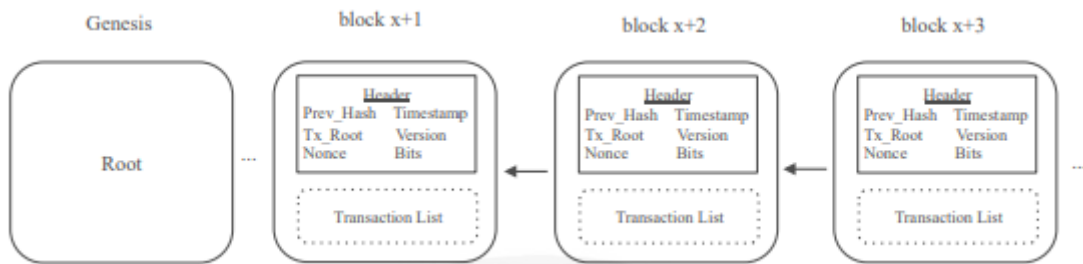
Figure 1 Blockchain network

Public and private key system have been invented way before blockchain in 1976 by Diffie and Hellman. They developed a system in which two parties can send information via a public network which is secured with public techniques and establish a secure connection. This system will works when one party sends the information enciphered in their respective public keys to the other and in order to decipher the information received from the first party, the second party needs private deciphering key [11] as shown in Figure 2.
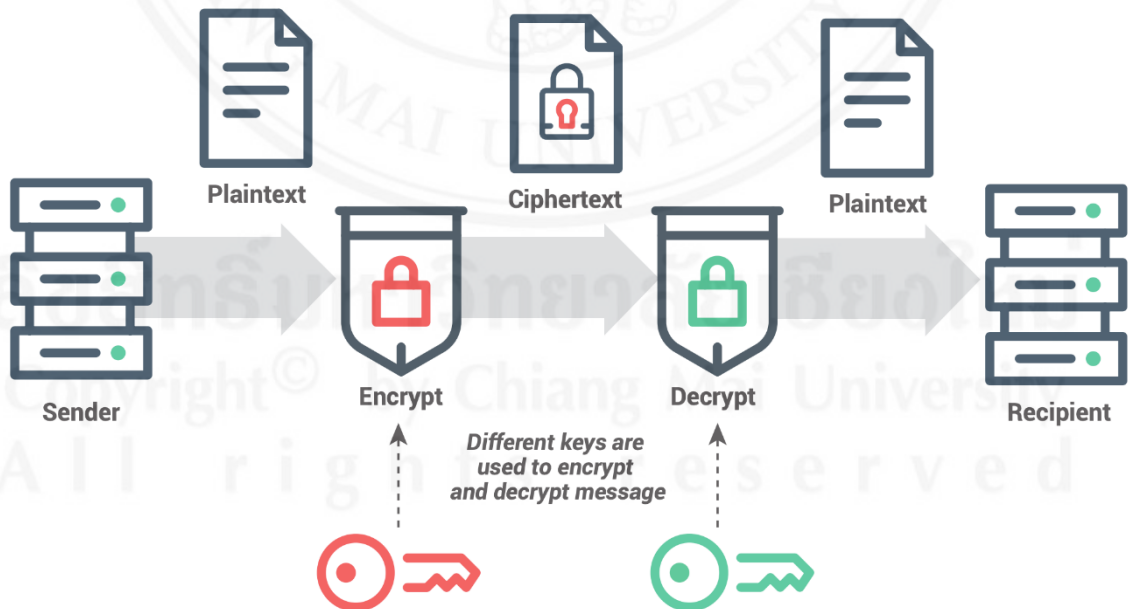
Figure 2 Public & Private key diagram

The evolution of blockchain has been a progressive process. Blockchain is currently delimited to Blockchain 1.0, 2.0, and 3.0, based on their applications. Blockchain technology has been studied by a wide variety of academic disciplines. For example, some research studies the technology which applies to blockchain such as smart contracts, cryptography, peer-to-peer networking. As an important emerging technology, blockchain will play a role in many fields. Therefore, we believe that the issues related to commercial applications of blockchain are critical for both academic and social practice [12]. IoT technology will play an increasingly important role in our society for the foreseeable future, in both civilian and military (adversarial) contexts, including the Internet of Drones, Internet of Battlefield Things and Internet of Military Things. Not surprisingly, IoT security is a topic of ongoing research interest [13]. In term of business, we can leverage blockchains in a variety of ways to gain an advantage over their competitors. They can streamline their core business, reduce transaction costs, and make intellectual property ownership and payments more transparent and automated [14]. However, there is a problem about privacy in blockchain. Blockchain's transparency, which is one of the main assets of this technology, could turn out to be a major issue. For instance, two companies which have transactions with one another, could be reluctant to have this information tracked by a third party, due to the commercial and client privacy implications that this may have [15]. Holders of Bitcoin can be tracked by analyzing the transactions they performed, mainly using public keys related to their payments.

2.4 Cryptocurrencies

The first world-known cryptocurrency was Bitcoin originated with the white paper that was published in 2008 under the pseudonym "Satoshi Nakamoto" [2]. It was published via a mailing list for cryptography and has a similar appearance to an academic paper. The creators' original motivation behind Bitcoin was to develop a cash-like payment system that permitted electronic transactions but still remained many of the advantageous characteristics of physical cash [16]. Bitcoin as an asset, it is likely that crypto assets such as Bitcoin will emerge as their own asset class and thus have the potential to develop into

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an interesting investment and diversification of investment instrument. Over time, Bitcoin itself might come to play a similar role to gold. The importance of crypto currencies is increasing day by day and new currencies take their place in the market because of the "profitability" since the most important attribute of investment for most of investors is "Profitability" [17]. The future of trading cryptocurrencies lies well with new emerging technologies that are benefits for mankind [18]. In term of investing portfolios, including the cryptocurrencies to investors' portfolios probably offers attractive returns and hedging properties [19]. There are many businesses and financial assets that emerge after the introduction of the new digital assets such as crypto currencies exchange platform or new ICO.

2.4.1 Example of Business emerging from cryptocurrencies

2.4.1.1 NFTs Business

Non-fungible tokens (NFTs) are blockchain-based assets representing ownership of unique digital or physical items. NFTs are widely used in collectibles, artwork, gaming, and other markets. With crypto assets re-entering the bull market in late 2020, NFT has also seen explosive growth, becoming the most popular Fintech application and crypto asset in 2021. According to the article [20] found that "non-fungible" literally and technically indicates that each NFT is a unique and indivisible token, hence theoretically there should be an infinite number of NFT types. However, the researchers usually classify NFTs into six major categories according to the scenarios in which they are most widely used was art, collectibles, games, metaverse, other, and utility.

2.4.1.1.1 NFTs Art

The first piece of NFTs art was put on an auction in March 2021, American digital artist Beeple sold his art piece call "Everydays: The First 5000 Days" Figure 3 at a Christie's auction for an astronomical US$69.4 million. Three months after this fist NFTs art was

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sold at the auction, there was a news of "CryptoPunk collectible – the first profile picture" Figure 4, which is starting to be popular among celebrities which can be sold up to 11.8 million USD. According to "The Art Market 2022" report [21], combined sales of all NFT art and collectibles on the Ethereum, Flow and Ronin blockchains have grown from US$4.6 million in 2019 to US$11.1 billion in 2021. Comparing those numbers with the global art market of US$65.1 billion, it can be explained that NFTs art growth has been supercharged since then. In present, there are many NFTs market platforms such as OpenSea, Rarible, Mintable, Foundation, and SuperRare etc. Among available platforms, OpenSea [22] was the most well-known. It was founded in year 2017. Now, there are more than 80 million NFTs and more than 2 million collections in the OpenSea NFTs market which has a volume up to 20 billion USD.
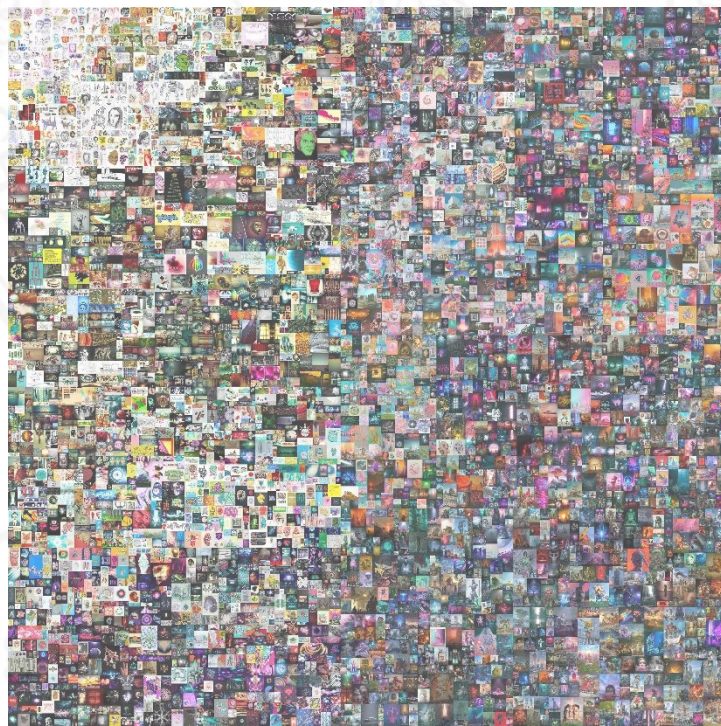
Figure 3 "Everydays: The First 5000 Days"

Figure 4 Yuga Labs' Bored Ape Yacht Club 8817.

