What makes private stablecoins stable?

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Abstract

Stability of crypto assets, in terms of their exchange rate vis-à-vis fiat currency, is an elusive goal. This note argues that for privately issued stablecoins to be successful in terms of delivering stability vis-à-vis current fiat money, they need to "piggy-back" from the credibility of the prevailing fiat money systems. The latter in turn are backed by publicly supported financial safety net. One way to "piggy-back" on the credibility of the latter is for the private issuer to suggest that stablecoins issued are collateralised by existing fiat money. Using data for the prices of 34 different stablecoins and the fiat currency or other assets the former promise to be pegged to, we apply a set of dynamic panel regression in order to investigate what determines relative stability. We find evidence that the design of stablecoin stabilisation mechanisms, and in particular the extent to which fiat money is used as collateral, as well as the presence of external auditors of such backing to enhance the credibility of such backing is crucial for the stability in terms of exchange rate of privately issued stablecoins, controlling for other factors of price developments of stablecoins.

1. Introduction

The history of financial innovation is littered with complex terms and acronyms. By contrast, one very recent financial innovation is simply called "stablecoin", and it essentially promises to be stable "digital cash". The term conveys the notion of simplicity, that is, what immediately comes to mind is a coin that can be exchanged against goods or stored to transfer purchasing power into the future. Related to the latter, the term suggests that is stable in value in some dimension. The impression of simplicity might be deceptive, however, and the present work digs down a bit deeper to clarify what stablecoins are.

The report argues that stablecoins need to be understood against the background of Bitcoin, which set out to provide an alternative to the money being created by central banks and banking systems. The initial idea of the originator of Bitcoin was to establish a peer-to-peer payments system, which did not involve a traditional commercial bank nor a central bank. Payments would not have to rely on either one of these institutions and in that sense, it would be comparable to how physical cash is currently being used, although this time in digital format. If such a coin was to be widely accepted, it could become a competitor to current money produced by banks and central banks.

Bitcoin has not succeeded in becoming money in particular because of its considerable volatility vis-à-vis with fiat currency. Stablecoins, sometimes referred to as the next-generation cryptocurrencies with Bitcoin being part of the first generation, promise to address that weakness head-on. Since 2015, many stablecoins have been issued and their market capitalization is growing. Could these crypto assets become currency, just like current fiat money? So far, the international monetary policy and regulatory community avoids referring to these assets as cryptocurrencies, unlike some of the trade press. That said, there are suggestions that these

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private coins could become the fulfilment of the Hayekian notion of currency competition, whereby types of money are being privately created. These developments beg the following question: Should central banks be getting concerned about this private competition for the status of money?

The short answer is no, at least not yet. The relative quantitative importance is still comparatively limited, although it is growing. Also, some new proposals, such as that for project Libra, appear to have accelerated investigations by public institutions including in particular central banks of the question of issuance of central bank digital currencies. Such digital currencies could be construed of as responses to the growing competition from private digital candidates for money. Or, it could be seen simply as a natural evolution in the thinking of central banks about elements to improve the efficiency of the current payment system, which is considered slow, costly and obscure especially when it comes to cross-border transactions. Be that as it may, the example of bitcoin suggests that stability of the value of a digital asset in terms of fiat money price is a crucial determinant of the success of that asset as a means of exchange or unit of account, and bitcoin seems to have so far failed to provide these functions. Rather, it seems to have been considered a speculative investment. A widely held view is that its instability vis-à-vis the US dollar (as well as other fiat currencies) remains a key obstacle to become private money. Stablecoins have been proposed to address this issue.

Some terminology is in order. A stablecoin is defined here by three criteria, which are as follows:

i) a digital token, which is traded on a crypto asset exchange platform and promises a more or less stable exchange rate in relation to something, which could be fiat currency such as the US dollar, or other another asset.

ii) The token aspires to become money, at a minimum to perform its store of value and payments function; if successful in this regard, it would be more similar to digital cash rather than credit money.

iii) The token might (or might not) be backed by something.

The third criterion is not restrictive. In fact, it says that the coin might be backed by something. That is, in practise, stablecoins differ depending on their backing mechanism. The key argument advanced in the present paper is that the quality of the backing is a crucial determinant of the stability of the coin in terms of its exchange rate vis-à-vis with current fiat money. In particular, stablecoin tend to be more stable the more fully they are collateralised by fiat money and the more *credible* the collateralisation is. In this context, financial activity regulatory licenses and regular formal audits tend to enhance such credibility.

The paper is organized as follows. Section 2 provides a brief overview of selected aspects of the stablecoin "landscape", defining different approaches to achieve stability and explaining the hypothesis investigated and empirical methodology used. Section 3 describes the data used and presents some simple descriptive statistics. Section 4 presents the results of on empirical analysis of the determinants of price stability for stablecoins. Section 5 concludes.

2. Hypothesis investigated and methodology

2.1 Hypothesis investigated

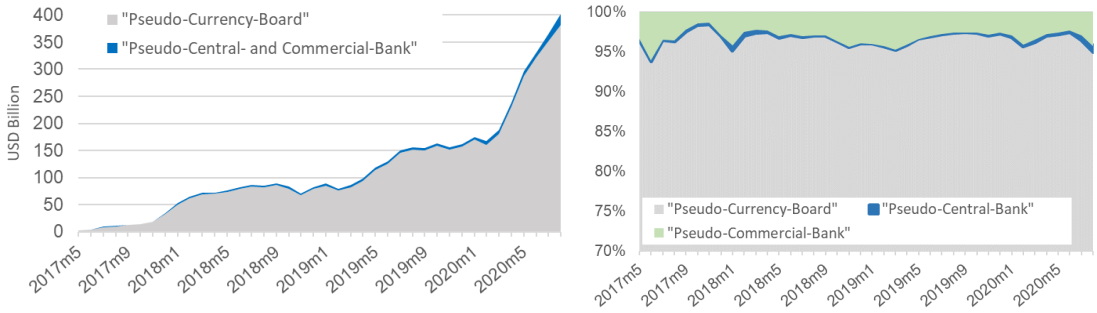
Broadly, three different approaches to establishing trust in the stability of value of the token could be distinguished. They differ essentially with regard to the redemption promise and the guarantee backing that promise. One way is to promise to redeem the token at par against a unit of fiat currency, say the USD, just as banks promise to return USD in the case of withdrawals from deposit accounts. This type of stablecoin is referred to here as "*pseudo-currency-board*" stablecoin (*PCurBoard*). Another way is to create a protocol that maintains parity to fiat currency without however promising redemption at par. Under one such approach, individuals obtain new

