Whether Bitcoin Has Same Properties as Gold in The Aspect of Hedging

and Safe Haven against Stock Markets

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Abstract

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And Safe Haven against Stock Markets

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Having a place of haven or a hedge against potential losses is an important feature of any investment strategy, but this is especially true during times of turmoil in the market. Bitcoin has demonstrated that it has the potential to become a new safe haven or hedging asset due to the fact that its value soared between 2010 and 2013 (during the Euro debt crisis and the banking crisis in Cyprus), and Bitcoin shares certain parallels with gold. In this study, we used the regression model developed by Baur and Lucey (2010) to investigate whether Bitcoin possesses the same hedging and safe-haven properties as gold against stock markets in the United States, the United Kingdom, China, Japan, and developed markets (world index) when extreme market conditions are present. The primary finding from the entire time from 2011-2022 implies that Bitcoin does not demonstrate hedge and safe haven properties like gold does, even though the safe haven property of gold is vanishing. Bitcoin, in particular, does not exhibit any of the characteristics of a safe haven in any of the markets in the study, and it only has hedge characteristics in Japan's stock market. A further implication of our research is that the properties of a hedge and a safe haven of Bitcoin may change over time. According to the findings of the subperiod, Bitcoin served as a hedge and safe haven against all markets during the cryptocurrency cycle from its beginning to its peak. In addition, when Bitcoin gets more maturity, the hedging property might disappear, while the safe-haven property may become visible in most markets. Despite the fact that Bitcoin might have aspects of a hedge and a safe haven, the findings imply that the link between bitcoin and the stock market is still fairly weak. If investors are considering utilizing Bitcoin as a hedging instrument or a safe haven, they should proceed with extreme caution.

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1. Introduction

Gold plays a vital role in an investment portfolio, particularly during heightened market volatility. Quite a few studies have been done on how gold can operate as a form of safe haven or hedging (Areal, Oliveira, & Sampaio, 2015; Baur & Lucey, 2010; Baur & McDermott, 2010; Baur & McDermott, 2010). As a result of the emergence of the financial crisis, hedging and safe havens have a pivotal role in the investments made by investors. This is because investors can reduce their exposure to losses when the market is experiencing stress. However, after the 2007-2008 Global Financial Crisis (GFC), gold's hedging and safe haven properties are becoming less significant (Baur & Glover, 2012; Klein, 2017). It's interesting to note that Bitcoin was invented one year after the Global Financial Crisis (GFC).

Bitcoin is a form of virtual money and payment system first proposed by Satoshi Nakamoto (2008). It was designed to enable users to conduct peer-to-peer transactions without the involvement of any financial intermediaries. The following are some of the appealing characteristics of Bitcoins: user autonomy (it is not supervised by bank or government), discretion (no personal identity is revealed in a transaction), less cost (low transaction fees and no bank fees), mobility (it is easy to access via phone or pc from anywhere in the world as long as there is internet), and limited supply (21 million coins). Even though the transaction fee was as high as $62.779 (USD), which was its greatest point in April 2021, the cost of each transaction after July 2021 was between $1 and $5. And although there is a cost involved, it is simple to switch between Bitcoin and actual money via a platform (such as Coinbase or Binance, for example). (Coinbase may levy a fee of up to one percent of the total amount transferred.)

Not only the conception of Bitcoin but also its subsequent proliferation may be traced back to the recent global financial crisis. Bitcoin became a topic of conversation during the European debt crisis that lasted from 2010 to 2013 and the Cypriot financial crisis that lasted from 2012 to 2013. From 2010 to 2013, coinciding with the financial crisis outbreak, the price of Bitcoin rose

instead of dropping. The rising price amid the ongoing financial crisis starts to get people's notice. There has been a rise in the level of interest among researchers in Bitcoin. The price of Bitcoin has been shown to be independent of economic and financial variables, according to research that has been done in the past (Kristoufek, 2015; Cobert et al., 2018). Several lines of evidence point to the fact that Bitcoin's low correlation with traditional assets makes it a candidate for the role of diversifier (Huang, Duan & Mishara, 2021; Guesmi et al., 2019; Stensås et al., 2019). In addition, Bitcoin can be considered a digital gold equivalent due to the similarities it shares with gold in several dimensions when seen from the standpoint of commodity qualities (Shahzad et al., 2019). (The supplies of Bitcoin and gold are both finite. Both Bitcoin and gold are divisible into smaller quantities. Neither Bitcoin nor gold pays interest). With the features of low correlation with financial variables and economics and the fact that gold can be used to act as a hedge or safe haven tool in the investment against other assets, Bitcoin shows potential to be a shelter for uncertainty. The significance of Bitcoin in the investment market as a hedge and safe haven is beginning to be investigated by researchers (Dyhrberg, 2016; Bouri et al., 2017b; Fang et al., 2019).

However, Bitcoin has been the subject of some criticism. When we talk about the volatility of Bitcoin's returns, it is not hard to see that the supply and demand of Bitcoin, as well as investor mood, contribute significantly to Bitcoin's high degree of volatility. It is quite likely that the return on Bitcoin follows a distribution that is not normal. Bitcoin's return has a leptokurtosis for its kurtosis, which indicates that the return of Bitcoin has a larger possibility of being either extremely low or extremely high. In addition, these higher orders of moments are steady, which may result in significant variation in the return on Bitcoin investment. We can see this by looking at the price of Bitcoin in the past. The difference between the highest point (at $64,400) and the lowest point (at $3,183) is about $60,000 between 2017 and 2021 (USD). And the price of Bitcoin dropped to approximately 17,000 USD in the second half of 2022. The volatility of Bitcoin causes discussions. Several studies have demonstrated that Bitcoin should be considered a speculative asset (Baur et

al., 2018; Ghysels & Nguyen, 2019). Cheah and Fry (2015) and Corbet et al. (2019) conducted research demonstrating the tendency of a Bitcoin bubble. Their findings are consistent with the speculative asset.

There is an ongoing dispute on whether or not Bitcoin can maintain its value. Advocates of Bitcoin, as well as some investors, have a bullish outlook on cryptocurrency. They claim that due to the inherent scarcity of Bitcoins, their value will remain stable even in the face of rising inflation. According to Winters (2022) at CNBC, billionaire investor Paul Tudor Jones is optimistic about Bitcoin as an inflation hedge, although Mark Cuban, owner of the Dallas Mavericks, holds the opposite position. He is of the opinion that Bitcoin is not a hedge against inflation, either now or in the foreseeable future. Omid Malekan, an adjunct professor at Columbia Business School who specializes in crypto and blockchain technology, believes that cryptocurrencies like Bitcoin can still grow more acceptable and stable over time, despite the huge drop in the price of Bitcoin (CNBC, 2022). In addition, Key (2022) at Yahoo! Finance recently reported that "Bitcoin could once more be considered by investors as a safe haven thanks to recent market activity," based on the statements of analysts from Bank of America.

Despite the ongoing debates, Bitcoin is reaching a more mature stage. According to a report published by Kawa (2015) at Bloomberg on September 17, 2015, Bitcoin has been classified as an official commodity by the United States regulator. According to research conducted in 2021 by the non-partisan research institute at the University of Chicago known as NORC (Young, 2021), around 13% of Americans engaged in cryptocurrency trading, whereas 24% of Americans traded stocks during the same period. Moreover, companies such as Tesla, MicroStrategy Inc., Marathon Digital Holdings, Coinbase, and Square Inc. have begun to hold cryptocurrencies. Other indicators of the maturation process of the cryptocurrency markets include the rebranding of the Staples Center as the Crypto.com Arena, the rebranding of the American Airline Arena as the FTX Arena, and the intention of Goldman Sachs to offer bitcoin and other digital assets to the clients of its

wealth management division (Son, 2021). In addition, the fact that the governments of Ukraine, El Salvador, Finland, and Georgia, as well as exchange-traded funds (ETFs) such as Grayscale Bitcoin Trust, Bitwise 10 Crypto Index Fund, and Ninepoint Bitcoin Trust, own Bitcoin, demonstrates that the cryptocurrency is maturing. In addition, Yahoo! finance (2022) revealed that "Bitcoin is now (Oct 2022) less volatile than both the S&P 500 and Nasdaq for the first time since 2020," which indicates that Bitcoin may have a tendency to be stable.