2.4.1.1.2 NFTs Game

NFTs have gained a significant amount of attention from the gaming community and developers [23]. For in-game items like items, characters, and in-game cosmetics, etc., NFTs were used to provide ownership data. The majority of NFT games allow players to purchase various goods for their inventories. If, however, the item is an NFTs, the player may recoup their investment by reselling the undesirable item once. If the item's value increased over time, the player might make money. The benefits of this technique extend beyond simply the gamers to the developers as well. In addition to receiving a royalty for each NFTs sold in the market, developers also receive compensation. This results in a business model where the intermediary market for NFTs benefits both players and developers. This implies that the objects amassed by players remain their property even if the game's makers stop supporting it. The example of a successful NFT game is Axie Infinity in Figure 5, which had 2.8 million daily active players and sold its most expensive character for $820,000. Moreover, the market for video games saw an increase in transaction volume to 3.6 billion [24].

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Figure 5 Axie Infinity

2.4.1.1 Cryptocurrencies Trading Platform Business

From the emerging of many cryptocurrencies that attract more investors many companies were found to develop various exchange platforms. There are three main types of exchange platforms which are Centralized cryptocurrency exchange platform, Decentralize cryptocurrency exchange platform, and Hybrid cryptocurrency exchange platform. The concept of centralization refers to the use of a middleman or a third party to assist in transactions in a secure manner. Both buyers and sellers trust the middleman to handle their properties. Centralized exchanges require their users to verify their personal information before using the tools provided by them. The levels of verification may be varied from exchange to exchange. These KYC checks are to ensure that crypto businesses comply with anti-money laundering measures. Approximately 99% of all crypto trades run through centralized exchanges. The advantages of the centralized exchange platform included usability, protected finances, and dependability. The platform does run the danger of being hacked, and investors must pay transaction fees in

order to complete each transaction. Centralized exchanges include those run by Binance, CoinBase, Kraken, and others. The decentralized cryptocurrency exchange, on the other hand, enables users to carry out peer-to-peer transactions without the involvement of a third party or an intermediary. Users' funds are instead kept on the blockchain by the decentralized exchanges rather than on the exchange itself. The conversion of fiat money for cryptocurrency is not made possible by these exchanges. These exchanges use smart contracts to automate the trades and transactions. A security breach is obviously impossible if the smart contract is well written. Governments and regulators have a tougher time closing down DEX because no firm is in charge of its operation. The advantages of this type of platform include reducing the risk of hacking, ensuring user anonymity, and preventing market manipulation, but its drawbacks include complexity, a lack of customer assistance, a requirement for upfront payment, and liquidity issues. Airswap, Blocknet, Venus, and more examples of decentralized cryptocurrency exchanges are available. Finally, a hybrid cryptocurrency exchange platform aims to combine the greatest aspects of centralized and decentralized exchanges into a single platform. They want to provide end users with both the security and freedom of a decentralized exchange, as well as the convenience of a centralized exchange. They offer users custody of their funds even if a third party is involved in the trading. The cryptocurrency trading market's hybrid types represent a new generation, although they are still "under development." Nash and Qurrex are two examples of this kind of platform.

2.4.3 Examples of Cryptocurrencies

2.4.3.1 Bitcoin (BTC)

The first cryptocurrency was created in the year 2008 original motivation behind Bitcoin was to develop a cash-like payment system. The transaction security system on bitcoin itself lies in the key and address. Regarding the test results from the article [25], it was shown that bitcoin block chain transaction system can be trust. Bitcoin was limit of 21 million coins. Another article [26] about price, volatility and trading volume of Bitcoin

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was conclude that changes in Bitcoin price are unpredictable and realized volatility is highly predictable from its past values. With this respect, Bitcoin is like other financial assets. Also, there is an additional finding in this article, which is not usually reported for other financial assets, is that the trading volume of Bitcoin improved predictions of Bitcoin volatility.

2.4.3.2 Ethereum (ETH)

Ethereum is an open-source blockchain-based platform used to create and share business, financial services, and entertainment applications with its own cryptocurrency [27] which have a limit of 18 million coin. The product that uses Ethereum blockchain-based platform such as OpenSea the famous NFT Trading platform [22] as same as Binance [28]. It was introduced in Vitalik Buterin's [29] paper and addressed several limitations of the Bitcoin's scripting language. The main contributions are full Turing-completeness, meaning that Ethereum supports all types of computations, including loops. Then Ethereum supports the state of the transaction, as well as several other improvements over the blockchain structure [30].

2.4.3.3 Binance (BNB)

Binace coin was the coin of biggest cryptocurrencies exchange in the world. Binance coin have a strict limit of 200 million Binance coin and never to be increased [28]. With the degree of biggest cryptocurrencies exchange in the world we can expect that Binance coin can be trust and have a sweet future ahead.

2.4.3.4 Cardano (ADA)

Cardano Coin was a coin of a proof-of-stake blockchain platform, which is different from Ethereum and Bitcoin that use proof of work [31]. The development of the Cardano blockchain platform began in 2015 as an attempt to change the way cryptocurrencies are conceived and developed. Even though the first sale of the Cardano coin occurred many

years after the first sale of Bitcoin and Ethereum, its market capitalization is already in the top 10 of all cryptocurrencies [32]. Cardano limited its coin to 45 billion coins.

2.4.3.5 Tether (USDT)

Tether is a blockchain-based cryptocurrency with a price linked to $1.00. Its circulating tokens are backed by an equivalent number in U.S. dollars. Stable coins mimic conventional fiat currencies that are kept in a particular bank account, such as the US dollar, the euro, or the Japanese yen. As new Tether coins are released based on user demand and reserves kept by Tether, the maximum supply is unknown, which is another distinctive aspect of Tether. A total of five different Tether coins are available. Tether in US dollars on the Omni layer of Bitcoin, Tether in euros on the Omni layer of Bitcoin, Tether in US dollars as an ERC-20 token, Tether in euros as an ERC-20 token, and beginning in 2020, Tether in US dollars as a TRC-20 token on the network TRON.2.5 Investor Sentiment on Stock Market.

2.6 Financial Crisis

The history of the stock market is full of events striking enough to earn their own names: the Great Crash of 1929, the Tronics Boom of the early 1960s, the Go-Go Years of the late 1960s, the Nifty Fifty bubble of the early 1970s, the Black Monday crash of October 1987, and the Internet or Dot.com bubble of the 1990s. Each of these events refers to a dramatic level or change in stock prices that seems to defy explanation [33]. In case study of Chinese stock market, the researcher found that investor sentiment can significantly affect stock price crash risk in Shanghai and Shenzhen A-share markets, especially in the Shenzhen A-share market, no matter from which perspective. Specifically, the rising investor sentiment in the current period can increase stock price crash risk in the next period in both stock markets [34]. Other interesting found is the informativeness of sentiment data about future volatility is generally lower for companies which either have

a small market capitalization or a high share of institutional investors. It is reasonable to assume that retail investors are less focused on these companies [35].

A financial crisis is a situation in which the value of assets falls rapidly, often triggered by a panic or a runaway bank. In a financial crisis, asset prices fall precipitously, businesses and consumers can no longer pay their debts, and financial institutions suffer liquidity shortages. A financial crisis is often associated with a panic or bank run, in which investors sell assets or withdraw money from savings accounts because they fear that the value of those assets will decline if they remain with a financial institution. The global financial crisis has prompted many countries to adopt a new regulatory measure. In an article by the Reserve Bank of Australia [36] the Australian central bank, it was mentioned that there are 3 factors that can trigger a financial crisis.

2.6.1 Cause of Financial Crisis

Firstly, excessive risk-taking in a favorable macroeconomic environment. In the years leading up to the GFC, economic conditions in the United States and elsewhere were favorable. Economic growth was strong and stable, and inflation rates, unemployment, and interest rates were relatively low. In this environment, real estate prices rose sharply. This led many countries to expect that home prices would continue to rise, resulting in households borrowing outrageously to buy and build homes. This is the cause of much of the mortgage lending, particularly in the United States. Much of this risky borrowing was done by investors looking to make short-term profits by 'flipping' houses, as well as by 'subprime' borrowers. The first cause was excessive risk-taking in a favorable macroeconomic environment. In the years leading up to the GFC, economic conditions in the United States and elsewhere were favorable. Economic growth was strong and stable, and inflation rates, unemployment, and interest rates were relatively low. In this environment, real estate prices rose sharply. This led many countries to expect that home prices would continue to rise, resulting in households borrowing outrageously to buy and build homes. This is the cause of much of the mortgage lending, particularly in the United

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States. Much of this risky borrowing was done by investors looking to make short-term profits by 'flipping' houses, as well as by 'subprime' borrowers

Second, increased borrowing by banks and investors. In the run-up to the financial crisis, banks and other investors in the United States and abroad borrowed more and more to expand their lending and buy MBS products. When housing prices began to fall, banks and investors suffered large losses because they had borrowed so much. In addition, banks and some investors increasingly borrowed money for very short periods of time, including overnight, to buy assets that could not be sold quickly. As a result, they increasingly relied on lenders-which included other banks-to make new loans while existing short-term loans were repaid.

Finally, regulation and policy failures were too lax in regulating subprime loans and MBS products. The institutions that created and sold the complex and opaque MBS to investors were not adequately regulated. Not only were there many individual borrowers whose loans were so large that they were unlikely to repay them, but fraud-such as exaggerating a borrower's income and overpromising investors about the safety of the MBS products they were sold-was becoming more common. Moreover, as the crisis unfolded, many central banks and governments did not fully recognize the extent to which bad loans had been made during the boom and the many ways in which mortgage losses spread through the financial system.

