BITCOINS: MONEY OF THE FUTURE?

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Abstract

Cryptocurrencies, one of which is Bitcoin, are becoming widely popular among investors reflecting the new generation and hoping for higher returns than investing in traditional investments. One of the factors attracting people to invest or accumulate Bitcoin is because they believe that Bitcoin is money that could even be the money of the future. This article seeks to investigate whether Bitcoin is money and can act as a substitute for fiat money globally.

This article shows that the volatility of Bitcoin prices calculated as a percentage CV of moving standard deviation is quite high compared to fiat money like the US Dollar and Thai Baht around 8.24 to 11.32 times from 2014 to 2023. This attribute hinders Bitcoin from performing the function of money as a medium of exchange. Such high volatility of Bitcoin also hinders Bitcoin's ability to function as a store of value. As for a unit of account function of money, the small unit of bitcoin that is a million times smaller than its base unit compared to regular fiat money makes it inconvenient to use bitcoin in real-life trading activities and for accounting.

In conclusion, this points out that Bitcoin could not meet the three money functions qualification, Bitcoins, therefore could not perform well as money for now even for the future.

Keywords: Bitcoin, Cryptocurrency, Money of The Future

Introduction

Nowadays cryptocurrencies are becoming widely popular among investors, especially those who are trying to find new investment alternatives, reflecting the phenomenon of new generation and hoping to get higher returns than investing in stock markets or other conventional investments. In the family of cryptocurrencies, Bitcoin is the most prominent one as an alternative investment.

Bitcoin was created using Blockchain technology. It is a database system with a high level of security based on a system of verification through a peer-to-peer network that is free from central regulation, making it highly efficient and reducing transaction costs. Since the inception of Bitcoin in 2009 and the first Bitcoin trade in late 2009, the trading volume of Bitcoin has been increasing despite its relatively high volatility. Currently, the market capitalization of Bitcoin is around 1,486 billion USD. The popularity of Bitcoin and its position as a modern financial innovation has led investors and academics to question whether Bitcoin can be a currency for the future. That is, whether it can replace paper money, especially the main global currencies at the moment either USD, Euro Dollar, or Japanese Yen (Moshirian F., 2007; Dobija, M, 2014).

However, the value of Bitcoin is so volatile that it may hinder its functioning as a currency. For instance, after the Bitcoin price started to rise above $ 10,000 in the second half of 2020, reaching a peak of over $ 63,000 in April 2021 then dropped to a low level of about $ 29,000 in July 2021. The most problematic for using Bitcoin as a means of exchange is the short-term fluctuation. Because the parties involved in trading goods and services cannot predict and plan about income and expenses at all. For example, bitcoin has almost halved its price in a month, from $63,503 in April 2021 to $34,616 in May 2021.

There are numerous studies on the volatility of Bitcoin. Dwyer (2015) analyzes monthly standard deviations of Bitcoin prices from Mt. Gox, BTC, and Bitstamp, finding that they are 5–7 times higher than those generally observed in stock markets. Bouoiyour and Selmi (2016), Bouri et al. (2017), Katsiampa (2017), and Ardia et al. (2019) use GARCH models to estimate daily volatility finding that the volatility level is comparatively high. Dirk G. Baur and Thomas Dimpfl (2021) studied the volatility of bitcoin prices and compared with those of major exchange rates such as US dollar against the euro and the Japanese yen. They concluded that the volatility of Bitcoin prices is extreme and almost 10 times higher than the volatility of such major exchange rates reflecting that Bitcoin cannot function as a medium of exchange. This article, therefore, would like to investigate whether Bitcoin has the qualities of being a currency.

This article proceeds as follows. The objectives of the study are in section 2. Section 3 describes the data and research methodology used in this study. Section 4 lays down some substance foundations of Bitcoin and reviews the literature on the functions of money. Section 5 discusses the study results. The conclusion is in section 6.

Objectives

The objective of this study is to investigate whether Bitcoin could perform its function as money by analyzing the patterns of volatility as follows.

1. To analyze whether bitcoin prices have more volatility, as compared to those of fiat money.

2. To analyze whether the size of the difference in the volatility of Bitcoin and fiat money exceeds the level that can be accepted as general currencies.