This study aims to examine Bitcoin's potential hedge and safe haven properties against four main stock markets (US, UK, China and Japan) and developed stock markets (world index). To achieve this, we study the relationship between the return of Bitcoin and the return of the stock market using a quantile-to-quantile regression (as the method in Baur & Lucey, 2010). Our sample period is from Oct 15, 2013, to Nov 30, 2022, which covers a significant amount of time, during which the Bitcoin market experienced both booms and crashes.

The contributions of this study are as follows: in the first place, this research contributes by reviewing and summarizing previous research on the properties of hedge and safe haven of Bitcoin (Tables 1, 2, and 3 summarize previous research on diversification properties of Bitcoin against different assets). Second, this study contributes new information to the ongoing discussion on whether or not Bitcoin will have the properties of a hedge and safe haven since data covers a recent period during which Bitcoin decreases sharply. Third, this study checks robustness according to the cryptocurrency cycle, which confirms that Bitcoin's hedge and safe haven property might be time-varying. Fourth, this study will also be helpful to investors who are searching for a hedge or safe haven to make their assets less risky.

The rest of the paper is organized as follows. In Section 2 of this paper, we provide the prior research that has been done in our field of study. In Section 3, we present the data and methodology that were used in the study. Our findings are presented in Section 4, which then leads into Section 5, in which we analyze and discuss the implications of our findings.

2. Literature review

In the literature review, we summarize the main findings of previous studies on the diversification properties of Bitcoin against other assets such as stocks, commodities, bonds, etc. Previous studies are separated into 3 tables: Bitcoin as a diversifier, Bitcoin as a hedge, and Bitcoin as a safe haven. We notice that the majority of studies are released after 2017. And most of the studies show that Bitcoin still has the properties as a diversifier and a hedge when the period covers 2020. However, for the property of safe haven, most studies cover 2020 show that the safe haven property is not found.

Table 1: Previous studies consider Bitcoin as a diversifier.

Authors	Period	Method	Main findings
Selmi et al. (2018)	2011-2017	Quantile regression	Bitcoin can serve as a diversifier against oil price changes
Stensås et al. (2019)	2011-2018	Quantile regression	Bitcoin can act as a diversifier for investors in developed countries.
Urquhart& Zhang (2019)	2014-2017	Quantile regression	Bitcoin is diversifier for the AUD, CAD and JPY.
Bakry et al. (2021)	2011-2020	Optimization	Bitcoin may operate as a diversifier in typical market conditions
Pho et al. (2021)	2010-2020	Value at risk	Bitcoin may be a better option for risk-seeking investors as a portfolio diversifier in the stock market of China.
Klabbers (2017)	2010-2016	Optimization	Bitcoin is an effective diversifier with on average a weight allocation between 0% to 5% for stock markets.
Aharon et al. (2021)	2010-2020	Connectedness Approach	Bitcoin has the property of a diversifier for exchange rate.
Kumar & Padakandla (2022)	2015-2020	Wavelet quantile correlation	Bitcoin exhibits long-run diversifier properties in portfolios.
Garcia& Benito (2020)	2011-2019	Copula	Bitcoin act as a diversifier for stock markets.
Stavroyiannis & Babalos (2017)	2013-2016	GARCH	Bitcoin does not actually hold diversifier properties against US stock.

Table 2: Previous studies consider Bitcoin as a hedge.

Author	Period	Method	Findings
Bouri et al. (2017b)	2011-2018	Quantile regression	Bitcoin has hedge and safe haven properties against Asia Pacific stocks.
Selmi et al. (2018)	2011-2017	Quantile regression	Bitcoin and gold can serve as hedges against oil price changes.
Stensås et al. (2019)	2011-2018	Quantile regression	Bitcoin acts as a hedge for investors in most of the developing countries.
Bouri et al. (2017c)	2011-2016	Quantile regression	Bitcoin is a strong hedge for energy commodities
Bouri et al. (2017b)	2011-2016	Quantile regression	Bitcoin does act as a hedge against uncertainty
Urquhart& Zhang (2019)	2014-2017	Quantile regression	Bitcoin is a hedge for the CHF, EUR and GBP.
Garcia& Benito (2020)	2011-2019	Copula	Bitcoin might function as a hedging asset against stock price fluctuations across all assessed global marketplaces.
Dyhrberg (2016)	2010-2015	GARCH	Bitcoin can clearly be used as a hedge against stocks in the Financial Times Stock Exchange Index and American dollar.
Chan et al. (2019)	2010-2017	GARCH	Bitcoin is an effective strong hedge against the Euro STOXX, Nikkei, Shanghai A-Share, S&P 500, and the TSX Index
Shahzad et al. (2020)	2010-2018	Quantile regression	Bitcoin is a strong hedge for Canada and Japan and a weak hedge for France and Italy
Choi & Shin (2020)	2010-2018	Vector Autoregression	Bitcoin can serve as a hedge for investors against USD and bond markets.
Akhtaruzzaman et al. (2021)	2011-2018	GARCH	Bitcoin can hedge the risk against industry portfolios and bonds.
Sakemoto & Ichikawa (2019)	2013-2018	Quantile regression	Traditional assets such as global equities and global bonds are weak hedges for Bitcoin
Klabbers (2017)	2010-2016	Optimization	Bitcoin has hedge properties for bonds
Kliber et al. (2019)	2014-2017	Stochastic Volatility Model	Bitcoin is weak hedge for stock markets of Venezuela, Japan, China, Sweden and Estonia.
Wang et al. (2019)	2013-2017	GARCH	Bitcoin can be hedged against China stocks market, China bonds and SHIBOR.
Das et al. (2020)	2010-2019	Decomposition	Bitcoin is a hedge to demand-side oil shocks and OVX.
Kyriazis (2020)	2011-2019	Correlation	Bitcoin is found to be an efficient hedge against oil and stock market indices.

Table 2 continued: Previous studies consider Bitcoin as a hedge.

Hoang et al. (2020)	2013-2018	Vector Autoregression	Bitcoin could be a hedger for commodity volatilities.
Bouri et al. (2020a)	2011-2019	Correlation	Bitcoin can act as a hedge relative to the conventional US stock market in the wake of heightened trade policy-related uncertainties
Okorie (2020)	2011-2018	Correlation	Bitcoin can also hedge S&P500 stocks' risks
Baur et al. (2022)	2011-2021	Optimization	Bitcoin may be a hedge for any asset that is more risky than the S&P500.
Borri (2019)	2015-2018	Quantile regression	Bitcoin could offer attractive returns and hedging properties when included in investors' portfolios.
Guesmi et al. (2019)	2012-2018	Copula	Bitcoin may offer hedging benefits for investors.
Hwang (2019)	2010-2017	GARCH	Bitcoin shows the weak hedging against markets of EU, UK, Japan and China.
Umar et al. (2021)	2010-2020	Wavelet based quantile-on-quantile	Bitcoin can be regarded as a hedging instrument during the times when there is a high level of political and economic uncertainty in the country
Kamran et al. (2021)	2011-2021	Correlation	Bitcoin offered hedging benefits when combined in a portfolio of Australia stocks.
Das et al. (2020)	2010-2019	Decomposition	Bitcoin outperforms gold and commodity in hedging OVX
Stavroyiannis & Babalos (2017)	2013-2016	GARCH	Bitcoin does not actually hold hedge properties against US stock.

Table 3: Previous studies consider Bitcoin as a safe haven.

Authors	Period	Method	Finding
Bouri et al. (2017b)	2011-2015	Quantile regression	Bitcoin has safe haven properties against Asia Pacific stocks.
Corbet et al. (2018)	2013-2017	Variance decomposition	Bitcoin is safe haven for gold and FX markets
Selmi et al. (2018)	2011-2017	Quantile regression	Bitcoin can serve as safe havens against oil price changes.
Bouri et al. (2017c)	2011-2016	Quantile regression	Bitcoin is a safe haven for energy commodities.
Urquhart& Zhang (2019)	2014-2017	Quantile regression	Bitcoin is safe haven during turmoil in the CAD, CHF and GBP.
Bakry et al. (2021)	2011-2021	Optimization	Bitcoin may have some borderline safe haven features in typical market conditions.

