CAN CRYPTOCURRENCIES ACT AS A HEDGE TO STOCK MARKET VOLATILITY? EVIDENCE FROM GEOPOLITICAL RISK AND ECONOMIC POCILY UNCERTAINTY

CHUA KAR HOON
JASMINE NG KAR YING
LEE KAI ZHEAN
SAW MIAO QI

BACHELOR OF FINANCE (HONOURS)

UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF BUSINESS AND FINANCE
DEPARTMENT OF FINANCE

APRIL 2022

21FN13M

CAN CRYPTOCURRENCIES ACT AS A HEDGE TO STOCK MARKET VOLATILITY? EVIDENCE FROM GEOPOLITICAL RISK AND ECONOMIC POLICY UNCERTAINTY

BY

CHUA KAR HOON
JASMINE NG KAR YING
LEE KHAI ZHEAN
SAW MIAO QI

A final year project submitted in partial fulfilment of the requirement for the degree of

BACHELOR OF FINANCE (HONS)

UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF BUSINESS AND FINANCE
DEPARTMENT OF FINANCE

APRIL 2022

DECLARATION

We hereby declare that:

(1) This undergraduate FYP is the end result of our own work and that due acknowledgement has been given in the references to ALL sources of information be they printed, electronic, or personal.

(2) No portion of this FYP has been submitted in support of any application for any other degree or qualification of this or any other university, or other institutes of learning.

(3) Equal contribution has been made by each group member in completing the FYP.

(4) The word count of this research report is _17101____.

	Name of Student:	Student ID:	Signature:
1.	Chua Kar Hoon	18ABB03762	
2.	Jasmine Ng Kar Ying	18ABB02009	
3.	Lee Khai Zhean	18ABB02000	
4.	Saw Miao Qi	18ABB02260	

Date: 14th April 2022

ACKNOWLEDGEMENT

First, we would like to take this opportunity to express our utmost gratitude to our research supervisor, Mr. Cheah Siew Pong, who is truly supportive throughout the completion of our undergraduate project and is exceptionally generous in sharing his knowledge in the field of our topic whenever we encountered difficulties. We appreciate him for contributing his valuable time and effort in guiding us with patience to improve the quality of our research. Without his superior knowledge and experience, we would not have achieved this outcome. It is our honour to be under his supervision.

Apart from that, we would like to offer our sincerest gratitude to our examiner, Dr. Tan Ai Lian for her constructive recommendations in improving the overall performance and quality of our paper. We are grateful for her time and willingness to provide us with quality advices and for always appreciating the efforts we put on our research. In addition, we appreciate her for providing us the project guidelines and constructive opinions for our research.

Other than that, we would also like to thank Universiti Tunku Abdul Rahman (UTAR) for providing us an opportunity to conduct this research. We appreciate the facilities provided by UTAR. For instance, Bloomberg Terminal that eases the data collection process as well as the e-database platforms, which allow us to access to voluminous journal articles required for this research. Throughout this project, we have gained better understanding in our topic and at the same time enhance our problem-solving skills and analytical skills.

Finally, we would like to credit our families and friends for their mental support, understanding, motivation and encouragement. Mostly importantly, we feel appreciated for all the hard work and team spirits contributed by each team member and all the dedications are gratefully acknowledged and highly appreciated.

TABLE OF CONTENTS

CHAPTER TWO: LITERATURE REVIEW

CHAPTER THREE: METHODOLOGY

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

VIX	Cboe Volatility Index
GEPU	Global Economic Policy Uncertainty
EPU	Economic Policy Uncertainty
GPR	Geopolitical Risk

ABSTRACT

Recently, cryptocurrencies are gaining attention from investors, policymakers and researchers around the world. This research examines the hedging capabilities of cryptocurrencies (Bitcoin, Ethereum, XRP, and Dogecoin) against Cboe Volatility Index (VIX), Global Economic Policy Uncertainty (GEPU) and Geopolitical Risk (GPR). Monthly data starting from October 2015 to March 2021 is used for this research. This research will apply Pooled Ordinary Least Square (OLS) model, Fixed Effect Model (FEM) and Random Effect Model (REM) to examine the direct impact of Cboe Volatility Index (VIX) and the indirect impact of uncertainties (GEPU and GPR) on cryptocurrencies' return. The regression models also have been proven that they are free from unit root through Levin-Lin-Chu Test, Im-Pesaran-Shin W-Stat Test, ADF-Fisher Chi-square Test and PP-Fisher Chi-square Test. By conducting Breusch-Pagan LM Test and Hausman Test, Pooled OLS model is shown to be the most suitable regression model in interpreting the result. In brief, the outcomes show that Cboe Volatility Index (VIX) as well as the indirect impact of Global Economic Policy Uncertainty (GEPU) and Geopolitical Risk (GPR) have no relationship with the cryptocurrencies' return. In other words, cryptocurrencies can act as a hedge to these risks. Investors, policymakers and future researchers can gain valuable information through the results of this research.

CHAPTER ONE: RESEARCH OVERVIEW

1.0 Introduction

Chapter one delivers the introduction related to the overview of cryptocurrency including Bitcoin, Ethereum, XRP, and Dogecoin, and the synopsis of the Economic Policy Uncertainty (EPU), Geopolitical Risk (GPR) as well as Cboe Volatility Index (VIX), which served as the independent variables of the cryptocurrency price. Besides that, chapter one will also cover the problem statements, research question, research objectives, hypothesis statement, significance of study, and the chapter layout of this study.

1.1 Research Background

1.1.1 Cryptocurrency

As the first cryptocurrency invented in 2009, Bitcoin (BTC) is the go-to name whenever cryptocurrency is mentioned. According to Nakamoto (2008), Bitcoin was originally designed as an alternative payment system that is free from central control and as a medium of exchange for the bookkeeping system. In addition, Bitcoin offers significant set of advantages that immediately distinguishes it from the traditional fiat-based transaction system. Such advantages include decentralized system; transactions

are pseudonymous and peer-to-peer, speedier process, lower processing fees, and with better security (Nakamoto, 2008).

Today, when it comes to these digital currencies, we have literally thousands of other options instead of Bitcoin and that is more than all the different types of paper currencies in the world. In fact, cryptocurrencies other than Bitcoin are usually considered as "altcoins" or alternatives to Bitcoin. While Bitcoin may have been the first major cryptocurrency to hit the market from its inception in 2009, many others have also gained high popularity, even they are not quite as high as the original. Based on coinmarketcap.com (2022), the top twelve largest cryptocurrencies by market capitalisation include Bitcoin (BTC), Ethereum (ETH), Tether (USDT), Binance Coin (BNB), USD Coin (USDC), XRP (XRP), Cardano (ADA), Solana (SOL), Terra (LUNA), Avalanche (AVAX), Binance USD (BUSD) and Dogecoin (DOGE).

According to coinmarketcap.com (2022), as of January 2022, Bitcoin (BTC) has recorded the highest capitalization in the cryptocurrency market with USD 794.62 billion and that is about 45% out of the total capitalization. In addition, it circulates 18.934 million coins of supplies in the cryptocurrency market. It is notable that in October 2021, the creation of Bitcoin futures based exchange-traded fund (ETF) was approved by the U.S. Securities and Exchange Commission and such fund hit the New York Stock Exchange (NYSE) on 19 of October. After the first milestone of Bitcoin in 2017 where BTC futures contracts were launched in (CME), a US-registered derivatives clearing organization (DCO) and designated contract market (DCM), as well as the Chicago Board Options Exchange (CBOE), the approval of issuance for Bitcoin (BTC) futures ETF in 2021 has marked another long-waited milestone of the cryptocurrency. Such issuance in the derivatives clearing organization and largest stock exchange market indicates the popularity and growing acceptance of cryptocurrency on top of the traditional choice of commodities and exquisite metals like gold. Consequently, cryptocurrencies eventually become an alternative class of asset to

shield investments including hedging purpose, investment purpose or even portfolio diversification despite the traditional investing assets.

In view of this, many has begun to question on whether cryptocurrencies could compete with traditional precious metals like gold as both of them share similar characteristics such as weakly correlated with other financial assets such as the equity stocks, decentralized, non-cash yielding and deflationary (Guesmi et al., 2019; Urquhart & Zhang, 2019). Not only have that, studies from Zhang and Wang (2021), Ahmed and Dutta et al. (2020) also suggested that during economic turmoil, both gold and Bitcoin behaved alike as safe havens for stock portfolio. Ever since Rehman and Apergis (2019) noticed that the trend of funds shifts from exquisite metals to cryptocurrency like Bitcoin, Bitcoin is deemed by scholars as a digital gold (Popper, 2015) or virtual gold (Dyhrberg, 2016 & Klein et al., 2018). Nevertheless, evidences from Baek (2019) and Junttila et al. (2018) suggested that the hedging behavior of gold is only effective for developed stock markets. Several empirical evidence suggests that gold is ineffective for hedging stock market risks when emerging stock markets are of concern (Beckmann et al., 2015; Bekiros et al., 2017). Consequently, it is an important question of whether Bitcoin could assume the traditional role of gold as an instrument for portfolio diversification and hedging in stock markets.

1.1.1.1 Bitcoin

Bitcoin is a decentralized digital currency, without a central bank or single administrator, that can be sent from user to user on the peer-to-peer bitcoin network without the need for intermediaries. Transactions are verified by network nodes through cryptography and recorded in a public distributed ledger called a block chain (Tsang & Yang, 2021). The cryptocurrency was created in 2008 by an unknown person or group using the name Satoshi Nakamoto and began to be used in 2009 when it was

released as open-source software (Nakamoto, 2008). Although Bitcoin is not legal tender in most parts of the world, it has become so popular that it has sparked the launch of hundreds of other cryptocurrencies, collectively known as altcoins. Bitcoin is often abbreviated to "BTC."

According to Bohme et al. (2015), the value of Bitcoin is based on scarcity. It is the basis for assigning value to any form of money. In current legal tender practice, monetary authorities or central banks hold and reserve currencies. The central bank of a country has the power to regulate the circulation and the absolute quantity of money. Banks can produce only a limited amount of these notes to finance a country's economy, resulting in a shortage. This scarcity will be recorded in the bank's books and will be preserved by law.

Bitcoin is one of the major digital currencies that uses peer-to-peer technology to facilitate instant payments (Nakamoto, 2008). The freelancers and companies with computing power collaborate within the bitcoin network and bitcoin "miners" to process transactions on the block chain with the aim of earning rewards by releasing alternate bitcoins and paying bitcoin transaction fees. These miners can be seen as localized authorities that reinforce the quality of the Bitcoin network. New bitcoins square measure discharged to miners at a gradual, however, alternate, rate of decline. solely 21 million bitcoins may be strip-mined. As of June 2021, their square measure over 18 million Bitcoins existing, but only 3 million remaining (‘Bitcoin USD (BTC-USD)’, 2021.). In this case, Bitcoin and other cryptocurrencies operate differently from rescript currencies. In central banking, the rate at which cash is issued matches the rate at which products grow. The system is designed to maintain the value stability of local systems such as Bitcoin, setting the release rate before the supported algorithms.

1.1.1.2 Ethereum

Ethereum is a decentralized, open source block chain with smart contract capabilities. Ether (ETH) is the platform's native cryptocurrency. Ethereum is the most actively used block chain after Bitcoin. Ethereum was first proposed by programmer Vitalik Buterin in 2013. The project was crowdfunded in 2014 and launched on July 30, 2015. The platform allows developers to deploy permanent and immutable decentralized applications. Users can interact with decentralized financial applications to provide a wide range of financial services without the need for typical financial intermediaries such as brokers, exchanges or banks, allowing cryptocurrency users to borrow against the assets they hold or lend at interest. Ethereum also allows the creation and exchange of NFT, a non-interchangeable token that is linked to digital art or other real-world objects and sold as unique digital property. In addition, many other cryptocurrencies operate as ERC-20 tokens on the Ethereum blockchain and use the platform for initial coin offerings (Coinmarketcap.com, 2021.).

Ethereum is built on the foundation of Bitcoin's innovations, with some differences (Ethereum.org, 2021). Ethereum pioneered the concept of a block chain smart contract platform. The smart contract is a computer program that automatically performs the necessary action to perform the agreement between the parties on the Internet. Its purpose is to reduce the demand for a credible intermediary between contractors, reduce transaction costs and improve reliability at the same time. Ethereum's main innovation is to design a platform that allows it to execute smart contracts using block chain, further reinforcing the benefits of smart contract technology that already exists. (Ethereum.org, 2021).

In addition to smart contracts, Ethereum's block chain can host other cryptocurrencies called "tokens" through its ERC-20 compliant standard. In fact, this is the common use

of the ETH platform which has issued more than 280000 accords with ERC-20 tokens. More than 40 of them, including USDT, Link and BNB, are among the top 100 cryptocurrencies by market capitalization (Ethereum.org, 2021).

Both Ethereum and Bitcoin allow digital currencies to be used without payment providers and since Ethereum is programmable, it can be used for many digital assets (Bernardmarr.com, 2021). This means that Ethereum is not only valid for payments, it is also a market place for financial services, games and applications that will not steal one's data or censor one (Ethereum.org, 2021).

1.1.1.3 XRP

According to Harper (2020), XRP is a digital currency that was issued and controlled partially by Ripple Inc, a payment solution organization, which is also an organization that manage a cross-border transaction network call RippleNet. XRP is the native virtual currency on XRP Ledger, which is an open-source, permissionless, and is not based on blockchain but rather the distributed ledger database. XRP can be used as a bridging instrument between two different currencies and due to its non-centralized characteristic, the transaction is quick and efficient (Ripple.com, 2021). In short, XPR is the digital currency that runs in RippleNet, a digital transaction platform. Meanwhile, RippleNet is run by a company named Ripple.

Fascinated by Bitcoin, in 2011, David Schwartz, Jed McCaleb and Arthur Britto started to develop the XRP Ledger. Their objective is to create a better version of cryptocurrency that improved the limitation of Bitcoin and create a digital currency that is more sustainable and specifically for payments. In June 2012, the development of

XRP ledger is completed and it is fully functioning. In September 2012, the founders created a company called NewCoin and quickly changed to OpenCoin and decided to gift 80 billion XRP to the company. In 2013, since the community starting to refer the digital currency as "XRP" more widely, the founders decided to rebrand their company to Ripple Labs, which is shorten to "Ripple" over time (XRP Ledger, 2021).

According to Ripple.com (2021), until 2021, RippleNet is used by several banks like Santander, Bank of America, CIMB Bank, and so forth. In order to perform actions like remittance of payments and currency swap, these banks had used the banking-focused "blockchain" of RippleNet and RippleNet claim that through the "blockchain", they had settled transaction that worth nearly 500 million around the 6 continents. Besides the banking-focus "blockchain", RippleNet also provide On-Demand Liquidity service, a service which XPR is used to provide liquidity during cross-border transaction between countries like Australia, United States, and Mexico.

Ripple had improved some drawbacks of traditional banks. For example, even though the platform needs to handle millions of transaction frequently, but the transactions are settled within seconds on RippleNet. Unlike traditional banks that take days or weeks to settle an international transfer. Besides the transaction period, the fees charged by Ripple for a standard transaction is 0.00001 XRP which is minimal comparing to traditional banks that charges large amount of fee for cross-border transaction (Frankenfied, 2021).

As mentioned above, XPR is developed associated with the goal to become a better cryptocurrency and to improve the limitations that exist in Bitcoin. According to Anderson (2021), XPR validate transactions differently compared to Bitcoin. When it comes to validating transactions, instead of using blockchain mining, RippleNet makes use of a completely unique distributed consensus mechanism which is conducting a

poll when participating nodes to affirm the authenticity. By doing so, the confirmation of transaction is done in instant without a central authority, making XPR faster and more dependable than other competitors. Second, the circulation mechanisms of XRP are different from Bitcoin. For Bitcoin, it is realized to the network through mining, there is no fixed timing and the supply is mainly depending on the speed of miners. For XRP, it's realizes is controlled by a smart contract which release a maximum of 1 billion XRP token each month and the unused proportion of XRP are shifted back to an escrow account. This is to ensure that the XRP will not be oversupply or undersupply.

1.1.1.4 Dogecoin

Like other cryptocurrencies, Dogecoin is a digital currency that can be used for transaction. Generally, Dogecoin is a fun and friendly alternative to traditional digital currency such as Bitcoin. The name and logo of this cryptocurrency is based on the popular dog meme on internet and the features of a Shiba Inu dog, thus it also had a name of "joke currency" or "memecoin" (Coinbase, 2021). According to Frankenfield (2020), Dogecoin is a peer-to-peer, open source digital currency. The blockchain of Dogecoin is based on the technology derived from Litecoin which the price is low and the supply is unlimited as it uses script algorithm.

