

Analysis on the Current State of Stablecoins

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Abstract

TBD Bitcoin is volatile. People do not like this feature Bitcoin. People therefore try to tweak Bitcoin to make a less volatile version. Or they try to bring less volatile currencies onto Bitcoin or other blockchain systems. This paper is essentially a survey of work on stablecoins but we aim at making a number of subtle research contributions to ensure this survey is actually useful to the reader. First and foremost, we are very selective in the concepts from finance we bring into the survey and explain each from first principles, while attempting to minimize or eliminate jargon. We distill proposals done to their fundamental primitives and describe these concepts rather than enumerating the intricate details of how particular ‘brands’ of stablecoins work?details that could change tomorrow (that said, we do provide, as the reader probably expects, a chart mapping brands into our categorization). Additionally, we also consider the question and potential for the stability of index-cryptocurrencies (namely gas which is used in Ethereum), which are very pertinent to a discussion of stablecoins, yet not typically addressed. Last, we offer some novel visualizations of exchange rates we have not seen before.

1 Introduction

Many early cryptocurrency proposals designed secure digital representations of government-issued money (which cryptocurrency enthusiasts typically call ‘fiat’). While Bitcoin was not the first proposal for a digital currency that is issued and operates independently of existing currencies and financial infrastructure, Bitcoin [8] is the first of this type to establish wide-scale deployment. Without government oversight, the exchange rate of Bitcoin is essentially subject to: (a) an algorithm which releases new BTC (Bitcoin’s currency) on a fixed schedule, and (b) the market for exchanging Bitcoin for other things of value, namely fiat currencies such as the USD, and potentially (c) the market for participating in transaction validation which is integral into how new BTC comes into circulation.

From the inception of exchanges for buying and selling BTC for USD in 2010 to the time of writing, the exchange rate of BTC with the USD has been marked by extremely volatile with large fluctuations in its value that are atypical of a government-managed currency. Figure 1 illustrates this volatility by plotting the exchange rate of BTC (with the USD) alongside the same exchange rate for three economic zones—Europe, UK, and Canada—which all appear relatively stable. Note that Figure 1 deliberately includes the UK’s referendum on exiting the EU (‘Brexit’) in June 2016, which was followed by a ‘sharp decline’ and ‘volatility’ in GBP’s exchange rate.¹ Relative to BTC however, this ‘severe swing’ looks like a mild pinch of GBP’s exchange rate with EUR in Figure 1.

In response to Bitcoin’s extreme volatility, a flood of proposals have been made for alternative designs that would offer a more stable exchange rate (called ‘stablecoins’) between the newly proposed stablecoin and a government-issued currency like the USD. Broadly, the proposals can be split into two categories: ones that essentially create a digital representation of a currency that can be transacted like a cryptocurrency, and ones that propose separate currencies with some mechanism for stability and/or intervention built into the design.

Contributions. This paper is essentially a survey of work on stablecoins but we aim at making a number of subtle research contributions to ensure this survey is actually useful to the reader. First and foremost,

¹Descriptions from the following *BBC* articles: “The markets facing trading turmoil” (27 Jun 2016) and “How does Brexit affect the pound?” (15 Jan 2019).