If the outcome of the analyses could not reject the hypothesis that the Bitcoin volatilities are not significantly different from those of fiat currencies or the magnitude of differences are not beyond the accepted magnitude, it could then lead to the conclusion that Bitcoin can function as money. Specifically, this article seeks to check whether the Bitcoin price volatility is about 10 times higher than the volatility of general exchange rates reflecting that Bitcoin cannot function as a medium of exchange as pointed out by Dirk G. Baur and Thomas Dimpfl (2021).

Data and Research Methodology

The Data Used

This article uses historical data of Bitcoin to investigate the volatility against two fiat currencies. One is the main global currency, US Dollar (USD) in terms of USD value per Euro Dollar. The other is the local currency, Thai Baht, in terms of Baht value per USD. Therefore, three time series of data are used in the study.

Bitcoin. Bitcoin data used in this study is daily historical data retrieved from coinmarketcap.com covering from September 17, 2014 to April 6, 2023. The record is composed of transaction data as date, open, high, low, close, volume, and market. This article uses close price to calculate a measure of volatility.

U.S. Dollar. USD data used in this study is daily historical data retrieved from the Wall Street Journal through wsj.com covering from January 1, 2014 to April 6, 2023. The record is composed of transaction data as date, open, high, low and close. This article uses close to calculate measure of volatility.

Thai Baht. The Thai Baht data used in this study is daily historical data from the Bank of Thailand covering from January 2, 2014, to April 5, 2023. The record is composed of transaction data as date, average buying rates, and average selling rates. This article uses the average of the buying rates and selling rates to calculate a measure of volatility.

Volatility Measurement

Studying the volatility of assets can use a variety of methods, such as a simple standard deviation, variances, the GARCH model, etc. For testing whether bitcoin prices have more volatility, as compared to the two fiat currencies, this study utilizes the test for equality of variances between Bitcoin prices and the USD value, and between Bitcoin prices and the Baht value. To mitigate the effect of the non-normality of the three time series, particularly Bitcoin prices, Levene's test (Levene, H. (1960) will be used in addition to F statistics.

For testing whether the size of the difference in the volatility of Bitcoin and fiat money exceeds the level that can be accepted as general currencies, this study utilizes the moving standard deviation method (MSD) using 14 day-period to compute the series of MSD.

The step of calculating MSD is as follows.

1. Calculating moving average using the formula:

$$MA = \frac{P_1 + \cdots + P_n}{n}$$

Where P_i is the price of the asset at time i

      n is the number of periods (in this case 14 days)

2. Finding the variance using this formula.

$$V = \frac{(P_1 - MA)^2 + \cdots + (P_n - MA)^2}{n}$$

3. Taking the square root of V to get the standard deviation.

$$\boldsymbol{\delta = \sqrt{V}}$$

Moving to the next period and following the above steps to get a series of moving standard deviations.

To compare the magnitude of differences of this volatility measure of the three series, the MSD ($\boldsymbol{\delta}$) has to be normalized by finding the Coefficient of Variation (CV) obtained by diving MSD with the mean of the period and calculating in percentage. (Trend Spider Learning Center, n.d.).

Literature Review

      Fundamentals of Bitcoin

      1. Creation of bitcoins, Bitcoin mining process

As already mentioned, Bitcoin was created from the development of digital innovation using Blockchain technology (Nakamoto, 2008; Luther, 2016; Krishnan, 2020). Transaction data is stored in blocks. Each block has a hash number which is generated by encryption with a hash function that converts all the data in the block to a hash number. Newly created blocks must always reference the previous block's hash number. In 2009, Satoshi Nagamoto created the Genesis Block, the first Bitcoin block, and gave rise to the first 50 Bitcoins.

The process of generating Bitcoin is the process of verifying Bitcoin transaction data by the miner. A miner is a person who connects their own computer to the Bitcoin network in a manner known as peer-to-peer. The miner has to verify the transaction data which

typically are bitcoin transfers between two parties, to check whether the sender has the right to transfer or not, and the amount transferred is according to the right or not. Then it will record information in the new block.