Table 3 continued: Previous studies consider Bitcoin as a safe haven.

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Shahzad et al. (2020)	2010-2018	Quantile regression	Bitcoin is a weak safe haven for the stock markets of Canada and France.
Klabbers (2017)	2010-2016	Optimization	The correlation values show that bitcoin has safe haven properties for the dollar and gold.
Umar et al. (2021)	2010-2020	Wavelet-based quantile-on-quantile	Bitcoin can be regarded as a safe haven asset during the times when there is a high level of political and economic uncertainty in the country.
Paule-Vianez et al. (2020)	2010-2019	Linear regression	Bitcoin is not a mere speculative asset but behaves like a safe haven.
Wang et al. (2019)	2013-2017	GARCH	Bitcoin can be a safe haven when extreme price changes occur in the monetary market of China.
Kumar & Padakandla (2022)	2015-2020	Wavelet quantile correlation	Bitcoin exhibited short-run safe haven property for NSE50.
Kamran et al. (2021)	2011-2021	Correlation	Bitcoin offered weak safe haven for a portfolio in Australia stock market.
Baur et al. (2021)	2010-2021	Quantile regression	Bitcoin does not act as a safe haven, instead it is identified as a risky asset.
Wen et al. (2022)	2019-2021	TVP-VAR	Bitcoin does not have the property of safe haven
Aharon et al. (2021)	2010-2020	Connectedness approach	Bitcoin's safe-haven property is not found during stress times.
Kristoufek (2020)	2014-2020	Quantile regression	The Bitcoin safe haven story is shown and discussed to be unsubstantiated and far-fetched.
Long et al. (2021)	2013-2020	Nonlinear autoregressive	Bitcoin cannot serve as safe-haven assets like gold
Choi & Shin (2022)	2010-2020	Vector autoregression	Bitcoin is not a safe haven against VIX.

2.1 Bitcoin and stock
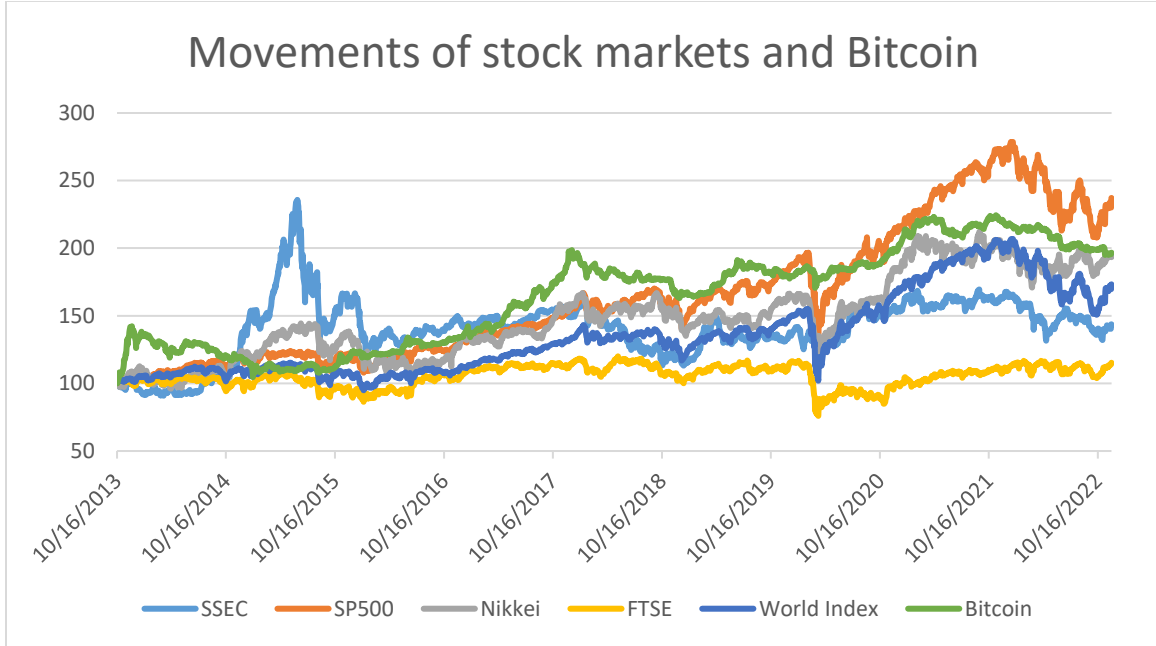
Fig. 1 Movement of stock markets and Bitcoin (Bitcoin use the secondary axis). For the stock markets, we calculate the movement as follows: we set the price of Oct 15, 2013, as a base value of 100. For Bitcoin, we take a natural log to adjust the scale, then set the price of Oct 15, 2013, as a base value of 100. It is interesting to find that the correlation between the movement of Bitcoin and the movements of stock markets is little in the beginning period.

The literature on the relationship between Bitcoin and stock markets is vast. From Fig. 1, we can see that the movement of Bitcoin is somewhat uncorrelated with stock markets from 2013-2017, then it seems to have the same or similar movements with stock markets. Many studies use different methods (correlation analysis, linear model, and GARCH model) and illustrate that Bitcoin is a hedge against stock returns. Dyhrberg (2016) analyzes data from 2010-2015 using the GARCH model and finds that Bitcoin can be used as a hedge against stocks in the Financial Times Stock Exchange Index. Within the same vein, Chan et al. (2019) analyzed data from 2010-2017 by the mean-variance method, Garcia-Jorcano and Benito (2020) examined data from 2011-2019 by the copula method, and Shahzad et al. (2020) investigated data from 2010-2018, the results show that Bitcoin is a hedge for the stock markets of Japan. Moreover, according to the studies of Chan et al. (2019), Garcia-Jorcano & Benito (2020), and Wang et al. (2019), Bitcoin functions as a hedging asset against stock price fluctuations in the markets of China. In addition, Chan et al.

(2019), Garcia-Jorcano & Benito (2020), Bouri et al. (2020a) and Okorie (2020) found that Bitcoin can act as a hedge against the US stock market. Besides, Stensås et al. (2019) analyzed data from 2011-2018 and found that Bitcoin operates as a hedge for the stock markets of Brazil, Russia, India, and South Korea. Furthermore, Shahzad et al. (2020) applied quantile to quantile relation and found that Bitcoin act as a strong hedge against the stock market of Canada and a weak hedge against the stock markets of France and Italy. In addition, Kliber et al. (2019) found that Bitcoin is a weak hedge for Venezuela, Japan, China, Sweden, and Estonia stock markets. However, some studies found contradictory results. In studies by Grobys (2020), Choin & Shin (2020), Baur et al. (2022) and Stavroyiannis & Babalos (2017), Bitcoin is not a hedging asset against the stock market of the US, which is a contrast to the conclusion of Chan et al. (2017) and Garcia-Jorcano and Benito (2020). Another reason might be the use of different methods. Choi and Shin (2020) applied the quantity equation (economics) method, while the methods used in other studies are mostly in the area of finance.

In the aspect of safe haven property, Bouri et al. (2017d) applied the quantile-to-quantile regression method to examine data from 2011-2015 and found that Bitcoin can act as a safe haven in the stock markets of China and Japan. Besides, Shahzad et al. (2019) used the cross-quantilogram method and found that Bitcoin is a weak safe haven for MSCI (stock market index). Within the same vein, Bouoiyour et al. (2019) and Mariana et al. (2021) found that Bitcoin is a safe haven against US stocks in the short term. Moreover, Shahzad et al. (2020) tested the hedge and safe haven properties for G7 stock markets and found that Bitcoin acts as a weak safe haven for the stock markets of Canada and France. However, several studies (Conlon & McGee, 2020; Choi & Shin, 2020; Baur et al., 2021; Wen et al., 2022; Kristoufek, 2020; Kumar & Padakandla, 2022; Stavroyiannis & Babalos, 2017) indicate that Bitcoin is not a safe haven against the stock market of US.