2.6.2 How the Global Financial Crisis Unfold

The catalysts for the GFC were falling U.S. house prices and an increasing number of borrowers who could not repay their loans. Home prices in the United States peaked in mid-2006, coinciding with a rapidly increasing supply of newly built homes in some areas. As home prices began to fall, the share of borrowers who could not repay their loans increased, meaning that debt in the United States rose sharply during the boom and was higher than in other countries. After the problem of high debt increased in the United States, there was stress in the financial system, which first became evident in 2007. Some

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lenders and investors began to incur large losses because many of the homes they repossessed after borrowers failed to make repayments could only be sold at prices lower than the loan amount. This is one reason why investors have been less willing to buy MBS products and have actively sought to sell their holdings. As a result, MBS prices are falling at an ever-increasing rate, making it much more difficult for investors who had purchased MBS with short-term loans to roll over those loans, exacerbating MBS sales and the decline in MBS prices.

After the problem occurred in 2006 and 2007, this crisis began to spread to other countries through the extensive operations of foreign banks in other countries. Finally, in September 2008, following the collapse of the U.S. financial firm Lehman Brothers, combined with the failure of a number of other financial firms, financial tensions reached their peak, triggering a global panic in financial markets. Investors around the world panicked and withdrew their money from banks and mutual funds around the world, not knowing who might fail next. As a result, financial markets became dysfunctional as everyone tried to sell at the same time, and many institutions that needed new funding could not get it. Businesses also became less willing to invest and households less willing to spend as confidence in the economy collapsed.

2.6.3 Policy Responses for the Global Financial Crisis

The main policy measures to address the global financial crisis were taken in September 2008 by central banks, which lowered interest rates to boost economic activity that had begun to slow in late 2007 due to stress in the financial system. After the collapse of Lehman Brothers in 2008 and the downturn in global growth, policy measures were tightened. Central banks quickly lowered interest rates to very low levels and lent large amounts of money to banks and other institutions with good assets that could not be borrowed in financial markets. Finally, they bought a substantial number of financial securities to prop up dysfunctional markets and boost economic activity once policy rates were close to zero. The next action was taken by the government, which was to increase government spending. Governments increased spending to boost demand and support

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employment throughout the economy. They also guaranteed deposits and bank bonds to boost confidence in financial firms and acquired stakes in some banks and other financial firms to prevent insolvencies that could have exacerbated panic in financial markets. The final measure was for regulators to increase their oversight of banks and other financial institutions. Among many new global regulations, banks must now more accurately assess the risk of the loans they make and use more resilient sources of funding.
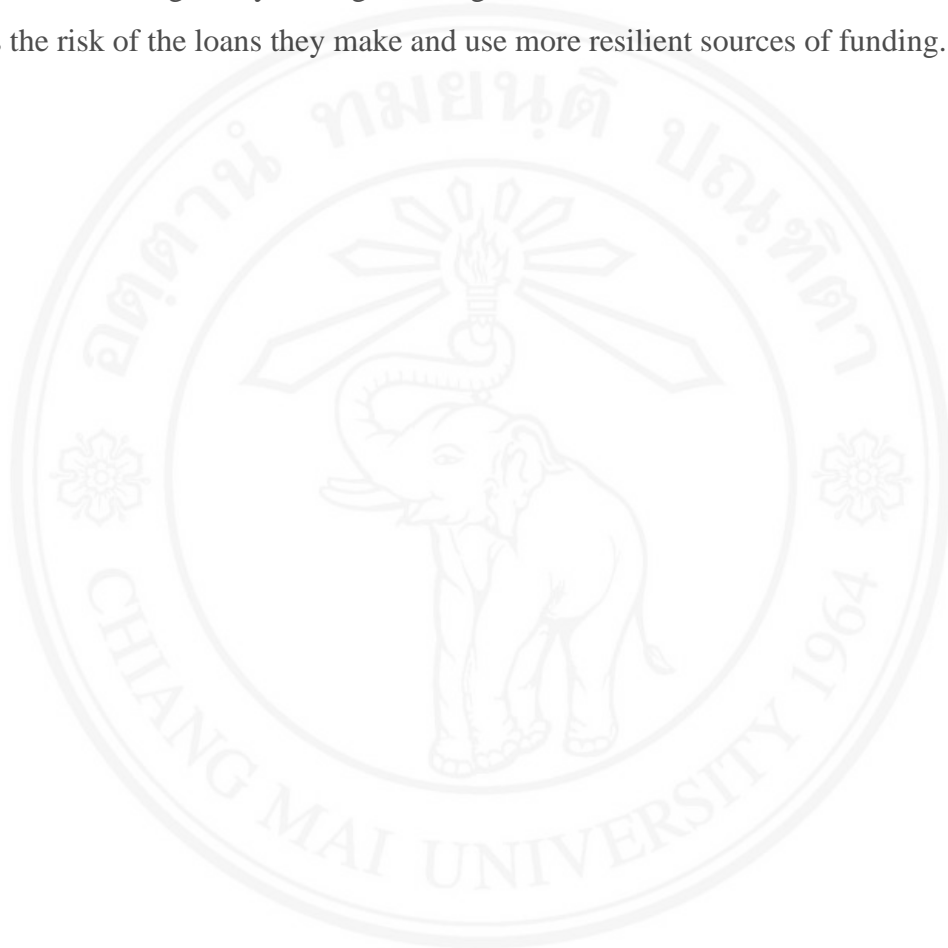
CHAPTER 3

METHODOLOGY

3.1 Research approach

Samples from reliable sources were cleaned and put through testing. Later, to assess the risk of the sample values, descriptive analysis and cumulative return were computed along with VaR and CVaR. To measure the link between the assets in the sample, Pearson correlation was used. Finally, the outcome will be compared to gold, a traditional safe haven asset. If cryptocurrencies do better overall than gold, it may indicate that they can replace gold as a new form of safe haven asset.

3.2 Data Collection Methods

All samples were gathered from the investing.com website, which offers free ".xlsx" file downloads. After collecting, the data was cleaned to get ready for more analysis..

3.3 Sample Selection

The time period of the data we collected is from January 1, 2018, to November 25, 2021. The sample period covers the pandemic period COVID -19 because the first group of confirmed cases from COVID -19 was reported in late December 2019. Therefore, our sample data cover the entire period from covid-19 [37].

Our sample data is nearly 48 months of daily prices of 4 major world stock indices sourced from the Black Well Global website [38] including the DowJones index (DJI), the NASDAQ-100 (NDX), the Hang Seng index (HSI), and the German DAX index, as well as 1 other major Thai index SET50. The cryptocurrencies were selected from the top five market capitalizations referenced by the CoinMarketCap website [32]. These include Bitcoin (BTC) - the first cryptocurrency introduced to the world, Ethereum (ETH) -the

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coin of the well-known open-source blockchain-based platform, Binance (BNB) -the coin of the world's largest cryptocurrency exchange, Cardano (ADA) -the coin of the public blockchain platform. Finally, we also consider the daily gold price and Tether (USDT) -known as a digital dollar, which is a different type of asset than cryptocurrencies.

3.4 Data Analysis

3.4.1 Cumulative Returns

The cumulative return is the total change in the investment price over a given period of time. After we determine the results of the cumulative returns of each asset, they are plotted on a graph and compared to each other to determine the findings from each asset over the study period. After we find the result of the cumulative return of each asset, the cumulative return is used to apply a portfolio with all stock index sample data and one of the assets assumed to be a safe haven. Then we can clearly see the impact of including each asset in each portfolio by visualizing it in the form of a chart. An equation of cumulative return was shown as Equation (1)

$$Cumulative\ return[t] = \left(\frac{price[t]}{price[0]} \right) - 1 \qquad \text{Equation (1)}$$

where cumulative return[t] is the cumulative return of a particular day t, $price[t]$ is the price of particular day and $price[0]$ was the price of the initial date.

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3.4.2 Value at Risk (VaR) & Conditional Value at Risk (CVaR)

Value at Risk (VaR) was calculated using the historical method, which is the simplest method for calculating Value at Risk. Market data for the last 860 days is used to calculate the percentage change for each risk factor on each day. Each percentage change is then calculated using current market values to represent 860 scenarios for future value. For each of these scenarios, the portfolio is valued using full, non-linear valuation models. The third worst day is assumed to have a VaR of 99%. The Var was calculated using Equation (2) Where V_i is the number of variables on day i and m is the number of days from which historical data is taken.

$$Value\ of\ risk = V_m \times \frac{V_i}{(V_i - 1)}$$
Equation (2)

The conditional value at risk (CVaR) was applied after the VaR calculation was completed. The CVaR values were derived from the calculation of VaR itself. The VaR calculation assumptions were based on the shape of the distribution of returns and the cut-off level used. It is the average of the values that exceed the VaR. The result of Cvar can be used to quantify the amount of tail risk in an investment portfolio. The equation for CVaR is Equation (3) where $p(x)dx$ is the probability density of obtaining a return with value"x". c is the cut-off point of the distribution at which the analyst sets the var breakpoint. Finally, the VaR in the equation is the agreed VaR level.

$$Conditional\ value\ at\ risk = \frac{1}{1-c} \int_{-1}^{VAR} xp(x)dx$$
Equation (3)

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Both Var and CVaR are applied to the sample data to see the risk result of each asset and compare the risk of each cryptocurrency to a stock index. If the risk is less than or equal to the risk of the stock index, this could be evidence that cryptocurrencies can be a safe haven.