To add a generated blocks to the blockchain, miners have to compete to solve complex mathematical equations, called Proof of Work (POW), to find a hash number that satisfies a requirement with a degree of predetermined difficulty. To find valid hashes for a block, miners must randomly find a number called nonce (number only once) so that the hash function can encode it into a hash number that meets the criteria. Any miner who finds valid hashes for a block first will be rewarded with a set amount of bitcoins. In 2009, which gave birth to Bitcoin, the mining reward for each block of transactions was 50 bitcoins. This amount is halved approximately every four years. Currently the reward is 6.25 bitcoins for a block of Bitcoin.

The difficulty of mining bitcoins tends to increase over time, depending on the number of miners in the network and the combined processing power. Increasing difficulty is required to maintain the target block time. It currently takes about 10 minutes to mine a Bitcoin block. After every 2016 blocks are mined, the Bitcoin protocol adjusts the mining difficulty. In the early days, since the inception of bitcoins, miners were able to use PCs to mine Bitcoin. Nowadays, bitcoin mining has to use high performance computers with specially developed software such as "ASIC" (application-specific integrated circuit chip). At the time of writing this article, approximately 19 million bitcoins have been mined and in circulation, leaving about 2 million to be mined. It is estimated that all bitcoins will be mined by 2140, after which miners will only receive transaction fees.

2. A Peer-to-Peer Database System Blockchain systems of any cryptocurrencies, including Bitcoin, use peer-to-peer data connection technology, called a decentralized ledger, which is a decentralized system to access and verify the data in the system for anyone who wants to connect a computer to the system. In a peer-to-peer database system, peers refer to the nodes or computers that perform the same tasks and have the same power within a blockchain network. For the Bitcoin system, each peer keeps a complete copy of the Bitcoin database and verifies the authenticity of transactions with other nodes to guarantee their accuracy without any middle-man or central server. Therefore, no administrator is required to maintain the function of the network. Instead, the peers in the network cooperate to handle deals and manage the Bitcoin system. On the contrary, transactions at a financial institution, like a bank, are kept confidential and only investigated by the bank.

However, the fact that P2P systems allow anyone to become a peer may also be an opportunity for individuals to hack the system by modifying the data in such a way as to double spending. Nevertheless, POW processes where miners compete to solve a mathematical puzzle with its own level of difficulty, require hackers to POW all blocks after

the modified block. In practice, this is almost impossible since an attacker has to control a majority or more than 50% of CPU power.

One of the advantages of P2P is the absence of an intermediary in transactions involving bitcoin transfers. It seems that P2P and Blockchain are efficient systems in terms of cost and time. However the person doing the transaction still pays the transaction fee and still has to wait for the transaction to be confirmed and put into the block (Klemens, 2020). Usually, bitcoin transactions take around 10 minutes to 1 hour depending on situations requiring different amounts of confirmation. Bitcoin exchanges allowing to buy and sell bitcoin typically require six confirmations or about 60 minutes before the funds show up in the receiver's account. The unconfirmed transactions wait in a waiting area known as the mempool. A transaction can get stuck in the mempool when the transaction fee included with that transaction is too low. At a time when demand for bitcoin rises, then bitcoin transaction fees rise. For example, during the 2017 bull market, the demand for a Bitcoin transaction was so high that a transaction fee could go as high as $50. At times of low demand, the fee can be as low as $0.20 to $0.30. As the time of this article writing, the average fee is about $7.25.

Function of Money.

There are many definitions of money [(Graham, 1940; Spruzen, 2001; Mishkin, Gamber & Hakes, 2006; IMF, 2012; Pierce and Tysome, 2014; European Central Bank, 2017)]. Synthesizing various definitions, it can be concluded substantially that money is any object generally accepted as a mean of exchanging goods and services and debts repayment in an economy. In the ancient time, the exchange of goods and services was carried out by a direct exchange known as the Barter System. However, such direct exchange of goods faced the problem of inconsistency of type and quantity of goods to be exchanged. Later, natural rare items were used as a medium of exchange, such as Crowry shell, lether, barley, peppercorns, and precious metals such as silver and gold (National Museum of American History, n.d.). Eventually, it evolved into paper money or currency, called fiat money as nowadays. It is fiat money because it is issued on the "fiat" or decree of a sovereign government, usually by the country's central bank or monetary authority.