The dogecoin runs on a blockchain technology which is a secure digital ledger with a decentralized database that stored all the transaction history. It is done by having all the coin holders carrying an identical copy of the blockchain ledger and the ledger will be updated frequently when there is a new transaction. Dogecoin is not suitable for storing value due to its unlimited supply. This means that the miners of Dogecoin can continuously earn Dogecoin from the mining process. Moreover, Dogecoin can be used for payment or tipping on Reddit or Tweet as a reward for high quality content (Rodeck & Curry, 2021).

In December 2013, to make fun at Bitcoin and act as a lighthearted joke for cryptocurrency enthusiasts, Billy Marcus and Jackson Palmer had created Dogecoin and used a popular meme at that time as their digital currency's logo. The community of Dogecoin enthusiasts is one of the most active communities in the cryptocurrency world which they had arranged some publicity stunts with the objective of raising the Dogecoin's profile at the early stage (Rodeck & Curry, 2021). For example, the community sponsors the Jamaican Bobsleigh team to participate the Winter Olympic in 2014 and send a Nascar driver to participate the Talladega Superspeedway NASCAR race (Hern, 2014).

Although Dogecoin started as a joke, but its value today had soared and gained more than 5000% in 2021 (Rodeck & Curry, 2021). At the same period, the value of S&P 500 index had increased by 19%. The soared value of Dogecoin is mainy due to the Elon Musk effect, whereby the CEO of Tesla and SpaceX, Elon Musk tweets with the reference to Dogecoin which then resulting in the soaring price. Besides Elon Musk, the celebrity endorsement of Dogecoin also includes Snoop Dogg, Gene Simmons, and Mark Cuban. "Dogecoin is like a big F-U towards the whole system" and "Yeah, this thing can have value" said Avi Felman. In addition, Felman also stated that Dogecoin is part of the GameStop boom, "people like these stories and they like such joke", The boom of Dogecoin is because it captures the mind of every investor (Sigalos, 2021).

Since Dogecoin is created to make fun of Bitcoin, during its development, the creators made the characteristic of Dogecoin completely different from Bitcoin, which is the supply. Bitcoin is created with scarcity, which is a maximum of 21 million bitcoins. However, Dogecoin has unlimited supply, making the value of Dogecoin preserves. Thus, Bitcoins are hold by investor for long-term investment and Dogecoin is only for short-term investment. Furthermore, the system of both cryptocurrencies are different. For Bitcoin, it is launched with a detailed paper that is wrote by Satoshi Nakamoto,

while Dogecoin is created as a joke by Billy Marcus and Jackson Palmer. The poor technical development of Dogecoin has caused it to be less secure when compared to Bitcoin (Locke, 2021).

1.1.2 Cryptocurrencies as Hedging Tools – Is It a Valid Alternative?

Investors continue to search for alternative investment instruments that can provide diversification or hedging advantages since the financial crisis happened over the last decade (Guesmi et al., 2019). According to Dyhrberg (2016), Bitcoin and gold have similar hedging capabilities. Due to gold's and cryptocurrencies' high average return, deflationary, decentralized, non-cash yielding and weak correlation with other financial assets, cryptocurrencies can be considered as alternative investment instruments to hedge (Guesmi et al., 2019; Urquhart & Zhang, 2019). Certain studies have proven that gold can serve as safe haven tools against the volatility of stock market, Economic Policy Uncertainty (EPU) as well as Geopolitical Risk (GPR) (Adekoya et al., 2021; Baur & Smales, 2020; Wu et al., 2019).

On the other hand, a question about whether gold will experience a reduction of the hedging or diversifying potential during 2008 financial crash and Coronavirus disease is brought up from recent researches (Bekiros et al., 2017; Cheema et al., 2020; Ji et al., 2020). Beckmann et al. (2015) and Bekiros et al. (2017) also suggests that gold is ineffective for hedging stock market risks when emerging stock markets are of concern. Gold also could reduce or lose its hedging or safe haven capabilities since it becomes quite risky in some settings during the difficult period of Coronavirus disease (Cheema et al., 2020). Therefore, it is an important question of whether cyptocurrencies is the valid alternative investment instruments to hedge against VIX, EPU and GPR.

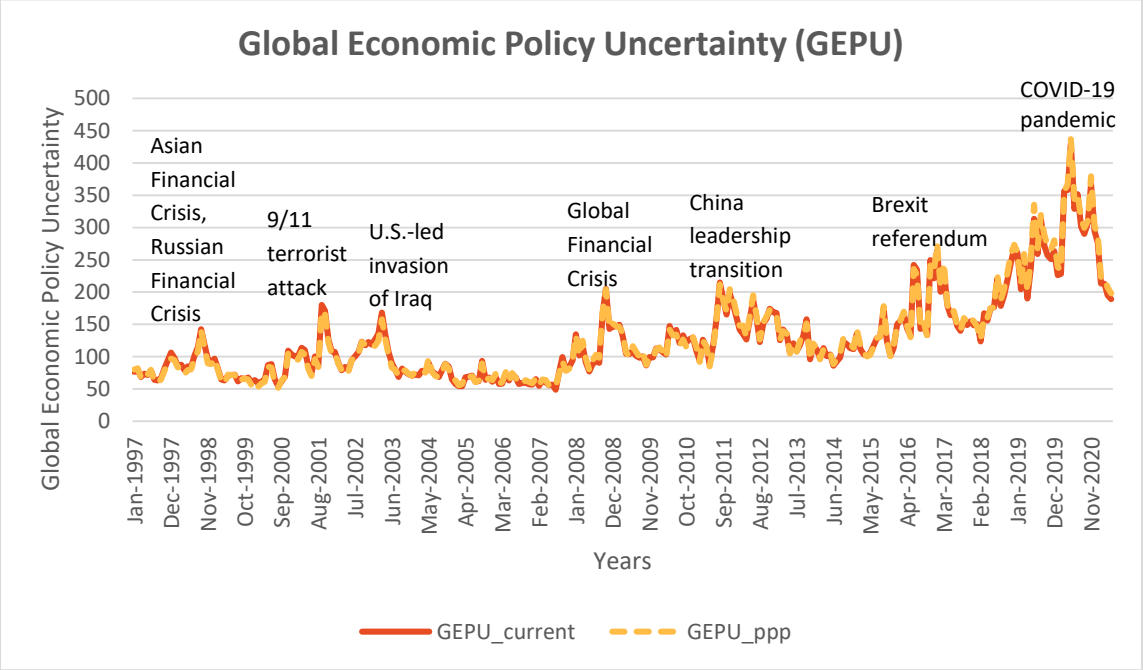

Figure 1.1. Global Economic Policy Uncertainty (GEPU) from 1997 to 2021. Adapted from Baker, Bloom and Davis (2021).

The financial market is volatile within the period especially during the recent COVID-19 pandemic. Davis (2016) and Nonejad (2021) found that significant events that cause impacts to countries' economies will give rise to the changes of G**lobal Economic Policy Uncertainty (GEPU)**.

EPU is referred to the changes in fiscal, monetary, regulatory and trade policies that are unable to predict by the economic agents (Solarin & Gil-Alana, 2021). According to Yu and Huang (2021), government intervention gives rise to Economic Policy Uncertainty. Economic recession, changes in the exchange rate (ER), anti-globalization and populist movements influence the EPU (Al-Thaqeb et al., 2020; D'Mello &

Toscano, 2020; Yin et al., 2017). According to Karnizova and Li (2014), a rise in EPU represents a higher probability of recession in the short term but a lower probability in the long term.

According to Constantinescu, Mattoo and Ruta (2019), the Economic Policy Uncertainty (EPU) index is closely related to other signals of economic instability such as stock market fluctuations, as well as economic variables such as industrial production and unemployment. This is because the other economic uncertainty will trigger the economic policy to change accordingly. The EPU brings significant impacts to financial markets and assets such as crude oil (Antonakakis et al., 2014), stocks (Antonakakis et al., 2013; Yu & Huang, 2021) and bonds (Wisniewski et al., 2015). Since EPU affects stock and bond, the linkage between cryptocurrencies and EPU is interesting to study (Al-Thaqeb & Algharabali, 2019). In this case, the EPU will affect individuals' and firms' investment decisions. For example, a delay in investment and recruiting decisions which can lead to an extended downturn is caused by a rise in uncertainty about fiscal policy (Karnizova & Li, 2014).

GEPU index constructed by Baker, Bloom and Davis (2016) is used to quantify the proportional occurrence of the articles on each country newspaper that comprise the terms related to the economy (E), policy (P) and uncertainty (U). The purpose of measuring with newspaper-based is to record uncertainty about when and what steps of economic policy will be carried out, who will make the decisions on economic policy as well as the impacts of economic policy actions (Davis, 2016). (refer to chapter 3 for more information)

In addition, **Geopolitical Risk (GPR)** is referred to the risk related to wars, terrorism and tensions between countries that influence the harmony of international relations

(Caldara & Iacoviello, 2018). Risk arising from war and terrorism leads to significant changes in government policy that will affect the economy and financial markets (Smales, 2021). According to Caldara and Iacoviello (2018), higher GPR leads to a significant decrease in stock returns. The oil prices and Geopolitical Risk have a positive relationship because the war, terrorism and tensions cause supply shocks. For example, the oil price increases because geopolitical events disrupt the production of oil. Central banks, business investors and the financial press consider GPR as a determinant of investment decisions (Caldara & Iacoviello, 2018). For example, the investment of domestic companies might be cancelled or deferred due to war threats, terrorism, tensions, and armed conflicts (Demir & Danisman, 2021).

The GPR index will be recorded by measuring geopolitical risk to provide more reliable data (Smales, 2021). For instance, outbreaks of wars such as the Gulf Wars in 1991 and 2003 as well as the Syrian civil war in 2011 cause the Middle East to face geopolitical uncertainty (Smales, 2021). According to Demir and Danisman (2021), the events that bring significant impacts to the business and financial cycles which include the uncertainty related to terrorism, nuclear threats, tensions and wars will be recorded in the GPR index.

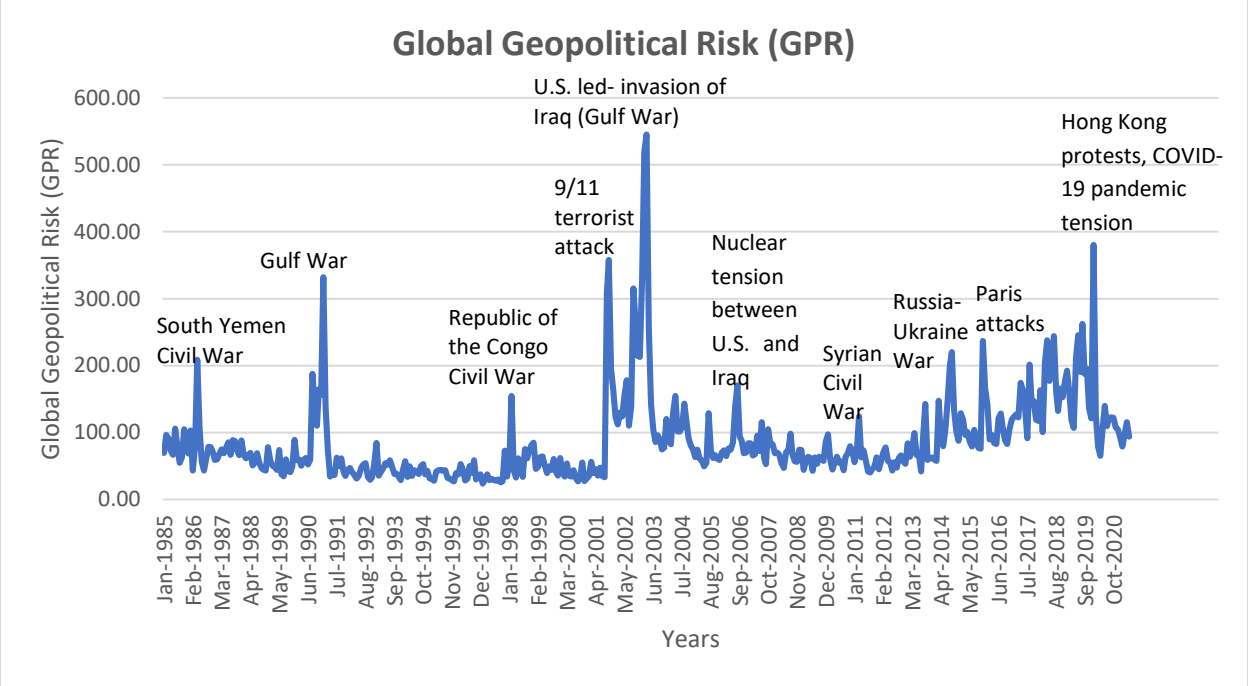

Figure 1.2. Global Geopolitical Risk (GPR) from 1985 to 2021. Adapted from Caldara and Iacoviello (2021).

The GPR index increases during or after the period of war, tension and pandemic (Caldara & Iacoviello, 2018; Wang et al., 2021). To measure the monthly Geopolitical Risk index, the existence of words connected with geopolitical uncertainty such as war, tension and other related events in the international newspapers are calculated. (Refer to chapter 3 for more information)

GPR brings significant impacts to the economy. For instance, economic activity and stock returns will be reduced by GPR (Caldara & Iacoviello, 2018). This situation will lead to the capital flows from emerging economies towards advanced economies (Caldara & Iacoviello, 2018). GPR will then affect the supply of domestic credits because the capital inflows reduced (Demir & Danisman, 2021). If the country of the supply side is having a higher Geopolitical Risk, the production will be disrupted or

delayed and it will affect the export. If the country of the demand side is having a higher Geopolitical Risk, the demand might be reduced. For example, the demand for durable products, real property, cars and other goods will reduce. This is because wars or terrorism will boost the anxiety of buyer and reduce buyer confidence (Demir & Danisman, 2021).

Moreover, the **stock market volatility index (VIX)** indicates the ‘‘risk-neutral’’ predicted stock market volatility for the S&P500 index (Bekaert & Hoerova, 2014). According to Bekaert and Hoerova (2014), VIX shows both stock market uncertainty and variance risk premium. (Refer to chapter 3 for more information)

During the pandemic of COVID-19, VIX will show growing uncertainty on the financial markets and economy (Dima et al., 2021). Since a negative correlation between asset returns and changes in volatility is occurred, a growth in VIX gives rise to a reduction in stock returns (Qadan et al., 2019). Since VIX will negatively affect the oil prices, the financial crisis that causes an increase in VIX index will reduce the oil prices (Sari et al., 2011). Callaghan (2015) stated that stock market volatility may reduce the economic activity because there are delays in companies’ investments and consumers’ purchases. VIX can also be used to predict stock returns, financial instability and economic activity (Bekaert & Hoerova, 2014).

1.2 Problem Statement

According to Shaikh (2019), the level of future market volatility will be increased by the increment of policy uncertainty. As stated by Akdağ and İskenderoğlu (2021), the

volatility of stocks will be increased by the Geopolitical Risks. This circumstance will cause a significant effect on the behaviour of the market participants.

The Cboe Volatility Index (VIX) is maintained at a high level during the COVID-19 pandemic. The VIX has significant forecasting power on the return of stock, economic activity and financial instability (Bekaert & Hoerova, 2014). The uncertainty of the stock market and equity variance premium can be reflected by VIX (Bekaert & Hoerova, 2014). Therefore, high VIX indicates increased uncertainty in the financial markets and economy. The Cboe Volatility Index (VIX) is chosen as one of the independent variables that will directly affect cryptocurrencies' return in our study.

Recently, the world is facing Economic Policy Uncertainty (EPU) such as economic shock due to the COVID-19 pandemic and US-China trade war. The economic shock includes increasing unemployment rate, falling GDP and others that occurred during the COVID-19 pandemic. It is not exaggerating to say that the economic shock due to the COVID-19 pandemic will certainly change the economic policy. Since the GEPU includes the GDP-weighted average of EPU indices for United States and China, US-China trade war will definitely bring huge impacts to the Global Economic Policy Uncertainty. For instance, US-China trade war was started by the United States on 6 July 2018, and $34 billion worth of Chinese commodities were imposed with 25% tariffs. Then, the US products were also imposed with similar tariffs by China (Zhang et al., 2019). Greater global economic uncertainty with no benefits to United States or China can be brought by the trade war between these two largest countries (Zhang et al., 2019). Therefore, EPU is chosen as one of the independent variables that will indirectly affect cryptocurrencies' return in our study.