stablecoins by borrowing, that is they receive them in exchange for promises to pay them back in the future. These promises in turn are backed by collateral provided by the borrower. Thus, the approach is similar to a commercial bank creating bank deposits when a customer is taking out a bank loan against the pledge of some collateral. The token is therefore referred to here as "*pseudo-commercial-bank*" (*PComBank*) stablecoin. Yet another approach consists of a protocol involving stabilizing the price of a stablecoin by buying or selling a second interest-bearing token. This type of stablecoin is referred to here as "*pseudo-central-bank*" (*PCenBank*) stablecoin. These terms borrow from arrangements in the current monetary system, and they are chosen to highlight some important *economic* aspects of the stabilization approach. They should not be confused with the institutions present in the current monetary system, such as currency boards to defend a currency peg, commercial banks (nor their own internal coins such as e.g. JPMCoin, use of which requires one to be a customer of and have an account with JPMorgan) or central banks nor the digital currencies they might issue. Incidentally, the latter, if issued, might directly inherit the quality as fiat money.

Conceptually, *PCurBoard* stablecoins involve establishing links to the publicly supported financial safety net. They thus benefit from the trust that comes with it. By contrast, *PCenBank* and *PComBank* stablecoins come somewhat closer to the idea of Hayek (1976) for types of money being privately created and competing with public money. One fundamental shortcoming of this approach is that they cannot rely however on a publicly (or privately) supported financial safety net to instil trust and prevent a run on the debt being created.

The fundamental assumption made here is that, to be successful in terms of stability vis-à-vis current fiat money, private stablecoins need to piggy-back from the credibility of the prevailing fiat money systems that is in turn backed by the publicly supported financial safety net. One way is for the private issuer to suggest that stablecoins issued are backed by existing fiat money. In this context, we test the hypothesis that *PCurBoard* stablecoins are more stable vis-à-vis fiat currency than are the other two stabilisation approaches. The former stablecoins are typically collateralised by assets in the form of fiat currency, although they might also in some cases be backed by gold or other commodities. Incidentally, while the market capitalisation of stablecoins measured in US dollar has been growing (Figure 1, left panel), the share of these stablecoins in terms of market capitalisation as of all stablecoins has only mildly been increasing over time (Figure 1, right panel).

Figure 1: Market capitalization of selected stablecoins



Note: Market capitalization of selected stablecoins in our sample. Values are in USD Billion (left panel) and percentages (right panel). Source: Estimates based on Coinmarketcap.

Another way for a private stablecoin issuer to establish or strengthen the link of stablecoins to the prevailing fiat money system is by seeking financial regulatory licenses and regular formal audits of the balance between stablecoins issued and collateral held as backing of such issuances. In this context, we test to what extent the existence of either regulatory licenses or formal audits enhance the stability performance of private stablecoins. In the case of both hypotheses, we control for a number of other potential determinants of stablecoin developments,

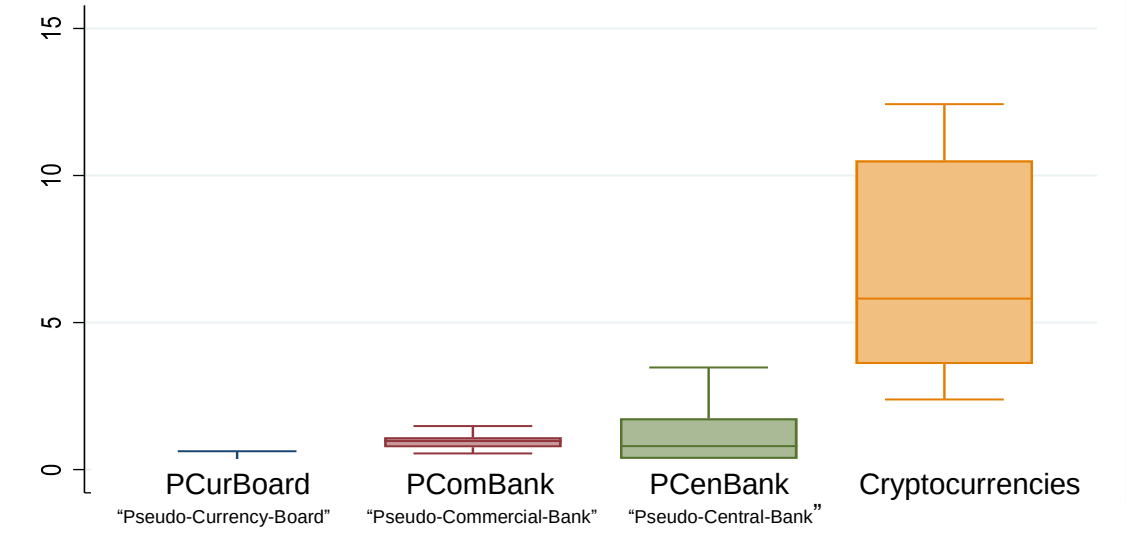
such as their market capitalisation, historical stability performance and lifetime, as well as broader crypto asset market developments (as proxied by developments in bitcoin which accounts for most of the market in terms of market capitalisation).

All the coins considered in our empirical analysis are tradeable, in principle by anyone, on crypto asset exchanges (and thus does not include stablecoins such as *JPM Coin* nor *Libra* that has been proposed for issuance). A simple measure of volatility of selected examples of stablecoins from each of these three categories of stablecoins is provided on Figure 2, together with Bitcoin for reference. The example, incidentally, is consistent with our first hypothesis.