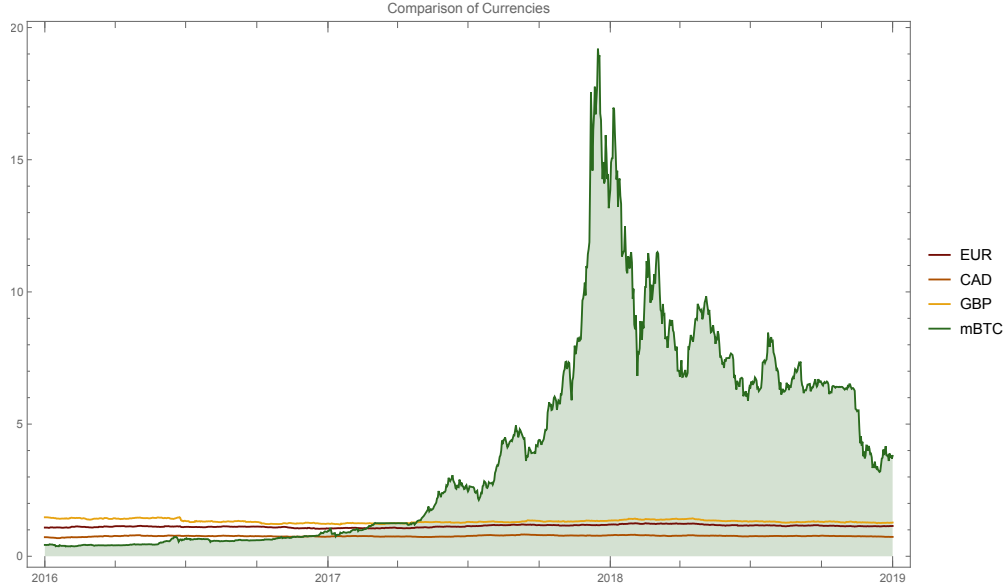


Figure 1: Comparison among fiat currencies and Bitcoin: The values are retrieved daily between 01 Jan 2016 and 01 Jan 2019. Note that $1000 \text{ mBTC} = 1 \text{ BTC}$.

we are very selective in the concepts from finance we bring into the survey and explain each from first principles, while attempting to minimize or eliminate jargon. Next we distill stablecoin proposals down to a set of fundamental primitives and describe these concepts rather than enumerating the intricate details of how particular ‘brands’ of stablecoins work—details that could change tomorrow. That said, we do provide, as the reader probably expects, a chart mapping existing stablecoin brands into our categorization. Additionally, we also consider the question and potential for the stability of index-cryptocurrencies (namely gas which is used in Ethereum), which are very pertinent to a discussion of stablecoins, yet not typically addressed. Last, we offer a novel visualization style for exchange rates we have not seen before used for exchange rates.

2 Related Work

Other blog posts, whitepapers, etc on systemizing stablecoins.

3 Preliminaries

3.1 Prices

If 1 BTC is worth \$3598.76 USD, as Google says it is at the time of writing, what does that actually mean? There are several subtleties here: (1) what that price actually represents, (2) the relationship between a quoted price and its actual price, (3) the concept that prices are really an exchange of one type of valuable good for another, and (4) the distinction between something’s price and its value. The quoted price means that two (hopefully different²) people recently exchanged BTC and USD at a valuation of 1 BTC for \$3598.76 USD. First, note that it does not necessarily mean that exactly 1 BTC was exchanged — it could have been 1 mBTC for \$3.60 or 1000 BTC for \$36M USD. Further, this valuation on the previous trade does not mean you will necessarily be able to exchange 1 BTC for \$3598.76 USD. Last sale price is an indicator of current

²A trade between the same person is called a wash trade and is illegal in most regulated markets.

price that becomes stale as time between subsequent exchanges increase (for example, for a house that last sold 30 years ago, last sale price on a house is not a good indicator of current price).

Instead, we will use the idea of that a cryptocurrency (or any asset) has two prices: (1) the most someone is willing to pay and (2) the least someone is willing to sell for. These are referred to as the best bid price and best ask (or offer) price respectively. Note that the best bid price should logically be less than the best ask price, otherwise an exchange would happen (such prices might occasionally ‘cross’ but this should be temporal and quickly resolved with an exchange). The spread between these prices is called the bid-ask spread.

To understand why this is relevant to stablecoins, consider an example. Say a stablecoin is designed to ensure one unit is always priced at \$1 USD. To argue stability, one must show both that (1) the bid price should never exceed \$1 dollar and (2) the offer price should never dip below \$1 USD. Note, conversely, that bids can dip below \$1 USD (everyone prefers to pay less than something is worth) and asks can exceed \$1 USD (everyone prefers to receive more than something is worth).

3.2 Exchange Rates

Consider that several hours after writing the previous section, 1 BTC is now priced at \$3566.56 USD. In one sense, the price of BTC decreased by \$32.20. However it is exactly equivalent to say the price of \$1 USD increased by 0.002 mBTC. This raises a natural question: did BTC decrease in price or did USD increase in price? With an exchange rate, it is impossible to tell. We only know that the price of BTC and USD became closer in price over this short period of time.