Besides, Geopolitical Risk (GPR) such as terrorism and wars cause unstable economic and recession (Eckstein & Tsiddon, 2004). For instance, Israeli-Palestinian conflicts,

Indonesia's terrorism and Syrian civil war. Due to the risk that arises from war and terrorism, the government might change the government policy, which will cause widespread effects on the economy, capital market as well as the volatility of asset price (Smales, 2021). Hence, GPR is chosen as one of the independent variables that will indirectly affect cryptocurrencies' return in our study.

Moreover, there is a lack of studies that examine the relationship among EPU, GPR, VIX and the cryptocurrencies' return. The idea of the impact of uncertainties on cryptocurrencies' return has not been adequately explored. Therefore, this research limitation gives rise to the general objective of our study. The equity returns will be influenced by the uncertainty of the stock market. Since the EPU such as economic shock due to the COVID-19 pandemic will increase the VIX, the indirect effect of EPU on cryptocurrencies' return is interesting to be investigated. According to Aysan et al. (2019), GPR will influence the equity returns in an opposite way, which means that the increase in Geopolitical Risk will cause the investors to sell their financial assets. Thus, the money will flow from traditional financial markets to the cryptocurrency market. In this case, the indirect effect of GPR on cryptocurrencies' return is worth to be examined.

In addition, many previous studies had only examined the direct effect of EPU and GPR on the stock market, oil market and Bitcoin. For instance, researches by Mokni (2021) and Aysan et al. (2019) only focus on the effect of EPU and GPR on Bitcoin. There is a lack of studies that examine the direct impact of the Cboe Volatility Index (VIX) on cryptocurrencies' return as well as the indirect effect of EPU and GPR on cryptocurrencies' return.

Furthermore, most of the studies only focus on Bitcoin, there are still limited studies that examine the hedging capabilities of other cryptocurrencies against VIX. Although

Bitcoin has the highest market cap among all the cryptocurrencies but it does not necessarily mean that Bitcoin can represent the whole cryptocurrency market. Thus, our team decided to choose another 3 different cryptocurrencies which are Ethereum, XRP, and Dogecoin to further examine the direct impact of VIX on cryptocurrencies' return, the indirect impact of EPU and GPR on cryptocurrencies' return as well as the potential of cryptocurrencies to act as hedging tool against uncertainties.

1.3 Research Questions

The following research questions were developed from the problem statement of this research:

1. Can cryptocurrencies act as a hedging tool against Cboe Volatility Index (VIX)?

2. Do Economic Policy Uncertainty (EPU) and Geopolitical Risk (GPR) have indirect impact on cryptocurrencies' return?

1.4 Hypothesis Statements

With the purpose in achieving the objectives of this study, there are two hypothesis tests will be carried out as follows: -

1.4.1 Hypothesis Statement 1

H1: Cryptocurrencies can act as a hedging tool against Cboe Volatility Index (VIX).

1.4.2 Hypothesis Statement 2

H2: Economic Policy Uncertainty (EPU) and Geopolitical Risk (GPR) have indirect impact on cryptocurrencies' return.

1.5 Research Objectives

GENERAL:

To analyse the ability of cryptocurrencies to act as hedging tool against uncertainties.

SPECIFIC:

Specifically, there are specific objectives of this paper are as following:

1. To analyse the ability of cryptocurrencies to act as a hedging tool against Cboe Volatility Index (VIX).

2. To analyse the ability of cryptocurrencies to hedge the indirect effect of Economic Policy Uncertainty (EPU) and Geopolitical Risk (GPR).

1.6 Significance of Study

The majority of the studies in respect of the effect of uncertainties on cryptocurrencies' return focus only on Bitcoin as the dependent variable and few of them consider other types of cryptocurrency. There are more than 5000 types of cryptocurrencies in the market and the total market cap is $1,768,703,407,500 ("All cryptocurrencies", 2021). This shows that Bitcoin cannot represent the whole cryptocurrency market. Therefore, our team would like to fill in the literature gap by considering more cryptocurrencies (Bitcoin, Ethereum, XRP and Dogecoin). This study focuses on the direct impacts of VIX as well as the indirect impacts of EPU and GPR on four cryptocurrencies' return which are Bitcoin, Ethereum, XRP and Dogecoin. Furthermore, this study will also identify the potential of cryptocurrencies to hedge against the volatility of the stock. This information is useful and can benefit users like researchers, investors, and policymakers.

First, in terms of researchers, this research can contribute to further research. There are empirical studies that examine the direct impacts of VIX, EPU and GPR on cryptocurrencies' return. However, there are limited numbers of studies that examine the direct impact of VIX and indirect impacts of EPU and GPR towards cryptocurrencies' return, our research can act as a reference for other researchers who is interested to study the reaction of cryptocurrencies towards other publicly available uncertainties measures. In addition, since there are limited studies that consider the hedging opportunity of cryptocurrencies, our research can act as a reference for other researchers who is interested to study the potential of cryptocurrency as a hedging tool towards uncertainties. This study will also help inspire researchers to study more cryptocurrencies instead of focus on only Bitcoin. The reason is that researchers might overlook some significant information in the cryptocurrency market if their researches focus only on Bitcoin.

Second, in terms of investors, this research will try to fill up the literature gap by considering the indirect effects of Global Economic Policy Uncertainty (GEPU) and Geopolitical Risk (GPR) on the return of Bitcoin, Ethereum, XPR and Dogecoin due to the changes of VIX. In order to maximize profit, the fluctuation of the financial asset price is the major concern of investors. Moreover, in order to reduce the risk of the financial asset, investors may adjust their portfolio through observation. This study allows the investors to have a clearer view on the impact of EPU and GPR on the volatility of the stock and at the same time introduce a new type of hedging tool to the investors to hedge undesired risk. Through our study, investors get to know the relationship among the VIX, EPU, GPR and cryptocurrencies' return. Investors get to expose to more alternatives and are be able to choose the more suitable investment when facing uncertainties.

Furthermore, in terms of policymakers, they can refer to this study when they are trying to develop new policies related to cryptocurrencies in the market. By referring to this study, policymakers can gain a deeper understanding about the direct impacts of VIX on the cryptocurrency market as well as the indirect impacts of EPU and GPR on the cryptocurrency market so that they can propose a better policy that may benefit the market in the future. Moreover, by understanding the potential of cryptocurrencies to hedge towards the volatility of the stock through this research, policymakers can find ways to propose some policies that can regulate and make cryptocurrencies better in the future. Besides, the efficiency of the market can be increased as the information considering the VIX, EPU and GPR will be disclosed timely and investors will have another alternative when hedging against the volatility of the stock.

1.7 Chapter Layout

This research consists of 5 chapters; the remaining chapters are structured as follow:

Chapter 2: This chapter will present the theoretical framework and provide discussion on the empirical results of previous studies that used EPU and GPR as the independent variables that affects the cryptocurrencies' price.

Chapter 3: This chapter explains the detail of the methodology of this research which includes the data collection method, research process, and research design.

Chapter 4: This chapter will include the discussion, analysis, and interpretation of the empirical results.

Chapter 5: This chapter will provide a brief summary of previous chapters, discussion, limitation, and recommendations for future research of this topic.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter reviews the relationship among stock market volatility, Economic Policy Uncertainty (EPU) and Geopolitical Risk (GPR) on previous studies. The following section analyses the relationship between each of the uncertainties among the others. Followed by the hedging tools against uncertainties. Last, gap of study will be discussed at the end of this chapter.

2.1 Relationship Among Uncertainties

2.1.1 Stock Market Volatility

In recent years, the awareness of investors to understand the volatility has increased and it is vital for the investors to understand this. From an investor's point of view, they must take into consideration of investment risk and return when they wish to start a new investment. According to Mamtha et al. (2015), the previous study found that the flow of information, trading volume, economic factors, and investors' behaviour are the cause of the stock market volatility. This also suggests that the investors have to

understand whether factors that cause market volatility should be considered internal or external (spill overs) and react accordingly.

According to Elsaied et al. (2020), most of the executives and individual investors used the concept of risk and return which is a crucial concept. The concept of risk and return involves many aspects, such as corporate social responsibility sustainable corporate finance, financial management, ethics, and artificial intelligence. Moreover, the researchers' findings claimed that stock market return and stock market risk have a significant positive relationship in between (Kim, Morley, & Nelson, 2004). If investors wish to achieve a high return in an investment, then they also have to consider the high risk in the investments such as they should accept that they are likely to lose money and pay high costs for the chance to earn a high return. Every business investment or company stock has its own process, whether it is less risky and has a stable return or it is riskier but profitable. For risk-averse investors, they will more prefer to invest in a lower-risk investment since it is more secure and the investors will not suffer much financial loss. Whereas, risk-taker investors are willing to take the risk and bear the costs for the opportunity to achieve high returns.

.

According to Li et al. (2005), the researchers had examined that there are 10 out of 12 largest international stock markets which included the United States (US), Canada (CA), Japan (JP), Australia (AU), Hong Kong (HK), Singapore (SG), the United Kingdom (UK), Germany (GM), France (FR), Italy (IT), Netherlands (NT), and Switzerland (SW) that have a positive but insignificant relationship when they are using the EGARCH-M models to estimate. However, when flexible semi-parametric norms of conditional variance are used, it shows that the negative relationship between returns and volatility is prevalent in most of these markets. There are multiple studies claim that stock market returns and stock market risk is negatively correlated. For example, a decline in company's stock value (negative returns) increased the company's financial

leverage and debt-equity ratio, this makes a greater risk of a stock, increased its volatility (Black, 1976).

According to Hong et al. (2021), the researchers had examined the relationships of stock market risk and stock market return of the U.S. market during the pandemic of COVID-19. The U.S. Senate committee members were selling off the stocks before the stock market crashed due to the COVID-19 pandemic, therefore; the stock market risk and return was increased dramatically after the Covid-19 pandemic is under control. That is because a crisis can be accompanied by opportunities. The COVID-19 outbreak has been a significant cause of market inefficiencies, even as it has created profit opportunities for traders and speculators. Rational investors may want to be warier of insider trading before making any decisions in the stock market, as it is a way of seeking to maximize returns.

2.1.2 Economic Policy Uncertainty

Economic policy is an important means of government intervention, while Economic Policy Uncertainty (EPU) has extensive and profound influence at the macro and micro levels. Besides, household consumption and investment decision can be affected. It even will affect the unemployment rate and also the country's economic growth. From a corporate point of view, EPU influences corporate decisions, such as capital investment, spending, and risk management, eventually, it will affect corporate stock price in the stock market (Wang & Kong, 2021). According to Ko and Lee (2015), the research results showed that the EPU index was negatively correlated with stock and it can be used to predict the future of the financial market returns. Moreover, changes in economic activity will cause fluctuation in the financial markets, therefore; it is

undeniable to say that a stable and efficient stock market will help in industrial development and economic growth.

According to Tsai (2017), the researchers had discussed the China, Japan, Europe, and United States four national or regional EPU impacts on the global stock markets investment risk of infection. By analysing stock returns from 22 stock markets around the world, they identified which region's EPU had the greatest impact on regional systemic risk and individual stock market volatility risk. The results show that the EPU's biggest influence in China is their risk of infection spreading in different areas other than the European market. EPU is less effective in America than it is in China; Japan's EPU will only affect infection risk in emerging markets; The risk of infection in the European market is not affected by EPU's four indices; Europe's European Monetary Union (EPU) was unaffected by the global stock market contagion. But judging by market movements, European and Chinese EPU have the biggest impact on Asian and European countries, respectively. These results may be due to high trade dependence between countries since the performance of international firms depends largely on the economic policies of their trading partners.

According to Helseth et al. (2020), the researchers focused on implied volatility as a measure of stock market uncertainty, as well as Economic Policy Uncertainty (EPU) which contains a few sources of uncertainty including regulatory uncertainty. Researchers studied 12 stock markets in the United States. Germany, Hong Kong, Canada, India, Australia, Eurozone (region), United Kingdom. South Korea, France, Japan, and the Netherlands between January 2000 and March 2019. The findings claimed that higher EPU leads to a significant increase in market volatility. The prediction results also showed that high levels of EPU will have high stock market returns estimation. Henceforth, this means that there is a positive relationship between EPU and stock market volatility. as higher EPU will lead to high market risk, eventually,

the stock market return will be increased as obeying the rules of high-risk high return in investment.

2.1.3 Geopolitical Risk

Geopolitical risk is the term used to describe military conflict to climate change and the UK to take off the wide range of problems. It is related to the risks of populism, but it is not the same. According to "Measuring the market impact of geopolitics" (2019), the aim of researchers' study is to peruse the relation between countries at the political, economic, or military level. Geopolitical risks occur in the normal relationship between countries or regions that are threatened. From investors' point of view, they focus on the relationship between the change of how to affect the economy and cause financial market volatility.

According to Hoque et al. (2019), research results show that the Geopolitical Risks in general no significant direct impact on the market, but its indirect effect through oil shocks and Economic Policy Uncertainty transfer significantly. The uncertainty of global economic policy has a negative impact on the overall stock market, and Geopolitical Risk is magnified by the impact. Geopolitical Risk also has a significant direct and indirect impact on industry share prices. The negative implication of Geopolitical Risk on stock market will lead to frequent withdrawal of international investors from stock market. This is due to the reason that the negative impact of a Geopolitical Risk may lead to higher stock market risk and negative stock market return, eventually, investors will exit the market and invest in other countries that provide stable stock markets.

According to Smales (2019), geopolitical events widely reported in the media can influence the stock market investors to demand a risk premium. The empirical results show that the Geopolitical Risk in oil price volatility and the stock market plays a vital role. Geopolitical Risk increase associated with positive or negative stock returns, also with the Geopolitical Risk is closely related to the interruption of the supply side is more consistent. For example, Geopolitical Risk has a greater impact on oil prices, which may be related to some geopolitical events of a local nature, such as oil field terrorist attacks, which directly affect oil production. Therefore, investors who invested in the oil market will have to pay attention to the Geopolitical Risk since it will eventually increase the stock market risk and also affect the stock market return.

2.2 Hedging Against Uncertainties

2.2.1 Hedging Behaviour of Cryptocurrency

According to a study by Wang et al. (2019), researchers had examined the mean and volatility spill over effects between Bitcoin and six traditional assets that include stocks, commodity futures (commodities), gold, foreign exchange (FX), monetary assets, and bonds in the Chinese market to explore whether Bitcoin can be used either as a hedging asset or as a safe haven. Based on their empirical results, the researchers have obtained few useful findings. The first finding is that, Bitcoin, on average, has high volatility, high rate of return and weak correlations with other assets. Next, their empirical results show that only the monetary market, i.e., the Shanghai Interbank Offered Rate (SHIBOR) has a mean spill over effect on Bitcoin whereas gold, monetary, and bond

markets have volatility spill over effects on Bitcoin, while Bitcoin has a volatility spill over effect only on the gold market. Furthermore, the researchers concluded that Bitcoin can be used as a hedging tool against stocks, bonds, and SHIBOR and it can diversify portfolios that include the foreign exchange (FX). Moreover, it can be a safe haven for SHIBOR when extreme price changes occur in the monetary market. The empirical results show that when investors encounter losses from stocks, bonds, and SHIBOR, they can benefit from Bitcoin due to the negative correlations between them and Bitcoin. Apart from that, the researchers stated that adding Bitcoin to portfolios that include commodities or foreign exchange (FX) can reduce non-systematic risk. That is, if a portfolio contains multiple assets at the same time, Bitcoin may play multiple different roles, such as a safe haven, a hedging asset, and a means of diversification (Wang et al., 2019).

However, according to Wang et al. (2019), their last finding claimed that Bitcoin cannot be regarded as a safe haven for commodity and gold. The reason is that, according to their empirical results, Bitcoin's returns are parallel with the commodities and gold when extreme market price changes occur. As a result, when extreme downward price movements occur in the commodities and gold markets, investors will suffer huge losses if they choose Bitcoin as a safe haven to avoid risk (Wang et al., 2019).

Based on past studies done by Paule-Vianez et al. (2020), researchers concluded that EPU has a negative impact on Bitcoin returns and it positively and significantly influences the volatility of both Bitcoin and gold. In this study, the researchers aimed to examine the influence of EPU on Bitcoin returns and volatility in order to determine the role played by cryptocurrency as if is it barely a means of exchange and store of value, a speculative asset or a safe haven. To obtain more robust results, the researchers have taken gold as a reference safe haven and compare the behaviour between Bitcoin and gold against EPU.