Therefore money and currency in this article have the same meaning as elaborated above and are used interchangeably. In determining whether anything is money or not, economists look at the functional properties of that thing. Economics money performs three important functions:

A medium of exchange. The function of money as a medium of exchange is to act as an intermediary instrument to facilitate the purchase and sale of goods and services between partners (Yang, 2007; Chen, 2023) To act as a medium of exchange, money must have a standard of value and remain reasonably stable accepted by all parties.

Money enables anyone who possesses it to participate as an equal market player. When consumers use money to purchase goods or services, they are effectively making a bid in response to an asking price. This interaction creates order and predictability in the marketplace. Producers know what to produce and how much to charge, while consumers can plan their budgets around predictable and stable pricing models. In modern economies, the medium of exchange is currency. Therefore, a currency must remain reasonably stable in value to work as an intermediary. If its value becomes unstable, it is no longer viable as a means of exchange.

A Store Of Value. It means that anything used as money can be saved, retrieved, and exchanged in the future without deteriorating in value, that is, over time, either be worth the same or more. Money that was used in the past as precious metals like silver and gold had intrinsic value due to their rarity and their shelf lives are essentially perpetual. Therefore, they qualified as a store of value. Later, when it developed to be fiat money, such as currency and coins, it still had this feature because fiat money is a currency issued by a government that is backed by the authority and power of that government and its economy. A monetary unit that serves poorly as a store of value destroys all incentives to save or even earn, and reduces the ability to trade (Downey, 2022).

A Unit of Account   A unit of account is a function of money that can be used as a measure in valuing things such as goods and services, liabilities, and other calculations. As a unit of account, money allows to compare the value of different assets using a common scale, such as a particular currency (Chegg, n.d). As a unit of account, money comprises of three characteristics.

1. Divisible – a unit of currency should be able to be divided into smaller components. Likewise, the sum of such components must be equal to the total value of the unit before dividing. For example, a Thai baht is divided into 100 stangs, each component will be worth one stang. Therefore, the sum of these 100 stangs is worth a Thai baht. This characteristic of divisibility makes it easy to declare the value of goods and services more accurately and effectively and to make a comparison between various values easily.
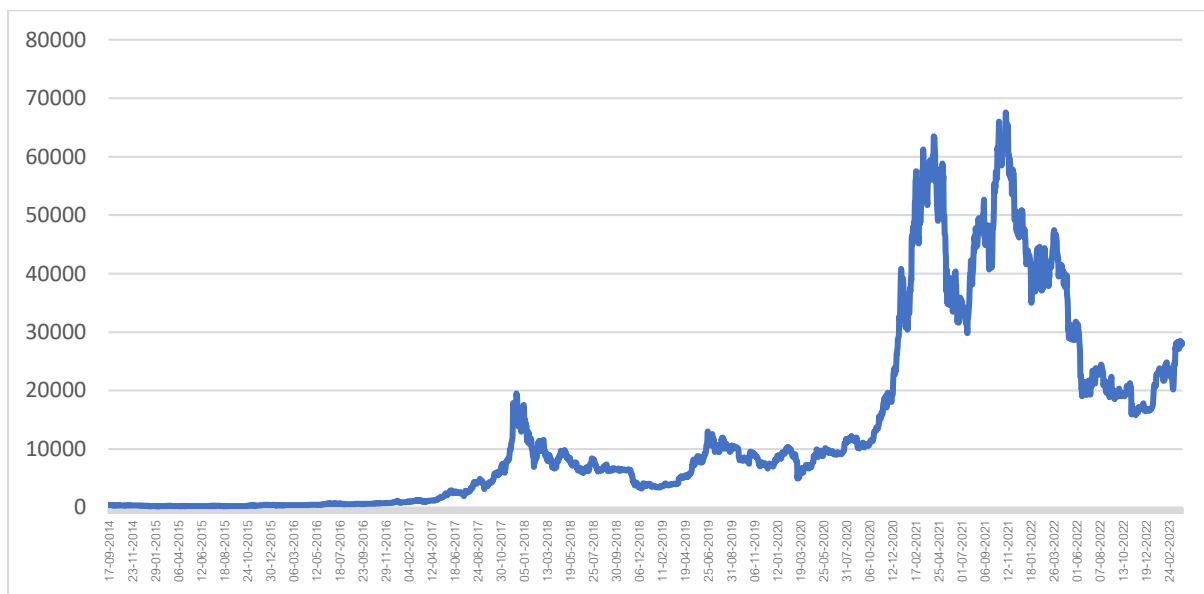
2. Fungible - Fungible means that the units that make up something are not unique, but all the same. Money is fungible in the sense that each currency note with the same numeric value written on it has the same value and will not be treated differently. For example, each 1 baht banknote has the same value even though the banknote is slightly torn and smeared compared to other clean and clear banknotes.