To determine which currency is moving, one might consider a third or fourth currencies to try and triangulate if BTC is moving in price, or USD is moving in price, or both. For example, in Figure 1 it certainly appears that BTC is the currency that is moving because the rest of the currencies are stable relative to each other. The only alternative is that USD, EUR, GBP, and CAD are volatile currencies that move together as a cluster relative to the stability of BTC. But it is much simpler to conclude that BTC is moving.

In order to apply this same logic in a visual way, we have created a number of charts like the one provided in Figure 2a. Unlike most exchange rate graphs, these do not use a time axis. Instead each axis is a reference currency. In this case, the price of GBP (plotted value) in USD (x-axis) and EUR (y-axis) forms a coordinate. For the last day of each month, a new coordinate is added and joined with a line from the previous value. This is inspired by similar charts on the website *FiveThirtyEight* for things like kicking distance in football³ and they appear to be called connected scatter plots.

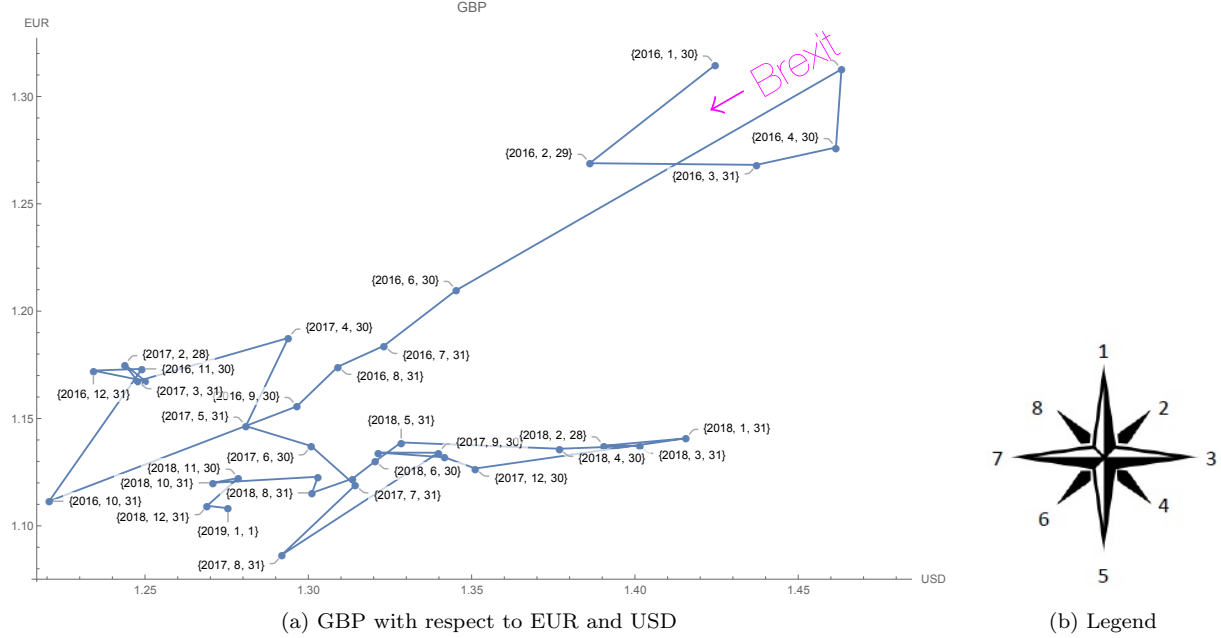
Lines in a connected scatter plot can move in any direction. Figure 2b shows how we number the directions from 1 (upward or due north) clockwise to 8 (north-west). For each direction, we describe the simplest interpretation of what that price direction means. By simplest, we mean specifically that we keep an explanation that involves a single currency moving rather than an explanation that involves a pair of currencies moving in tandem. For example, in Figure 2a, GBP shows a drastic movement along direction 6 starting at the time period marked Brexit. This means that GBP is losing value against both EUR and USD. The simplest explanation is that the movements are originating from GBP which is consistent with it losing value after Brexit. Later, GBP shows a lot of horizontal movements along the 7/3 line. The simplest explanation for this segment is volatility in USD rather than GBP.

We will return to these charts later in Section 7 where we will use a government currency as one reference (USD on the x-axis) and a cryptocurrency as the other reference (BTC on the y-axis). A stablecoin should exhibit mostly vertical movements along the 1/5 direction.

