CORRELATION OF THE RETURNS OF SELECTED STABLECOINS WITH BITCOIN AND ETHEREUM

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Abstract

The phenomenon of cryptocurrencies has become one of the most controversial topics in the last few years, both among the professional public in economics and finance and among ordinary people who trust and invest in them. The main goal of the work is to find out the correlation between stablecoins that failed and did not maintain the promised stability around their peg and prominent cryptocurrencies with a large market capitalization, namely Bitcoin and Ethereum. The task is to find out the connection of stablecoins to significant cryptocurrencies. With a high correlation, these stablecoins cannot be stable if they are connected to a highly volatile asset. Price movement data of selected cryptocurrencies are used with a daily resolution from freely available portals. The correlation is calculated based on the primary return indicator and the Pearson correlation coefficient. The calculations show that the returns of QCash and NuBits cryptocurrencies are correlated with Bitcoin and Ethereum, and this correlation was not confirmed for the other studied failed stablecoins.

Keywords: stablecoin, cryptocurrency, correlation

JEL Classification: G11, G12, 039

Introduction and theoretical background

Cryptocurrency is a subset of the class of digital currency Chuen (2015). Cryptocurrency is also virtual or digital currency (Mufty, 2017). The term cryptocurrency is used because all transactions and issuance of new units use a cryptographic system developed using blockchain technology DeVries (2016). In general, cryptocurrencies, or virtual currencies, can be defined as a medium that functions as a currency, i.e. it can be exchanged for services or goods, but unlike standard fiat currency, it is not bound and independent of geographical borders, central banks, or other sovereignties or authorities. Such currencies implement mechanisms for the exchange of digital information and are built on cryptographic methods that ensure the security of transactions and, at the same time, their verifiability Maese et al. (2016). They have overgrown in price and popularity Foley et al. (2019). The investment use of cryptocurrencies instead of their use as currency by ordinary people is mainly used

because they are highly volatile (Swan, 2015). The so-called stablecoins Kolodziejczyk (2020) should solve their high volatility. A stablecoin continues to be a digital currency (cryptocurrency) that attempts to offer price stability while offering an additional level of security against being backed by a reserve asset such as an already existing fiat currency (e.g., USD, EUR), gold, or even another cryptocurrency. Stablecoins were designed to dramatically reduce volatility concerning cryptocurrencies such as the Bitcoin mentioned above (BTC) or Ethereum (ETH). The advantage over the asset to which the stablecoin is linked is its implementation with the help of blockchain technology. Such cryptocurrencies are cryptographically secured, allowing users to transact almost instantly without double spending or an intermediary. Furthermore, it is possible to integrate them with smart contracts Liao (2022) programmatically due to blockchain technology. The first such cryptocurrency was BitUSD.

Stablecoins are simply cryptocurrencies with a stable value. Since it is a cryptocurrency, it is generally not controlled by any government; it can be quickly sent or received, even across national borders, without interference from the authorities. Unlike most other cryptocurrencies, it does not suffer from ailments such as high volatility, which would prevent its use in everyday life as a payment for goods and services Samani (2018). For quantification, it is necessary to add that the volatility of, e.g. cryptocurrency Bitcoin against the US dollar is ten times higher than the volatility among major international fiat currencies Yermack (2015). The stability of stablecoins is solved by tying the value of the given stablecoin (so-called peg) to another currency (e.g. USD), commodity (gold), or another financial instrument. Stablecoins pursue price stability by holding reserve assets as collateral or using algorithmic formulas to control supply Hayes (2022).

Due to different implementation options, stablecoins can be divided into several groups, depending on how their stability is achieved:

Collateralized stablecoins
Crypto-Collateralized stablecoins
Algorithmic stabilization

The main task of stablecoins was to solve the high volatility of traditional digital currencies in order to be able to use the advantages of cryptocurrencies in the standard payment system for services and goods. There are currently around 200 stablecoins (Portal 101 Blockchain) in circulation, primarily used to facilitate the trading, borrowing, or lending of other cryptocurrencies in online marketplaces. Countless people put their trust in them, saying they are the monetary system's future. Although the idea is to have a stable digital currency, stablecoins also carry a risk that is even higher because they claim to represent a specific stability. Thus, one of the most significant risks is the risk of a high loss of value of the cryptocurrency that implements the stability mechanism. This risk is written into stablecoins that gained popularity but ultimately failed. By the end of 2022, we registered up to 23 failed (Portal CryptoSec) stablecoins. One of the most significant impacts on investors was the fall of the Terra/ Luna stablecoin.