Some related work exists. Lyons and Viswanath-Natraj (2020) find that trades of private market investors, as for example opposed to reserve management on the part of the stablecoin issuer, tend to stabilise prices around the peg of stablecoins. Moreover, they find that arbitraging activity increases as the stablecoins is traded on additional exchanges, thus increasing investor access, and resulting in significantly lower volatility. The authors consider data on prices as well as order flows of stablecoins, focusing however primarily on Tether. Data on five other stablecoins is used to form a control group to assess the relevance of the migration of Tether to an additional exchange and to describe recent developments across stablecoins during the Covid-19 pandemics.

Makarov and Schoar (2020) find that there can be persistent price differences for the same crypto asset across different exchanges, with most but not all likely explained by the existence of national capital controls, as the divergences between different exchanges tend to be larger across rather than within countries. The work is part of a literature on the functioning of trading and arbitrage in crypto assets, and is thus not directly but more loosely related to our work. We might however want to mention the observation that there can be persistent price differences for the same crypto asset across different exchanges.

Figure 2: Volatility of selected stablecoins



Note: Standardized 15-day rolling averages of historical volatility of daily returns, as measured since beginning of 2016. Cryptocurrencies includes the top 10 cryptocurrencies according to the trading volume and market cap. The other categories include the stablecoins considered in this work. Boxplots show interquartile range, mean and excludes outliers beyond 1.5 times the interquartile range. Source: estimates based on Coinmarketcap.

Bullman et al. (2019) describe the functioning mechanism of different stablecoins, and propose a taxonomy based on the stabilization mechanism and what is backing the value, identifying four types: tokenised funds, where the stablecoins are backed by funds that are retained by a custodian; off-chain collateralized stablecoins where the assets are in the possession of the

issuer until the user claim the assets back; on-chain collateralized stablecoins, where the usually crypto-assets are held in a decentralized manner: and finally, supported only by users' expectations about the future purchase power of the stablecoin, defined as algorithmic stablecoin. This classification is qualitatively similar to ours, but we focus more on the stability of the currency and the intrinsic characteristics of the stablecoins that might be linked with the financial safety net.

Griffin et al. (2020) provides an in-depth analysis on the connections between Bitcoin and Tether, finding evidence of price manipulation in the cryptocurrencies ecosystem. Baur et al. (2020) analyse six stablecoins to verify whether the stablecoins might be a safe haven for Bitcoin investors, finding that stablecoins are not consistently stable at all times, especially when the volatility of the Bitcoin is high and the price is falling rapidly.

Our work differs in several respects. First and foremost, we place a sharper focus on design aspects of stablecoins, including in particular their links to the existing publicly supported financial safety net and aspect related to their governance and transparency. What aspects of the design of stablecoins tend to make them more stable? Reflecting this difference in focus to the above-mentioned study, we consider a larger number of stablecoins, that is altogether 34 in our analysis. Second, we use a different methodological approach. In particular, we exploit both cross-sectional information on design elements as well as changes over time.

From the regulatory perspective, the announcement of Libra in 2019 produced an unprecedented response from the regulators at a global level, albeit the phenomenon of stablecoins started years before.[2] The first coordinated response from the G7 Working Group on Stablecoins wars about the potential risks of global stablecoins, especially for the transmission of monetary policy.[3] The Financial Stability Board issued a consultation report aimed to address the regulatory issues raised by global stablecoins, in an attempt to find a common response to the phenomenon, considering also the potential benefits for emerging markets and developing economies.[4] At the European level, the European Commission and the Council[5] released a joint statement, where they firmly affirm "no global "stablecoin" arrangement should begin operation in the European Union until the legal, regulatory and oversight challenges and risks have been adequately identified and addressed." However, their advice is to have a coordinated common response to develop a new EU legislation on crypto-assets, including stablecoins. Finally, the European Central Bank (ECB) released an analysis carried out by the ECB Crypto-Assets Task Force (European Central Bank, 2020) where they analyse the risks in view of the emerging stablecoins initiatives and in case of a broad adoption. One potential risk is the so-called liquidity run, where financial users might lose confidence in the instrument and ask for redemption massively. This potential risk underlines the importance of the collateral for stablecoins and crypto assets in general.

2.2 Methodology

The following section describes our econometric methodology. We consider four types of measures of price stability: (1) the simple monthly standard deviation of returns: (2) a moving average 15 days' standard deviation of returns; (3) the deviation of the price in levels from the peg; and (4) the half-life. The monthly standard deviation is calculated from the daily returns of the stablecoins prices for a time interval of one month. The moving average 15 days' standard deviation is calculated from the daily returns using a window of 15 days, and then averaged across the month. The deviation from the peg is simply the closing price minus one, expressed in basis point, and can be positive or negative. A positive deviation indicates that the stablecoin is trading at premium, while a negative deviation indicates that the stablecoin is trading at

[2] In our database, the first observations for NuBits and bitCNY are dated September 2014, and for Tether February 2015. For reference, Bitcoin and Litecoin are populated since April 2014.
[3] See G7 Working Group on Stablecoins (2019).
[4] See FSB (2020)
[5] See Council of the European Union (2019)

discount. The half-life, in number of days, is the speed of mean reversion, and represents the time horizon (in days) that the price need, on average, to halve its distance from the peg. In other words, it represents the time where a shock will dissolve by 50%. It is calculated running an autoregressive process of order 1, or AR(1) on the deviation from the peg, and applying the following formula:

$$Half\ life = \frac{\log 0.5}{\log |\emptyset_1|}$$

where $\emptyset_1$is the coefficient in the equation $dev_t = \alpha + \emptyset_1 dev_{t-1} + \varepsilon_t$, with $|\emptyset_1| < 1$. The half-life is calculated considering a time frame equal to three months, in order to have at least around 75 observations to estimate the AR coefficient. The value is calculated daily and then averaged across the month. The units are number of days.

Let $i=1,..,N$ the index for the stablecoins in the sample, and $t=1,..,T$ the time series dimension of the panel (in months), we consider three different specification of our dynamic panel regression.