3.3 Valuation

Recall that in the previous section, 1 BTC was priced at \$3566.56 USD. This simply means that two people recently swapped some amount of BTC and USD for the stated valuation. Does this mean 1 BTC is worth \$3566.56 USD? Value can mean different things in different contexts. The market value of a currency does

³ “The 52 Best—And Weirdest—Charts We Made In 2016,” *FiveThirtyEight*, 30 Dec 2016.



Direction	Interpretation
1/5	Y is losing (1) / gaining (5) value
2/6	Plotted asset is gaining (2) / losing (6) value
3/7	X is losing (3) / gaining (7) value
4/8	Plotted asset is gaining (4) / losing (8) value against X , while losing (4) / gaining (8) value against Y

(c) The simplest interpretation of the plots where X refers to the currency on the x-axis and likewise Y .

Figure 2: Brexit's effect on GBP.

present one type of value — its replacement value, or the cost in USD to replace it. Note that more technically, one should determine replacement value from the set of best offer prices sufficient to cover the volume of BTC being valued.

But does this mean that BTC is fundamentally worth \$3566.56 USD. This is unlikely because by the time you read this paper, the price of BTC in USD is probably quite different from this quoted value (perhaps humorously so). So what constitutes fundamental value? And why do prices change over time?

Stocks, which represent ownership in a firm, and thus a stake in the firm's equity. Therefore shares (called equities) have a fundamental value called its book value: simplified, it is the firm's capital or equity (the value of its assets minus the value of its liabilities, as reported on its annual audited financial statement) divided by the number of outstanding shares. Working in reverse, the price of a single share multiplied by the number of shares represents the market capitalization of the firm. In theory, these numbers should be the same but often are not. When the market capitalization exceeds the reported capital, the market believes the firm's capital will increase over time. If the market capitalization is less than the reported capital, it demonstrates a lack of confidence in the soundness of the firm's financial statements. Floating currencies like the USD, EUR, GBP, and CAD do not have the equivalent of a book value.

To explain Bitcoin's exchange rate with fiat currencies, an oft-repeated theory has emerged that attributes Bitcoin's value to the hydro consumed by blockchain mining. While imprecise, the theory suggests that if a valuable resource x is consumed to produce y , the value of x is imparted into y . Setting aside the nuance that the hydro contributed to the Bitcoin system only indirectly produces new coins (it produces blocks, and blocks produce coins only for now), there is no economic principle underlying this transfer of value.

3.4 Stability and Volatility

When the price of a currency changes over time, it is due to one of two reasons: new information about the currency's fundamental value (even if we cannot concretely say what it is) and transitory volatility due to trading by uninformed traders [5]. For a government issued currencies, national inflation rates, macro-economic policies, changes in trade flows, and changes in capital flows seem predictive of changes in the country's currency [5]. Note that a cryptocurrency, like Bitcoin, has none of these indicators.

While volatility can be measured mathematically, most stablecoins do not offer a concrete, positive definition of what stability means. They tend to be defined by a negative sentiment rather than a positive one:

3.5 Money

Cryptocurrencies have gained a wide application after Bitcoin was first introduced in Satoshi Nakamotos (pseudonymous) 2008 whitepaper [8]. For Bitcoin and any other cyptocurrency to function as money, they need to fulfill a set of properties that determine the strength and adoption of them *i.e.*, they are expected to serve as a medium of exchange, a unit of account, and a store of value. However, due to high fluctuations in their prices, majority of the cryptocurrencies do not meet these properties and hence they cannot be adopted as money [4]

3.6 Lending

Despite quite a few blockchain applications in financial technologies, there has been little deployment of lending. Lending is difficult to be deployed on the blockchains, bdue to the monetary instability observed in the existing cryptocurrencies [10]. This volatility has led the cryptocurrencies to be used more as speculative investments instead of serving as store of value and unit of account. In a lending situation with volatile currencies, where their values are being depreciated or appreciated over time, the cash taker will eventually owe more than what he has borrowed or the vice versa. Therefore, the volatility in the value of cryptocurrencies causes serious concerns and difficulties both for cash takers and cash providers [10]. In contrast, lending perfectly works if a loan is done with a stable cryptocurrency, whose value remains stable over the time.