3. Countable – As a unit of account, money should be able to be counted and be subjected to mathematical operations such as addition, subtraction, division, and multiplication. This is the characteristic that enables individuals and organizations to account for their revenues, expenditure, profits/losses, debt and wealth.

Study results

1. Overall pattern of Bitcoin Prices

The overall pattern of Bitcoin prices from September 17, 2010 to April 6, 2023 is shown in Figure 1. Bitcoin prices maintain at around $200- $500 during 2011 to late 2016. As discussed in the introduction, after the price started to rise above $ 10,000 in the second half of 2020, reached a peak of over $ 63,000 in April 2021 and dropped to a low of about $ 29,000 in July 2021, bitcoin has seen price volatility all along. Particularly, a big drop in the price of almost halved happened in a month, from $63,503 in April 2021 to $34,616 in May 2021.

Sources: daily historical data retrieved from coinmarketcap.com

Figure 1 Bitcoin Prices in US Dollars 2014-2023

2. Test for Equality of Variances Between Bitcoin-USD and Bitcoin-Baht

This section looks into the differences of variances between Bitcoin and USD and between Bitcoin and Thai Baht. The result of testing for equality of variances between Bitcoin and USD using Eviews 12 application yields the outcome as in Table 1. Both F-statistic and Levene's test are significant at 99% confident meaning that the volatility of Bitcoin and USD value are different.

Table 1 Test for Equality of Variances Between Bitcoin and USD

Variable	Count	Std. Dev.	Mean Abs. Mean Diff.	Mean Abs. Median Diff.	Mean Tukey-Siegel Rank
BITCOIN	3124	16044.37	12438.08	10960.2	3044.499
USD	2417	0.082711	0.061715	0.059364	2417.5
All	5541	13705.28	7012.581	6179.354	2771
Method		df	Value	Probability	
F-test		(3123, 2416)	3.76E+10	0	
Levene		(1, 5539)	3641.941	0	

Table 2 Test for Equality of Variances Between Bitcoin and Thai Baht

Variable	Count	Std. Dev.	Mean Abs. Mean Diff.	Mean Abs. Median Diff.	Mean Tukey-Siegel Rank
BITCOIN	3124	16044.37	12438.08	10960.2	3003.914
Thai Baht	2256	1.788082	1.462512	1.442798	2256.5
All	5380	13840.17	7223.023	6364.853	2690.5
Method		df	Value	Probability	
F-test		(3123, 2255)	80513822	0	
Levene		(1, 5378)	3398.543	0	

The result of testing for equality of variances between Bitcoin and Thai Baht as in Table 2 shows that F-statistic and Levene's test is significant at 99% confidence meaning that the volatility of Bitcoin and Thai Baht values are different.