The first specification regards the type of stablecoins considered in our framework, which could be PCurBoard, *PCenBank*, or *PComBank* The regression is formally:

$$Y_{i,t} = \alpha + \gamma Y_{i,t-1} + \beta_1 CUB_{i,t} + \beta_2 CB_{i,t} + \beta_3 Volume_{i,t} + \beta_4 Lenght_i + \\ + \beta_5 BitRet_t + \beta_6 BitVol_t + \phi_t + \varepsilon_{i,t}$$

where $Y_{i,t}$ represents the four measures of price stability considered, for coin *i* and month *t*; $Y_{i,t-1}$ refers to the one-period lagged value of the dependent variable $Y_{i,t}$; $CUB_{i,t}$ and $CB_{i,t}$ represents a dummy variable that assume the value of 1 if the coin belong to the *PCurBoard* or *PCenBank* type. We exclude the dummy for *PComBank* stablecoins, that serves as a reference in our panel regression. Length represents the length, in days, since the currency exists our database; $BitRet_t$ is the average daily return of the bitcoin for month t; $BitVol_t$ is the average change (delta) trading volume from the previous to the actual month for the bitcoin. We decide to include the bitcoin return and trading volume given the strong connections between the trading activity of these two cryptocurrencies (see Griffin et al., 2020). Finally, ϕ_t represents a month fixed effect.

The second specification regards the collateral declared to be used by the stablecoin issuers, which might take the form of Fiat money, Commodities (gold in our sample), crypto-assets, or without collateral, where the stabilization is carried out through algorithmic control of the demand of supply or stablecoins. We refer to the latter as algorithmic collateral. Formally

$$Y_{i,t} = \alpha + \gamma Y_{i,t-1} + \beta_1 Fiat_{i,t} + \beta_2 Com_{i,t} + \beta_3 Algo_{i,t} + \beta_4 Volume_{i,t} + \beta_5 Lenght_i + \\ + \beta_6 BitRet_t + \beta_7 BitVol_t + \phi_t + \varepsilon_{i,t}$$

where $Y_{i,t}$ represents the four measures of price stability considered, for coin i and month t; $Y_{i,t-1}$ refers to the one-period lagged value of the dependent variable $Y_{i,t}$; $Fiat_{i,t}$ and $Com_{i,t}$ represents a dummy variable that assume the value of 1 if the collateral is Fiat money or gold. *Algo* refers to algorithmic collateral. We exclude the dummy for crypto-assets collateral, which serves as a reference. The other control variables are the same of the previous specification.

The third specification includes a dummy variable for the presence of a license or if the issuer of the stablecoin declared to be audited, in order to verify the presence and the availability of the collateral. Formally:

$$Y_{i,t} = \alpha + \gamma Y_{i,t-1} + \beta_1 X_{i,t} + \beta_3 Volume_{i,t} + \beta_4 Lenght_i + \beta_5 BitRet_t + \beta_6 BitVol_t + \phi_t \\ + \varepsilon_{i,t}$$

where $Y_{i,t}$ represents the four measures of price stability considered, for coin i and month t; $Y_{i,t-1}$ refers to the one-period lagged value of the dependent variable $Y_{i,t}$; $X_{i,t}$ a dummy variable

that assume the value of 1 if the issuer has a license, or if the issuer is audited. The other control variables are the same of the previous specification.

3. Data and descriptive statistics

Our empirical analysis relies on data obtained from Coinmarketcap, which is a crypto asset market information service providing daily data on prices and market capitalization in US dollars of more than 2000 crypto assets, as well as various of their design features. Unfortunately, the database does not directly identify stablecoins, as defined for the purposes of the present study, nor does it provide a systematic and complete description of all features of crypto assets that are considered in our study in the analysis of stablecoin features. We thus use some judgement in i) identifying stablecoins from the large list of crypto assets and ii) in identifying their stabilization approach, type of collateral used (if any), licenses, and presence of a formal audit. In doing so, we tend to rely however as much as possible on the existing literature: Coinmarketcap explicitly identifies some crypto assets as stablecoins[6] and there are additional lists of stablecoins from specialized websites.[7]

Our final dataset consists of 34 stablecoins. 15 are *PCurBoard* stablecoins, another 12 are *PComBank* and yet another seven *PCenBank* stablecoins. In terms of collateral used, 26 stablecoins have at least some forms of collateral, either in form of fiat money (13 stablecoins), gold (2 stablecoins), or a combination of fiat money and crypto assets (11 stablecoins). Eight stablecoins have no collateral. 11 stablecoins report to have at least one regulatory license and 12 stablecoins report that they are being formally audited, although in the case of two of them it is hard to verify whether their activity is in fact audited or not. 21 stablecoins promise to be stable vis-à-vis the USD, and the others are pegged to the price of different currencies or commodities. The complete list of stablecoins with their features are presented in Table 1.

Table 1: Characteristics of the stablecoins in the sample

Name	Symbol	Collateral	Aims to be stable vis-à-vis…	Audited	License	Date of Introduction
Tether	USDT	Fiat money	USD	Yes	Yes	25-Feb-2015
TrueUSD	TUSD	Fiat money	USD	Yes	Yes	6-Mar-2018
STASIS EURO	EURS	Fiat money	EUR	Yes	Yes	30-Jul-2018
Paxos Standard	PAX	Fiat money	USD	Yes	Yes	27-Sep-2018
Gemini Dollar	GUSD	Fiat money	USD	Yes	Yes	6-Oct-2018
USD Coin	USDC	Fiat money	USD	Yes	Yes	8-Oct-2018
StableUSD	USDS	Fiat money	USD	No	No	6-Feb-2019
CryptoFranc	XCHF	Fiat money	CHF	Yes	Yes	2-Jul-2019
Binance GBP Stable Coin	BGBP	Fiat money	GBP	No	No	29-Jul-2019
USDK	USDK	Fiat money	USD	Yes	No	29-Jul-2019
xEURO	XEUR	Fiat money	EUR	No	Yes	16-Aug-2019
Binance USD	BUSD	Fiat money	USD	Yes	Yes	20-Sep-2019
Universal Protocol Token	UPT	Fiat money	USD	No	No	8-May-2020
PAX Gold	PAXG	Commodities	GOLD	Yes	Yes	26-Sep-2019
Tether Gold	XAUT	Commodities	GOLD	Yes	Yes	7-Feb-2020
bitCNY	BITCNY	Crypto assets	CNY	No	No	23-Sep-2014
Single Collateral DAI	SAI	Crypto assets	USD	No	No	27-Dec-2017
EOSDT	EOSDT	Crypto assets	USD	No	No	17-Jun-2019
USDQ	USDQ	Crypto assets	USD	No	No	18-Jun-2019
HUSD	HUSD	Crypto assets	USD	Yes	No	15-Oct-2019
EURBASE	EBASE	Crypto assets	EUR	No	No	21-Oct-2019
Dai	DAI	Crypto assets	USD	No	No	22-Nov-2019
QCash	QC	Crypto assets	CNY	No	No	12-Dec-2019

[6] Coinmarketcap.com includes tags in the cryptocurrencies details that allows identifying the stablecoins. For example, some of them are "stablecoin", "stablecoin-asset-backed", "stablecoin-algorithmically-stabilized".