Many past studies have found evidence that Bitcoin can hedge against some regions' stock markets. However, some previous research found contradicting results. One possible reason for the contradiction (whether Bitcoin is a hedge against the US stock market) might be different time periods. Chan et al. (2019) used data from 2010-2017; Garcia-Jorcano and Benito used data from 2011-2019; while Grobys (2020) used data from 2015-2020. And since Bitcoin came out, its price has gradually increased, even during the GFC, and COVID-19 is literally the first crisis it met. Before 2019-2020, the period of the data did not cover the recession, which makes the results limited. For the contradiction of the property of a safe haven against the US stock market, we can see more studies reject the property of a safe haven against the US stock market. One possible reason is also different time periods. The results from later studies might be unbiased since the data period covers the recession. Another possible reason for the contradiction in the properties of hedge and safe haven might be that Bitcoin is getting mature and stable. When speculators leave, the correlation between Bitcoin and stock markets might change.

Based on the previous studies, I expect that Bitcoin may not act as a hedge or safe haven against the US stock market and is less negative when against other stock markets in this study.
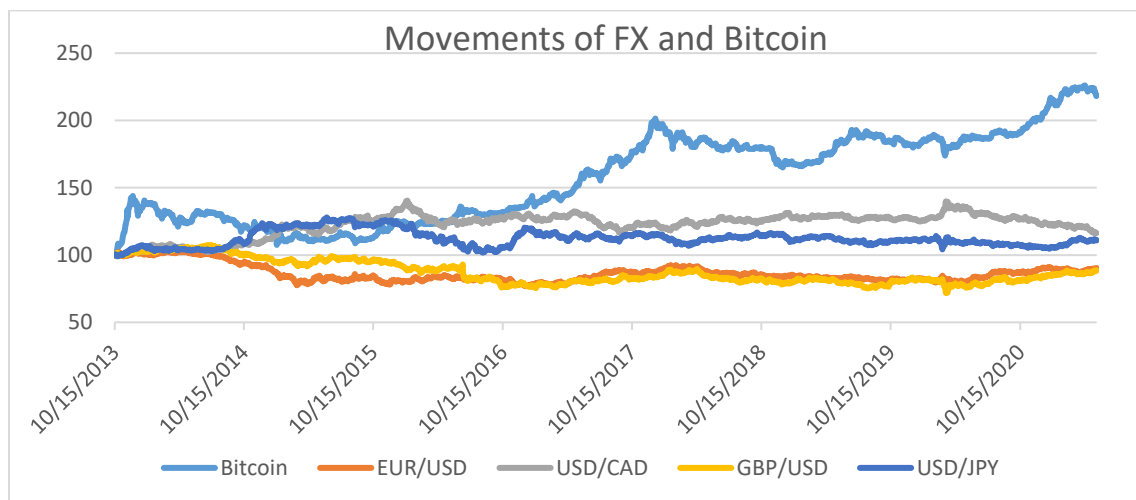
2.2 Bitcoin and exchange

Fig. 2 Correlation between Bitcoin and Foreign exchange markets is slightly negative.

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From Fig. 2, we can informally see that movements of foreign exchange and Bitcoin are uncorrelated or even negatively correlated. Previous studies using different methods (Variance decomposition, GARCH model) demonstrate that Bitcoin acts as a hedge or safe haven against exchange markets in several regions. Dyhrberg (2016) and Corbet et al. (2018) examined data from 2013-2017, Hwang (2019) used data from 2010-2017, and Choi and Shin (2020) applied several methods (GARCH-based method, quantile to quantile regression, generalized variance decomposition and quantity equation) to analyze the correlation between Bitcoin and exchange rate and found that Bitcoin can be used to hedge against the American dollar. Besides, Urquhart & Zhang (2019) and Hwang (2019) found that Bitcoin can act as a hedge against EUR and GBP. Moreover, Urquhart and Zhang (2019) found that Bitcoin can be a hedge against CHF and Hwang (2019) found that Bitcoin can be a hedge against JPY. In the aspect of safe haven property, Klabbers (2017) found that Bitcoin can be a safe haven against USD by the method of mean-variance. And Urquhart and Zhang (2019) found that Bitcoin can be a safe haven against GBP, CAD and CHF. However, Aharon et al. (2021) applied the connectedness approach to analyze data from 2010-2020 and found that the safe haven property of Bitcoin does not show up during stress times; the result shows that Bitcoin is not a safe haven against CAD, CHF, GBP, JPY and EURO.

From previous studies, we can see that Bitcoin might act as a hedge or safe haven against the exchange rate of developed countries. Even though most of the previous studies show the hedge and safe haven, the newer study might be more informative since the data period covers the recession.

2.3 Bitcoin and commodities

The relationship between the movements of commodities and Bitcoin is shown in Fig. 3. Several previous research examined Bitcoin's hedge and safe haven property against commodities. Bouri et al. (2017d) applied the quantile-to-quantile regression method to analyze data from 2011-2015 and found that Bitcoin is a strong hedge for the Standard & Poor's Goldman Sachs

Commodity Index (S&P GSCI). Moreover, after dividing the Standard & Poor's Goldman Sachs Commodity Index (S&P GSCI) into the energy commodities index and non-energy commodities index, Bouri et al. (2017c) applied quantile to quantile regression to analyze data from 2011-2016 and found that Bitcoin is an effective hedge and safe haven against fluctuations in the S&P GSCI energy commodities index.
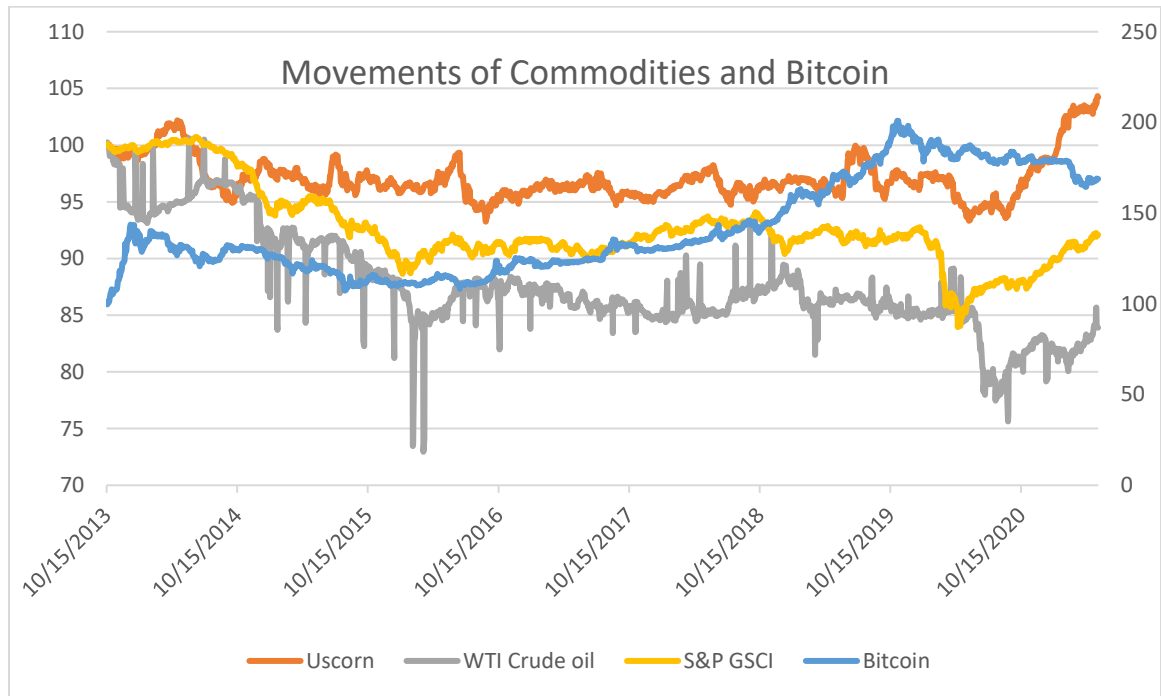

Fig. 3 Movement of commodities and Bitcoin (Bitcoin use the secondary axis). This figure shows a slightly negative relationship between the movement of Bitcoin and the movements of commodities.

In addition, Das et al. (2020) examined data from 2010-2019 and found that Bitcoin is a hedge to demand-side oil shocks. In line with the findings, Kyriazis (2020) and Hoang et al. (2020) found that Bitcoin can hedge against oil volatilities. Furthermore, Selmi et al. (2018) used quantile-to-quantile regression to examine data from 2011-2017 and found that Bitcoin can be used as a hedge and a safe haven in the event of oil price fluctuations. However, some studies show that Bitcoin does not have safe-haven functionality against the volatility of oil (Baur et al., 2021; Syuhada et al., 2022; Wen et al., 2022).