The reason for calculating the correlation of stablecoins with Bitcoin and Ether is to determine whether stablecoins are tied to these significant cryptocurrencies. In their work, the authors Hoang & Baur (2021) investigated the stability of stablecoins through correlation, but such stablecoins, which are working until now, did not fall or lose their peg during the examined period. Thus, they examined stablecoins that are large, their market capitalization is higher, and did not experience significant price

fluctuations, e.g. Tether (USDT), USD Coin (USDC), Paxos Standard (PAX), True USD (TUSD). According to their claims and the work results, stablecoins should show a correlation of returns with more substantial cryptocurrencies with a large market capitalization; mainly, it is a correlation with the bitcoin cryptocurrency, so we decided to investigate this correlation. If the correlation is significant, then stablecoins cannot be stable. It is very volatile if they are strongly linked to an asset, like Bitcoin Hoang & Baur (2021). We will focus on the correlation of the returns of those stablecoins that did not maintain stability around their peg. These cryptocurrencies were not addressed in the mentioned article.

Material and methods

We chose an approach where we first get data for stablecoins that are known to have failed, i.e. lost their peg to the FIAT currency they were tied to. For this selection, we will use commonly available data sources from providers including Coinmakertcap (https://coinmarketcap.com/), Nomics (https://nomics.com/), and Finance Yahoo (https:// finance.yahoo.com). The mentioned portals provide freely available historical data with a daily resolution. Using the available Python programming language, we obtained this data from the given portals and edited it into the required standardized form. We need an overview of a sufficiently large time horizon without the need for high granularity to choose cryptocurrencies for analysis. Therefore, we obtained the data at a daily resolution since, in this form, the time developments of crypto-currencies are available on most portals dedicated to cryptocurrencies or finance. The time horizon for the given data will not be the same since different stablecoins were created in different periods and mainly ran into problems or maintained specific stability at different points.

Thus, the choice of stablecoins for analysis is given by a simple key. We will select stablecoins whose linkage to the selected asset was maintained in a favorable ratio with this asset, and at a certain point in time, it was the case that the value of the given cryptocurrency diverged from the value of its peg. By a favorable value ratio, we will understand the state when the value of the stablecoin deviated negligibly from the value of its asset compared to the values after the collapse. In other words, we used stablecoins that can be considered close to their peg for a certain period of their lifetime and lost their peg in a specific part of their lifetime, or their peg ceased to exist.

Further in the analyses, we will operate with returns as the fundamental quantifier of the asset. As profitability, we will consider the commonly used logarithmic profitability, which is understood as the natural logarithm of simple profitability and is calculated as

$$x_i = \ln \frac{P_i}{P_{i-1}} \tag{1}$$

where P_i represents the value of the interest at the end of the time subinterval i a P_{i-1} and the value of this interest at the end of the time subinterval *i-1*. Such a calculation is fully consistent with the work of Hoang & Baur (2021).

For our work, we will use the Pearson correlation coefficient to calculate the correlation between two quantities as calculated in the article by Hoang & Baur (2021), even though logarithmic returns do not satisfy the normal distribution condition, but more alpha-stable distribution Parker (2022). In statistics, Pearson's

correlation coefficient (Pearson's product-moment correlation coefficient) expresses a measure of linear correlation between two data sets. For two data sets X and Y, where $\in X$ and $\in Y$, the correlation between these sets is calculated using the relation

$$r_{xy} = \frac{\mathrm{Cov}(X, Y)}{\sigma_X \sigma_Y} \tag{2}$$

where Cov represents the operator of the covariance, and is the standard deviation of given sets X and Y respectively.

To double-check our results, we also compute the Spearman correlation coefficient. Spearman correlation assumes that two variables can be described using a monotonic function instead of a strict linear function as in the case of Pearson correlation. We will compute spearman correlation via

$$r_s = \frac{\mathrm{Cov}\,(R(X), R(Y))}{\sigma_{R(X)} \sigma_{R(Y)}} \tag{3}$$

where *Cov* represents the operator of the covariance, R means the rank of a given variable, and σ is the standard deviation.