[7] https://cryptoslate.com/cryptos/stablecoin/ provides a list of 46 stablecoins, but not all of them are present also in coinmarketcap.com. Some additional insights comes from https://blog.idex.io/all-posts/updated-list-of-stablecoins?rq=stablecoins and https://download.blockdata.tech/blockdata-stablecoin-report-blockchain-technology.pdf

Name	Symbol	Collateral	Aims to be stable vis-à-vis…	Audited	License	Date of Introduction
USDx stablecoin*	USDX	Crypto assets	Basket of Stablecoins	No	No	30-Dec-2019
cUSD Currency	CUSD	Crypto assets	USD	No	No	5-Mar-2020
HonestCoin*	USDH	Crypto assets	USD	No	No	10-Aug-2020
NuBits	USNBT	Algorithmic	USD	No	No	24-Sep-2014
Brazilian Digital Token	BRZ	Algorithmic	REAL	No	No	19-Jul-2019
Neutral Dollar	NUSD	Algorithmic	USD	No	No	19-Sep-2019
Rupiah Token	IDRT	Algorithmic	IDR	No	No	24-Sep-2019
Anchor*	ANCT	Algorithmic	USD	No	No	9-Nov-2019
TerraKRW	KRT	Algorithmic	WON	No	No	15-Jan-2020
Neutrino USD	USDN	Algorithmic	USD	No	No	30-Jan-2020
USDJ	USDJ	Algorithmic	USD	No	No	14-Apr-2020

*Note: stablecoins in the sample, sorted by the type of collateral and the date of introduction in the Coinmarketcap database. *Honestcoin and Eurbase are (not fully) collateralized by crypto assets and fiat currency. Anchor declare to be stable to the USD deflated by US price index since introduction of Anchor). USDx aims to be stable vis-à-vis with a "fixed portfolio consisting of USDC, PAX and TUSD. More details on the auditing and the license are presented in Appendix. Source: Coinmarketcap and respective websites or white papers of single stablecoins.*

Table 2 reports some descriptive statistics for the stablecoins in our sample. As mentioned, most stablecoins are pegged to the USD, although some are pegged to other currencies or even gold or a basket of other crypto assets. The data provided by Coinmarketcap are in USD. Thus to make the series comparable, we convert the reported USD price into the specific currency values or prices to which the stablecoin is pegged.[8]

Table 2 shows that the vast majority of stablecoins in our sample have an average closing price around one with some notable exceptions, especially in the case of *PCenBank* stablecoins. The simple standard deviation of the closing price reveals a large heterogeneity among stablecoins: Some stablecoins are quite successful in maintaining their price close to the peg, with a minimum average deviation of six basis point for Binance GBP Coin, while others . The half-life, expressed in days, illustrate that some coins recover fast after a shock. By contrast, NuBits is characterised by a very high half-life statistics (an average value of 393 days), This observation is due to the fact that the coin, among the ones with longest history in our sample, lost parity with the USD on March 2018 and never returned to parity.[9] Figure 3 shows the (dynamic) stability performance, as measured by the average monthly standard deviation of the returns and the average monthly half-life of days of deviation of stablecoins.[10] The figure shows that the most frequently traded stablecoin, Tether, appears to be the one with lowest average volatility, followed by other *PCurBoard* stablecoins. However, TerraKRW, QCash, USDJ and Anchor shows good performances as well in terms of volatility vis-à-vis with the other coins in the sample. cUSD coin is the least stable in our sample, with an average monthly value above 50%.

[8] Exchange rates with respect to the USD are retrieved from FRED, Federal Reserve Bank of St. Louis, except for the exchange rate of the Rupiah, which comes from the Central Bank of Indonesia. Cryptocurrencies prices comes from Coinmarketcap.

[9] See Bullman et al (2019) for more details on the NuBits case.