The main reason for the contradiction in the findings might be the data from different periods. The data used in new studies cover the time of COVID-19, which makes the result less limited. From previous studies, we can see that Bitcoin might work as a hedge in the commodities market, but it may lose the safe haven property against oil volatilities.

2.4 Bitcoin and gold
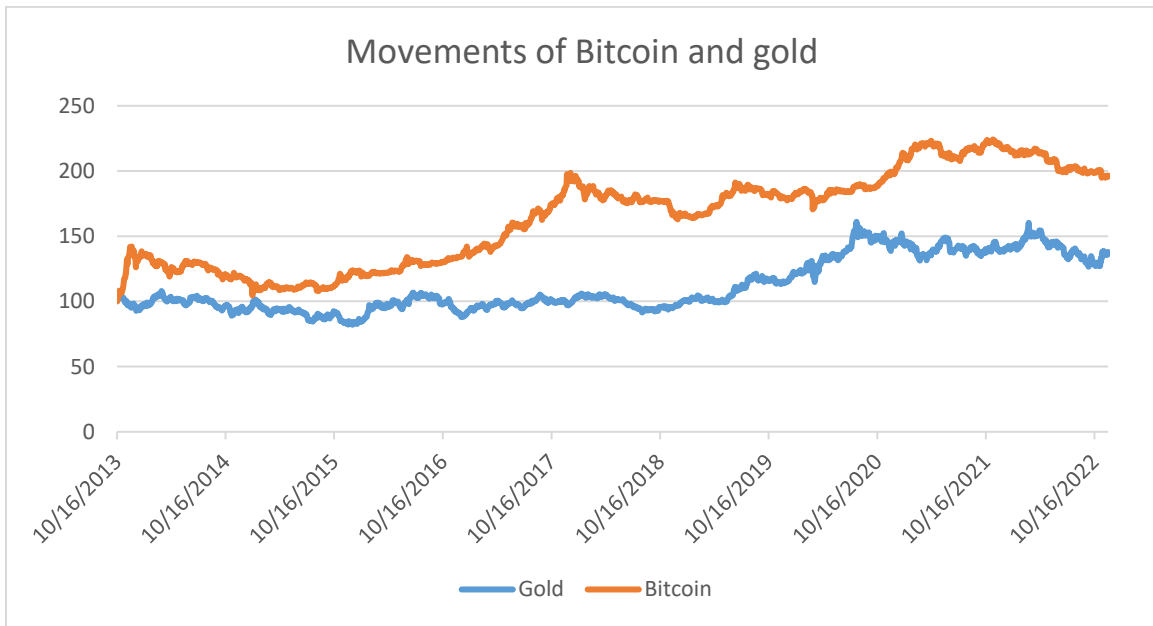
Fig. 4 Movement of Bitcoin and gold (Bitcoin use the secondary axis). The relation between movements varies with periods.

Klabbers (2017) used the mean-variance method (data from 2010-2016) and found that Bitcoin can act as a safe haven against gold from the correlation values. Besides, Corbet et al. (2018) used the method of generalized variance decomposition (data from 2013-2017) and found that Bitcoin can be a safe haven against gold.

From Fig. 4, it is interesting to notice the correlation between gold and Bitcoin changes over time. Based on previous studies, Bitcoin can be a hedge or safe haven against gold. However, if Bitcoin can be a safe haven against gold, then Bitcoin may not have the same property of a safe

haven against other assets. If we expect Bitcoin to be a digital gold, then a positive correlation between Bitcoin and gold is expected.

2.5 Bitcoin and mixed portfolios

Most of the studies show that Bitcoin can be a hedge or even a safe haven for mixed portfolios by different standard methods (correlation analysis, GARCH model, linear regression, etc.). Eisl et al. (2015) analyzed data from 2010-2015 and found that the return of Bitcoin is not or little correlated with the returns of other assets in the portfolio involving equity, fixed income, money market, commodities, real estate, and alternative, which illustrates the Bitcoin might be a hedge against the portfolio. In addition, Smales (2019) examined data from 2011-2018 and found that Bitcoin can act as a weak hedge against other assets in the portfolio involving gold, 10-year notes, SP500, Nasdaq, and Apple. Borri (2019) used quantile-to-quantile regression to test data from 2015-2018 and found that holding cryptocurrencies could offer attractive returns and hedging properties in portfolios involving gold, VIX, commodity, and SP500. Moreover, Guesmi et al. (2019) applied the copula method to analyze data from 2012-2018 and found that Bitcoin may offer diversification and hedging benefits for portfolios involving gold, oil, and stocks. Akhtaruzzaman et al. (2021) examined data from 2011-2018, and the result shows a weak correlation between Bitcoin and industry portfolios involving Global markets, basic materials, consumer goods, consumer services, diversified REITs, health care, industrials, oil and gas, technology, telecom, utilities, financials, which means Bitcoin can act as a hedge in the portfolio. Moreover, Bakry et al. (2021) applied optimization approach and Monte Carlo simulation to test data from 2011-2021 and found that Bitcoin may have some borderline safe haven against the portfolio involving equity, currency, global economic activity, energy, fixed-income, and commodity. Dastkhan & Saber (2022) analyzed data from 2015-2021 and found that in times of crisis, Bitcoin provides a safe haven for banking and petrochemical industry indexes and can avert losses in portfolios,

including these assets. However, in Klabbers's (2017) research, Bitcoin is neither a hedge nor a safe haven for a global market portfolio involving stock indexes, bonds, commodity indexes, and real estate indexes. Furthermore, Klein et al. (2018) analyzed data from 2011-2017 and found that Bitcoin offers no hedging capabilities against equity investment involving SP500, MSCI World, and MSCI EM50.

Most of the previous studies show that Bitcoin might be used as a hedge and safe haven in a mixed portfolio, especially if a portfolio is well diversified.

2.6 Bitcoin and VIX
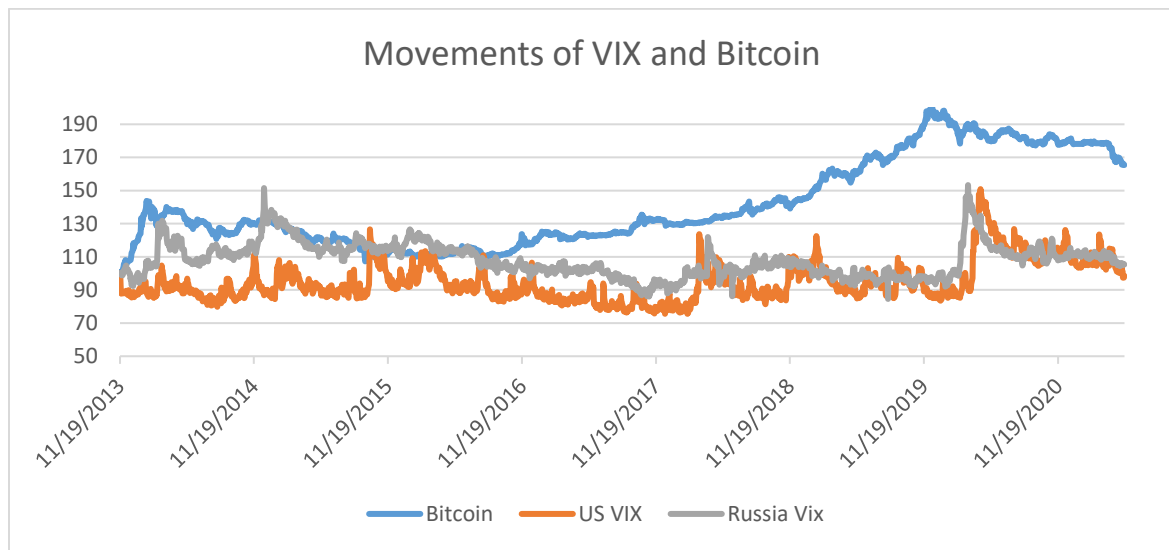
Fig. 5 Movements of VIX and Bitcoin. This figure shows a negative correlation between the Bitcoin movement and VIX movements.