3.4.3 Standard Deviation

Standard deviation Standard deviation is used to calculate the volatility of each asset, which is displayed in a 30-day window. Volatility is a statistical measure of the dispersion of returns for a given security or market index. In most cases, the higher the volatility, the riskier the security. We can use the standard deviation result in combination with VaR and CVaR to understand whether cryptocurrencies are riskier than stock indices or not. The equation for standard deviation is Equation (4) where Σ means" sum of", x is a value in the data set, μ is the mean of the data set, and N is the number of data points in the population.

$$S.D. = \sqrt{\frac{\Sigma|x - \mu|^2}{N}}$$ Equation (4)

3.4.4 Differencing

Prior to applying Pearson Correlation to eliminate trend and seasonality from sample data, the Differencing approach will be used. To make the sample data stationery, we must perform differencing on it. Because so many practical analytical techniques, statistical tests, and mathematical models rely on stationarity, it is crucial. The models may produce fake results that we cannot use as proof of analysis if the sample data we enter into them is not stationary data. In this situation, we're using the ". diff" function of Pandas. [39].

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3.4.5 Pearson Correlation

The Pearson correlation will apply to sample data by using pandas python library using ".corr" function. The result will be plot in heat map in order to read the result properly. If the coefficient value lies between ± 0.50 and ± 1, then it is said to be a strong correlation. For the Moderate correlation If the value lies between ± 0.30 and ± 0.49, then it is said to be a medium correlation.
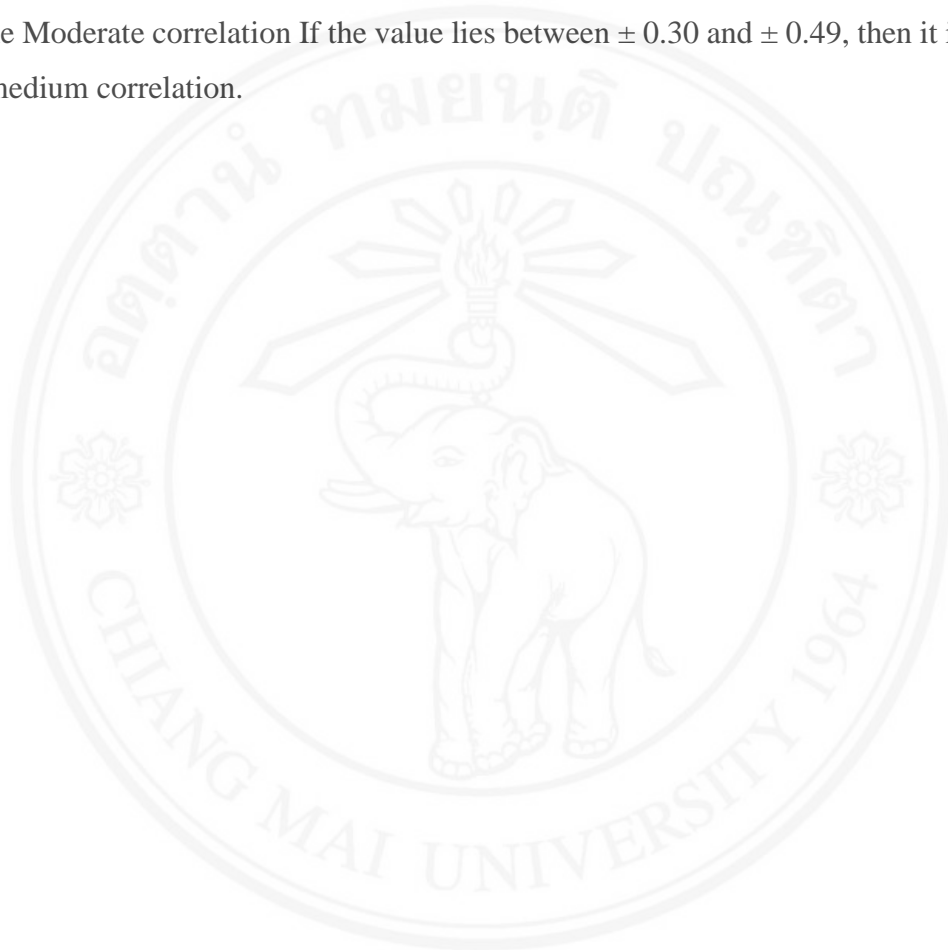
CHAPTER 4

RESULT

4.1 Results on Descriptive Analysis

We begin by listing all of the raw daily price data which includes 11 different assets including five stock indices, five cryptocurrencies, and gold. The daily financial return is then determined and entered in Table 2. We use descriptive statistics on the financial return result once we have it. As the result in Table 3**Error! Reference source not found.** descriptive statistics demonstrate that there are 861 daily return data on 11 assets in our entire sample. USDT has the lowest mean and standard deviation of the group. The greatest maximum was BNB with 0.69 percent financial return, and the lowest minimum was ETH with a minimum of -0.44 percent financial return.

Table 1 The example of collected sample data

Date	NDX	SET50	HSI	DJI	DAX	Gold	BTC	ETH	USDT	BNB	ADA
2018-01-18	6811.38	1182.70	32121.94	26017.81	13281.43	1327.19	11045.0	991.01	1.0235	14.14	0.6500
2018-01-19	6834.33	1183.60	32254.89	26071.72	13434.45	1331.80	11476.0	979.57	1.0174	14.93	0.6458
2018-01-22	6906.28	1185.78	32393.41	26214.60	13463.69	1334.11	10771.0	999.37	1.0093	12.90	0.5675
2018-01-23	6963.46	1192.74	32930.70	26210.81	13559.60	1341.39	10819.0	1042.47	1.0030	13.10	0.5598
2018-01-24	6919.35	1195.60	32958.69	26252.12	13414.74	1358.15	11414.0	1051.95	1.0036	13.77	0.6290
...	...	...	...	...	...	...	...	...	...	...	...
2021-11-18	16482.97	989.18	25319.72	35871.34	16221.73	1858.46	57014.0	4003.13	1.0005	531.90	1.7886
2021-11-19	16573.34	984.39	25049.97	35602.18	16159.97	1844.60	58130.0	4295.39	1.0009	581.00	1.8637
2021-11-22	16380.98	989.18	24951.34	35619.26	16115.69	1805.04	56299.0	4086.52	1.0007	559.70	1.7765
2021-11-23	16306.72	987.26	24651.58	35813.74	15937.00	1789.73	57602.0	4340.45	1.0003	591.30	1.7508
2021-11-24	16367.81	989.19	24685.50	35805.17	15878.39	1788.50	57209.0	4270.00	1.0003	590.60	1.6664

Table 2 The example of stock index, gold and cryptocurrencies daily financial return data

	NDX	SET50	HSI	DJI	DAX	Gold	BTC	ETH	USDT	BNB	ADA
Date											
2018-01-19	0.003369	0.000761	0.004139	0.002072	0.011521	0.003474	0.039022	-0.011544	-0.005960	0.055870	-0.006462
2018-01-22	0.010528	0.001842	0.004295	0.005480	0.002176	0.001734	-0.061433	0.020213	-0.007961	-0.135968	-0.121245
2018-01-23	0.008279	0.005870	0.016586	-0.000145	0.007124	0.005457	0.004456	0.043127	-0.006242	0.015504	-0.013568
2018-01-24	-0.006334	0.002398	0.000850	0.001576	-0.010683	0.012495	0.054996	0.009094	0.000598	0.051145	0.123616
2018-01-25	-0.000441	-0.011743	-0.009231	0.005358	-0.008676	-0.007437	-0.023480	0.010238	-0.000797	-0.042121	0.020668
...	...	...	...	...	...	...	...	...	...	...	...
2021-11-18	0.010725	0.002696	-0.012879	-0.001675	-0.001809	-0.004553	-0.055842	-0.067085	0.000100	-0.080235	-0.047046
2021-11-19	0.005483	-0.004842	-0.010654	-0.007503	-0.003807	-0.007458	0.019574	0.073008	0.000400	0.092311	0.041988
2021-11-22	-0.011607	0.004866	-0.003937	0.000480	-0.002740	-0.021446	-0.031498	-0.048627	-0.000200	-0.036661	-0.046789
2021-11-23	-0.004533	-0.001941	-0.012014	0.005460	-0.011088	-0.008482	0.023144	0.062138	-0.000400	0.056459	-0.014467
2021-11-24	0.003746	0.001955	0.001376	-0.000239	-0.003678	-0.000687	-0.006823	-0.016231	0.000000	-0.001184	-0.048207

Table 3 The example of sample data descriptive analysis

	NDX	SET50	HSI	DJI	DAX	Gold	BTC	ETH	USDT	BNB	ADA
count	860.000000	860.000000	860.000000	860.000000	860.000000	860.000000	860.000000	860.000000	860.000000	860.000000	860.000000
mean	0.001154	-0.000114	-0.000215	0.000482	0.000306	0.000391	0.003147	0.003871	-0.000023	0.007004	0.003927
std	0.016335	0.013584	0.013470	0.014818	0.013958	0.009328	0.049259	0.065509	0.002868	0.073856	0.075762
min	-0.121932	-0.116964	-0.081822	-0.129265	-0.122386	-0.057225	-0.381776	-0.447032	-0.027517	-0.439614	-0.415617
25%	-0.005267	-0.005678	-0.007683	-0.004384	-0.004589	-0.004083	-0.019629	-0.026172	-0.000600	-0.028596	-0.036023
50%	0.001802	-0.000095	0.000685	0.001108	0.000879	0.000793	0.002064	0.001765	0.000000	0.003641	-0.001062
75%	0.008848	0.005386	0.007517	0.006551	0.006591	0.005218	0.025386	0.035325	0.000600	0.038391	0.038869
max	0.100722	0.092660	0.050483	0.113650	0.109759	0.037005	0.236010	0.387285	0.021375	0.699683	0.337025