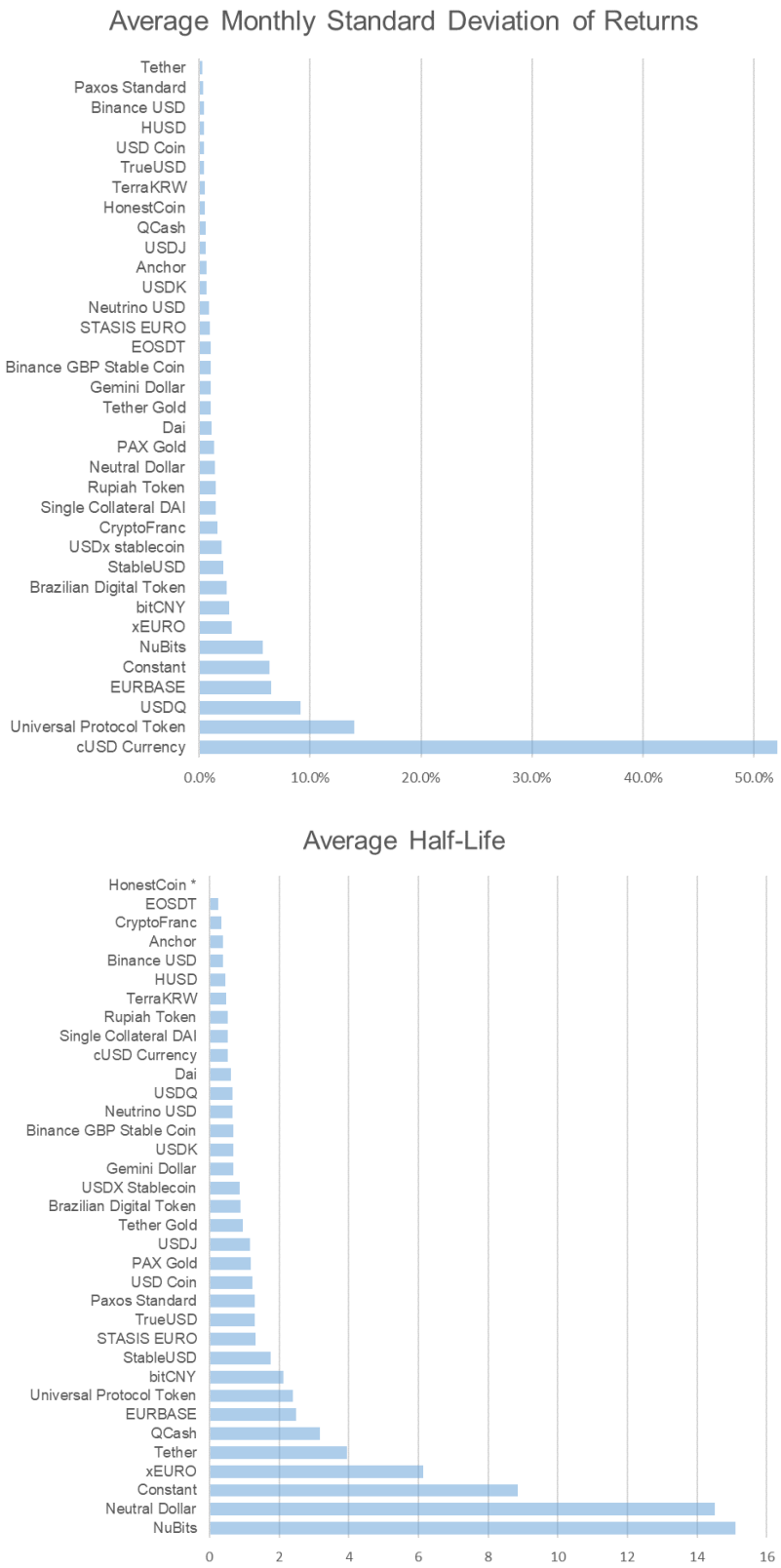
[10] Our subsequent econometric analysis is carried out with two volatility measures estimated using the log returns of the stablecoins prices (monthly standard deviation and 15-days rolling window standard deviation), and two measures related to the deviation from the peg (the deviation itself, and the half-life). Descriptive statistics of the returns are presented in the Annex, Table 8

Table 2: Descriptive statistics of sample stablecoins

Name	*Obs.*	*Average close price*	*Standard deviation of close price*	*Average deviation from peg (bps)*	*Half-life (days)*
"Pseudo-currency-board" stablecoins (PCurBoard)					
Binance GBP Stable Coin	400	1.0006	0.0109	6.1550	0.7230
Binance USD	347	1.0020	0.0051	19.6263	0.4463
CryptoFranc	427	1.0030	0.0131	30.2137	0.2715
EOSDT	442	0.9981	0.0084	-18.5140	0.3135
Gemini Dollar	696	1.0024	0.0124	24.4142	0.4429
HUSD	322	1.0020	0.0052	19.9588	0.4854
HonestCoin	22	1.0031	0.0045	30.6162	0.7709
PAX Gold	341	1.0093	0.0171	92.7511	1.2282
Paxos Standard	705	1.0040	0.0061	39.7829	1.5633
StableUSD	573	0.9954	0.0426	-46.2740	1.1143
Tether	2,010	1.0008	0.0167	7.9404	7.8150
Tether Gold	207	1.0021	0.0127	20.9434	0.9678
TrueUSD	910	1.0045	0.0075	44.6601	1.4229
USD Coin	694	1.0053	0.0077	53.1892	2.3345
USDK	400	0.9967	0.0101	-32.9927	1.0470
"Pseudo-commercial-bank" (PComBank)					
Constant	532	37.6489	366489.4	366489.4	81.9794
Dai	284	1.0064	63.6961	63.6961	0.5435
EURBASE	316	1.0039	38.9097	38.9097	0.2717
QCash	264	0.9955	-44.5311	-44.5311	4.0980
STASIS EURO	764	0.9956	-44.2976	-44.2976	1.3080
Single Collateral DAI	896	1.0044	44.3141	44.3141	1.1516
USDJ	140	1.0004	3.8927	3.8927	1.2982
USDQ	441	0.9764	-235.773	-235.773	0.7086
Universal Protocol Token	116	0.0040	-9960.32	-9960.328	2.0586
bitCNY	2,150	1.0119	119.488	119.488	0.5206
cUSD Currency	180	0.0038	-9962.04	-9962.04	0.7055
USDx stablecoin	246	1.0002	1.5740	1.5740	0.4720
xEURO	382	1.0011	11.3955	11.3955	1.2685
"Pseudo-central-bank" (PCenBank)					
Anchor	297	0.7912	0.0049	-2087.7940	0.3642
Brazilian Digital Token	410	0.9936	0.0386	-63.5929	1.1968
Neutral Dollar	348	0.8872	0.1430	-1127.5020	31.6383
Neutrino USD	215	0.9975	0.0110	-24.5216	0.9804
NuBits	2,169	0.6231	0.4348	-3769.2720	393.5443
Rupiah Token	343	1.0089	0.1538	89.2214	0.0867

Note: descriptive statistics of the stablecoins in the sample. The average deviation from peg is expressed in basis points (bps) and it is calculated after converting every stablecoins into their reference currency, commodity price, or stablecoin basket. Source: *authors' estimation on data from Coinmarketcap*