Bouri et al. (2017a) applied quantile-to-quantile regression to analyze data from 2011-2016 and found that Bitcoin has a time-varying safe haven property against US VIX. Moreover, Bouri et al. (2017b) examined data from 2011-2016 and found that Bitcoin has demonstrated to be a hedge against worldwide volatility (VIX of Brazil, Canada, China, France, Germany, India, Japan, Mexico, Russia, South Africa, Sweden, Switzerland, the UK, and the US. However, Choi & Shin (2020, 2022) analyzed data from 2010-2018 and found that Bitcoin is not a safe haven for VIX

when the financial market is distressed. In line with this finding, Kristoufek (2020) and Long et al. (2021) conclude that Bitcoin cannot be a safe haven for VIX.

Fig. 5 gives a rough look of the movements of VIX and Bitcoin. Previous studies show that Bitcoin can act as a hedge but not a safe haven against VIX. If Bitcoin is a hedge or safe haven against VIX in the region, then there is a high chance that Bitcoin is a hedge or safe haven against the stock market in that region since VIX is a measure of the stock market's expectation of volatility.
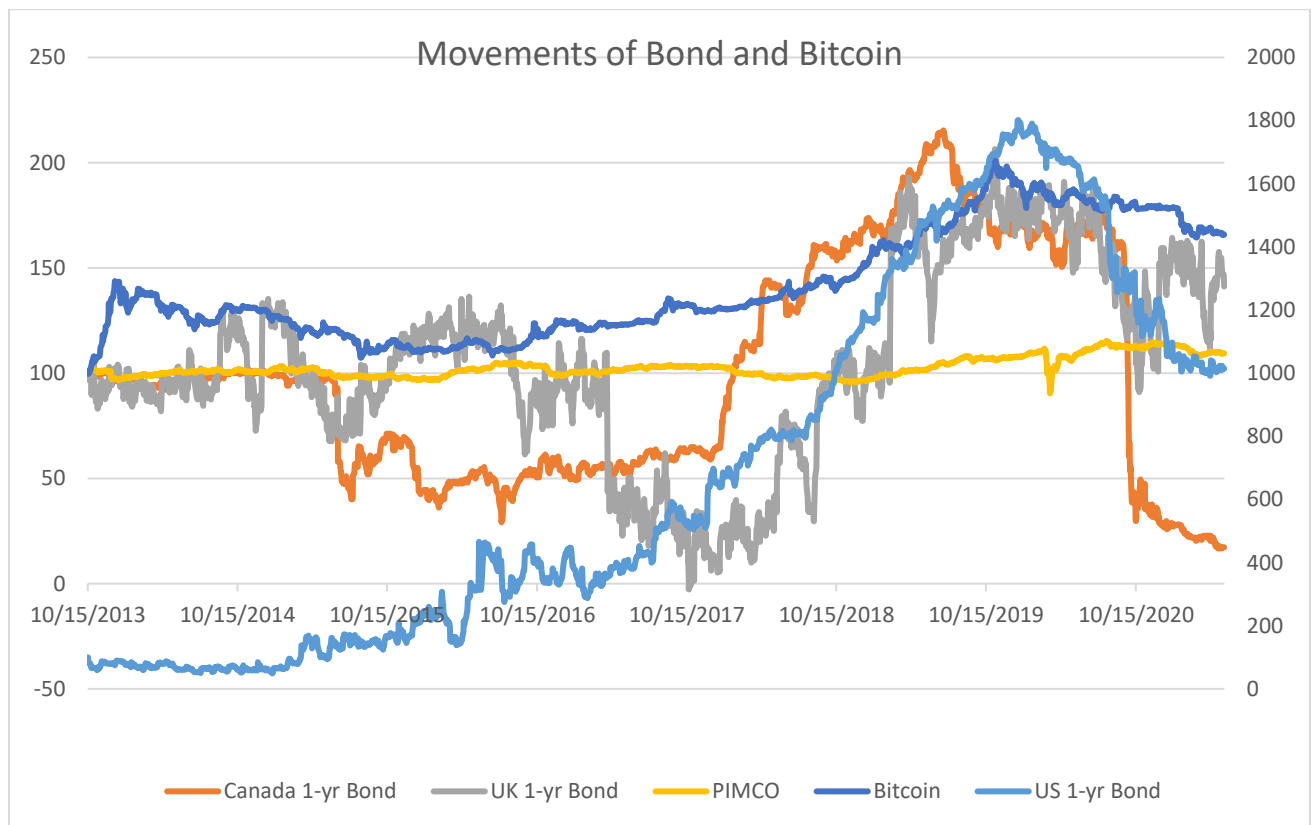
2.7 Bitcoin and bond

Fig.6 Bitcoin use the secondary axis.

According to several research, the potential hedging value of bitcoin in comparison to bonds appears to be consistent. Using GARCH models, Fang et al. (2019) and Akhtaruzzaman et

al. (2021) found that Bitcoin can be used as a hedge against the PIMCO bond index. In addition, Choi and Shin (2020) argue that the vector autoregressive model suggests that Bitcoin could be a viable hedge for investment in United States Treasury notes maturing in one year. According to the study by Sakemoto and Ichikawa (2019), the quantile-to-quantile regression approach reveals that FTSE World government bonds are ineffective hedges against Bitcoin. According to Klabbers's (2017) findings, bitcoin can be used as a hedge against government bonds (US bonds, UK bonds, and Japan Bonds). In addition, Wang et al. (2019) discovered that Bitcoin has the potential to act as a hedge for the Chinese bond index.

According to the findings of prior research, Bitcoin has the potential to act as a hedge or safe haven against government bonds. Fig. 6 also shows that Bitcoin might have little or no correlation with certain bonds (e.g. UK 1-yr).

3. Data and methodology

3.1 Definition of diversifier, hedge and safe haven

We use the definition following Baur and Lucey (2010) and Baur and McDermott (2010).

Diversifier: An asset that is positively correlated (but not perfectly) with another asset or portfolio on average. A diversifier does not reduce losses when the market is in bad condition.

Weak hedge: An asset that is uncorrelated with another asset or portfolio on average. Strong hedge: An asset that is negatively correlated with another asset or portfolio on average. A hedge does not reduce losses when the market is in extremely bad condition. A hedge could be positively or negatively correlated with other assets in normal times and negatively correlated on average.

Weak safe haven: A asset is uncorrelated with another asset when the market is in turmoil or extremely bad condition.

Strong safe haven: An asset that is negatively correlated with another asset when the market is in turmoil or extremely bad condition. The property of a safe haven is that the asset is non-positively correlated with a portfolio in extremely adverse market conditions. Extreme adverse market condition is the return of the market below the 10th percentile of market returns.

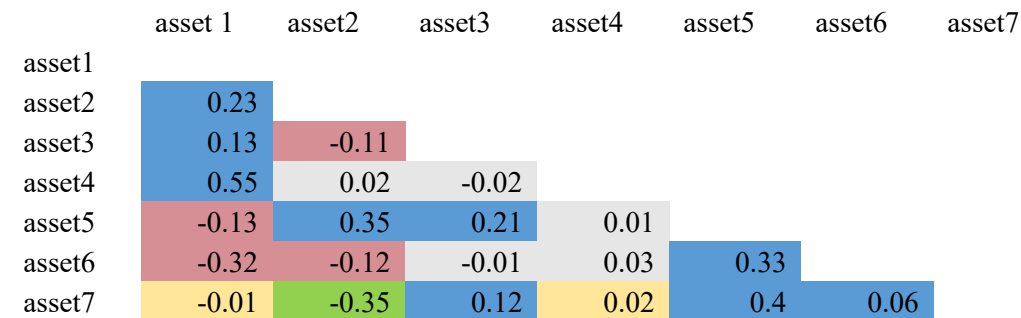|	asset 1	asset2	asset3	asset4	asset5	asset6	asset7
asset1							
asset2	0.23						
asset3	0.13	-0.11					
asset4	0.55	0.02	-0.02				
asset5	-0.13	0.35	0.21	0.01			
asset6	-0.32	-0.12	-0.01	0.03	0.33		
asset7	-0.01	-0.35	0.12	0.02	0.4	0.06	

Fig.7 Sample of correlation matrix representing diversifier, hedge and safe haven. Note: the yellow and green boxes (safe haven property) are applicable only in an adverse market.