Category	Sub-Category	Examples	Rank
Backed	Directly-Backed & Redeemable	USDC	20
		TrueUSD	26
		Paxos	38
		Gemini Dollar	52
		StableUSD (USDS)	685
		Stronghold USD	891
		Petro	1210
		Ekon, WBTC, empata	⊥
	Directly-Backed	Tether	6
		EURSToken	95
		BitCNY	304
		Terracoin	1280
		Saga	1495
		GJY, Novatti AUD, UPUSD	⊥
	Indirectly-Backed	Dai	57
		BitUSD	398
Intervention	Market	Nubits	892
	Algorithmic with subjective external information	Nomin (nUSD)*	⊥
	Algorithmic with objective external information	CarbonUSD*	1262
		Ampleforth*	⊥
	Algorithmic with only internal information	Basecoin	⊥

Table 1: Systemization the current stablecoin projects on January 11, 2019. The Projects that are in bold are discussed in this paper.

4 Systemization of stablecoins and Justification

5 Backed

5.1 Redeemable and Directly-Backed.

5.2 Non-Redeemable and Directly-Backed.

5.3 Non-Redeemable and indirectly-Backed.

5.4 Redeemable and indirectly-Backed.

6 Intervention-based

6.1 Currency Board

6.2 Algorithmic with subjective external information

6.3 Algorithmic with objective external information

6.4 Algorithmic with only internal information

We performed a search query on [coindesk.com](https://www.coindesk.com/) and found the following projects which are mostly used in every articles published about stablecoins until January 11, 2019. ⁴ Table 1 represents these projects and the methods they apply to achieve stability. (we should mention the search term that we used to extract our resources from coindesk)

Distribution of articles speaking about stablecoin: 2014: 2, 2017: 4, 2018: 112, 2019 (up to Jan 11): 4.

7 What Stability looks like

8 Investigation of gas volatility

The two spikes in the Fig 3 correspond to (i) January 2018 when Cryptokitties ⁵ was launched for the first time and (ii) when the FCOIN ⁶ was launched and required a lot of on-chain voting. Both these events have caused the GasPrice to go up as Ethereum users had to pay more Gas for their transactions to go through.

[it would be nice to have a chart : Ether, Electricity \(Global energy index\), and Gas](#)

Our analysis in Section 1 shows that cryptocurrencies exhibit less stable behavior compared to fiat currencies. Hence, we aim to analyze the price stability of *Gas*. In Ethereum blockchain, every transaction contains a number of operations and there is a precise amount of gas unit associated with each.⁷ Since Ether is volatile, this concept is introduced to have fixed cost for operations. Thus, even though the price of Ether changes, the amount of Ether corresponding to a unit of gas decreases; so that users pay the same price for the transactions on the Ethereum blockchain. Hence, the notion of gas is yet to be investigated to find out whether it exhibits behavior similar to fiat currencies or cryptocurrencies.

Figures 5b- ?? illustrate how the values of EUR, ETH and Gas change with respect to BTC and gold. EUR plot in Figure 5b tends to have more movements in the directions 1-5 and 3-7 suggesting that while the value of EUR stays the same according to one axis, it changes according to the other. For instance, between June 2018 and August 2018, the value of EUR increased with respect to BTC, while it stayed the

⁴<https://www.coindesk.com/>

⁵Cryptokitties website <https://www.cryptokitties.co/>

⁶Fcoin website <https://www.fcoin.com>

⁷<http://ethdocs.org/en/latest/contracts-and-transactions/account-types-gas-and-transactions.html#what-is-gas>