By using the methodology of simple linear regression with ordinary least squares, the researchers concluded that EPU positively influences Bitcoin and gold returns for the whole sample but only the influence of gold returns is statistically significant. This finding supported the previous finding of Wang et al. (2019) where Bitcoin cannot be a safe haven for gold due to the parallel return between them. On the other hand, when analysing the influence of EPU on extreme quantiles with quantile regression, the researchers found that EPU has a negative impact on Bitcoin returns in the lowest quantiles and a positive impact on these returns in the highest quantiles. This simply indicates that with no coincidence for the lowest quantiles, EPU increases Bitcoin and gold volatility at the highest quantiles (Paule-Vianez et al., 2020).

The results obtained from both methodologies suggest that Bitcoin not only act as a store of value or means of exchange but it also has characteristics of investment assets. For instance, its dependence on investor sentiment and high volatility. On the contrary, the fact that the Bitcoin returns increase in the highest quantiles supports the role of Bitcoin as a safe haven during times that are more uncertain. In addition, the researchers added that Bitcoin can be considered as a tool to protect savings in times of economic uncertainty as it can act as a safe haven. Moreover, it is qualified as a relevant asset for constructing diversified portfolios (Paule-Vianez et al., 2020).

As for Geopolitical Risk (GPR), study by Su et al. (2020) claimed that Bitcoin can be viewed as an asset that is created to avoid GPR. This paper explores the Granger causality between the global geopolitical environment and Bitcoin market, in order to ascertain whether Bitcoin can hedge the risks aligned with the global geopolitical incidents. In this study, researchers have performed the bootstrap full, and the sub-sample rolling-window Granger causality tests to explore the correlative influences between geopolitical risks and Bitcoin prices (Su et al., 2020). Based on their empirical results, it was found that geopolitical risk (GPR) positively affect Bitcoin prices (BCP).

In view of such matter, the positive impacts concluded that the Bitcoin currency can be viewed as an alternative asset developed to avoid geopolitical risk (Su et al., 2020).

During year 2016 to year 2017, numerous geopolitical events have occurred around the world. Such events include the Syrian Civil War, terrorist attacks in France and Belgium, counterattacks to the "Islamic State", tensions from North Korea, the U.S. election as well as the Brexit. Thus, it is not exaggerating to say that these events have driven the GPR to rise (Caldara & Iacoviello, 2021).

It is certain that the high GPR due to the numerous geopolitical events has made the public uncertain about the future and the sentiments and confidence of investors as well as the consumers took a significant dip in such circumstances. Moreover, in order to minimise losses, the public tended to store assets that have hedging properties and ability. As a result, this caused the demand for the Bitcoin (BTC) currency to soar, despite its price already undergoing in a skyward trend. Consequently, the Bitcoin price (BCP) then further experienced upward trend (Ciaian et al., 2015; Bouri et al., 2017; Wang et al., 2019; Al Mamun et al., 2020). By taking consideration in these evidences, researchers stated they agree that GPR possessed the ability to affect the Bitcoin price positively during year 2016 to year 2017 where many geopolitical events happened around the world. Hence, study claimed that Bitcoin can perceived as an asset that is created to avoid GPR (Su et al., 2020).

2.3 Literature Gap

Based on the literature review above, some literature gaps have been identified. Primarily, previous studies have shown that Bitcoin, the cryptocurrency with the highest market capitalisation as of January 2022, could hedge uncertainties such as stock market volatility, GEPU, and GPR. However, most of those studies did not take into account the other cryptocurrencies and therefore resulting in an ambiguous finding. Generally, most of the empirical evidences claimed that Bitcoin can be viewed as a safe haven during times that are more uncertain and an asset that is developed in order to avoid GPR (Wang et al., 2019; Su et al., 2020; Paule-Vianez et al., 2020). However, empirical results by Mokni et al. (2021) indicate that Bitcoin does not act as a strong hedge against the aggregate U.S. EPU but a strong safe-haven for this aggregate measure of uncertainty when the Bitcoin market is bearish. Similarly, there are researchers who pointed out that Bitcoin does act as a hedge against uncertainty as it reacts positively to uncertainty at both higher quantiles and shorter frequency movements of Bitcoin returns (Bouri et al., 2017). Moreover, study by Qin et al. (2021) states that the prices and volatility of Bitcoin are also determined by external (EPU and GEPU) and Bitcoin specific factors (cyber-attacks and speculative bubbles), and thus Bitcoin cannot always be considered a hedge against Global EPU. One of the causes contributing to the conflicts may be resulted by different research period done on examining the hedging capability of the cryptocurrency.

Moreover, it is hard to find a research paper that explains the relationship between VIX, GEPU, GPR and how cryptocurrencies could play a role to act as a hedging tool in uncertain times. Most of the papers focus on only one particular variable when accessing to the capability for cryptocurrencies to hedge. For instance, study by Wang et al. (2019) focuses on only the stock market volatility, and study by Su et al. (2020)

focuses on only the GPR and meanwhile study by Paule-Vianez et al. (2020) focuses on only the EPU. Thus, this result in an ambiguous finding for cryptocurrencies to hedge in different uncertainties.

As discussed earlier, the world is facing Economic Policy Uncertainty (EPU) such as the economic shock due to the COVID-19 pandemic and US-China trade war. Fascinatingly enough, unlike the 9/11 Terrorist Attack, Russia-Ukraine War or even Syrian Civil Wars, COVID-19 pandemic is the first event that imposed such high degree of uncertainties that had ever degraded the stock market and soared the economic policy risk. Thus, it is certain that the current world is more sensitive towards economic policy risk (EPU) than ever before. As a result, researchers are interested to examine and explore if the cryptocurrencies can act as suitable shelters to protect investments when times are uncertain by including more variables into the research.

CHAPTER THREE: METHODOLOGY

3.0 Introduction

This chapter shows the method in collecting data and the research techniques applied in the research like source of data, description of variable included, and illustration of economic framework used in this study. Besides that, this chapter will also explain the procedure of each test to make sure the efficiency and effectiveness in examining the result. Finally, this chapter will include the selection of the most suitable model in estimating the impact of the volatility on the return of cryptocurrencies.

The economic framework used in this study is Pooled Ordinary Least Square (OLS) model, Fixed Effect Model (FEM) and Random Effect Model (REM). Pooled OLS model is a multivariate model which it estimates the relationship between one dependent variable and one or more than one independent variable. It assumes that all characteristic among the observation is the same. Next, FEM assumes that the variables are constant across the cross-sectional data. Whereas REM assumes that the variables are random and unpredictable across the cross-sectional data.

Before estimating the models, we need to determine the stationary of the data in order to ensure all of the data is at I(0) which is at the level integration. To do so, we will apply unit root tests which are Levin-Lin-Chu Test, Im-Pesaran-Shin Test, ADF Fisher Chi-square Test, and PP Fisher Chi-square Test. Next, in order to estimate relationship between the variables, Pooled OLS model, FEM and REM is applied. Finally for the model selection, to choose between Pooled OSL model and REM, Breusch-Pagan

Lagrange Multiplier Test is applied. If the result shows that REM is more preferable, then Hausman Test is applied to see whether FEM is more suitable or REM is more suitable.

3.1 Research Design

Research design refers to a structure which particularly design to answer the research question and manipulate the variance (Dulock, 1993). Since research method helps to deliver the research objective, it should be formed before the data collection. The development of such framework refers to qualitative approach or quantitative approach. For this study, quantitative approach will be applied as this study focus on the relationships between variable using historical data.

According to Devault (2020), quantitative approach had several advantage which are it can be tested several time, making it less argued by others. Second, there is less chance in obtaining error because it is a straightforward approach. Third, the data collection and analysis are unbiased. The advantages are brought by the characteristic of the quantitative approach which it is used to test theory and see whether the theory is appropriate which the deductive logic with standard argument of theories that result in data point are involved. Besides that, quantitative approach tries to generalize the findings through large and random samples (Wright et al., 2016).

3.2 Data Collection Procedure

3.2.1 Data Collection Methods

According to the general objective stated in Chapter 1, this study aims to analyses the effect of the uncertainties on the cryptocurrencies' return, thus, the Cboe Volatility Index (VIX), Global Economic Policy Uncertainty (GEPU) index, Geopolitical Risk (GPR) index, closing price of Bitcoin, Ethereum, XRP, and Dogecoin will be utilized. The observations of the data are in monthly frequency. Due to the creation period and availability of the closing price of the cryptocurrencies, the sample size of the cryptocurrencies is different from each other. For VIX index, GEPU index, and GPR index, the sample size is 66 observations which is from October 2015 to March 2021.

The VIX index is obtained from the website of CBOE VIX index, the GEPU index is obtained from the website of Economic Policy Uncertainty, and the GPR index is obtained from the website of Matteo Iacoviello. Finally, the monthly price of the cryptocurrencies (Bitcoin, Ethereum, XRP, and Dogecoin) are obtained from the website of CoinMarketCap. Table 3.1 shows the sources involved in the data collection.

Table 3.1: Variables and Source of Data

Variables	Proxy	Definition	Source of Data
Cboe Volatility Index	VIX	An index that reflects the market's 30 days expectation towards the volatility of the U.S. stock market (S&P 500) .	Cboe (2021)

Global Economic Policy Uncertainty	GEPU	A GDP-weighted mean of national EPU indices for 16 countries. Each of the national EPU indexes reflects the information of own-country newspaper about policy-related economic uncertainty.	Economic Policy Uncertainty (2021)
Geopolitical Risk	GPR	An index of counting the occurrence of geopolitical tensions-related words in the international paper.	Matteo Iacoviello (2021)
Bitcoin	BTC	A decentralized cryptocurrency introduced by Satoshi Nakamoto us 2008 and launched in January 2009.	CoinMarketCap (2021)
Ethereum	ETH	A decentralized open-source blockchain introduced by Vitalik Buterin in 2014 and officially launched on July 30, 2015.	CoinMarketCap (2021)
XRP	XRP	A digital currency of XRP ledger which is founded in 2012. Although it is an open-source but it is not based on blockchain like other cryptocurrency.	CoinMarketCap (2021)
Dogecoin	DOGE	A decentralized cryptocurrency which is create in December 2013. It is created as a joke with a logo based on a popular Shiba Inu meme.	CoinMarketCap (2021)

3.2.2 Data Processing

By referring to the Table3.1, the data were obtained from several sources, such as Cboe VIX index, Economic Policy Uncertainty Index, Matteo Iacoviello, and CoinMarketCap. After the collection of data, these data are then reorganized using Microsoft Excel and transformed into log form. After the data are logged, difference between t and $(t-1)$ are made so that it shows the return of the cryptocurrencies and the changes in the uncertainty index. After the processing of data, the observation will start at September 2015 and ends in March 2021 to make the number of observation for each variable to be identical. Next, the results from the Eviews will be analyzed, presented, interpreted, and explained. Besides that, the result will also be compared with the past study to check the consistency.

3.3 Rationale of Chosen Variables

3.3.1 Cryptocurrencies' Return

Cryptocurrencies have a rigorous development in recent years. The development and the growing numbers of cryptocurrencies have attracted investors to invest. Cryptocurrencies' return is referred to the return that investors could earn when investing in cryptocurrencies. Our study will use the monthly data of cryptocurrencies' price. The data includes the monthly price of Bitcoin, Ethereum, XPR and Dogecoin. These monthly data will be tested as the dependent variable in our study.

3.3.2 Cboe Volatility Index (VIX)

Cboe Volatility Index (VIX) assesses the expectation of stock market volatility in line with the S&P 500 index options ("VIX index", 2021). Similar to the Dow Jones Industrial Average (DJIA), VIX is quantified on a real-time basis during every trading day and the dissimilarity between the VIX and DJIA is that the DJIA assesses price while VIX assesses volatility (Whaley, 2009). According to Qadan, Kliger and Chen (2019), investors prompt to adjust their portfolios by increasing the diversity of their investments due to an increase in the VIX. Although the VIX assesses the volatility of the stock market, it will also influence the investment activities other than the stock investment.

Since the VIX will bring significant effect on the investors' behavior, the relationships between EPU, GPR and VIX are worth to be investigated. As stated by Li et al. (2016), Economic Policy Uncertainty (EPU) will positively affect the VIX. For instance, economic downturn during the COVID-19 pandemic increases the volatility of the stock market (Dai et al., 2021). GPR has a substantial influence on the volatility of the stock markets. According to Akdağ and İskenderoğlu (2021), Geopolitical Risks (GPR) increased the volatility of stock markets.

While the volatility of the stock market increases, the investors might choose to reduce the stock investment. This situation may lead the flow of money from stock markets to the cryptocurrency market. The cryptocurrencies prices might be affected. According to Gaies et al. (2021), there is a negative relationship between VIX and Bitcoin returns. Thus, the VIX which is a fear index will also affect the investors' attitudes (Gaies et al., 2021).

By including the VIX as one of the independent variables, the consideration of investors on the VIX when they are investing in cryptocurrencies can be well justified.

3.3.3 Global Economic Policy Uncertainty (GEPU)

Global Economic Policy Uncertainty (GEPU) Index measures the proportional occurrence of 21 countries newspaper articles that comprise the terms related to the economy (E), policy (P) and uncertainty (U) (Baker, Bloom & Davis, 2016). The GEPU Index includes the GDP-weighted average of national EPU indices for 21 countries ("Global Economic Policy Uncertainty Index", 2021). The GEPU is closely related to the world economy. Economic policy uncertainty derives from the major economic shocks and disruptions (Davis, 2016). This is because the government will change the economic policy in response to the economic shock and uncertainty.

Since the investment involves a lot of uncertainties, it is crucial to examine the uncertainties which will directly or indirectly bring impact to the investment return. The confidence of investors will reduce and the discouragement of firms from investing will increase due to uncertainties. Previous studies proved that the EPU has an impact on the stock and bond markets (Fang, Yu & Li, 2017). According to firm-level data, stock price volatility will increase as well as investment and employment will reduce by policy uncertainty (Baker, Bloom & Davis, 2016). According to the macro economies data, policy uncertainty will give rise to the decreases in output, investment and employment in the United States (Baker, Bloom & Davis, 2016). According to Demir et al. (2018), investors will be anxious about the overall economy as well as reduce the confidence and trust in their fiat currencies due to the uncertainty regarding

government decisions. The cryptocurrency market considers the Economic Policy Uncertainty index (EPU) as an important aspect (Yen & Cheng, 2021).

Recently, the world is facing uncertainty which leads to the rise in economic policy risk on the market. The economic activity will be affected by the economic policy decisions (Fang, Yu & Li, 2017). The economic growth, production, consumption, firm investments and stock prices will be affected by the uncertainty respecting government intervention in the economy because they will respond to the changes in the Economic Policy Uncertainty index (Chang et al., 2015).

By including the GEPU as one of the independent variables, the investment decision on the cryptocurrencies might be affected by the indirect effect of GEPU on cryptocurrencies' return.

3.3.4 Geopolitical Risk (GPR)

Geopolitical risks (GPR) index measures the existence of terms related to geopolitical uncertainty such as war, tension and other related events in the international newspapers. The monthly Geopolitical Risk (GPR) index is constructed and determinants are studied since 1985 using the newspaper method (Caldara & Iacoviello, 2018). GPR is considered by entrepreneurs, central bank and market participants as a crucial factor in investment decisions and stock market dynamics (Caldara & Iacoviello, 2018).

Business cycles and the performance of financial markets will be affected by the fluctuations in GPR which involves tensions, political instability and terrorism (Lee,

Lee & Li, 2021). Since there are previous studies that proved GPR is related to the financial markets, the effect of GPR on financial markets should not be ignored (Lee, Lee & Li, 2021). The geopolitical situations will influence the stocks and bonds with an undiversified and unexpected risk (Lee, Lee & Li, 2021). Geopolitical risks may change investors' expectations and decisions on the financial assets.

Armed conflicts and political instabilities frequently appear in some countries. For example, the Iraq war, 9/11 attacks, Russia-Ukraine War, Yemen civil war and other events. The economic effects of GPR include reducing stock returns, depressing economic activity and flows of capital from emerging countries towards advanced countries (Caldara & Iacoviello, 2018). The Geopolitical Risk is a key factor that contributes to the volatility of stock markets. Since GPR is closely related to the economy and the volatility of the stock markets will be affected by the economic condition, the investors who invest in cryptocurrencies should consider its impact. According to Gaies et al. (2021), the VIX has an effect on Bitcoin returns.

By including the GPR as one of the independent variables, the indirect effect of GPR on cryptocurrencies' return can be well justified.