After that we calculate the cumulative returns and plot graph to compare them. Figure 6 is a visualize of gold and stock index cumulative return. The result shows that the cumulative return trends in the big picture of gold and stock index are going in the different way. Moreover, the best performer in cumulative returns among them was Gold and NDX in the first half of COVID-19incidence. However, in the second half it seems that NDX was doing better on cumulative returns followed by FBX. Figure 7 is a visualize of gold and cryptocurrencies cumulative return. We can clearly see that cryptocurrencies outperform gold in term of cumulative return except USDT and the best cumulative return performance among cryptocurrencies was BNB. In Figure 8 we visualize gold and other cryptocurrencies separately from BNB because BNB cumulative return was far higher than other asset, so it makes other assets cumulative return was hard to visualize. The result found that almost all cryptocurrencies outperform gold in terms of cumulative return except USDT which very stable.
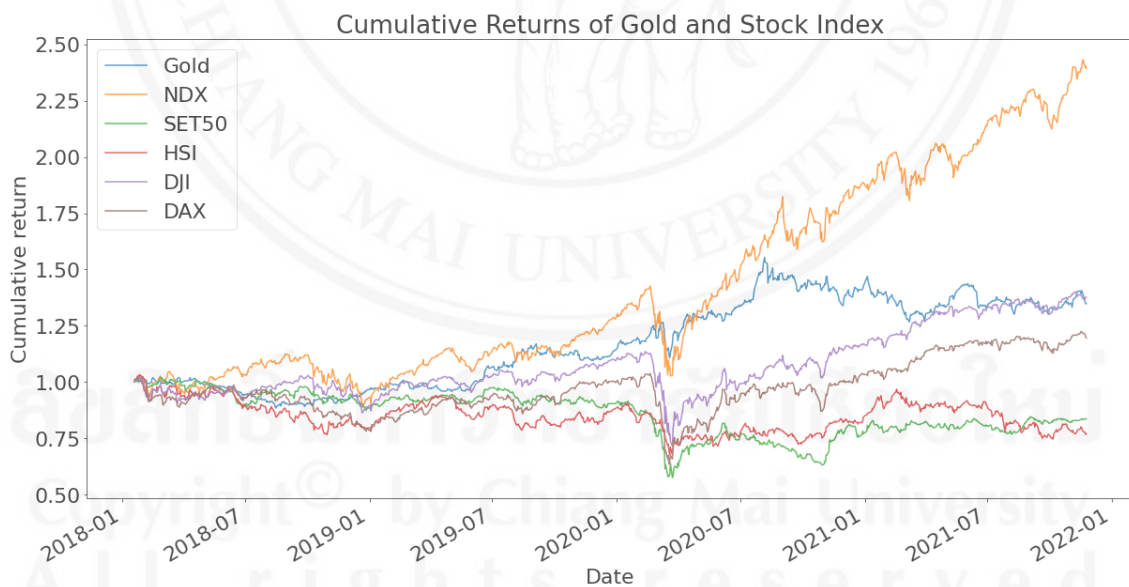
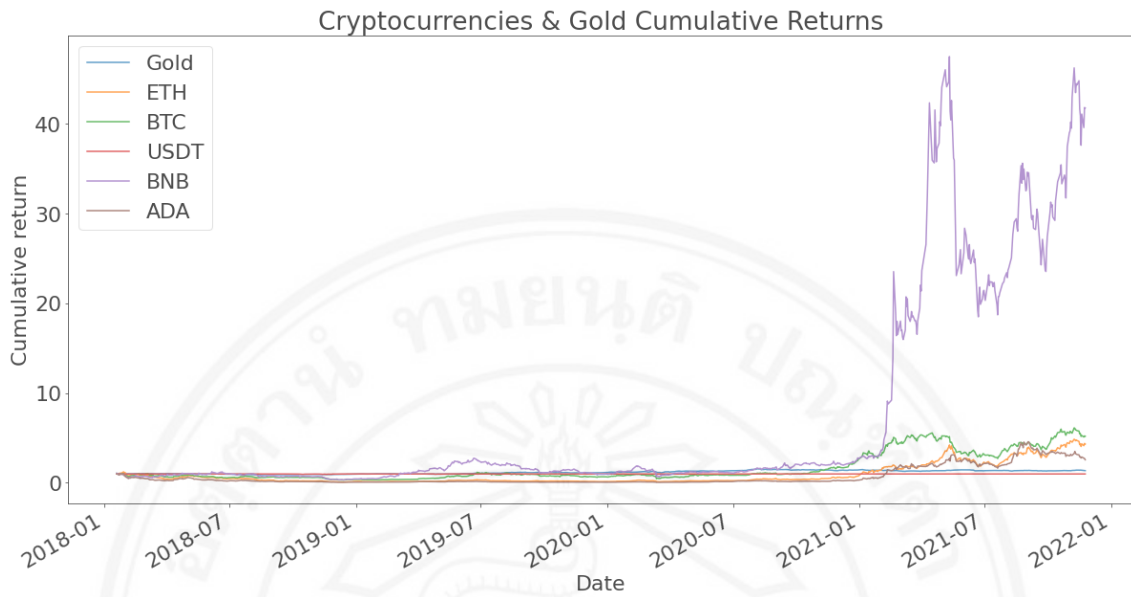Figure 6 Stock Index & Gold Cumulative Returns Visualize
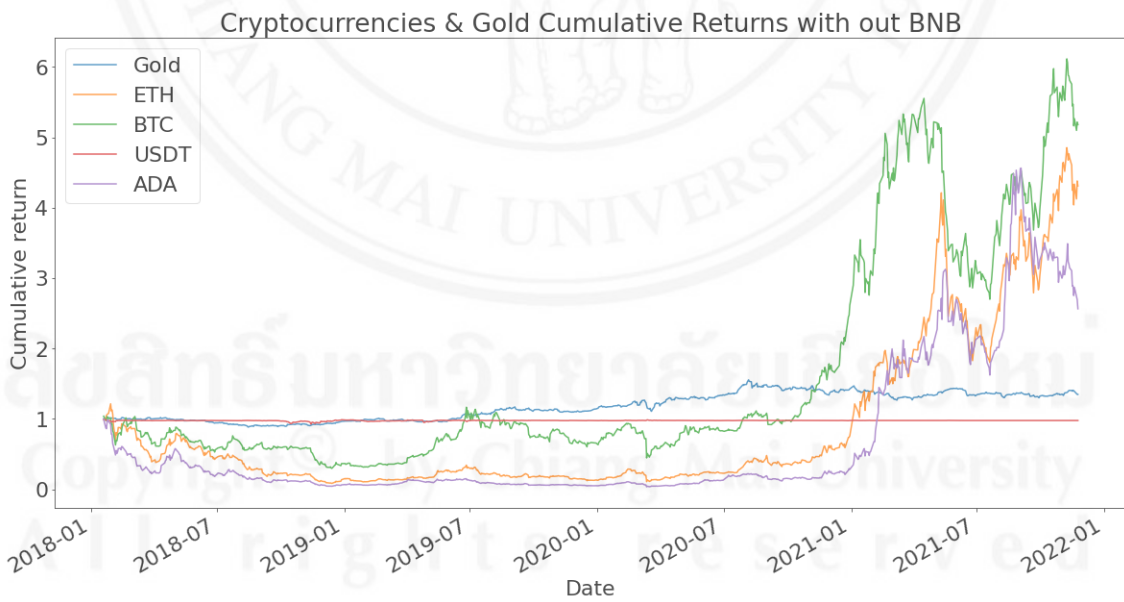
Figure 7 Cryptocurrencies & Gold Cumulative Returns

Figure 8 Cryptocurrencies & Gold Cumulative Returns without BNB

In overall the cumulative returns of most of the cryptocurrencies, except USDT, are far higher than all the stock market indexes, which is a good sign that these cryptocurrencies are doing well in term of cumulative return in Covid19 pandemic period. Among cryptocurrencies, USDT has the lowest cumulative returns as it shown in Figure 9 . This can be said that cryptocurrencies can sustain their value in the time of financial crisis since in the period of COVID-19crisis cryptocurrencies still make a lot of cumulative return.
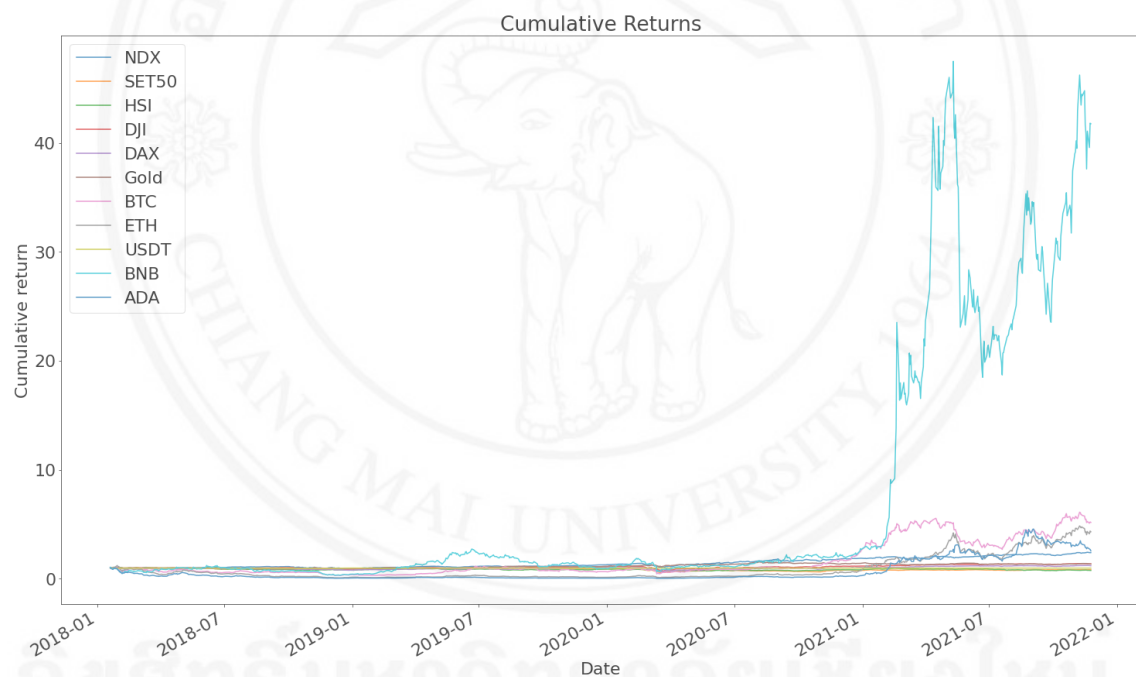
Figure 9 All Assets Cumulative Returns