Results and discussion

Selection of stablecoins

The goals we have set in the work, and the related questions we want to answer, have a familiar character, namely that it is a group of cryptocurrencies called stablecoins, which in some way have not been successful, have lost stability, be it temporary or permanent. Figure 1 shows the time courses of any stablecoins in the selected time interval that became unsuccessful in time and could not maintain a peg to their asset for various reasons. It houses the infamous TerraUSD (ticker USTC), Coffin Dollar (COUSD), bitUSD, DefiDollar (DUSD), Open Dolar (USDO), DEI (DEI), BondAppetite USD (USDAP), NuBits (ticker USNBT) and Qcash (ticker QC). The dashed line shows the peg of individual stablecoins.

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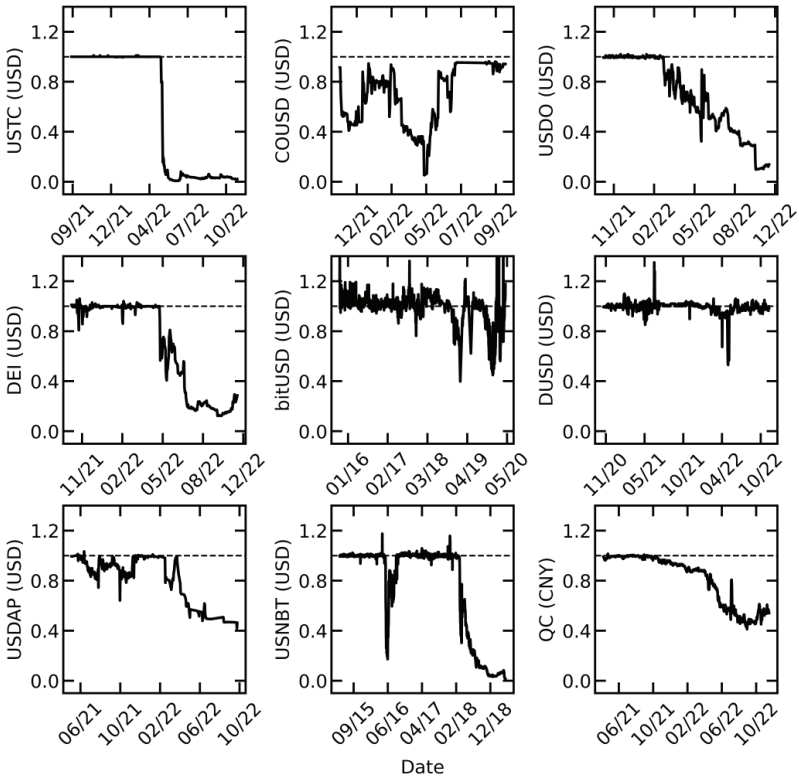
Figure 1 Failed stablecoins. Individual charts show the price of a given stablecoin in time, with its peg depicted as a dashed line.



Source: Authors' elaboration based on the data from the Finance Yahoo portal.

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All of these stablecoins except QC were designed with a peg to the US Dollar (USD) except the last mentioned QC, which was designed with a peg to the Chinese Yuan (CNY). When calculating the correlation, we considered stablecoins that lost their peg and did not return to it in the observed time horizon. These are stablecoins Terra (USTC), USD Open dollar (USDO), DEI, Bond Appetite USD (USDAP), Qcash (QC), and NuBits (USNBT). In order to confirm the behavior of our calculations, we also included in the analysis the stablecoin Tether (USDT), whose correlation with Bitcoin was

calculated in the article by Hoang & Baur (2021). In the article mentioned above, Hoang & Baur (2021) focused on the correlation of stablecoins that were stable throughout their lifetime and calculated it based on data from October 2018 to December 2019. While we calculate the correlation of stablecoins that did not maintain stability, and the time window will be at the time of stability of stablecoins. The time windows of the calculated correlation of stablecoins with Bitcoin and Ethereum can be seen in Table 1.

Table 1 Selected stablecoins and time window of computed returns correlation

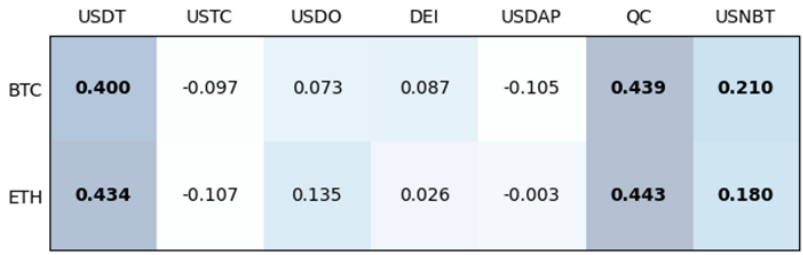
Cryptocurrency name	Ticker	Pegged to	From	To
Tether	USDT	USD	31.10.2018	26.12.2019
Terra	USTC	USD	1.6.2021	30.4.2022
USD Open dollar	USDO	USD	1.8.2021	28.2.2022
Dei	DEI	USD	1.11.2021	1.5.2022
Bond Appetite USD	USDAP	USD	10.12.2021	10.3.2022
Qcash	QC	CNY	15.2.2019	1.10.2021
NuBits	USNBT	USD	1.10.2016	1.3.2018