3. The magnitude of volatilities using %CV of MSD

The volatility patterns as measured by %CV of MSD on Bitcoin prices, USD value and Baht values are shown in Figure 2, Figure 3 and Figure 4 respectively. The %CV of Bitcoin MSD in Figure 2 shows the high volatility of between 0.48% – 25.04% during September 30, 2014 and April 6,2023. While the %CV of US Dollar MSD in Figure 3 depicts a patterns of lower volatility between 0.15% – 2.67% during January 20, 2014 and April 6,2023. And the %CV of Thai Baht MSD in Figure 4 depicts a similar pattern of lower volatility between 0.06% – 2.46% during January 21, 2014 and March 28, 2023.
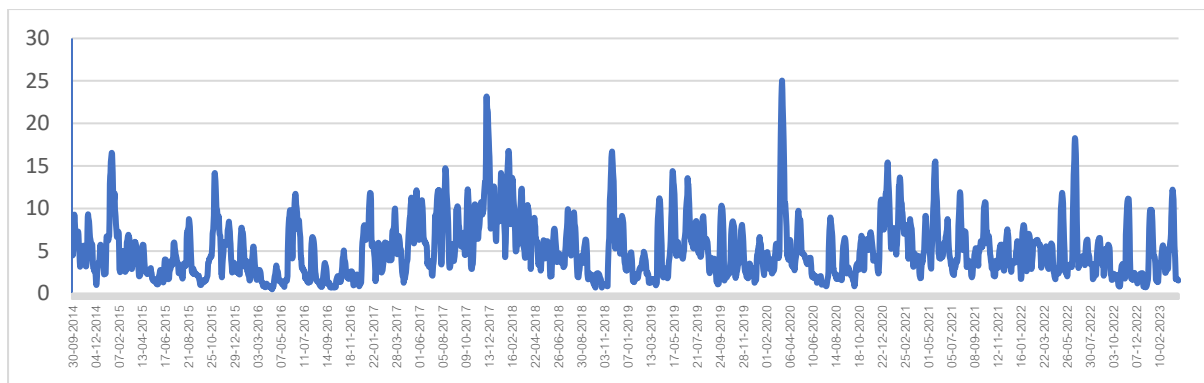
Figure 2 %CV of Bitcoin Price Volatility (in US Dollar) 2014-2023
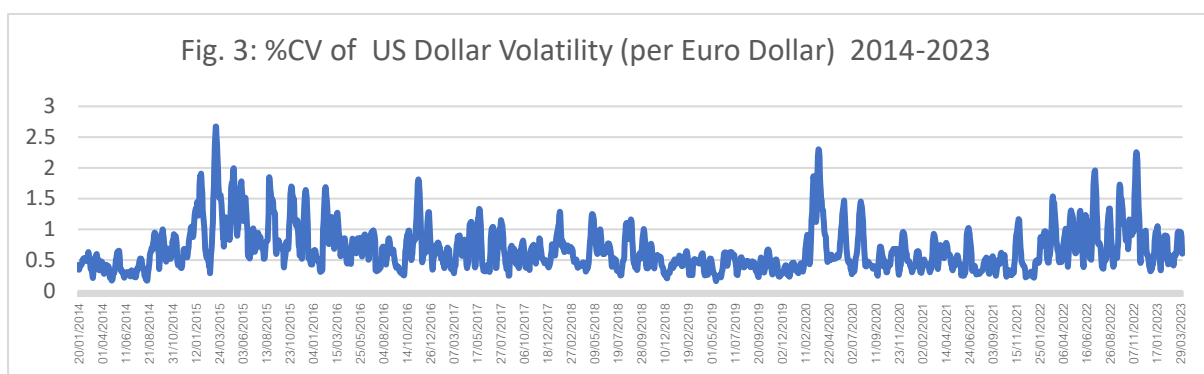

Figure 3 %CV of Bitcoin Price Volatility (in US Dollar) 2014-2023
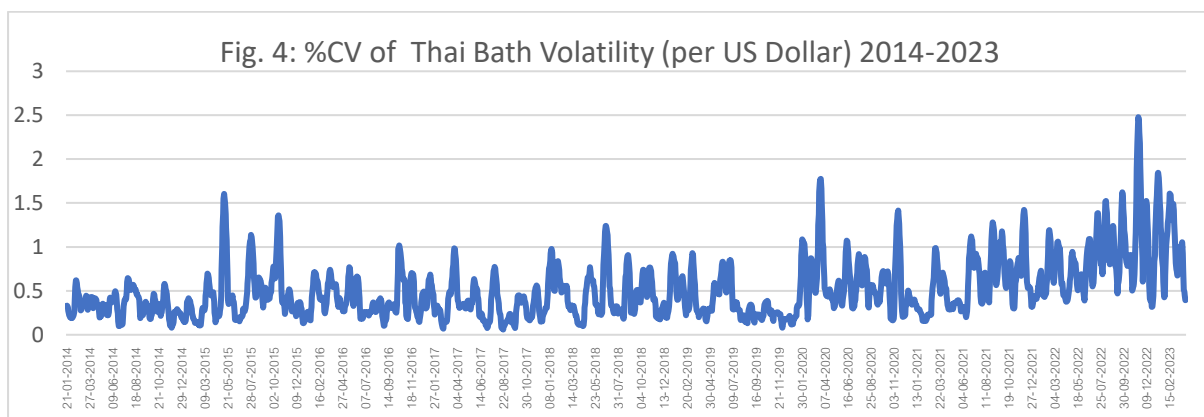