3.4 Economic Framework

Motivated by Wang, Wang, Yin and Ji (2021), an econometric model in which the return of the cryptocurrencies as a function of return of cryptocurrencies in the previous

period, VIX and (VIX × Uncertainties) is proposed in this paper. This model consists of one dependent variable and two independent variables.

$$RET = f[RET(-1), VIX, VIX \times UCT] \quad (3.1)$$

Where, RET = Return of cryptocurrencies

RET(-1) = Return of cryptocurrencies in previous period

VIX = Cboe Volatility Index

UCT = Indirect impact of uncertainties (GEPU and GPR)

As shown in the base model, there will be two uncertainties that will affect the VIX and in other words, indirectly affect the return of the cryptocurrencies. Thus, there will be a total of two model in this paper. The first model will be GEPU act as the uncertainties that affects the VIX in another words indirectly affects the return of cryptocurrencies:

$$RET_t = \beta_0 + \beta_1 RET_{t-1} + \beta_2 VIX_t + \beta_3 (VIX \times GEPU)_t + \mu_t \quad (3.2)$$

Where, RET_t = Return of cryptocurrencies

RET_{t-1} = Return of cryptocurrencies in previous period

VIX_t = Cboe Volatility Index

$(VIX \times GEPU)_t$ = Indirect impact of GEPU

The second model will be GPR act as the uncertainties that affects the VIX in another words indirectly affects the return of cryptocurrencies:

$$RET_t = \beta_0 + \beta_1 RET_{t-1} + \beta_2 VIX_t + \beta_3 (VIX \times GPR)_t + \mu_t \quad (3.3)$$

Where, RET_t = Return of cryptocurrencies

RET_{t-1} = Return of cryptocurrencies in previous period

VIX_t = Cboe Volatility Index

$(VIX \times GPR)_t$ = Indirect impact GPR

As shown in Equation (3.2) and (3.3), the RET_t act as the dependent variable in the model, and the independent variables consists of RET_{t-1} , VIX_t , and $(VIX \times UCT)_t$ where UCT could be GEPU or GPR. Besides that, the time period (t), represent the monthly data from September 2015 until March 2021.

Next, β_0 refers to the intercept of the return of cryptocurrencies, β_1 refers to the estimated coefficient of the return of cryptocurrencies in previous period, β_2 refers to the estimated coefficient of the Cboe Volatility Index, and β_3 refers to the Indirect impact of the uncertainties which is either GEPU or GPR. Then, μ_t represent to the error term of the model. t refers to the time period and (t-1) refers to the lag of one-time period.

3.5 Empirical Testing Procedures

3.5.1 Unit Root Test

Non-stationary of a variable may occur due to the presence of unit root. Non-stationary means that the trend of the variable is non-predictable and varying. Whereas stationary means that the trend of the variable is predictable and not varying. Unit root test is known as the most suitable test in determining the stationary of a variable and the existence of unit root. It is important to make sure that the model does not incudes any non-stationary variable as they might cause the result to be misleading and affect the research (Granger & Newbold, 1974).

3.5.1.1 Levin-Lin-Chu Tests

Levin-Lin-Chu Test a complicated test which a single regression consists of data from several individual panel. It assumes that all of the panel have a common autoregressive parameter. Thus, the situation of some panel contains unit root while others do not are prohibited. According to Panel-data unit-root tests (2021), the Levin-Lin-Chu Test that have a panel-specific means but without any time trend requires the number of time period grow faster than the number of panels. Such requirement ensures that the ratio of the panel-to-time period tend to be zero asymptotically. Besides that, this test also includes the Augmented Dickey-Fuller regressor for each panel with a specific number of lags.

Levin-Lin-Chu Test estimates two additional sets equation which regress Δy_{it} and Δy_{it-1} with the independent variable, X_{it} and the lag terms, Δy_{it-j}, which j = 1, … , p_i. The coefficient of the two regression is $\widehat{\beta_i}$ and $\hat{\delta}$. The autocorrelation and deterministic elements in $\Delta \hat{y}_{it}$ are removed, as shown below:

$$\Delta \hat{y}_{it} = \Delta y_{it} - \sum_{j=1}^{p_i} \beta_{ij} \Delta y_{it-j} - X_{it}\delta \tag{3.4}$$

Likewise, $\hat{y}_{it-1}$ can be defined as:

$$\hat{y}_{it-1} = y_{it-1} - \sum_{j=1}^{p_i} \hat{\beta}_{ij} \Delta y_{it-j} - X_{it}\hat{\delta} \tag{3.5}$$

Next, both $\Delta \hat{y}_{it}$ and $\hat{y}_{it-1}$ are standardized by dividing the regression standard error:

$$\Delta \hat{y}_{it} = (\Delta \hat{y}_{it}/S_i) \tag{3.6}$$

$$\hat{y}_{it-1} = (\hat{y}_{it-1}/S_i) \tag{3.7}$$

Finally, the coefficient $\propto$ can be obtained by pooling the equations:

$$\Delta \hat{y}_{it} = \propto \hat{y}_{it-1} + \varepsilon_{it} \tag{3.8}$$

Under the null, a modified t-statistic, $t_{\propto}^{*}$ for the resulting $\hat{\alpha}$ is normally distributed

$$t_{\propto}^{*} = \frac{t_{\propto} - (NT)S_N \hat{\sigma}^2 s\epsilon(\hat{\alpha})\mu_{mT^*}}{\sigma m T^*} \tag{3.9}$$

where $t_{\propto}$ refers to the standard t-statistic for $\hat{\alpha} = 0$, S_N refers to the average standard deviation ratio, $\hat{\sigma}^2$ refers to the estimated variance, and $s\epsilon(\hat{\alpha})$ refers to the standard error of $\hat{\alpha}$. N refers to the cross section units in the model and T refers to the observed period. μ_{mT^*} is the adjusted mean and $\sigma m T^*$ is the adjusted standard deviation. T^* is obtained by:

$$T^* = T - \left(\sum_i p_i/N\right) - 1 \tag{3.10}$$

If the $t_{\propto}^{*}$ is smaller than the critical value, the null hypothesis is rejected which conclude that there is no unit root and the variable is stationary if the null hypothesis is rejected.

3.5.1.2 Im-Pesaran-Shin Test

Unlike Levin-Lin-Chu Test, Im-Pesaran-Shin Test allows some panels can have unit root. Although having unit root in some panels are allowed, but when most of the panel have unit root, the power of the test will diminish. The simplest way is to compute ADF test for each individual panel if everything is heterogeneous (Chapter 9 Unit Root Testing, 2021).

Levin-Lin-Chu Test begins by estimating a ADF regression for each of the cross-section:

$$\Delta y_{it} = \alpha y_{it-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta y_{it-j} - X_{it}\delta + \varepsilon_{it} \tag{3.11}$$

The null hypothesis is displayed as below:

$H_0: \propto_i = 0$ for all i

which means that the all panel have unit root

After the ADF regression for each cross-section are estimated, the average of the t-statistic from all of the ADF regression is adjusted to get the most desired test statistic:

$$\overline{t_{NT}} = \left(\sum_{i=1}^{N} t_{iT_i}(p_i) \right) \Big/ N \tag{3.12}$$

where t_{iT_i} refers to the t-statistic of the individual ADF regression, p_i refers to the autoregressive coefficient, and N refers to the number of cross-section.

If the lag order in Equation (3.11) is non-zero for some cross-section, Im-Pesaran-Shin shows that $\overline{t_{NT}}$ will has an asymptotic standard normal distribution:

$$W_{\overline{t_{NT}}} = \sqrt{N}\left(\overline{t_{NT}} - N^{-1}\sum_{i=1}^{N} E(\overline{t_{NT}}(p_i))\right) \Bigg/ \sqrt{N^{-1}\sum_{i=1}^{N} Var(\overline{t_{NT}}(p_i))} \rightarrow N(0,1)$$

(3.13)

where $E(\overline{t_{NT}}(p_i))$ refers to the expected mean of the ADF regression t-statistic and $Var(\overline{t_{NT}}(p_i))$ refers to the variance of the ADF regression t-statistic.

The null hypothesis will be rejected if the $\overline{t_{NT}}$ is lower than the t-bar statistics critical value, which conclude that non-zero fraction of the panel processes is stationary.

3.5.1.3 Augmented Dicky-Fuller (ADF) Fisher Chi-square Test

Augmented Dicky-Fuller (ADF) test is said to be better than the Dickey-Fuller (DF) Test because of its ability to handle a model that are more complex and with a larger size. ADF statistic is displayed in negative sign and the greater the negative number, the greater the probability in rejecting the null hypothesis. The null hypothesis denotes that there is existence of unit root among the variables (Davidson & MacKinnon, 2004).

The first step in DF test is determining the AR(1) equation which is written as:

$$y_{it} = \emptyset y_{it-1} + \varepsilon_{it} \tag{3.14}$$

To test whether $\emptyset$ equals to 1, both side of the equation is subtracted with y_{it-1}:

$$y_{it} - y_{it-1} = (\emptyset - 1) y_{it-1} + \varepsilon_{it} \tag{3.15}$$

$$\Delta y_{it} = \delta y_{it-1} + \varepsilon_{it} \tag{3.16}$$

where $\delta = \emptyset - 1$

Augmented Dicky-Fuller test is different from Dicky-Fuller test in which ADF test accepts AR dynamic with higher-order, in which AR(p) model is written as:

$$\Delta y_{it} = \delta y_{it-1} + \sum_{I=1}^{p} \beta \Delta\, y_{it-I} + \varepsilon_{it} \tag{3.17}$$

To test the stationarity of each regressor, trend and/or intercept and be taken into account while adopting the ADF test. First, intercept is considered along with AR model:

$$\Delta y_{it} = \propto + \delta y_{it-1} + \varepsilon_{it} \tag{3.18}$$

where $\propto$ refers to the intercept in the AR

Second, considering trend and intercept along the AR model:

$$\Delta y_{it} = \propto + \delta y_{it-1} + \gamma_{it} + \varepsilon_{it} \tag{3.19}$$

where γ_{it} refers to the trend in the AR

Third, the null hypothesis for both ADF test and DF test is written as below:

$$H_0: \delta = 0$$

Fourth, the stationary of each of the variable is evaluated using conventional t-ratio for δ:

$$t_{\delta} = \hat{\delta}/se(\hat{\delta}) \tag{3.20}$$

where $\widehat{\delta}$ refers to the estimated coefficient of δ and $se(\hat{\delta})$ refers to the standard error of the estimated coefficient.

If the t-ratio is smaller than the upper DF critical value, reject the null hypothesis, which conclude that no unit root is present in the regressor.

3.5.1.4 Phillips-Perron (PP) Fisher Chi-square Test

The test statistic of PP test is built on the DF statistic in the ADF test. The difference is PP test is a better option when the heteroscedasticity and the autocorrelation of the model is unspecified (Newey & West, 1987). Besides that, PP test is more suitable for research that have a small sample size.

Same as the ADF test, PP test also consider the intercept and the intercept and trend along the AR model which shows in equation (3.18) and equation (3.19)

Same as ADF test, the null hypothesis is written as:

$$H_0: \delta = 0$$

But, when it comes to the t-statistic, PP test is different from the Augmented Dicky-Fuller (ADF) test, which is written as below:

$$\widetilde{t_\delta} = t_\delta \left(\frac{\gamma_0}{f_0}\right)^{\frac{1}{2}} - \frac{T(f_0 - \gamma_0)(se(\hat{\delta}))}{2f_0^{\frac{1}{2}}s} \quad (3.21)$$

where $\hat{\delta}$ represents the estimated coefficient of δ, t_δ represents the t-ratio of δ, $se(\hat{\delta})$ refers to the standard error of the estimate coefficient. Next, γ_0 refers to the consistent estimate of the error variance in equation (3.16) and f_0 refers to the estimator of the residual spectrum at zero frequency.

If the t-statistic is smaller than the upper DF critical value, reject the null hypothesis, which conclude that there is no unit root in the regressor.

3.5.2 Panel Regression Model

3.5.2.1 Pooled Ordinary Least Square (OLS) Model

According to Alam (2020), Pooled Ordinary Least Square (OLS) model is the most common model being used when it comes to the panel data. It estimates the data like other model for cross-sectional data, the difference is the changes in the dimension were ignored in the Pooled OLS model. Pooled OLS model just simply pooled the data from different individual without any provision on the individuals to prevent difference in coefficients that caused by the individual differences. To prevent the coefficient difference, there are some assumption being made which are the intercepts and slope of the individuals are constant, heterogeneity will be taken into account and zero time effect. The equation of the model can be written as below:

$$Y_{it} = \beta_0 + \beta_1 X_{1it} + \cdots + \beta_k X_{kit} + \mu_{it} \quad (3.22)$$

Where i refers to the individual unit and t refers to the time period. Y_{it} refers to the observation of i individual at the time period t and X_{it} refers to the independent variable of i individual at the time period t . β_0 refers to the intercept of the model and β_1 to β_k refers to the coefficient of the independent variable. The intercept and coefficient do not have i and t due to the assumption above which there is no time effect and the intercept and slope are constant. Finally, μ_{it} refers to the error term of the model.

3.5.2.2 Fixed Effect Model (FEM)

Fixed Effect Model (FEM) is based on the basics of the Pooled OLS model which it assumes that the intercepts are different for different individuals but the slope are still constant. The changes in the assumption will change the equation into:

$$Y_{it} = \beta_{0i} + \beta_1 X_{1it} + \cdots + \beta_k X_{kit} + \mu_{it} \quad (3.23)$$

Where i refers to the individual unit and t refers to the time period. Y_{it} refers to the observation of i individual at the time period t and X_{it} refers to the independent variable of i individual at the time period t. The i subscript that added to β_0 indicates that different individual can have a different intercept and β_1 to β_k refers to the coefficient of the independent variable.

According to Twumasi-Ankrah, Ashaolu and Ankrah (2015), the appropriate way to estimate the equation (3.23) is to include a dummy variable for each of the individuals and it will further transform the equation into:

$$Y_{it} = \beta_{0,1}D_{1i} + \beta_{0,2}D_{2i} + \cdots + \beta_{0,k}D_{ki} + \beta_1 X_{1it} + \cdots + \beta_k X_{kit} + \mu_{it} \quad (3.24)$$

Where i refers to the individual unit and t refers to the time period. Y_{it} refers to the observation of i individual at the time period t and X_{it} refers to the independent variable of i individual at the time period t. The D_{ki} refers to the dummy variable of the individuals and $\beta_{0,k}$ refers to the intercept of these dummy variable. Besides that, β_1 to β_k refers to the coefficient of the independent variable. Finally, μ_{it} refers to the error term of the model.

3.5.2.3 Random Effect Model (REM)

Under Random Effect Model (REM), random individual differences are added into the model. According to Twumasi-Ankrah, Ashaolu and Ankrah (2015), it is done by consisting of a fixed part that represent the average of the population, $\bar{\beta}_0$, through specifying the intercept parameter β_{0i}. Besides that the error term of the random individual differences are also added into the equation as below:

$$Y_{it} = \bar{\beta}_0 + \beta_1 X_{1it} + \cdots + \beta_k X_{kit} + (\mu_{it} + \varepsilon_{it})$$

$$Y_{it} = \bar{\beta}_0 + \beta_1 X_{1it} + \cdots + \beta_k X_{kit} + v_{it} \quad (3.25)$$

Where i refers to the individual unit and t refers to the time period. Y_{it} refers to the observation of i individual at the time period t and X_{it} refers to the independent variable of i individual at the time period t . $\bar{\beta}_0$ refers to the intercept parameter which consist of the fixed part that represent the average of the population and β_1 to β_k refers to the coefficient of the independent variable. Finally, μ_{it} refers to the error term of the model and ε_{it} refers to the error term of the random individuals.

3.5.3 Model Selection

3.5.3.1 Breusch-Pagan Lagrangian Multiplier Test (BP-LM)

According to Saada, Haniffb and Alic (2016), BP-LM test is developed by Breusch and Pagan (1980) and it is used to evaluate whether Pooled-OLS model is suitable or not when it comes to interpreting the result. This test makes a discrimination between Pooled OLS model and Random Effect Model (REM). The null hypothesis of the test is shown as below:

$$H_0: \sigma_\lambda^2 = 0$$

which means that there is no effect from the variance of error term, in other words, Pooled OLS model is preferable.

The LM statistic is used as the test statistic for this model and it follows the Chi-square distribution with one degree of freedom:

$$LM = \frac{nT}{2(T-1)}\left[\frac{T^2\bar{e}'\bar{e}}{e'e} - 1\right]^2 \sim \mathcal{X}^2(1) \qquad (3.26)$$

where $\bar{e}$ refers to the n×1 vector of the group means of the pooled regression residuals and $e'e$ refers to the R-squared of the pooled OLS model.