Source: Authors' elaboration based on the data from the Coinmarketcap portal

Correlation of the returns of selected stablecoins

Based on the formulas mentioned in the Data section, we calculated the return and, subsequently, the Pearson and Spearman correlation of selected stablecoins, including Tether, with Bitcoin and Ethereum. In Figures 2 and 3, we can see the correlation results.

Figure 2 The Pearson correlation of stablecoins with Bitcoin and Ethereum counts. With bold font are denoted values with a 5% significance level.



Source: Authors' elaboration based on the data from the Coinmarketcap portal

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Figure 3. The Spearman correlation of stablecoins with Bitcoin and Ethereum counts. With bold font are denoted values with a 5% significance level.

	USDT	USTC	USDO	DEI	USDAP	QC	USNBT
BTC	**0.425**	-0.102	0.060	0.083	0.024	**0.532**	**0.130**
ETH	**0.464**	**-0.136**	0.059	0.004	0.113	**0.577**	**0.136**

Source: Authors' elaboration based on the data from the Coinmarketcap portal

Based on the results shown in figure 2, for Pearson correlation, with methodological consistency with the paper Hoang & Baur (2021), we can conclude that Tether, Qcash, and NuBits with a significance level of 5 % have a bead with Bitcoin and Ethereum. For these cryptocurrencies, the null hypothesis was rejected. The null hypothesis, in this case, means that stablecoins are uncorrelated, so the correlation is 0. The alternative hypothesis means that cryptocurrencies are correlated. The correlation of Tether with Bitcoin was confirmed to us in the article by Hoang & Baur (2021), with a slight deviation of the result by 0.07. Terra and Bond Appetite USD negatively correlate with both examined cryptocurrencies. With stablecoins USD Open dollar and Dei, we found a slight positive correlation, which from the results and interpretation of the Pearson correlation coefficient, shows no correlation between them.

A slightly different approach obtained the results. Thus, we can conclude very similar results using a more generalised Spearman correlation. The only difference is that regarding this approach, we can also see the correlation of USTC with Ethereum.

Conclusion

Several cryptocurrencies suffered the fate of high volatility and thus lost the trust of their investors. For this reason, we decided to examine some cryptocurrencies that were said to be stable. For a while, they looked like they could hold their peg. Nevertheless, there came a time when their price fell out of sync, the value dropped, and they could never recover to their peg value because users and investors lost interest in them. Such a failure can take several forms. One of them is stablecoins, which at a certain point in their lifetime, intensely stopped following the asset concerning which they had a peg in such a way that they were unable to rise to the present, and thus there is a strong assumption of their complete failure. The second case was stablecoins when the very design of the cryptocurrency caused a significant fluctuation around its peg; its value fell, experienced instability, but eventually returned to the value of the peg. Such stablecoins include, for example, Coffin Dollar USD (COUSD-USD). The development and, thus, the fluctuation of selected cryptocurrencies can be seen in Figure 1.

Our goal was to examine the correlation of returns of failed stablecoins at the time of their price stability with cryptocurrencies with a large market capitalization

- Bitcoin and Ethereum. For the correctness of our calculations, we used the Tether token for the calculations, where we were confirmed to be tied to Bitcoin and Ethereum, as well as QCash and NuBits. In other failed cryptocurrencies such as Terra, USD Open dollar, DEI, and Bond Appetite USD, this dependence on returns was not confirmed for us. The reason for examining these cryptocurrencies was to verify the claims from the works of Hoang & Baur (2021) and Kristoufek (2020), according to which stablecoins should show a correlation of returns with more substantial cryptocurrencies with a large market capitalization, mainly a correlation with the bitcoin cryptocurrency.

As another subject for work, we propose to find out if any indicator would predestinate them to extinction from a specific moment.

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