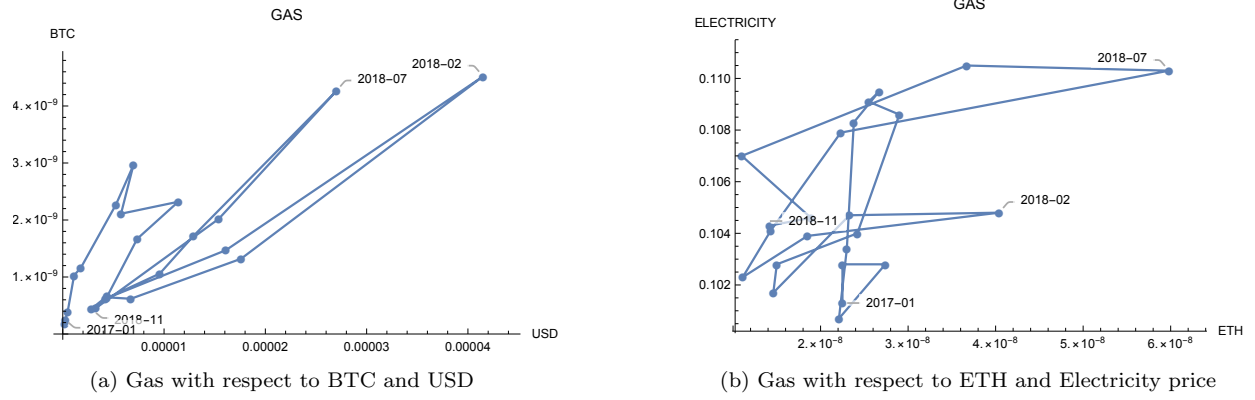


Figure 3: Ethereum average GasPrice chart. As mentioned in the Section 8, the two spikes in the chart represent specific events happened in certain dates which have increased the GasPrice.

same according to USD. This type of movement suggests that EUR-USD exchange rate is going under less change, whereas BTC-EUR rate is subject to high volatility. On the other hand, in the first half of 2017, while EUR retained its value against BTC, EUR to USD rate went under change.

ETH plot in Figure ?? illustrates more volatility against BTC and gold, as there are horizontal, vertical and diagonal changes. The fact that the points are spread in a large range of values indicates drastic changes in ETH price with respect to BTC and Gold.

Compared to Figure 5b and Figure ??, gas plot (Figure ??) has mostly diagonal changes, spread over a smaller range. There are less number of changes compared to ETH. Except from the changes between May 2018-July 2018 and January 2018-March 2018, the gas price changes in a smaller range. Even though there are fluctuations in the gas price, it can be inferred that gas price is less volatile than ETH. Also, it worths mentioning that gas is changing over a small scale in x-axis (USD), when compared to Ether's plot over the same axis in a larger interval.