Reject the null hypothesis if the LM statistic is higher than the critical value, which concludes that REM is preferable

3.5.3.2 Hausman Test

According to Saada, Haniffb and Alic (2016), Hausman test is developed by Hausman (1978) and it is used to evaluate whether Fixed Effect Model (FEM) and Random Effect Model (REM) is more appropriate in interpreting the result by considering the correlation between the λ_i and the independent variables. The null hypothesis is written as below:

$$H_0: Cov(\lambda_i, X_{it})$$

which means that there is no correlation between the λ_i and the independent variables, in other words, REM is preferable.

The Hausman test-statistic follows the Chi-squared distribution with k degree of freedom with k degree of freedom.

$$H = (\hat{\beta}_{FE} - \hat{\beta}_{RE})'\left[Var(\hat{\beta}_{FE}) - Var(\hat{\beta}_{RE})\right]^{-1}(\hat{\beta}_{FE} - \hat{\beta}_{RE}) \sim \chi_k^2 \qquad (3.27)$$

where $\hat{\beta}_{FE}$ refers to the beta value of the FEM and $\hat{\beta}_{RE}$ refers to the beta of REM. Var for both $\hat{\beta}_{FE}$ and $\hat{\beta}_{RE}$ refers to the beta variance for both FEM and REM respectively.

Reject the null hypothesis if the Hausman test-statistic is greater than the critical value, which concludes that REM is preferable.

3.6 Chapter Summary

This chapter had shown the sources of data and the application of methodology applied for the analysis. Pooled Ordinary Least Square (OLS) model, Fixed Effect Model (FEM) and Random Effect Model (REM) will be applied to analysis the relationship between the Return of cryptocurrencies and the return of cryptocurrencies in the previous period, Cboe Volatility Index (VIX) and the indirect impact of two uncertainties (GEPU and GPR). Then, to decide which model is more preferable, Breusch-Pagan LM Test and

Hausman test is applied. The empirical result of the research will be shown in the following chapter.

CHAPTER FOUR: EMPIRICAL RESULT AND DISCUSSION

4.0 Introduction

This chapter shows the result that had been obtained using the methodology presented in Chapter 3. This chapter comprise section 4.1 which is the result of the unit root test, section 4.2 which shows the result of the Pooled Ordinary Least Square (OLS) model, Fixed Effect Model (FEM) and Random Effect Model (REM), and section 4.3 show the result of Breusch-Pagan LM Test and Hausman test. Finally, section 4.4 will be the chapter summary.

4.1 Unit Root Test

The analysis starts with the unit root test on all of the variable using Levin-Lin-Chu Test, Im-Pesaran-Shin W-Stat Test, ADF-Fisher Chi-square Test, and PP-Fisher Chi-square Test. If the null hypothesis is rejected, it means that the variable is stationary. Table 4.1 summarized the result obtained from the few unit root test stated above in terms of level and considers the intercept of all respective variable.

Table 4.1: Unit Root Test Result

Variables	Intercept (Level)			
	Levin-Lin-Chu Test	Im-Pesaran-Shin W-Stat Test	ADF-Fisher Chi-square Test	PP-Fisher Chi-square Test
Crypto Return (RET)	-18.9951 (0.0000***)	-17.4522 (0.0000***)	175.659 (0.0000***)	147.545 (0.0000***)
VIX	-18.0246 (0.0000***)	-18.1542 (0.0000***)	193.346 (0.0000***)	231.668 (0.0000***)
GEPU	-23.1111 (0.0000***)	-21.3629 (0.0000***)	218.566 (0.0000***)	219.382 (0.0000***)
GPR	-16.2570 (0.0000***)	-15.4743 (0.0000***)	167.081 (0.0000***)	170.967 (0.0000***)

Notes: The rejection of null hypothesis at 10%, 5% and 1 % significance level are represented by *, **, *** respectively. The parentheses value is the P-value. Lag length selection is based on Schwarz Info Criterion (SIC) and the maximum lags implemented is 13.

According to the result of the Levin-Lin-Chu Test, Im-Pesaran-Shin W-Stat Test, ADF-Fisher Chi-square Test, and PP-Fisher Chi-square Test, the p-value of all variables are 0.0000, it indicates that the null hypothesis about the Cryptocurrencies' return, VIX, GEPU, and GPR are unit root non-stationary are all rejected at 1% significance level as the p-value are lower than the significance level. This result indicates that the variables are all stationary and all of them are I(0) regressors when taking into account

of the intercepts. The result of all unit root tests is consistent with each other. In summary, in this stage, it is confirmed that only I(0) regressor are included.

4.2 Panel Regression Model

The models shown below are the models that had been formulated in Chapter 3. To deliver the specific objective, which is to analyse the ability of cryptocurrencies to hedge against indirect effect of Global Economic Policy Uncertainty (GEPU) and Geopolitical Risk (GPR), model (1) and (2) were formed.

$$RET_t=\beta_0+\beta_1 RET_{t-1}+\beta_2 VIX_t+\beta_3(VIX\times GEPU)_t+\mu_t \quad (1)$$

$$RET_t=\beta_0+\beta_1 RET_{t-1}+\beta_2 VIX_t+\beta_3(VIX\times GPR)_t+\mu_t \quad (2)$$

Table 4.2 and 4.3 shows the result of model (1) and (2) in Pooled OLS model, FEM model and REM model.

Table 4.2: Result of Model (1)

	Pooled OLS	FEM	REM
RET(-1)	-0.329071 (0.0000***)	-0.330014 (0.0000***)	-0.329071 (0.0000***)
VIX	-0.159640 (0.3636)	-0.159725 (0.3659)	-0.159640 (0.3661)

VIX×GEPU	-0.223007 (0.7563)	-0.222607 (0.7580)	-0.223007 (0.7575)
C	0.116515 (0.0138**)	0.116583 (0.0142**)	0.116515 (0.0143**)

Notes: The rejection of null hypothesis at 10%, 5% and 1 % significance level are represented by *, **, *** respectively. The parentheses value is the P-value.

From the result shown in Table 4.2, the first variable is Cryptocurrencies return in the previous period. The reason for including this variable in the model is because the price momentum from previous period will affect the price movement in current period. By referring to Grinblatt and Han (2005) and Guren (2014), both of the study had used such variable in their model when explaining the price momentum in the financial market and housing market. From the table, the p-value of this variable in all three regression model are 0.0000 which indicates that this variable is significant at 1%. In the pooled OLS model, on average, when the previous return increase by 1%, the current return will drop by 0.329071%, holding other variables constant. For the FEM, when the previous return increase by 1%, on average, the current return will drop by 0.330014%, ceteris paribus. For the REM, when the previous return increase by 1%, the current return will drop by 0.329071%, holding other variables constant.

Furthermore, for VIX, this variable had negative sign for its coefficient in all regression models which indicates that VIX will influence the cryptocurrencies' return adversely. For pooled OLS model, on average, when the VIX index increase by 1%, the cryptocurrencies' return will decrease by 0.159640%, ceteris paribus. In terms of FEM, when the VIX index increase by 1%, on average, the cryptocurrencies' return will decrease by 0.159725%, holding other variables constant. For the REM, when the VIX index increase by 1%, on average, the cryptocurrencies' return will drop by 0.159640%,

ceteris paribus. But, by referring to the p-value in each regression model, the null hypothesis of there is no relationship between the cryptocurrencies' return and VIX index is not rejected as the p-value from all of the regression model is greater than 10% significance level. Thus, by relating to the first specific objective of this research which is to analyse the ability of cryptocurrencies to act as a hedging tool against Cboe Volatility Index (VIX), it had been proven that cryptocurrencies can hedge against VIX index as there is no relationship between these two variables. The fluctuation of VIX index had no effect on the cryptocurrencies return,

Moreover, the coefficient of the indirect impact of GEPU is also in negative sign for all of the regression model which indicates that the indirect impact of GEPU will influence the cryptocurrencies' return adversely. Similar to the VIX, the p-value for the indirect impact from GEPU are all greater than the significance level of 10%. Which indicates that there is no relationship between the cryptocurrencies' return and the indirect impact of the GEPU. This result had addressed the second specific objective, which is to analyse the ability of cryptocurrencies to hedge against indirect effect of Economic Policy Uncertainty (EPU) and it had proven that cryptocurrencies can hedge against the indirect effect from the GEPU. Since there is no relationship between both variables, the fluctuation in the EPU will not had any indirect impact towards the cryptocurrencies' return.

Table 4.3: Result of Model (2)

	Pooled OLS	FEM	REM
RET(-1)	-0.329942 (0.0000***)	-0.330886 (0.0000***)	-0.329942 (0.0000***)
VIX	-0.174014	-0.174082	-0.174014

	(0.3127)	(0.3151)	(0.3153)
VIX×GPR	-0.085851 (0.8143)	-0.085955 (0.8150)	-0.085851 (0.8152)
C	0.109666 (0.0143**)	0.109741 (0.0147**)	0.109666 (0.0148**)

Notes: The rejection of null hypothesis at 10%, 5% and 1 % significance level are represented by *, **, *** respectively. The parentheses value is the P-value.

Based on the table above, the first variable is the previous return of the cryptocurrencies. As stated before, this variable is added into the model to represent the price momentum. From the table, the coefficient of previous return from the pooled OLS model is -0.329942 which indicates that when the previous return increase by 1%, on average, the current return will decrease by 0.329942%, holding other variables constant. For the FEM, when the previous return increase by 1%, on average, the current return will fall by 0.330886%, ceteris paribus. In terms of REM, when the past return increase by 1%, on average, the current return will drop by 0.329942%, ceteris paribus. Since the p-value of this variable in all regression models is 0.0000, it indicates that the null hypothesis of there is no relationship between the previous return and current return is rejected and it had proven the point of view from Grinblatt and Han (2005) and Guren (2014) which price momentum can affect an assets pricing and return.

Next, similar to Model (1), the coefficient of the VIX index is also negative sign in all regression model which it will adversely affect the cryptocurrencies return. In terms of the pooled OLS model, when the VIX index increase by 1%, on average, the cryptocurrencies return will drop by 0.174014%, ceteris paribus. For FEM, when the VIX index increase by 1%, on average, the cryptocurrencies return will decrease by 0.174082%, holding other variables constant. For REM, when the VIX index increase

by 1%, on average, the cryptocurrencies return will drop by 0.174014%, holding other variables constant. Same as Model (1), the p-value in each regression model is greater than the significance level of 10%, which indicates that there is no relationship between the cryptocurrencies return and the VIX index. The cryptocurrencies can act as a hedging tool against the VIX as the fluctuation in the VIX will not had any impact towards the cryptocurrencies' pricing and return.

Besides that, to deliver the second specific objective, which is to analyse the ability of cryptocurrencies to hedge against indirect effect of Geopolitical Risk (GPR), the third variable of this model is the indirect impact of GPR towards the cryptocurrencies' return. Similar to the indirect impact of GEPU, the p-value of the GPR indirect impact is also greater than the significance level of 10% in all regression model. Thus, the null hypothesis of there is no relationship between the cryptocurrencies' return and indirect impact of GPR is not rejected and cryptocurrencies had the ability to hedge against the indirect effect from the GPR. Since there is no relationship between both variables, the fluctuation in the GPR will not had any indirect impact towards the cryptocurrencies' return.

4.3 Selection of Regression Model

Table 4.4 shows the result of Breusch-Pagan LM Test and Hausman Test which is conducted to evaluate the most suitable regression model in interpreting the result.

Table 4.4 Model Selection Result

	(1)	(2)
Breusch-Pagan LM Test	1.740342 (0.1871)	1.739929 (0.1871)
Hausman Test	0.271632 (0.9653)	0.272063 (0.9652)

Notes: The rejection of null hypothesis at 10%, 5% and 1 % significance level are represented by *, **, *** respectively. The parentheses value is the P-value

According to Table 4.4, the p-value for Model (1) and (2) in the Breusch-Pagan LM Test are all greater than the significance level of 10%. The null hypothesis of there is no effect from the variance of error term, in other words, Pooled OLS model is preferable is not rejected. Thus, Pooled OLS model is more preferable than REM.

For the Hausman Test, it is used to evaluate whether Fixed Effect Model (FEM) or Random Effect Model (REM) is more suitable in interpreting the result. Since the p-value for both model is greater than the 10% significance level, the null hypothesis of no correlation between the λ_i and the independent variables, in other words, REM is preferable is not rejected.

To conclude, from the Hausman test, it shows that REM is more preferable than FEM, but in the Breusch-Pagan LM Test is shows that Pooled OLS model is more preferable than the REM. Thus, Pooled OLS model is the most suitable model in interpreting the result.

4.4 Diagnostic Checking

There will be two tests that will be conducted the ensure the robustness of the result. The first test is the Variance Inflation Factor (VIF) which is used to detect multicollinearity problem. The second test is the Serial Correlation LM test which is to detect the autocorrelation problem.

4.4.1 Multicollinearity

Table 4.5 Result of Variance Inflation Factor

	R^2	VIF
RET(-1)	0.001985	1.0000
VIX	0.047689	1.0023
VIX×GEPU	0.047059	1.0022
VIX×GPR	0.008588	1.0000

According to Stine (1995), when the Variance Inflation Factor (VIF) is large enough, it indicates that there is a multicollinearity problem and Chatterjee and Price (1991) suggest that 10 can be considered as large enough to indicate the problem.

From table 4.5, it shows that the VIF for the variable of Return of Cryptocurrencies in the previous period, VIX, VIX×GEPU, and VIX×GPR are all smaller than 10 which indicates that there is no multicollinearity between the variables.

4.4.2 Autocorrelation

Table 4.6 F-statistic from Serial Correlation LM test

	(1)	(2)
F-statistic	4.297550 (0.000005***)	4.309452 (0.000004***)

Notes: The rejection of null hypothesis at 10%, 5% and 1 % significance level are represented by *, **, *** respectively. The parentheses value is the P-value.

According to table 4.6, the F-statistic of Model (1) and (2) had a p-value that are lower than the 1% significance level. Which means that the null hypothesis of there is no serial correlation is rejected at 1% significance level for both models. Since there are 12 lag orders for both models in the LM test, thus generally, up to lag 12 there is autocorrelation problem for both models.

4.5 Re-estimation of result

Since the issue of autocorrelation is detected in the diagnostic checking, the pooled OLS model is then re-estimated with robust standard errors. The reason is from Chapter 4.3, Pooled OLS model is chosen to be the most suitable model in interpreting the result.

Table 4.7: Result of Pooled OLS model from Model (1)

	Before Re-estimation	After Re-estimation
RET(-1)	-0.329071 (0.0000***)	-0.329071 (0.2129)
VIX	-0.159640 (0.3636)	-0.159640 (0.2649)
VIX×GEPU	-0.223007 (0.7563)	-0.223007 (0.7381)
C	0.116515 (0.0138**)	0.116515 (0.1149)

Notes: The rejection of null hypothesis at 10%, 5% and 1 % significance level are represented by *, **, *** respectively. The parentheses value is the P-value.

After the re-estimation, the coefficient of all variables is still the same, but the p-value of the variables had changed. The return of cryptocurrencies in previous period had become insignificant at 10% significance level. For the remaining independent variable, although there are changes in the p-value, but the result is still the same which there is no relationship between the return of cryptocurrencies and the VIX, same goes to the

indirect effect of GEPU. In short, all of the variables had no relationship with the return of cryptocurrencies.

Table 4.8: Result of Pooled OLS model from Model (2)

	Before Re-estimation	After Re-estimation
RET(-1)	-0.329942 (0.0000***)	-0.329942 (0.2120)
VIX	-0.174014 (0.3127)	-0.174014 (0.1647)
VIX×GPR	-0.085851 (0.8143)	-0.085851 (0.5911)
C	0.109666 (0.0143**)	0.109666 (0.0940*)

Notes: The rejection of null hypothesis at 10%, 5% and 1 % significance level are represented by *, **, *** respectively. The parentheses value is the P-value.

Same as Model (1), after the re-estimation, the coefficient of all variables is still the same, but the p-value of the variables had changed. The return of cryptocurrencies in previous period had also become insignificant at 10% significance level. The VIX and indirect impact of GPR still had no relationship with the return of cryptocurrencies. In short, all of the variables had no relationship with the return of cryptocurrencies.

4.6 Chapter Summary

As a summary, the unit root tests were carried out to ensure all the variable chosen are stationary at level only. Furthermore, the relationship between the cryptocurrencies' return and the independent variables are captured through the panel regression model section. According to the result, only the past cryptocurrencies' return can influence the current period cryptocurrencies' return. For VIX and the indirect impact of GEPU and GPR, these variables had no relationship with the cryptocurrencies' return, in other words, cryptocurrencies had the ability to hedge against these risks. Subsequently, Breusch-Pagan LM Test and Hausman Test are conducted to determine which regression model is the most suitable in interpreting the result and Pooled OLS model is shown to be the most suitable regression model. For the diagnostic checking, there is no multicollinearity problem among the variable but there is an existence of autocorrelation problem. Re-estimation of the Pooled OLS model is made, and all of the independent variables had no relationship with the return of the cryptocurrencies. All the empirical results had been displayed and the conclusion will be made in Chapter 5.