Figure 4 %CV of Thai Bath Volatility (per US Dollar) 2014-2023

In order to perceive the comparison visually, the three series of CVs are shown in the same chart as in Figure 5. It is clearly seen the difference in magnitude of volatility of bitcoin prices and the fiat money values.
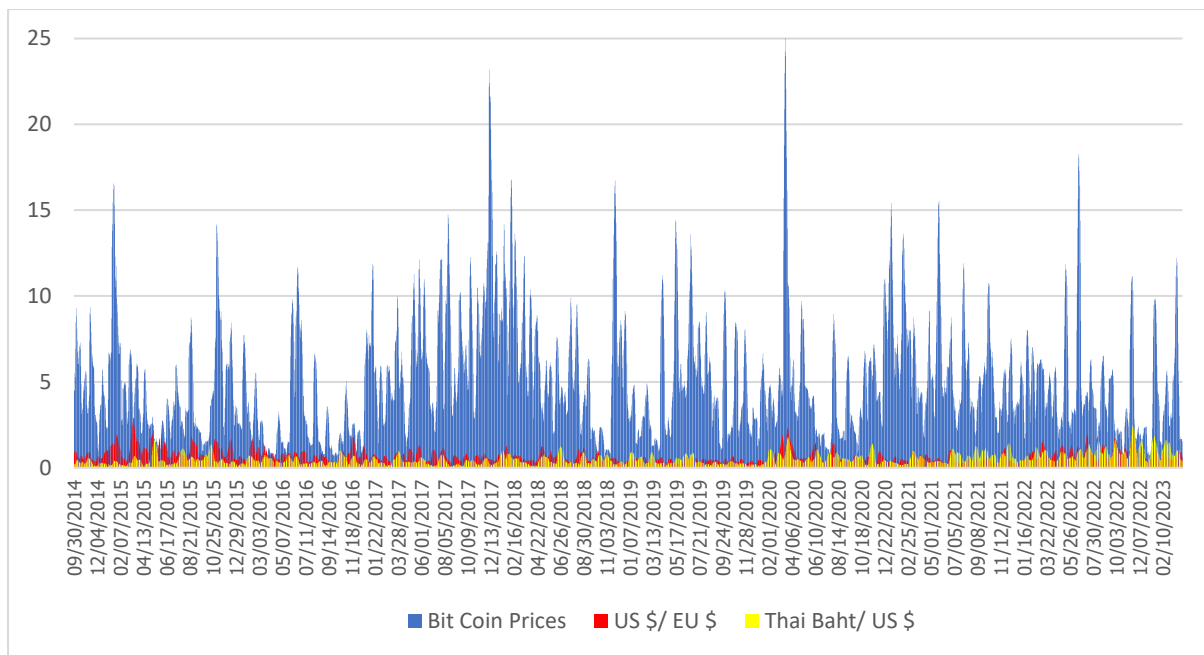
Figure 5 Comparison of Percentage Volatility of Bit Coin Prices, US $/ EU $ and
Thai Baht/ US $

To compare the differences of percentage CV of Bitcoin prices and the two fiat money values annually, the table 3 tabulates the average prices (value) and percentage CV of Bitcoin, US Dollar per EU Dollar and Thai Baht per US dollar. The average volatility of Bitcoin prices is higher than the average volatility of US dollar and Thai Baht around 8.24 to 11.32 times during 2014 to 2023

Table 3 The average value and percentage CV of Bitcoin, US Dollar per EU Dollar and Thai Baht per US dollar during 2014-2023