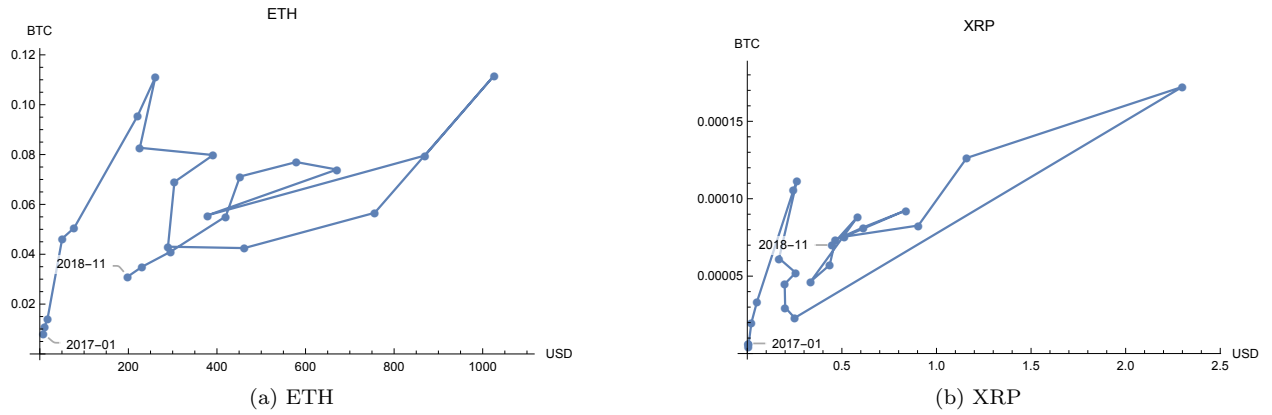


Figure 4: Volatility in cryptocurrencies

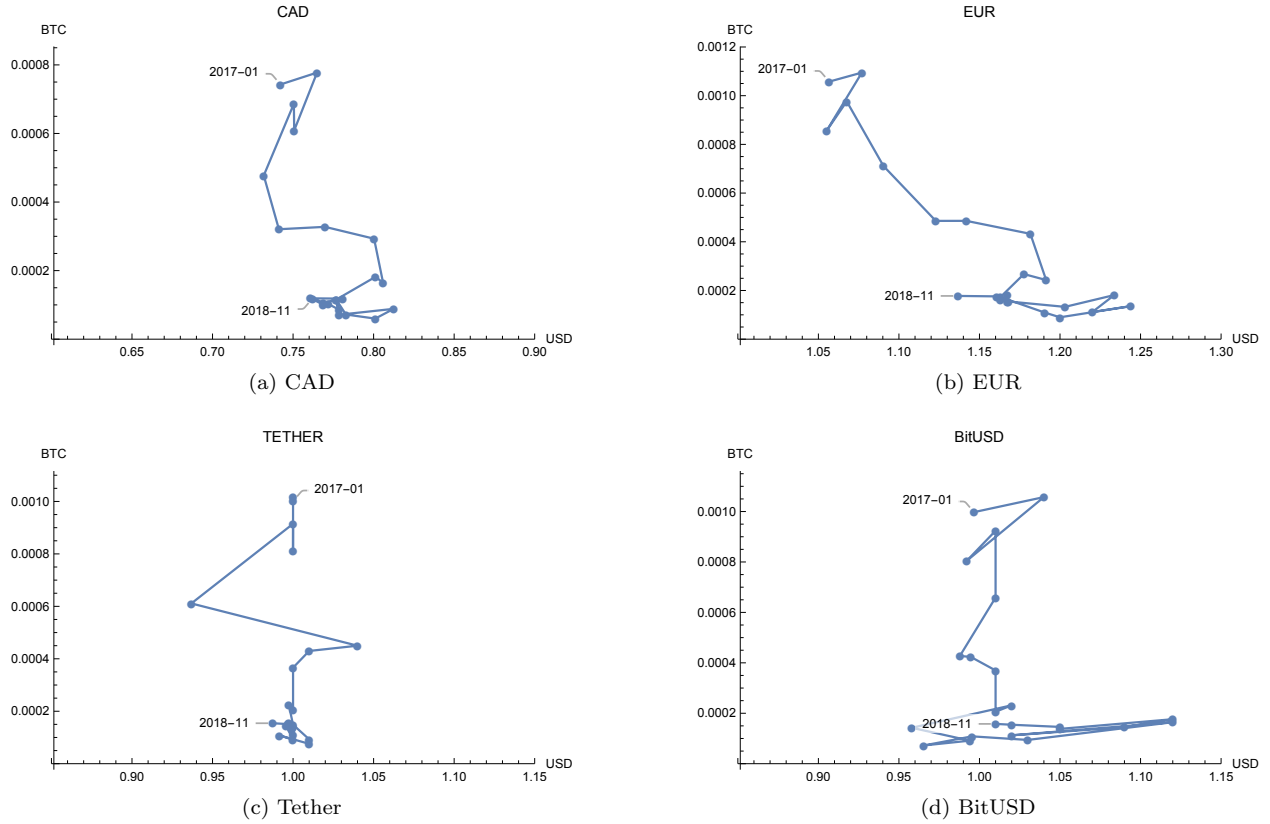


Figure 5: Stability in two government-issued fiat currencies (CAD and EUR) and two stablecoin projects (Tether and BitUSD). Note that the x-axis is sized consistently across all four plots, with a \$0.30 USD spread.

9 Conclusion and Discussion

In this paper, we analyze the current state of stablecoins with the various options that have been so far proposed to achieve price stability. We also discuss various issues that stablecoins would address. According to the charts represented in the paper, gas is relatively stable in price, while Bitcoin and Ether show volatile behaviour. The reason could be the fact that how users interact with the interface to set the gas price when sending transactions to the Ethereum. By analyzing the properties of gas together with the existing methods to create stablecoin, we can later propose what properties stablecoins should attain.

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10 Appendix

A The current state of stablecoins (might be needed for the paper)

Stablecoins have a market value of \$3 billion and this corresponds to the 1.5% of the total market value of the cryptoassets [2]. Each proposing different properties, stablecoins can be categorized into three groups based on the way they achieve stability: fiat-collateralized, crypto-collateralized, and non-collateralized.

1) Fiat-collateralized stablecoins: These types of stablecoins are backed by fiat currency. Generally, there is a 1:1 peg between the fiat currency and the stablecoin that indicates a convergence between their values [3]. While USD is currently the most common choice to back the stablecoin, IBM states that they are also interested in projects that use other national fiat currencies, as they will be helpful for their blockchain integration [6]. Tether and TrueUSD are prominent examples of USD pegged tokens.