Figure 3: Overview of stablecoins' performances

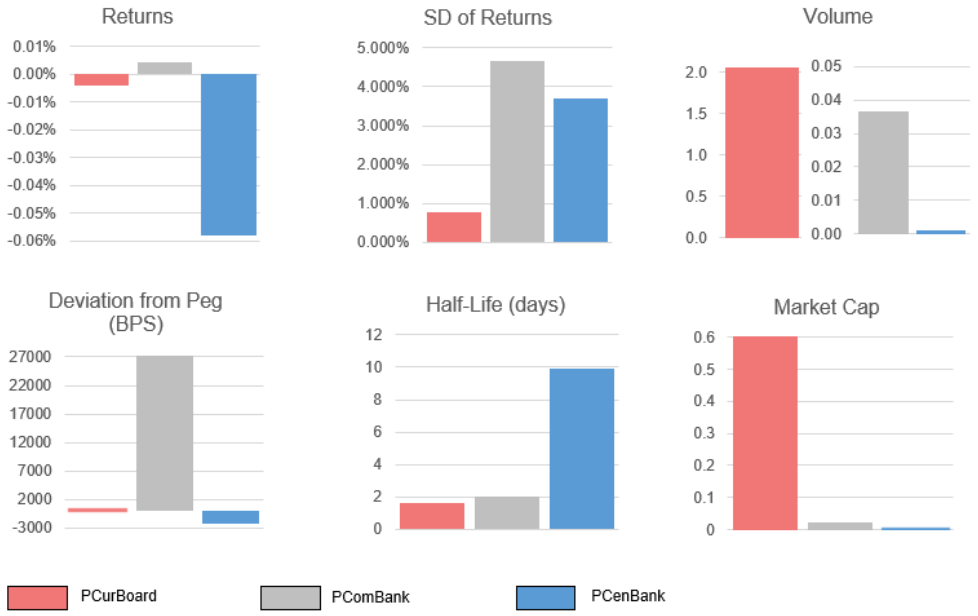


*Note: average monthly standard deviation of returns is obtained using daily return and then calculating the simple standard deviation of returns for each month. The average half-life is calculated using a rolling window of three months of data in order to estimate the AR(1) coefficient. *The half-life is not available for HonestCoin Source: authors' estimation on data from Coinmarketcap*

Interestingly, the ranking is quite different when considering average half-life as a stability performance measure. In this case, Tether is characterised by a value of close to 4 days, which means that deviations from the peg might be quite persistent. By contrast, most stablecoins have an average half-life around one day, which could be interpreted as signalling a quite efficient stabilization mechanism in returning to the peg.

Figure 4 to Figure 6 provide average performances along these dimensions for groups of stablecoins (e.g. according to the type of stabilization approach used, type of collateral used, and presence or not of licenses). Regarding Figure 4 shows that *PCurBoard* stablecoins tend not to provide positive return, while displaying the lowest volatility, as measured by average deviation from peg and half-life. As an aside, they are by far the most traded and with the highest market capitalization in the sample. *PComBank* stablecoins provide a small positive return, while they have the highest average standard deviation and highest deviations from the peg among the three different types of stablecoins considered here. The former stablecoins' half-life is somewhat similar to that of *PCurBoard* stablecoins. In terms of volume traded and market capitalization, *PCurBoard* stablecoins are in a different order of magnitude compared to the other two categories.[11]

Figure 4: Monthly average statistics by type of stablecoins



Note: average monthly statistics are obtained using daily data and calculating the measure for each month. The half-life is calculated using a rolling window of three months of data in order to estimate the AR(1) coefficient. Volume traded and Market capitalization are in USD billion. Source: authors' estimation on data from Coinmarketcap.

Concerning the type of collateral used by the issuers of stablecoins, we note that Fiat money and gold (Commodities) as a collateral display a very similar pattern in most measures, with the exception of the deviation from the peg, where the value is lower for the gold-pegged stablecoins (see Figure 5). In general, being collateralized by Fiat money or commodities reduces the instability of the price for the stablecoins in the sample. The algorithmic collateral seems to perform well in terms of reduction of the deviation from the peg, albeit in case of shocks the half-life is five times larger, on average, compared to the other types of collateral. In terms of market capitalization and volume traded, most of the trading activity involves the Fiat Money collateralized stablecoins. Figure 6 shows that the presence of a license reduces dramatically the volatility of the price, reduces the averages deviations from the peg, and display a lower

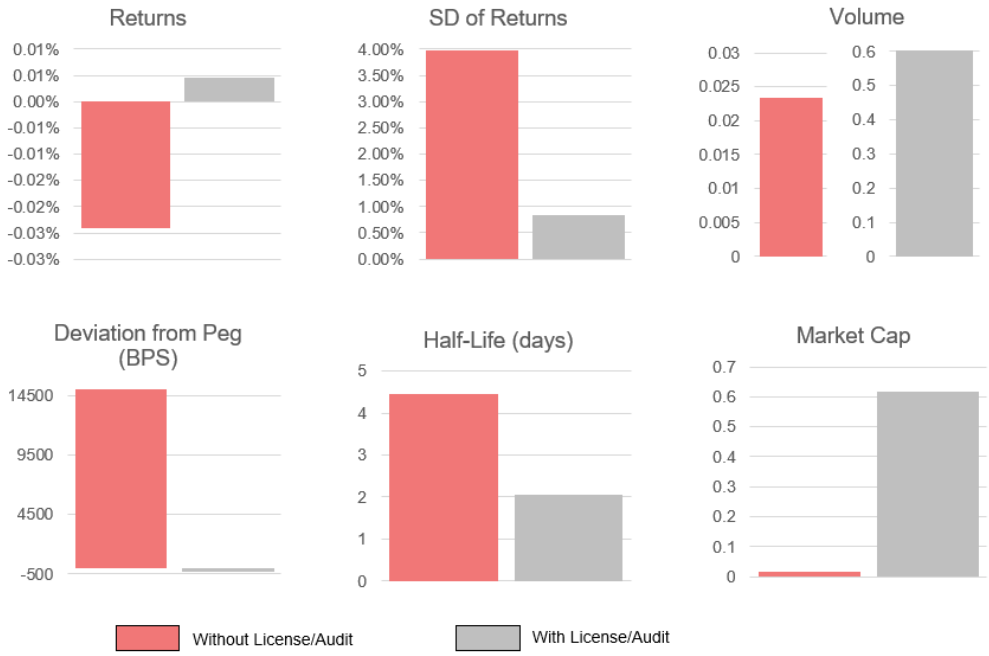
[11] For reasons of comparability, we report two different scale in the plots when the difference between the groups is extremely high.

half-life time in days. The market seems to believe more in issuers that have some forms of licensing in place, as testify by the trading volume and the market capitalization.