Year	Price of Bitcoin (in US$)		US$/ Euro Dollar			Thai Bath/ US $		
	Average Price	%CV (1)	Average Price	%CV (2)	(1)/(2)	Average Price	%CV (3)	(1)/(3)
2014	363.11	4.89	1.33	0.49	9.98	32.43	0.34	14.38
2015	270.44	4.55	1.11	1.10	4.14	34.18	0.47	9.68
2016	559.63	3.01	1.11	0.75	4.01	35.27	0.41	7.34
2017	3,762.93	7.35	1.13	0.62	11.85	34.00	0.34	21.62
2018	7,763.31	6.17	1.18	0.62	9.95	32.30	0.47	13.13
2019	7,333.94	4.69	1.12	0.42	11.17	31.09	0.38	12.34
2020	10,775.97	4.78	1.14	0.70	6.83	31.27	0.60	7.97

Table 3 (Continue)

Year	Price of Bitcoin (in US$)		US$/ Euro Dollar			Thai Bath/ US $		
	Average Price	%CV (1)	Average Price	%CV (2)	(1)/(2)	Average Price	%CV (3)	(1)/(3)
2021	47,045.10	6.01	1.18	0.48	12.52	31.88	0.59	10.19
2022	28,763.52	4.52	1.05	0.88	5.14	35.01	0.87	5.20
2023	22,435.19	4.54	1.07	0.67	6.78			
Average					8.24			11.32

4. Reasoning against Bitcoin as a unit of account

The quality of money as a unit of account has to fulfill the 3 aspects i.e., divisible, fungible, and countable. Government fiat money have all these 3 qualities. They are divisible, meaning that they can be subdivided into smaller units and can be conveniently used in real life transaction. The US dollar is divided into smallest units as cents, whereby one US dollar has 100 cents. The British pound Sterling is divided into smallest units as pence, whereby one pound Sterling is composed of 100 pence. With the same manner, Thai baht is also subdivided into a smallest unit as stang and one baht is composed of 100 stangs. As for bitcoin, the satoshi is the smallest denomination of bitcoin. The satoshi to bitcoin ratio is 100 million satoshis to one bitcoin. As of the time of this publication, 1 US dollar is 0.000033 bitcoin. Therefore, It is conceivable that it is quite inconvenient in practice to buy a 3-US dollar hamburger with 0.000099 bitcoin.

The small unit of bitcoin that is a million times smaller than its base unit compared to regular fiat money makes it impossible to use bitcoin in real-life trading activities. This is in addition to the phenomenon that the bitcoin value is unrealistically high which is not the scope of this article. The shortcoming of the divisibility qualification of bitcoin overshadows the other attributes of fungibility and countability of bitcoin making it incapable of being a good unit of account.

Conclusion and Suggestion.

The study results in the previous section have shown that the variance of Bitcoin prices are different from the variances of USD and Thai Baht from 2010 to early 2023, implying that a price pattern of cryptocurrencies such as Bitcoin is different from a family of fiat money, take as examples, USD and Thai Baht. Further investigation into the magnitude of the volatility of the three assets using the percentage CV of 14-day moving standard deviation, it finds that the average volatility of Bitcoin prices is higher than the average

volatility of US dollar and Thai Baht around 8.24 to 11.32 times during 2014 to 2023. The finding is consistent with the study of Dirk G. Baur and Thomas Dimpfl (2021) that the volatility of bitcoin prices is higher than those of major exchange rates such as US dollar against the euro and the Japanese yen of almost 10 times. This analysis reflects that Bitcoin cannot function as a medium of exchange.

Such high volatility of Bitcoin also hinders Bitcoin's ability to function as a store of value. As Max Kubát points out based on comparing historical volatility for BTC and assets like currencies, gold, and shares, that to hoard bitcoins is more risky than hold other types of assets. It cancels the store of value money function of Bitcoin (Max Kubát, 2015). As for a unit of account function of money, the small unit of bitcoin that is a million times smaller than its base unit compared to regular fiat money makes it inconvenient to use bitcoin in real-life trading activities and for accounting.

In conclusion, as pointed out that Bitcoin could not meet the three money functions qualification, Bitcoins, therefore could not perform well as money for now even for the future.

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