Discussion about centralization: In order to back up with stablecoins with fiat, one needs to place trust on a third party. Centralization ensures that the amount of money to back the stablecoin with, is held in an account [11] and the peg is attained. However, involvement of a third party causes controversy, as the third party can deny giving money to the users. Tether explains this point as follows [9]:

“Redemptions will not be unreasonably denied, but we reserve the right to selectively deny redemption and creation of Tethers on a case-by-case basis.”

2) Crypto-collateralized stablecoins: These types of stablecoins use other cryptocurrencies as a back up value rather than fiat currency.

Over-collateralization is needed in this case as the underlying cryptocurrency is also volatile [3]. MakerDAO and Reserve use this approach – utilizing a smart contract to back the stablecoin with another cryptocurrency [6].

If there is a black swan event ⁸ where the underlying currency loses its value and does not worth anything, the stablecoin also loses its value [12]. Due to the over-collateralization in this type of stablecoins, the loss of value will be drastic. This is the reason that a group of experts strongly discourage this approach.

3) Non-collateralized stablecoins: Unlike the previous types, this group of stablecoins are not backed by fiat currencies or another cryptocurrency. Here, the stability is achieved algorithmically which helps to provide better scalability [2].

Basis is one of the first projects of this type that achieves price stability using the dual-token model [9]. In this method, there is dynamic adjustment of the existing supply of the stablecoin. While one token is stable, the other is used to achieve the stability of the value. If the value of Basis increases (an increase over \$1), more Basis tokens are produced to increase the supply which will lead to a decrease in the price and if there is a decrease in the price, a bond that is worth a Basis token is issued and some Basis tokens are bought to decrease the supply [7].

B Issues that stablecoins address

As mentioned in Section ??, currencies have to serve as a store of value, a unit of account, and a medium of exchange [13]. To do so, they have to denote a minimum level of value stability. In this regard, stablecoins are proposed to fulfill these properties, due to their non-fluctuating value compared to fiat currencies or any other alternative *e.g.*, commodity. In addition, they purport to solve a group of critical issues that were introduced by cryptocurrencies. In this section, we discuss these issues.

⁸A black swan event is characterized as being unexpected, random and having significant effects to the current situation. This type of an event is hard to predict [1].

B.1 Cryptocurrencies as Medium of Exchange

Despite the fast growth of the cryptocurrencies and decentral applications, there is still little deployment of them in the daily payment procedures of businesses. The main reason is that these assets are volatile in the price and hence highly risky to be deployed by merchants and retailers *i.e.*, it is impossible for a company employer to provide the employees' incomes in a volatile cryptocurrency *e.g.*, BTC that has a high level of future value and price uncertainty. On the other hand, having a stable price over the time, stablecoins can serve as a true medium of exchange, while they preserve all the advantages of using cryptocurrencies as opposed to fiat currencies.

B.2 Cryptocurrencies as Unit of Account

Money has to serve also as a unit of account– the common measure that sets price to goods and services. Fiat currencies *e.g.*, USD, EUR *etc.* serve this functionality correctly, so they are used as units of account in the US and Europe respectively. Unfortunately, cryptocurrencies such as BTC, not having a stable price, do not seem to be used as a unit of account, hence will not be able to serve as money. However, given the price stability that stablecoins offer, they have a higher chance to be used as a digital representation of a unit of account.

B.3 Cryptocurrencies as Store of Value

Any asset, commodity, or money that maintains its value is called a store of value. As mentioned in Section ??, highly volatile cryptocurrencies (*i.e.*, Bitcoin) cannot fulfill this property of money, as they cannot maintain their purchasing value for long-term. In contrast, stablecoins can be accepted as a store of value as their price remains stable over the time.

B.4 Lending with Cryptocurrencies

B.5 Remittance

Although cryptocurrencies, especially Bitcoin, play a revolutionary role in financial systems, they are yet not easy to transact with due to their volatile characteristics. Therefore with stablecoins, one can benefit from decentralized nature of the token, while there is no price volatility risk. In addition, stablecoins make the cross border payments, remittances, easier.