According to the definition, the blue boxes in Fig. 7 mean that one asset is a diversifier for the other asset. Red boxes mean that one asset can be a strong hedge for the other. The grey boxes mean that one asset can be a weak hedge for the other. The yellow boxes mean that one asset can be a weak safe haven for the other. And the green box means that one asset can be a strong safe haven for the other.

3.2 Data

We used daily and weekly stock indices of SSEC (for China), S&P500 (for the US), Nikkei 225 (for Japan), and FTSE 100 (for the UK), which are the four most important and highest market cap in the world and World Index (MSCI World Index are made up of large and mid-cap representation in 23 developed markets countries) obtained from the data stream. And daily data and weekly price of Bitcoin (from Coindesk) and gold (from DataStream). All data are from Oct 15, 2013, to Nov 30, 2022. Then we calculated the return of each stock index, Bitcoin and gold by using the logarithm of the daily return series, by $r_t = \ln(P_t) - \ln(P_{t-1})$. Thus, we have 2221 daily observations for SSEC (China), 2226 daily observations for NIKKEI225 (Japan), 2307 daily

observations for FTSE100 (UK), 2298 daily observations for S&P500 (US), and 2376 daily observations for MSCI world, 3333 daily observations for Bitcoin and 2377 daily observations for gold.

Table 4: Descriptive statistics of the returns.

Variable	Observations	Mean	Std	Min	Max	ADF	Kurtosis	Skewness
Bitcoin	3333	0.00143	0.04187	-0.5181	0.3575	-46.43***	16.35	-0.6438
Gold	2377	0.00014	0.00874	-0.05898	0.04693	-43.47***	6.18	-0.177
Sp500	2298	0.00038	0.011	-0.12765	0.08968	-51.32***	19.46	-0.84
Nikkei225	2226	0.00029	0.0128	-0.08253	0.07731	-43.50***	7.33	-0.116
SSEC	2221	0.00014	0.0135	-0.08873	0.05604	-45.51***	10.4	-1.11
FTSE100	2307	0.00006	0.0102	-0.11512	0.08667	-45.39***	15.81	-0.865
MSCI	2376	0.00024	0.00953	-0.1044	0.0841	-45.87***	21.49	-1.13

Table 4 shows the descriptive statistics of the returns. All returns are calculated by the difference of nature logs of price between 2 days. It is not surprising to see that Bitcoin has the highest return.

The descriptive statistics in table 4 reveal that Bitcoin has the highest Sharpe ratio, mean and standard deviation, and the kurtosis of Bitcoin and gold are quite similar. We also checked the stationarity of all the series with the augmented Dickey-Fuller (ADF) test, and the results show that all series are stationary.

3.3 Methodology

Previous research shows that several methods are used to analyze the hedge and safe haven properties. Among all the methods, Markowitz optimization is the most used. Even though the optimization method is widely used, there are significant problems using Markowitz's model in analyzing Bitcoin's hedge and safe haven property. First, Markowitz's model evaluates portfolios based on variances instead of downside risk. Second, the model significantly depends on the quality of the data since it is sensitive to estimation errors. Given Bitcoin's high volatility, using the model to study it could be problematic. Third, Markowitz's model assumes that investors are risk-averse, but Bitcoin is rather not a choice for risk-averse investors. Other methods, such as copula, VAR

and GARCH-based mean-variance, were also used in previous studies. However, choosing the proper function or model is important. In the copula method, choosing different copula functions will produce different results. And the most difficult part of the copula analysis is to choose the proper function. The method of VAR does not measure worst-case loss and assumes a normal data distribution. The GARCH-based mean variance has the same assumption problems as the Markowitz optimization method. Thus, in this study, we use the method (three principle regression equations) in Baur and Lucey (2010). The method is straightforward without normality assumption, and it will capture coefficients when the market is in a bad situation and take care of the problem of heteroskedasticity. When we test the hedge or safe haven property of Bitcoin, we would like to see how Bitcoin performs when the market is in an extremely bad situation. And this method focuses on the tail performance, especially the left tail. The model used follows the model proposed by Baur and Lucey (2010).

$$r_{gold/bitcoin} = a + b_t r_{stock,t} + e_t \qquad \text{Eq1}$$

$$b_t = c_0 + c_1 D(r_{stock}q_{10}) + c_2 D(r_{stock}q_5) + c_3 D(r_{stock}q_1) \qquad \text{Eq2}$$

$$h_t = \pi + \alpha e_{t-1}^2 + \beta h_{t-1} \qquad \text{Eq3}$$

Eq1 examines the relationship between the return of gold/Bitcoin and the return of stock markets. Eq 2 includes the dummy variables which capture the extreme stock market movement. $q_i = 1$ if the movement is in the low i^{th} (i=1, 5, 10) percentile (extreme falling stock markets). Eq 3 captures the heteroskedasticity in the data.

If one of the parameters of c_1, c_2, c_3 is significantly different from zero, it means there is a non-linear relationship between the return of Bitcoin/gold and the return of the stock. If c_1, c_2, c_3 in Eq2 is non-positive, it means the gold/Bitcoin is a weak safe haven against the stock market. If parameters are significantly negative, it means that gold/Bitcoin is a strong safe haven against the

stock market. If c_0 is zero, it means that gold/Bitcoin is a weak hedge against the stock market. If

c_0 is negative, it means that gold/Bitcoin is a strong hedge against the stock market.

4. Empirical results and implication

In the paper, we tested whether Bitcoin has the same feature as gold against the stock

markets: hedging and safe-haven properties. Then we look at the correlation between Bitcoin and

gold informally and formally to see whether they correlate. If there is a positive correlation between

the return of Bitcoin and the return of gold, there might be the same feature of hedging and safe

haven properties.

Table 5: Pearson Correlation Coefficients (Observations =2377)
Prob > |r| under H0: Rho=0

	Bitcoin	Gold
Bitcoin	1.000	0.0647*** (0.0016)
Gold	0.0647*** (0.0016)	1.000

Table 5 shows a positive correlation between the return of Bitcoin and the return of gold, implying that Bitcoin might have the same property of hedge and safe haven as gold.

From Fig. 4 and Table 5, there is a positive correlation between the return of Bitcoin and

the return of Gold, meaning Bitcoin may have the same features as gold.

Table 6: The role of gold as a hedge and safe haven asset for daily returns.

	Hedge	0.10	0.05	0.01	Observations
US	0.0335*	-0.0734	-0.1002*	0.254***	2298
China	0.0326	-0.0321	0.0226	-0.025	2221
Japan	-0.033**	-0.0485	0.0513	0.0092	2226
UK	-0.0642***	-0.0194	0.0628	0.106***	2307
World	0.1171***	-0.2005***	-0.0366	0.2185***	2376

Note: hedge represents the coefficient of C_0, 0.10, 0.05, and 0.01 represent the percentile of lowest market performance. The same is in Table 7 and Table 8.

The coefficients in Table 6 illustrate that gold is not a hedge or safe haven against stock markets in the US stock since the coefficient of hedge is positively significant from zero, and the coefficient when the market is in 1% volatility is positively significant from zero. The result also shows that gold is a weak hedge and weak safe haven (all coefficients are not significant) against the stock market in China. In Japan's stock market, gold plays the role of a strong hedge (the coefficient is negatively significant) and a weak safe haven. This is in line with the findings of Yousaf et al. (2021). Moreover, gold is a strong hedge against the UK stock market. Lastly, for the world index (developed markets), gold is neither a hedge nor a safe haven. The results also show that non-linear relation between the return of gold and the return of the stock market in many cases. It is interesting to find that the signs of coefficients change for MSCI. It means, on average, gold is a diversifier against MSCI; when the MSCI index performs badly (10% to 5% low market performance), gold acts as a safe haven. But when the market is in an extremely bad situation, the safe haven property of gold disappears. This makes sense since most other markets might also be in a bad situation when the MSCI index is in an extremely bad situation. Investors in most markets start to sell gold around the same time, which will make the price of gold drop a lot. And this will finally make the safe haven property of gold leave. We also notice that gold acts better as a hedge and safe haven in Asian markets.