CHAPTER FIVE: DISCUSSION, CONCLUSION AND IMPLICATION

5.0 Introduction

This chapter discusses the impact and shortcomings of this study in accordance with the results and findings in the preceding chapter. This chapter delivers a discussion of major findings, implications of study, limitations of study as well as suggestions for the future research.

5.1 Discussion of Major Findings

The main contribution of this research is to make an analysis on the capability of cryptocurrencies to act as a hedging tool against the Cboe Volatility Index (VIX), indirect effect of Geopolitical Risk (GPR), and Economic Policy Uncertainty (EPU). The methodologies applied are the unit root test and panel regression model which include Pooled OLS model, FEM model and REM model.

By applying the panel regression model, the result shows that the cryptocurrencies have the ability to hedge against VIX, as it is negative coefficient in all regression model. Moreover, the cryptocurrencies have to the ability to hedge against the indirect effect

from EPU and GPR since both of the indirect effect of EPU and GPR have negative coefficient. This suggests that the VIX, EPU and GPU will adversely affect the cryptocurrencies' return.

Cboe Volatility Index (VIX) and cryptocurrencies' return were found to have no relationship, thus cryptocurrencies can act as a hedging tool against Cboe Volatility Index (VIX). However, there is negative correlation between Cboe Volatility Index (VIX) and cryptocurrencies' return as the coefficient is in negative sign, which fulfils the requirement of hedging. Normally, the most popular hedging method used by investors were through derivatives whereas hedging can also be done through diversification (Abid et al, 2019). For example, an investor created a portfolio that invest in stocks and cryptocurrencies. When the stocks are facing higher risk that affect the investor's return, then cryptocurrencies can play a role to hedge the stock market in order to diversify the risk (Lhabitant, 2004). Therefore, the first hypothesis of can the cryptocurrencies act as a hedging tools against the Cboe Volatility Index (VIX) is valid.

The indirect influence of EPU and GPR were found to have no relationship with cryptocurrencies' return, and hence cryptocurrencies can hedge against the indirect effect of EPU and GPR. However, according to Cheng et al. (2020), the EPU has direct impact on cryptocurrencies' return as they found that the cryptocurrencies return will be affected by the changes of EPU. For instance, Bitcoin monthly returns are positively predicted by the changes of China EPU as China government banned the cryptocurrency trading on September 2017, which also strengthen the ability of the prediction of the Bitcoin return (Cheng et al, 2020). On top of that, Geopolitical Risk (GPR) was found to have predictive power on returns and price volatility on cryptocurrencies (Aysan et al, 2019). In addition, as discussed earlier, since the indirect impact of GPR and EPU were found to have no relationship, it therefore can be hedged through diversification. Thus, the second hypothesis of Geopolitical Risk (GPR) and

Economic Policy Uncertainty (EPU) have indirect impact on cryptocurrencies' return is rejected.

5.2 Implications of Study

Investors make investment decision by considering several factors. One of the factors that will influence the investment decision is risk, especially for those risk averse investors who prefer to hedge against the risks. Investors are well-informed about the alternatives used to hedge or actions to be taken when there is a rise in VIX, GEPU and GPR. Based on the results of this research, cryptocurrencies can hedge against VIX, GEPU and GPR. This suggests that the investors can invest in the cryptocurrencies during COVID-19 pandemic, war, financial crisis, high stock market volatility and others.

Besides, this research helps the investors in portfolio management and risk management. Investors are able to create and manage the best investment plan according to their goals, risk preference and budget. Risk management process includes risk transfer through hedging, diversification and insurance. Empirical results may significantly influence their decision on investment strategies as cryptocurrencies can function as one of the investment instruments to hedge against the VIX, GEPU and GPR.

Since the VIX, GEPU and GPR affect economy and financial markets, policymakers can gain valuable knowledge through this research. Policymakers can adjust their

policies by considering the impact of VIX, GEPU and GPR. Adjustment of policies should be made to maintain and improve macroeconomic stabilization (Frenkel & Khan, 1990). Since the VIX, GEPU and GPR reflect the current market condition, policymakers can design proper policies and implement the monetary policies as well as fiscal policies accordingly. This research is also useful for the policymakers in designing policies that are used to regulate cryptocurrencies in the future. Since cryptocurrencies are receiving more attention and concern recently, the policies and regulations developed can help to reduce the risk of investors in uncertain times.

Furthermore, this research does not only provide valuable information about Bitcoin but also valuable information of other cryptocurrencies on hedging VIX, GEPU and GPR. Thus, the future researchers can take this research as a pioneer to study on the other cryptocurrencies. In addition, this research can inspire future researchers to study the capabilities of the cryptocurrencies in the use of hedging, speculating, arbitraging and others. Moreover, this research suggests the future researchers to widen their extent of study on latest issue by examining the linkage between cryptocurrencies and the other risks.

5.3 Limitations of Study

There are rooms for improvements for the future research. Few limitations will be justified in this research and recommendations will be further discussed in the next part. Based on our empirical analysis, we confirmed the cryptocurrencies' capability as a hedging tool against the uncertainties. Generally, most investors will have a portfolio with multiple assets to hedge against the uncertainties. If a portfolio contains multiple

assets at the same time, then cryptocurrencies may play multiple roles. The roles cab include a hedging asset, a safe haven, or even means of diversification. However, according to Wang et al. (2019), when Bitcoin, one of the cryptocurrency being examined in this research, plays multiple roles in a portfolio, it can complicate the portfolio management. This study does not opine about how to position cryptocurrencies in a portfolio with other assets to hedge against uncertainties. If this question can be solved in the future research, it is certain that many can gain a better understanding on the financial function of cryptocurrencies.

Apart from that, this study includes only four cryptocurrencies with the highest current market capitalisation, which is Bitcoin, Ethereum, XPR and Dogecoin for the variable of cryptocurrencies' return. Yet, one questionable statement arises of using only four cryptocurrencies to measure cryptocurrencies' return, taking into consideration that there are variety of cryptocurrencies out there that can also be used in this case. In view of the fact that this study includes only four cryptocurrencies instead of all listed cryptocurrencies in the market, it hence might not be able to capture the picture as a whole. Although the researchers have chosen the top four cryptocurrencies with highest market capitalisation, but there is possibility that the rankings of the market capitalisation could change due to unforeseen circumstances in the future. Thus, there is a possibility that other cryptocurrencies might react differently towards independent variables.

5.4 Recommendations for Future Research

Associated with objectives, recommendations are deemed as resolutions for limitations to avoid the occurrence of repeated mistakes. One suggestion on the portfolio complication is that the future researchers can study on how to position the cryptocurrencies in a portfolio effectively with other assets to hedge against uncertainties. As mentioned above, when a cryptocurrency plays multiple roles in a portfolio, it can complicate the portfolio management. Therefore, future researchers should be careful on deciding which cryptocurrencies to be included in a portfolio and its suitable proportion so that it will not lead to unnecessary complications due to bloated portfolio. If cryptocurrencies can be well positioned in a portfolio, it is certain that the market participants will get to understand their financial function in greater depth.

Another suggestion for the future researchers is that they can include more data for more precise results. For example, future researchers can include more cryptocurrencies in their study to examine if the selected cryptocurrencies react similarly or contrarily from the previous cryptocurrencies. As a result, future researchers are able to make comparisons in depth among those selected cryptocurrencies, and to what stretch the reaction of each cryptocurrencies, vary one from another, towards the independent variables. For instance, other cryptocurrencies such as Convex Finance (CVX) and IoTeX (IOTX), in some degree, might be not suitable to be used as hedging tools. The linkage on whether Convex Finance (CVX) and IoTeX (IOTX) can also be used to hedge against uncertainties, its effect is yet to study.

REFERENCES

Abid, I., Dhaoui, A., Goutte, S., & Guesmi, K. (2019). Hedging and diversification across commodity assets. *Applied Economics*, *52*(23), 2472–2492. https://doi.org/10.1080/00036846.2019.1693016

Adekoya, O. B., Oliyide, J. A., & Oduyemi, G. O. (2021). How COVID-19 upturns the hedging potentials of gold against oil and stock markets risks: Nonlinear evidences through threshold regression and markov-regime switching models. *Resources Policy, 70*, 101926.

Akdağ, S., & İskenderoğlu, Ö. (2021). The impact of global uncertainty and risks on the global tourism index. *Journal of Tourism Theory and Research, 7*(2).

Al Mamun, M., Uddin, G. S., Suleman, M. T., & Kang, S. H. (2020). Geopolitical risk, uncertainty and Bitcoin Investment. *Physica A: Statistical Mechanics and Its Applications*, *540*, 123107. https://doi.org/10.1016/j.physa.2019.123107

Alam, M. (2020). Panel data regression: a powerful time series modeling technique. Retrieved from https://towardsdatascience.com/panel-data-regression-a-powerful-time-series-modeling-technique.

All cryptocurrencies. (2021). CoinMarketCap. Retrieved from https://coinmarketcap.com/all/views/all/

Al-Thaqeb, S. A., & Algharabali, B. G. (2019). Economic policy uncertainty: A literature review. *The Journal of Economic Asymmetries*, *20*, e00133.

Al-Thaqeb, S. A., Algharabali, B. G., & Alabdulghafour, K. T. (2020). The pandemic and economic policy uncertainty. *International Journal of Finance & Economics.*

Anderson, S. (2021). Bitcoin vs. ripple: What's the difference?. Retrieved from https://www.investopedia.com/tech/whats-difference-between-bitcoin-and-ripple/

Antonakakis, N., Chatziantoniou, I., & Filis, G. (2013). Dynamic co-movements of stock market returns, implied volatility and policy uncertainty. *Economics Letters, 120*(1), 87-92.

Antonakakis, N., Chatziantoniou, I., & Filis, G. (2014). Dynamic spillovers of oil price shocks and economic policy uncertainty. *Energy Economics, 44*, 433-447.

Aysan, A. F., Demir, E., Gozgor, G., & Lau, C. K. M. (2019). Effects of the geopolitical risks on Bitcoin returns and volatility. *Research in International Business and Finance, 47*, 511–518.

Baek, C. (2019). How are gold returns related to stock or bond returns in the U.S. market? Evidence from the past 10-year gold market. *Applied Economics*, *51*(50), 5490–5497.

Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring economic policy uncertainty. *The quarterly journal of economics, 131*(4), 1593-1636.

Baker, S. R., Bloom, N., & Davis, S. J. (2021). Global economic policy uncertainty index. Retrieved from http://www.policyuncertainty.com/global_monthly.html

Baltagi, B. H., Song, S. H., Jung, B. C., & Koh, W. (2007). Testing for serial correlation, spatial autocorrelation and random effects using panel data. Journal of econometrics, 140(1), 5-51.

Baur, D. G., & Smales, L. A. (2020). Hedging geopolitical risk with precious metals. *Journal of Banking & Finance, 117*, 105823.

Beckmann, J., Berger, T., & Czudaj, R. (2015). Does gold act as a hedge or a safe haven for stocks? *A smooth transition approach. Economic Modelling*, *48*, 16–24.

Bekaert, G., & Hoerova, M. (2014). The VIX, the variance premium and stock market volatility. *Journal of econometrics, 183*(2), 181-192.

Bekiros, S., Boubaker, S., Nguyen, D. K., & Uddin, G. S. (2017). Black swan events and safe havens: The role of gold in globally integrated emerging markets. *Journal of International Money and Finance, 73*, 317-334.

Bernardmarr.com. (2021). What is the difference between bitcoin and ethereum? Retrieved from https://www.bernardmarr.com/default.asp?contentID=1307

Bitcoin USD (BTC-USD). (2021). Retrieved from https://finance.yahoo.com/quote/BTC-USD/

Black, F. (1976). Studies of stock price volatility changes. Proceedings of the 1976 Meeting of Business and Economics Statistics Section of the American Statistical Association, vol. 27, pp. 399– 418.

Böhme, R., Christin, N., Edelman, B., & Moore, T. (2015). Bitcoin: Economics, technology, and governance. *Journal of Economic Perspectives, 29*(2), 213-238. doi:10.1257/jep.29.2.213

Bouri, E., Gupta, R., Tiwari, A. K., & Roubaud, D. (2017). Does bitcoin hedge global uncertainty? evidence from wavelet-based quantile-in-quantile regressions. *Finance Research Letters, 23*, 87–95. https://doi.org/10.1016/j.frl.2017.02.009

Bouri, E., Molnár, P., Azzi, G., Roubaud, D., & Hagfors, L. I. (2017). On the hedge and safe haven properties of bitcoin: Is it really more than a diversifier? *Finance Research Letters, 20*, 192–198. https://doi.org/10.1016/j.frl.2016.09.025

Bradley, C., & Stumpner, P. (2021, April 20). *The impact of covid-19 on Capital Markets, one year in*. McKinsey & Company. Retrieved December 13, 2021,

from https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/the-impact-of-covid-19-on-capital-markets-one-year-in.

Caldara, D., & Iacoviello, M. (2018). Measuring geopolitical risk. *FRB International Finance Discussion Paper*, (1222).

Caldara, D., & Iacoviello, M. (2021). Measuring geopolitical risk. Retrieved from https://matteoiacoviello.com/gpr.htm

Callaghan, M. (2015). Stock market volatility and economic activity. University of Canterbury.

Chang, T., Chen, W. Y., Gupta, R., & Nguyen, D. K. (2015). Are stock prices related to the political uncertainty index in OECD countries? Evidence from the bootstrap panel causality test. *Economic Systems*, *39*(2), 288-300.

Chapter 9 Unit Root Testing. (2021). Estima. Retrieved fromhttps://estima.com/ecourse/samples/PanelSampleChapter.pdf

Chatterjee, S., and Price, B. (1991). Regression Diagnostics, New York: John Wiley.

Cheema, M. A., Faff, R. W., & Szulczuk, K. (2020). The 2008 global financial crisis and COVID-19 pandemic: How safe are the safe haven assets?. *Available at SSRN 3590015*.

Cheng, H. P., & Yen, K. C. (2020). The relationship between the economic policy uncertainty and the cryptocurrency market. *Finance Research Letters*, *35*, 101308. https://doi.org/10.1016/j.frl.2019.101308

Ciaian, P., Rajcaniova, M., & Kancs, d'A. (2015). The economics of Bitcoin Price Formation. *Applied Economics*, *48*(19), 1799–1815. https://doi.org/10.1080/00036846.2015.1109038

Coinbase (2021). What is dogecoin?. Retrieved from https://www.coinbase.com/learn/crypto-basics/what-is-dogecoin

Coinmarketcap.com. (2021). What are peer-to-peer (P2P) networks? Retrieved from https://coinmarketcap.com/alexandria/article/what-is-peer-to-peer-p2p

Constantinescu, C., Mattoo, A., & Ruta, M. (2019). Policy uncertainty, trade, and global value chains: Some facts, many questions. doi:10.1596/1813-9450-9048

Dai, P. F., Xiong, X., Liu, Z., Huynh, T. L. D., & Sun, J. (2021). Preventing crash in stock market: The role of economic policy uncertainty during COVID-19. *Financial Innovation, 7*(1), 1-15.

Davidson, R., & MacKinnon, J. (2004). Econometric theory and methods. Oxford University Press: New York.

Davis, S. J. (2016). An index of global economic policy uncertainty (No. w22740). *National Bureau of Economic Research.*

Demir, E., & Danisman, G. O. (2021). The impact of economic uncertainty and geopolitical risks on bank credit. *The North American Journal of Economics and Finance, 57*, 101444.

Demir, E., Gozgor, G., Lau, C. K. M., & Vigne, S. A. (2018). Does economic policy uncertainty predict the Bitcoin returns? An empirical investigation. *Finance Research Letters, 26*, 145- 149.

Devault, G. (2020). Advantages and disadvantages of quantitative research. Retrieved from https://www.thebalancesmb.com/quantitative-research-advantages-and-disadvantages-2296728

Dima, B., Dima, Ş. M., & Ioan, R. (2021). Remarks on the behaviour of financial market efficiency during the COVID-19 pandemic. The case of VIX. *Finance Research Letters,* 101967.

D'Mello, R., & Toscano, F. (2020). Economic policy uncertainty and short-term financing: The case of trade credit. *Journal of Corporate Finance, 64*, 101686.