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4.2 Risk Analysis

4.2.1 Standard Deviation Analysis

We use financial return to measure volatility by calculating standard deviation from daily financial return then visualize it in a graph. The result in Figure 10 shows the visualize of the calculation of 30-day standard deviation in line chart. It shows that the volatility of cryptocurrencies is going in the same way with stock index, which seems to be fluctuating but cryptocurrencies are more fluctuated than stock index. On the other hand, the volatility of gold and USDT seem to be lower and more stable especially USDT.
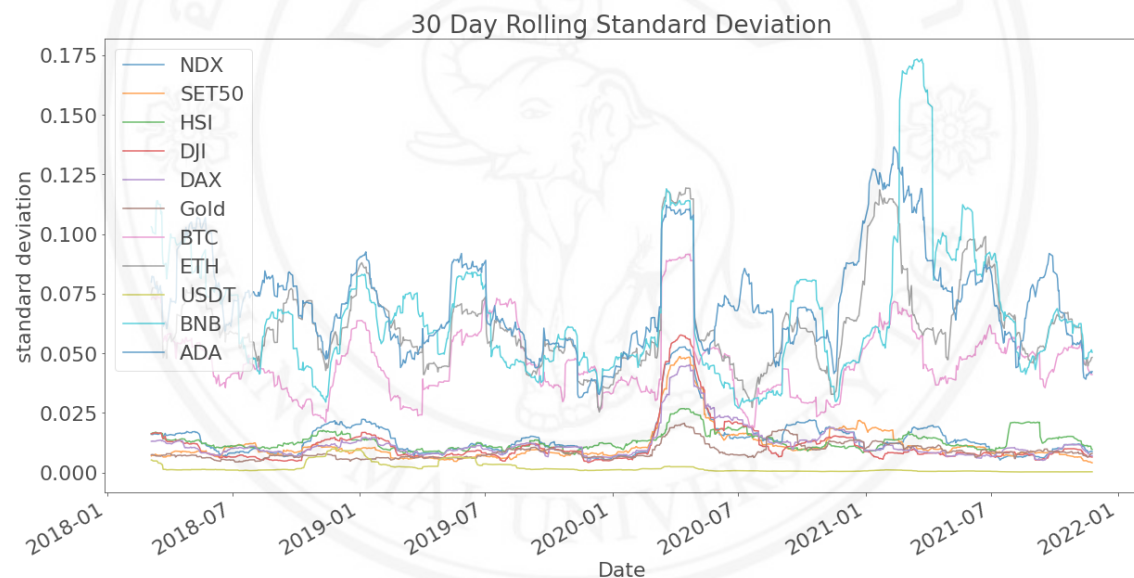
Figure 10 30 Day Rolling Standard Deviation

Next, we use Boxplot to visualize the daily financial return to observe the portfolio risk by looking into interquartile range, the wider the box the more risk that asset has. In Figure 11 was the result of box plot visualize which show that most of cryptocurrencies, excepts USDT, clearly have more risk than the other asset as we can clearly see the interquartile range was wider than other assets. The assets that have the shortest interquartile range are USDT, and Gold. Overall results show that cryptocurrencies have

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a lot more risk than stock index because they fluctuate to the point that the price is expected to be less predictable. The cryptocurrencies that have highest risk is BNB followed by ETH, ADA, BTC. USDT is an exception because the result of cumulative return already told us that USDT is a stable coin so it does not show any signal in standard deviation analysis.
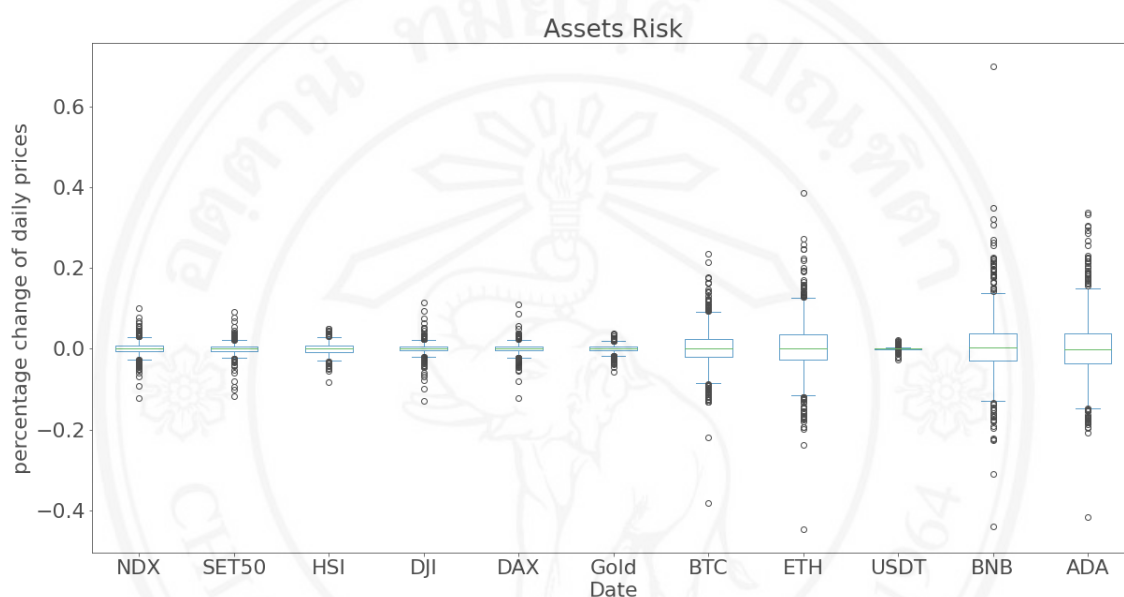

Figure 11 All Asset Box Plot

4.3.2 VaR & CVaR Analysis

Value at Risk (VaR) and Conditional Value at Risk (CVaR) are tools we use to assess financial risk and tail risk, respectively. In a bar plot, VaR and CVaR will both be shown in Figure 13. Visualization of the calculated VAR results reveals that, with the exception of USDT, all stock indices had a higher level of financial risk than the majority of cryptocurrencies. According to our sample data, ADA was ranked first, followed by ETH, BNB, and BTC. Out of all the sample assets, gold and USDT have the lowest level of financial risk. The CVAR results in Figure 12 demonstrate that cryptocurrencies, specifically BNB, ADA, ETH, and BTC, are the assets with the highest tail risks. The

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least risky assets are gold and the USDT. The majority of cryptocurrencies, with the exception of USDT, which has the lowest VaR and CVaR values across all sample sets, have high VaR and CVaR values as a consequence of risk analysis. Another intriguing fact is that, with the exception of USDT, BTC has the lowest value in VaR and CVaR of all the cryptocurrencies.
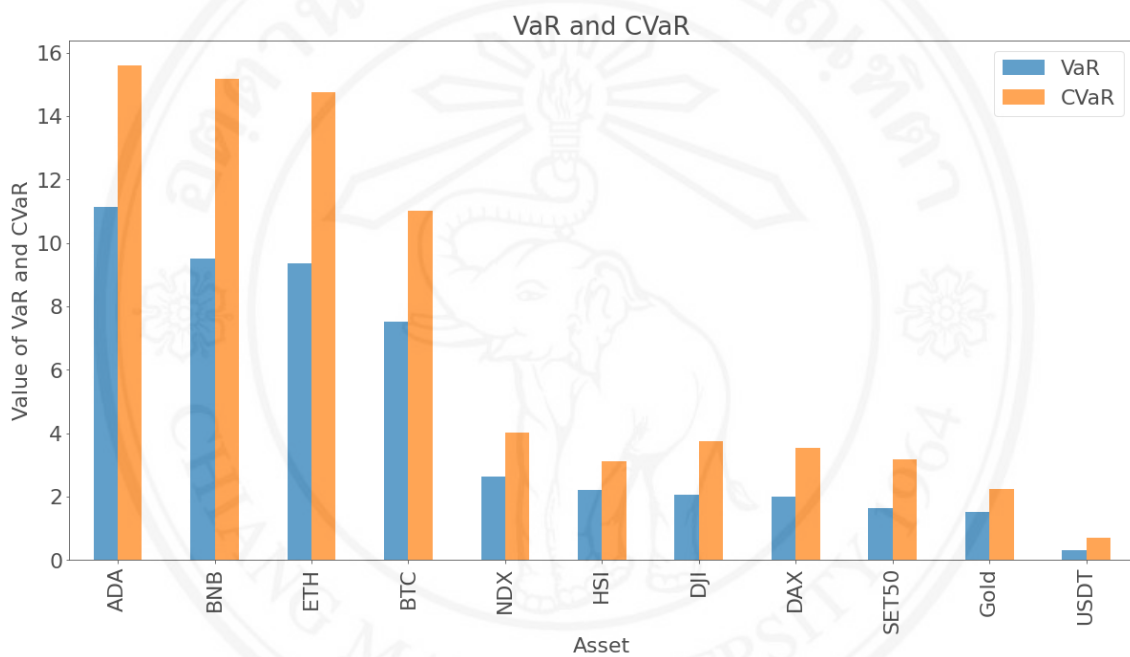