Table 7: The role of Bitcoin as a hedge and safe haven asset for daily returns.

	Hedge	0.10	0.05	0.01	Observations
US	0.6032***	-0.108	0.2355	0.9137***	2298
China	0.2586**	-0.155	-0.375*	0.4185**	2221
Japan	0.0059	-0.2043	0.3217	1.5093***	2226
UK	0.3768***	-0.1615	-0.1175	1.628***	2307
World	0.7482***	-0.3075	0.3335	1.099***	2376

Table 7 shows that, for example, in the US, Bitcoin is not a hedge for US stock markets since the coefficient is positively significant, in line with Baur et al. (2022) and Grobys (2021).

Moreover, Bitcoin does not act as a safe haven for the US stock market since the coefficients of the hedge are not significant from zero, which is in line with the findings of Conlon & McGee (2020). The result also shows that Bitcoin is only a weak hedge against the stock markets in Japan, which is in line with Kliber et al. (2019). Surprisingly, Bitcoin loses the features of safe haven property against all the markets and hedge properties against most markets in the paper, which is in contradiction to previous findings (Dyhrberg, 2016; Bouri et al., 2017d; Hwang, 2019; Stensås et al., 2019; Chan et al., 2019; Wang et al., 2019), but in line with the findings in recent studies (Garcia & Benito, 2020; Choi & Shin, 2022; Baur et al., 2022; Baur et al., 2021, Wen et al., 2022; Kristoufe, 2020).

Comparing the results from Gold and Bitcoin against stocks, we find that in all markets in this study, gold performs better than Bitcoin as a hedge or safe haven. We can see that when the coefficients of the hedge move from gold to Bitcoin, they just become less significant. And when we compare the coefficients from 10% and 5%, it is not hard to tell both assets show some reverse relation with stock markets. But when the stock market is in an extremely bad situation, the safe haven property of Bitcoin disappears in all markets, and the safe haven property of gold disappears in some markets, which makes sense since when investors from several markets are selling Bitcoin/gold because the stock market is in stress, the property of safe haven may disappear. This possibility is in line with the findings of Ghazali (2013). We can also find that the relations between gold/Bitcoin and stocks are non-linear in many cases.

For the robustness check, we divide the whole period (2011-2022) into three subperiods by the cryptocurrency cycle. The first one is from Oct 16, 2013- Dec 18, 2017, which is considered as the start to the boom period. The second one is from Dec 19, 2017- Nov 08, 2021, which is considered as the boom to the peak period. The third one is from Nov 09, 2021- Nov 30, 2022, which is considered as the peak to bottom. From the coefficients of Table 8, we can conclude that: First, from start to boom, Bitcoin showed properties of hedge and safe haven against all the markets

in this study. We can also notice from previous research that Bitcoin shows little to no correlation with these stock markets during this period. Second, during the stage from boom to peak, Bitcoin only acts as a hedge against the stock market in Japan, and the safe haven property disappears against all the markets. Third, from peak to bottom, Bitcoin showed the property of a safe haven against Asian markets (China and Japan). When we compare the coefficient in sub-periods, we can see even though the safe haven property disappears during the period from boom to peak; Bitcoin still works a little better in Asian markets. The reason Bitcoin lost the hedge and safe haven property in the second stage might be that there are a lot of speculators in the cryptocurrency market when the cryptocurrency market is immature; when speculators leave the market, the price decreases sharply. This finally makes the property of a hedge and safe haven gone. Comparison between subperiods and whole period allow us to conclude that Bitcoin's hedge and safe haven property might be time-varying and perform better in Asian markets. The reason might be the average inflation is relatively low in Asian markets (for 2021, -0.2% in Japan, 0.85% in China, and 4.7% in the US), so the financial environment in Asia is better. Moreover, with the mature process of cryptocurrency, the hedge property of Bitcoin may disappear; however, the safe haven property of Bitcoin may show up in all markets.

Table 8: Robustness-check: sub-periods.

	Cycle	Hedge	0.10	0.05	0.01	Observations
China	Boom	0.0257	-0.1223	0.3067	-0.0557	1021
	Peak	0.3059**	-0.3512	-1.26***	1.4493**	941
	Bottom	0.9865***	-1.4336	0.3246	-0.4881	259
Japan	Boom	-0.184	-0.1748	-0.0837	0.2986	1024
	Peak	0.0753	-1.058***	1.0426***	2.1919***	943
	Bottom	0.2339	-0.3851	1.0775	N.A.	259
US	Boom	0.015	0.1005	-0.4146	1.643	1032
	Peak	0.7845***	-0.8055*	0.2482	1.3285***	999
	Bottom	0.999***	1.0119*	-0.3533	0.6085**	267

Table 8 continued: Robustness-check: sub-periods

UK	Boom	0.03946	-0.8597*	0.963**	-0.975	1057
	Peak	0.4042**	0.2979	-0.9026*	1.925***	983
	bottom	1.2133***	1.8117***	-2.9247***	1.3491***	267
World	Boom	0.1601	-1.1177**	0.489	1.3097	1081
	Peak	0.804***	-0.696	0.2503	1.434***	1018
	bottom	1.2543***	0.6525	0.3671	1.0979***	277

Note: start to boom is the period from Oct 16, 2013-Dec 18, 2017; boom to the peak is the period from Dec 19, 2017- Nov 08, 2021; peak to bottom is the period from Nov 09, 2021- Nov 30, 2022.

From the empirical results from the whole period (2011-2022), we find that Bitcoin is not a good tool to be a hedge or a safe haven as gold. However, subperiod results suggest that investors in Asian markets may use Bitcoin as a safe haven to reduce loss when the market is stressed. When Bitcoin becomes mature, investors in the Asian market, investors can combine stock and Bitcoin investments to maximize returns and reduce the downside stock market risk. But investors in US and UK stock markets should consider more since the outcome at the current period does not guarantee that Bitcoin will be a safe haven even though there is a trend. When the cryptocurrency cycle is not stable, gold is still a better choice for the Asian market (except for investors who can tell the current stage of cryptocurrency) as well as US and UK stock markets. Also, investors should consider the overall financial environment since, on average, Bitcoin acts as a diversifier/weak hedge against all the markets in the study. Lastly, investors should be more cautious when investing in Bitcoin than in gold.

5. Conclusion

In this study, we used the method proposed by Baur and Lucey (2010) to analyze whether Bitcoin has hedging and safe haven properties against the stock markets, just like gold does. We find from the results that the hedge and safe haven property of Bitcoin may change as the cryptocurrency market matures. The property of a hedge may disappear as Bitcoin matures against

most markets, but the safe haven property may show up in the future. Moreover, at this moment, Bitcoin does not have the same hedge and safe haven property as gold. Bitcoin did not show safe haven property against all markets in the study and only showed hedge property against Japan's stock market. It appears that the connection between Bitcoin and stock markets is not as close as gold. The reason might be that the investors for Bitcoin are mainly the young generation, whose investment decisions may be far from those of investors in stock markets.

Our findings are helpful to investors because it provides more information with empirical proof that Bitcoin has some of the benefits of gold when it comes to protecting them against sharp declines in stock market indices. This study also contributes by summarizing and reviewing past studies on the characteristics of Bitcoin's safe haven and hedging. Moreover, this study adds additional information to the current debate over whether or not Bitcoin will eventually have the characteristics of a hedge and safe haven. In addition, this study covers the recent big drop in Bitcoin and finds that Bitcoin's hedge and safe haven property might be time-varying. With this finding, future studies could analyze Bitcoin's hedge and safe haven property when the cryptocurrency becomes more mature.

Even though the empirical analysis shows some hedge and safe haven properties of Bitcoin, Bitcoin is still young compared to gold. Thus, investors still need to be careful when involved in Bitcoin. We also have to be aware that the current stage of cryptocurrency is still early; when Bitcoin become less volatile, and the cryptocurrency market gets as mature as the stock market or gold, we can have the final word on the hedge or safe haven properties of Bitcoin, which may challenge the result of our findings. For now, it is still unclear due to some restrictions, such as how government regulation will eventually affect the cryptocurrency in the future and how the exchange rate will affect the analysis in the future.

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