Dos Santos, R. P. (2017). On the philosophy of bitcoin/blockchain technology: Is it a chaotic, complex system? *Metaphilosophy*, *48*(5), 620–633. https://doi.org/10.1111/meta.12266

Dulock, H. L. (1993). Research design: Descriptive research. *Journal of Pediatric Oncology Nursing*, *10*(4), 154-157.

Dutta, A., Das, D., Jana, R.K., & Vo, X.V. (2020). COVID-19 and oil market crash: Revisiting the safe haven property of gold and Bitcoin. *Resources Policy*, *69*. https://doi.org/10.1016/j.resourpol.2020.101816

Dyhrberg, A. H. (2016). Hedging capabilities of bitcoin. Is it the virtual gold? *Finance Research Letters*, *16*, 139–144.

Dyhrberg, A. H. (2016). Hedging capabilities of bitcoin. Is it the virtual gold? Finance *Research Letters*, *16*, 139–144.

Eckstein, Z., & Tsiddon, D. (2004). Macroeconomic consequences of terror: theory and the case of Israel. *Journal of monetary economics*, *51*(5), 971-1002.

Elsaied, F., Noor, H., Resiq, T., & Nobanee, H. (2020). On the relationship between risk & return. Retrieved from https://www.researchgate.net/publication/342703091_On_the_Relationship_Between_Risk_Return

Ethereum price today, ETH marketcap, chart, and info. (2021). Retrieved from https://coinmarketcap.com/currencies/ethereum/

Ethereum.org. (2021). ERC-20 token standard. Retrieved from https://ethereum.org/en/developers/docs/standards/tokens/erc-20/

Ethereum.org. (2021). Introduction to smart contracts. Retrieved from https://ethereum.org/en/developers/docs/smart-contracts/

Ethereum.org. (2021). What is Ethereum? Retrieved from https://ethereum.org/en/what-is-ethereum/

Fang, L., Yu, H., & Li, L. (2017). The effect of economic policy uncertainty on the long-term correlation between US stock and bond markets. *Economic Modelling, 66*, 139-145.

Fauzi, M. A., Paiman, N., & Othman, Z. (2020). Bitcoin and cryptocurrency: Challenges, opportunities and future works. *The Journal of Asian Finance, Economics and Business*, *7*(8), 695–704. https://doi.org/10.13106/jafeb.2020.vol7.no8.695

Frankenfield, J. (2020). Dogecoin (DOGE). Retrieved from https://www.investopedia.com/terms/d/dogecoin.asp

Frankenfield, J. (2021). Ripple. Retrieved from https://www.investopedia.com/terms/r/ripple-cryptocurrency.asp

Frenkel, J. A., & Khan, M. S. (1990). Adjustment policies and economic development. *American Journal of Agricultural Economics, 72*(3), 815–820. https://doi.org/10.2307/1243064

Gaies, B., Nakhli, M. S., Sahut, J. M., & Guesmi, K. (2021). Is Bitcoin rooted in confidence?–Unraveling the determinants of globalized digital currencies. *Technological Forecasting and Social Change, 172*, 121038.

Geopolitical Risk (GPR index). (2021). Matteo Iacoviello. Retrieved from https://www.matteoiacoviello.com/gpr.htm

Global Economic Policy Uncertainty Index. (2021). Economic Policy Uncertainty. Retrieved from http://www.policyuncertainty.com/global_monthly.html

Granger, C., & Newbold, P. (1974). Spurious regressions in econometrics. *Journal of Econometrics, 2*(2), 111-120.

Grinblatt, M., & Han, B. (2005). Prospect theory, mental accounting, and momentum. Journal of financial economics, 78(2), 311-339.

Guesmi, K., Saadi, S., Abid, I., & Ftiti, Z. (2019). Portfolio diversification with virtual currency: Evidence from bitcoin. *International Review of Financial Analysis, 63*, 431–437.

Guren, A. (2014). The causes and consequences of house price momentum. Cambridge, MA.

Harper, C. (2020). What is XRP, and how is it related to Ripple?. Retrieved from https://www.coindesk.com/what-is-ripple-what-is-xrp

Helseth, M. A. E., Krakstad, S. O., Molnár, P., & Norlin, K. M. (2020). Can policy and financial risk predict stock markets? *Journal of Economic Behavior & Organization*, *176*, 701–719. https://doi.org/10.1016/j.jebo.2020.04.001

Hern, A (2014, March 27). Dogecoin raises $55,000 to sponsor nascar driver. Retrieved from https://www.theguardian.com/technology/2014/mar/27/nascar-dogecoin-sponsor-josh-wise-talladega-superspeedway

Historical Data for Bitcoin. (2021). CoinMarketCap. Retrieved from https://coinmarketcap.com/currencies/bitcoin/historical-data/

Historical Data for Dogecoin. (2021). CoinMarketCap. Retrieved from https://coinmarketcap.com/currencies/dogecoin/historical-data/

Historical Data for Ethereum. (2021). CoinMarketCap. Retrieved from https://coinmarketcap.com/currencies/ethereum/historical-data/

Historical Data for XRP. (2021). CoinMarketCap. Retrieved from https://coinmarketcap.com/currencies/xrp/historical-data/

Hong, H., Bian, Z., & Lee, C. C. (2021). COVID-19 and instability of stock market performance: evidence from the U.S. *Financial Innovation, 7*(1). https://doi.org/10.1186/s40854-021-00229-1

Hoque, M. E., Soo Wah, L., & Zaidi, M. A. S. (2019). Oil price shocks, global economic policy uncertainty, geopolitical risk, and stock price in Malaysia:

Factor augmented VAR approach. *Economic Research-Ekonomska Istraživanja*, *32*(1), 3700–3732. https://doi.org/10.1080/1331677x.2019.1675078

Ji, Q., Zhang, D., & Zhao, Y. (2020). Searching for safe-haven assets during the COVID-19 pandemic. *International Review of Financial Analysis*, *71*, 101526.

Junttila, J., Pesonen, J., & Raatikainen, J. (2018). Commodity market based hedging against stock market risk in times of financial crisis: the case of crude oil and gold. *Journal of International Financial Markets, Institutions & Money*, *56*, 255–280.

Karnizova, L., & Li, J. C. (2014). Economic policy uncertainty, financial markets and probability of US recessions. *Economics Letters*, *125*(2), 261-265.

Kethineni, S., Cao, Y., & Dodge, C. (2017). Use of bitcoin in darknet markets: Examining facilitative factors on bitcoin-related crimes. *American Journal of Criminal Justice*, *43*(2), 141–157. https://doi.org/10.1007/s12103-017-9394-6

Kim, C. J., Morley, J. C., & Nelson, C. R. (2004). Is there a positive relationship between stock market volatility and the equity premium? *Journal of Money, Credit, and Banking*, *36*(3a), 339–360. https://doi.org/10.1353/mcb.2004.0055

Klein, T., Pham Thu, H., & Walther, T. (2018). Bitcoin is not the new gold—A comparison of volatility, correlation, and portfolio performance. *International Review of Financial Analysis*, *59*, 105–116.

Ko, J.-H., & Lee, C.-M. (2015). International economic policy uncertainty and stock prices: Wavelet approach. *Economics Letters*, *134*, 118–122. https://doi.org/10.1016/j.econlet.2015.07.012

Kuo Chuen, D. L., Guo, L., & Wang, Y. (2017). Cryptocurrency: A new investment opportunity? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2994097

Lee, C. C., Lee, C. C., & Li, Y. Y. (2021). Oil price shocks, geopolitical risks, and green bond market dynamics. *The North American Journal of Economics and Finance, 55*, 101309.

Lhabitant, F. (2004). Hedge Fund Diversification. *Hedge Fund Diversification*. https://www.researchgate.net/publication/228582361_Hedge_Fund_Diversification

Li, Q., Yang, J., Hsiao, C., & Chang, Y. J. (2005). The relationship between stock returns and volatility in international stock markets. *Journal of Empirical Finance, 12*(5), 650–665. https://doi.org/10.1016/j.jempfin.2005.03.001

Li, X. L., Balcilar, M., Gupta, R., & Chang, T. (2016). The causal relationship between economic policy uncertainty and stock returns in China and India: Evidence from a bootstrap rolling window approach. *Emerging Markets Finance and Trade, 52*(3), 674-689.

Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. *Review of Economics and Statistics*. February, 47, pp. 13–37.

Locke, T. (2021, May 7). 3 important differences between bitcoin and dogecoin, according to experts. Retrieved from https://www.cnbc.com/2021/05/07/differences-between-bitcoin-and-dogecoin-experts.html

Mamtha, D., & Srinivasan, K. S. (2015). Stock market volatility – Conceptual perspective through literature survey. *Mediterranean Journal of Social Sciences*. Published. https://doi.org/10.5901/mjss.2016.v7n1p208

Measuring the market impact of geopolitics. (2019) Schroders. Retrieved from https://www.schroders.com/en/sysglobalassets/digital/insights/2019/pdfs/2019_sept_measuring-the-market-impact-of-geopolitics_kw_il_cs1696.pdf

Mokni, K. (2021). When, where, and how economic policy uncertainty predicts Bitcoin returns and volatility? A quantiles-based analysis. *The Quarterly Review of Economics and Finance, 80,* 65-73.

Mokni, K., Bouri, E., Ajmi, A. N., & Vo, X. V. (2021). Does bitcoin hedge categorical economic uncertainty? A quantile analysis. *SAGE Open*, *11*(2), 215824402110163. https://doi.org/10.1177/21582440211016377

Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system. Retrieved from https://bitcoin.org/bitcoin.pdf

Newey, W., & West, K. (1987). A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. Econometrica, 55(3), 703.

Nonejad, N. (2021). Predicting equity premium using news-based economic policy uncertainty: Not all uncertainty changes are equally important. *International Review of Financial Analysis, 77,* 101818.

Panel-data unit-root tests. (2021). Stata. Retrieved from https://www.stata.com/features/overview/panel-data-unit-root-tests/

Paule-Vianez, J., Prado-Román, C., & Gómez-Martínez, R. (2020). Economic policy uncertainty and Bitcoin. is bitcoin a safe-haven asset? *European Journal of Management and Business Economics*, *29*(3), 347–363. https://doi.org/10.1108/ejmbe-07-2019-0116

Popper, N. (2015). *Digital gold: The untold story of Bitcoin*. London: Penguin.

Qadan, M., Kliger, D., & Chen, N. (2019). Idiosyncratic volatility, the vix and stock returns. *The North American Journal of Economics and Finance, 47*, 431-441.

Qin, M., Su, C.-W., & Tao, R. (2021). Bitcoin: A new basket for eggs? *Economic Modelling*, *94*, 896–907. https://doi.org/10.1016/j.econmod.2020.02.031

Rehman, M.U., & Apergis, N. (2019). Determining the predictive power between cryptocurrencies and real time commodity futures: evidence from quantile causality tests. *Resources Policy, 61*, 603−616. https://doi.org/10.1016/j.resourpol.2018.08.015.

Ripple.com. (2021). Ripplenet: The financial network of the future. Retrieved from https://ripple.com/ripplenet

Ripple.com. (2021). XRP: The best digital asset for global payments. Retrieved from https://ripple.com/xrp/

Rodeck, D. & Curry, B. (2021). An introduction to dogecoin, The meme cryptocurrency. Retrieved from https://www.forbes.com/advisor/investing/what-is-dogecoin/

Saada, N. M., Haniffb, M. N., & Alic, N. (2016). Model estimator selection tests: A case for long-term and medium-term issuances of corporate bonds.

Sari, R., Soytas, U., & Hacihasanoglu, E. (2011). Do global risk perceptions influence world oil prices?. *Energy Economics, 33*(3), 515-524.

Shaikh, I. (2019). On the relationship between economic policy uncertainty and the implied volatility index. *Sustainability, 11*(6), 1628.

Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *The journal of finance, 19*(3), 425-442.

Sigalos, M. (2021, May 7). How dogecoin went from a joke to one of the world's top cryptocurrencies. Retrieved from https://www.cnbc.com/2021/05/07/what-is-dogecoin.html

Smales, L. A. (2019). Geopolitical risk and volatility spillovers in oil and stock markets. *SSRN Electronic Journal*. Published. https://doi.org/10.2139/ssrn.3414134

Smales, L. A. (2021). Geopolitical risk and volatility spillovers in oil and stock markets. *The Quarterly Review of Economics and Finance, 80,* 358-366.

Solarin, S. A., & Gil-Alana, L. A. (2021). The persistence of economic policy uncertainty: Evidence of long range dependence. *Physica A: Statistical Mechanics and its Applications, 568*, 125698.

Stine, R. A. (1995). Graphical interpretation of variance inflation factors. The American Statistician, 49(1), 53-56.

Su, C.-W., Qin, M., Tao, R., Shao, X.-F., Albu, L. L., & Umar, M. (2020). Can bitcoin hedge the risks of geopolitical events? *Technological Forecasting and Social Change, 159*, 120182. https://doi.org/10.1016/j.techfore.2020.120182

Treynor, J. L. (1962). Toward a theory of market value of risky assets. Unpublished

Tsai, I. C. (2017). The source of global stock market risk: A viewpoint of economic policy uncertainty. *Economic Modelling, 60*, 122–131. https://doi.org/10.1016/j.econmod.2016.09.002

Tsang, K. P., & Yang, Z. (2021). The market for bitcoin transactions. *SSRN Electronic Journal*. doi:10.2139/ssrn.3554458

Twumasi-Ankrah, S., Ashaolu, J. T., & Ankrah, I. (2015). HIV/AIDS scourge and economic growth in sub-Sahara Africa. *Universal Journal of Public Health, 3*(2), 84-88.

Urquhart, A., & Zhang, H. (2019). Is bitcoin a hedge or safe haven for currencies? An intraday analysis. *International Review of Financial Analysis, 63*, 49–57.

VIX historical price data. (2021). Cboe. Retrieved from https://www.cboe.com/tradable_products/vix/vix_historical_data/

VIX index. (2021). Cboe. Retrieved from https://www.cboe.com/tradable_products/vix/

Wang, G., Tang, Y., Xie, C., & Chen, S. (2019, September 17). Is bitcoin a safe haven or a hedging asset? Evidence from China. *Journal of Management Science*

and Engineering. Retrieved January 20, 2022, from https://www.sciencedirect.com/science/article/pii/S2096232019300885

Wang, H., Wang, X., Yin, S., & Ji, H. (2021). The asymmetric contagion effect between stock market and cryptocurrency market. Finance Research Letters, 102345.

Wang, K. H., Xiong, D. P., Mirza, N., Shao, X. F., & Yue, X. G. (2021). Does geopolitical risk uncertainty strengthen or depress cash holdings of oil enterprises? Evidence from China. *Pacific-Basin Finance Journal, 66*, 101516.

Wang, Y., & Kong, D. (2021). Economic policy uncertainty and the energy stock market: Evidence from china. *Energy Research Letters*. Published. https://doi.org/10.46557/001c.28171

Whaley, R. E. (2009, April 30). Understanding the vix. *The Journal of Portfolio Management.* Retrieved January 20, 2022, from https://doi.org/10.3905/JPM.2009.35.3.098

Wisniewski, T. P., & Lambe, B. J. (2015). Does economic policy uncertainty drive CDS spreads?. *International Review of Financial Analysis, 42*, 447-458.

Wright, S., O'Brien, B. C., Nimmon, L., Law, M., & Mylopoulos, M. (2016). Research design considerations. *Journal of graduate medical education, 8*(1), 97-98.

Wu, S., Tong, M., Yang, Z., & Derbali, A. (2019). Does gold or Bitcoin hedge economic policy uncertainty?. *Finance Research Letters, 31*, 171-178.

XRP Ledger. (2021). XRP's origin: Build a better bitcoin. Retrieved from https://xrpl.org/history.html

Yen, K. C., & Cheng, H. P. (2021). Economic policy uncertainty and cryptocurrency volatility. *Finance Research Letters, 38*, 101428.

Yin, D. A. I., Zhang, J. W., Yu, X. Z., & Xin, L. I. (2017). Causality between economic policy uncertainty and exchange rate in China with considering quantile differences. *Theoretical & Applied Economics*, *24*(3).

Yu, X., & Huang, Y. (2021). The impact of economic policy uncertainty on stock volatility: Evidence from GARCH–MIDAS approach. *Physica A: Statistical Mechanics and its Applications*, *570*, 125794.

Zhang, D., Lei, L., Ji, Q., & Kutan, A. M. (2019). Economic policy uncertainty in the US and China and their impact on the global markets. *Economic Modelling*, *79*, 47-56.

Zhang, H., & Wang, P. (2021). Does Bitcoin or gold react to financial stress alike? Evidence from the U.S. and China. *International Review of Economics and Finance*, *71*, 629-648.