Figure 12 Var and CVar Result

4.4 Portfolio Analysis

We simulate a portfolio with samples from all stock indexes and add one cryptocurrency to each portfolio in order to compare it to a portfolio with equal weights of stock index and the conventional safe haven of gold and examine the influence of cumulative return in each portfolio. When compared to portfolios that contain gold or USDT, the results in Figure 13 show that the majority of cryptocurrencies are performing well in terms of cumulative return at the end of the sampling data period. The portfolios that comprised

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ETH and ADA were not performing well in terms of cumulative return at the start and middle of the sampling period, but towards the end of the sampling period, things had started to turn around. At the beginning of the sample period, the cumulative return of the BTC portfolio was lower than the cumulative return of the gold portfolio, but it gradually started to rise by the middle of the period and at the conclusion, it was much higher than the cumulative return of the gold portfolio. However, in terms of cumulative return, a portfolio with BNB consistently beat a portfolio with gold, particularly near the end of the study period. Finally, the portfolio risk analysis revealed that, as shown in Figure 15, portfolios with cryptocurrency are riskier than those without.

In conclusion, it can be said that some cryptocurrencies, such as BNB, may be useful for speculating or as a hedge against the loss of cumulative return from stocks. For investors searching for high-risk, high-return investments, other cryptocurrencies like ETH, BTC, and ADA may not be the ideal option for speculating or mitigating losses, but they may still be a good alternative.
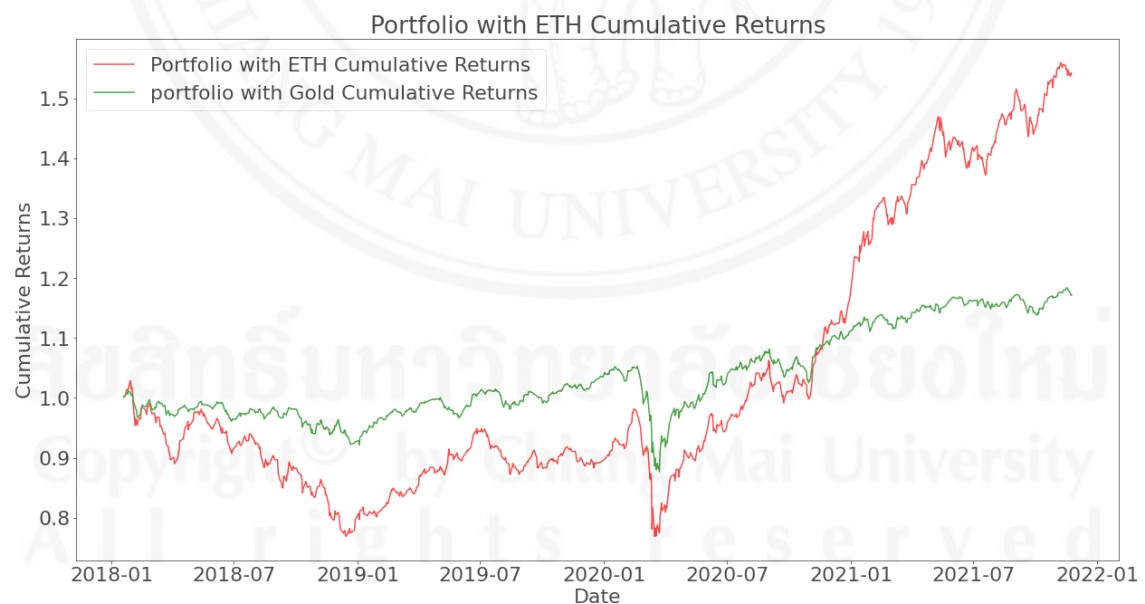
Portfolio with BTC Cumulative Returns
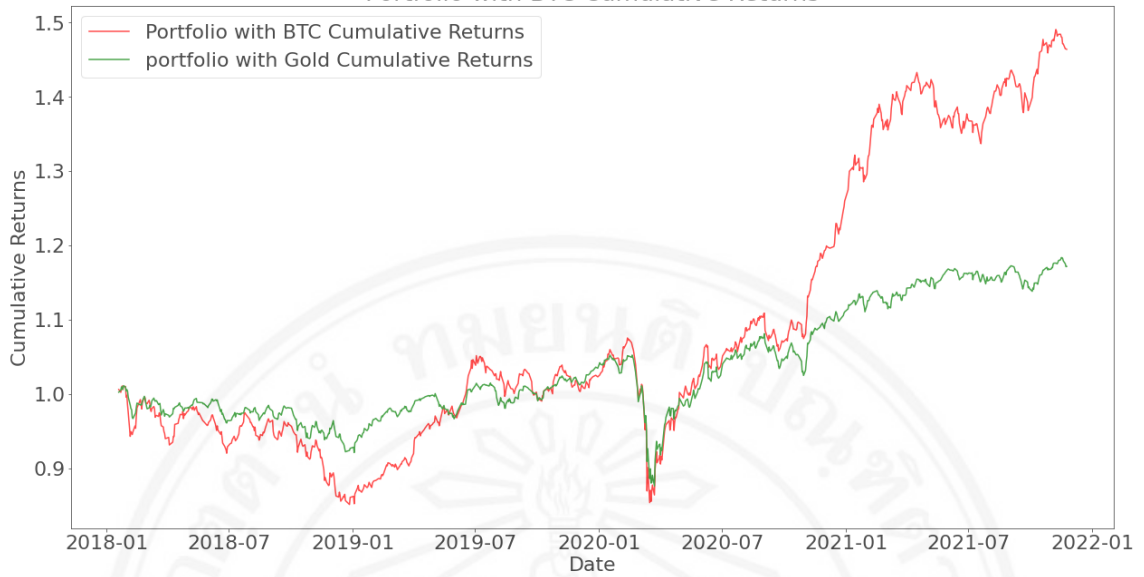
Portfolio with USDT Cumulative Returns
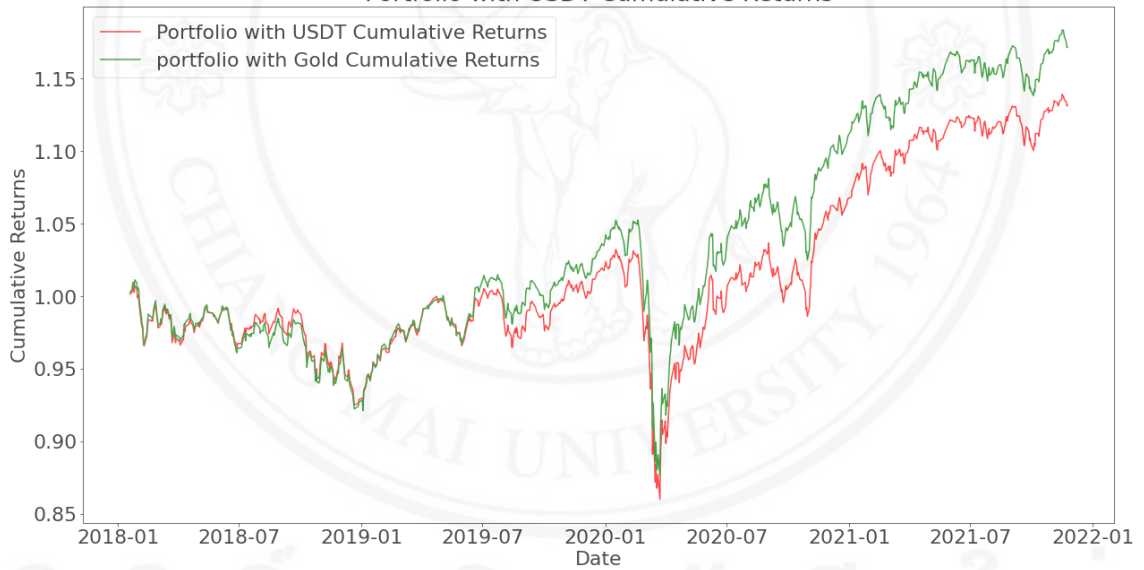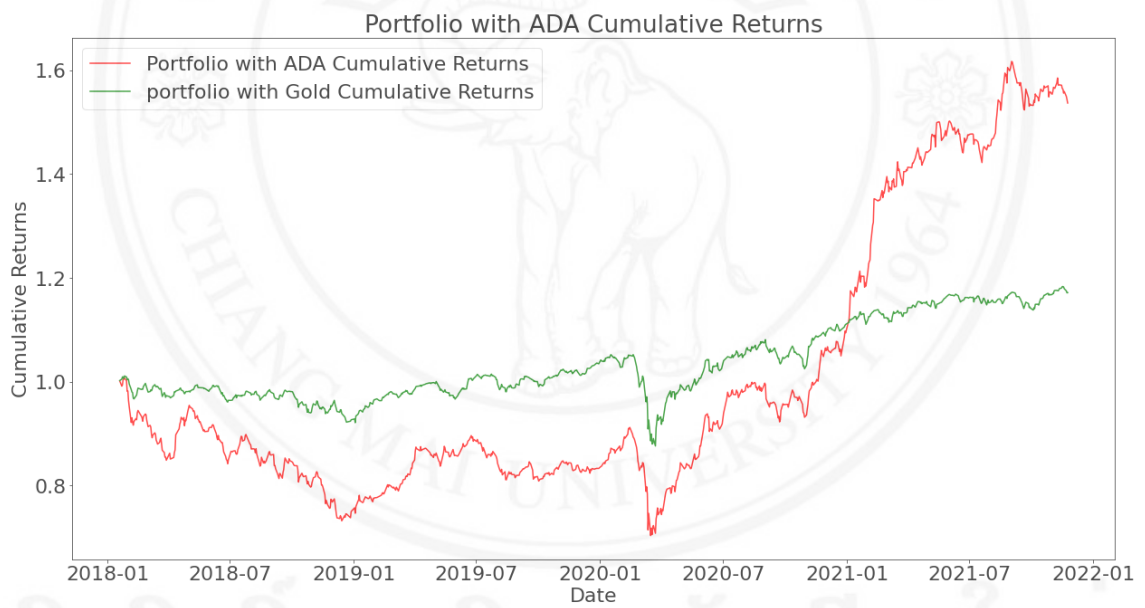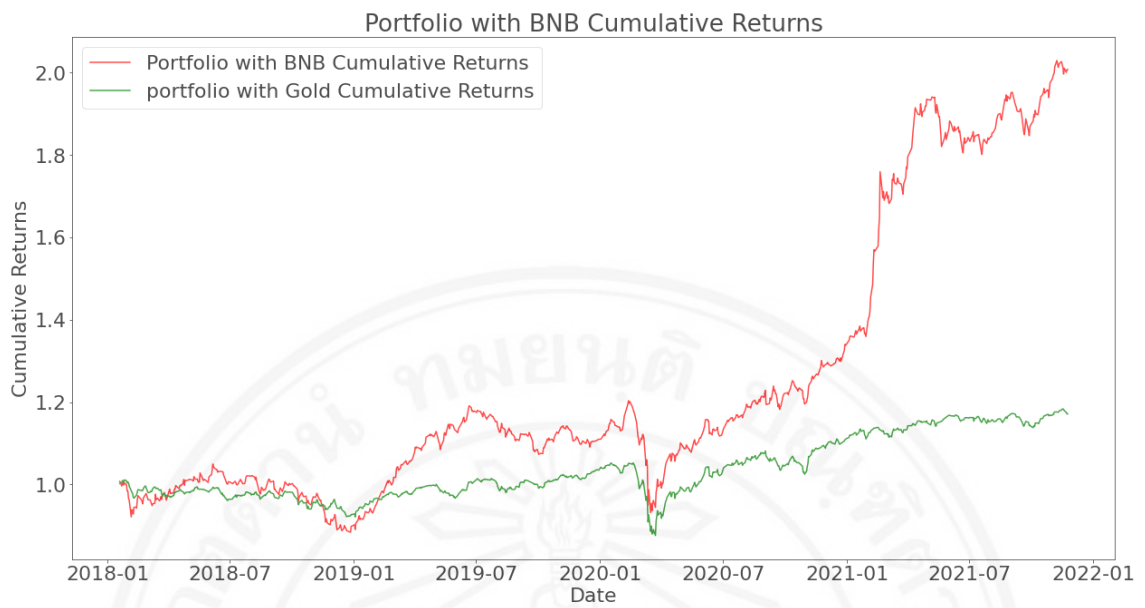
Figure 13 All Portfolio Cumulative Return Results

```
risk of portfolio with Gold : 8.962299608143194 %
risk of portfolio with ETH : 15.14049630158504 %
risk of portfolio with BTC : 12.793119742127306 %
risk of portfolio with USDT : 8.74050772874318 %
risk of portfolio with BNB : 15.97962030386866 %
risk of portfolio with ADA : 16.47133471328846 %
risk of portfolio with out cryptocurrencies :8.715385870884226 %
```

Figure 14 Portfolio Risk

4.5 Correlation Analysis

The Pearson correlation result is shown as a heat map in Figure 15. If the correlation coefficient in the heat map is close to 1, it indicates a strong positional relationship; however, if it is close to -1, it indicates a strong negative correlation Last but not least, if the correlation coefficient is close to zero on the heat map, there is no association between the assets. The result shows that all cryptocurrencies have substantial correlations among themselves but very weak correlations with the USDT. With the exception of BTC, which has a moderate correlation with SET50, cryptocurrencies appear to have a low degree of correlation with the NDX DJI and DAX indexes. Finally, the results indicate that there is little to no correlation between any cryptocurrency and the HSI index. With the exception of the HSI index, which has a minor degree of correlation with Gold, classic safe haven assets such as Gold appear to have substantial correlations with NDX,SET50,DJI, and DAX indexes. Furthermore, it appears that the majority of cryptocurrencies, with the exception of BTC, have a moderate correlation with gold. Compared to other cryptocurrencies, BTC appears to have a stronger correlation with gold.
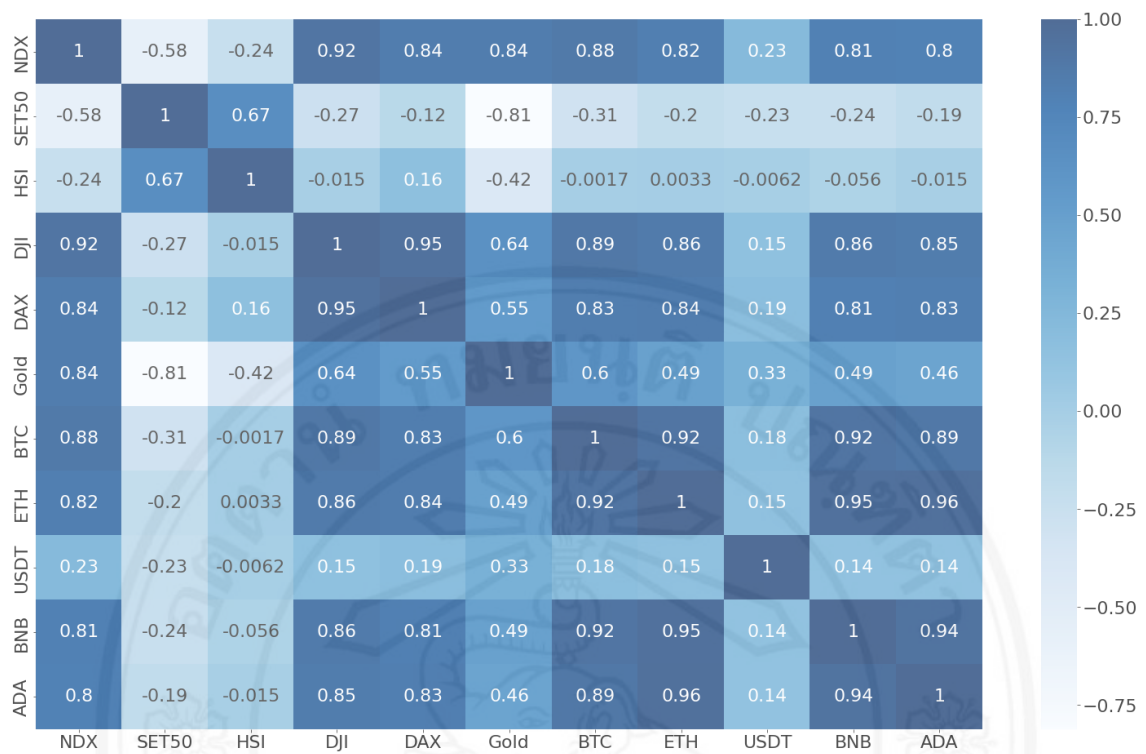
36

Figure 15 Pearson Correlations Result

CHAPTER 5

CONCLUSION

According to the empirical findings, throughout the Covid-19 epidemic period's end, the majority of cryptocurrencies performed well in terms of cumulative returns despite having significant financial risks. Pearson correlations reveal a correlation between the majority of stock indices and the majority of cryptocurrencies. When compared to a portfolio with gold, portfolio analysis reveals that some cryptocurrencies may be better assets for speculating or protecting against the loss of cumulative return from stocks because the price of cryptocurrencies moves in the opposite direction from the other assets, minimizing loss in the portfolio with BNB. However, those cryptocurrencies only have one characteristic that makes them safe haven assets: they maintain or even increase in value during market downturns. The other crucial criteria, which states that safe haven assets should not correlate or should have a negative correlation with other financial assets, was absent from the majority of cryptocurrencies, nevertheless. In addition, we discovered that the VAR and CVAR of all cryptocurrencies are greater than stock indexes as a consequence of our risk study, indicating that most cryptocurrencies are significantly riskier. The results of volatility testing, which point to these digital assets as potentially volatile, are another cause for concern. Thus, it provides compelling evidence that the majority of cryptocurrencies cannot serve as safe haven assets at this time. The USDT, on the other hand, is a unique form of asset. It does not correlate with other stock indices, has low volatility, and may maintain value during a crisis. These qualities match those of gold, a well-known safe haven asset. But once more, the USDT's value is tied to the US dollar. Having USDT is equivalent to having USD. Cryptocurrencies that are pegged to the US dollar might also be seen as safe haven assets if the US currency is. Since cryptocurrencies are still relatively young, the data we have may not be sufficient to draw firm conclusions. However, as more data becomes available and more digital assets become accessible in the future, we could revisit this question and have a clearer picture.

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CURRICULUM VITAE

Author's Name   Mr. Nathaphat Na Chiangmai

Place of Birth   Thailand

Education	2020 - Now	Master of Science in Digital Innovation and Financial Technology, Chiang Mai University
	2014 - 2018	Bachelor of Science Animation and Game, Chiang Mai University