Figure 5: Monthly average statistics by collateral

Note: average monthly statistics are obtained using daily data and calculating the measure for each month. The half-life is calculated using a rolling window of three months of data in order to estimate the AR(1) coefficient. Volume traded and Market capitalization are in USD billion.. Source: authors' estimation on data from Coinmarketcap .

Figure 6: Monthly average statistics by presence of license/audit



Note: average monthly statistics are obtained using daily data and calculating the measure for each month. The half-life is calculated using a rolling window of three months of data in order to estimate the AR(1) coefficient. Volume traded and Market capitalization are in USD billion.Source: authors' estimation on data from Coinmarketcap .

4. Empirical Results

In the following section, we analyse the empirical results of the regression based on our four measures of stability, which includes the monthly standard deviation, the fifteen days rolling window average standard deviation, the deviation from the peg, and the half-life. The results are presented in the following subsections.

4.1 Type of stablecoin

As we have seen from the descriptive figures presented in the previous section, *PCurBoard* stablecoins seems to provide, on aggregate, the better performances in terms of price stability. Given the considerable cross-sectional differences in terms of return volatility even among the same type of stablecoins (see Annex 2), we want to assess whether this supposed stability is statistically significant and common to the group of stablecoins controlling also for other factors. We estimate a dynamic panel regression on a set of dummy variables, to discern differences among groups of stablecoins. We include the lagged value of the dependent variable to control for autoregressive components, as well as Bitcoin return and volume traded to take into account the trading pattern with the pair Bitcoin/stablecoins. We expect that *PCurBoard* stablecoins display a negative coefficient, which can be interpreted as a measure of higher efficiency in terms of price stability.

Column (1) and (2) of Table 3 includes two standard volatility measures as a dependent variable. The coefficient of the *PCurBoard* dummy is in this case negative and significant, also including monthly fixed effect, indicating a negative relationship between return volatility and *PCurBoard* stablecoins. We observe also that in three out of four models, the Δ Bitcoin volume traded is positive and statistically significant, indicating that an increase in the trading activity of bitcoin have a detrimental effect in the volatility of the stablecoins. Other control variables are not significant, as well as the *PCenBank* dummy.

Column (3) of Table 3 shows the model estimated using the deviation as a dependent variable. In this case, we have different, but compatible, results if we include or not the monthly fixed effect. In the first specification, we find that *PCurBoard* stablecoins dummy has a negative relationship with the deviation from the peg, indicating that these stablecoins experienced less pronounced deviation in our panel. However, including monthly fixed effect, the variable is no longer significant, but the dummy related to the *PCenBank* stablecoins is positive and significant. The inclusion of monthly fixed effect allows controlling for potential omitted factors, and the non-significance of the *PCurBoard* dummy might indicate that there could be periods where these stablecoins are not able to manage efficiently the distance to the peg, most likely due to market frictions and unbalances in the trading activity. Nevertheless, it appears from our analysis that the algorithmic stabilization mechanism that *PCenBank* stablecoins have in place is not sufficient to prevent large deviations from the pegged currency. The Δ Bitcoin volume traded in this case is negative and statistically significant, which indicate that the higher the trading activity in the bitcoin market, the lower is the deviation from the peg. This is potentially a liquidity effect in the market, where an increase in the trading activity in cryptocurrencies helps to close the gap between the traded price of stablecoins and the peg.

Column (4) of Table 3 displays the results of the model estimated on the half-life of deviation. In this case, *PCenBank* stablecoins display a positive relationship with the half-life. In other words, their speed of mean reversion is lower, thus they ability to recover from a shock is worse compared to the other type of stablecoins. *PCurBoard* stablecoins does not perform statistically differently from the *PComBank* stablecoins. The lagged Y variables are positive and significant in all specifications

Table 3: Price stability and type of stablecoin

	(1)		(2)		(3)		(4)	
	Average Monthly SD of returns (Y)		Average Rolling 15 days SD of returns (Y)		Average Monthly SD Deviation from PEG(Y)		Average Monthly Half-Life (Y)	
Lag (1) Y	0.7667***	0.7704***	0.6940***	0.7311***	3.4417***	3.5634***	0.0530***	0.0519***
	(0.031)	(0.029)	(0.049)	(0.030)	(0.481)	(0.478)	(0.007)	(0.010)
PCurBoard	-0.0098**	-0.0092**	-0.2042**	-0.1386**	-57.5734*	-13.5226	0.3627	-0.0095
	(0.004)	(0.005)	(0.101)	(0.070)	(30.712)	(15.167)	(1.007)	(1.325)
PCenBank	-0.0016	-0.0015	-0.0918	-0.0094	-35.3577	40.6218*	6.9630***	7.5041**
	(0.005)	(0.005)	(0.109)	(0.084)	(30.940)	(22.814)	(2.524)	(3.009)
Bitcoin average monthly return	-0.0075	-0.0806	-0.0509	-18.6406	-8.2279	200.1258	-2.9650	-17.175***
	(0.008)	(0.063)	(0.109)	(11.694)	(8.675)	(192.022)	(3.476)	(2.742)
Δ Bitcoin volume traded	0.0094**	0.0362	0.1166**	3.4382*	-14.5100**	-67.7171*	6.7823	0.9320
	(0.004)	(0.030)	(0.049)	(2.034)	(6.316)	(41.003)	(5.907)	(2.986)
Length	-0.0000	0.0000	-0.0000	0.0000	-0.0039	0.0376	0.0023***	0.0025***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.020)	(0.036)	(0.001)	(0.001)
Average Monthly Volume traded	0.0000	-0.0001	0.0002	-0.0028	-0.0046	-1.7489	-0.0947**	-0.0834
	(0.000)	(0.000)	(0.001)	(0.004)	(0.031)	(1.609)	(0.040)	(0.056)
Constant	0.0126**	0.0097	0.2571**	4.3447	60.1302*	-91.5596	-1.4882	-1.8800
	(0.006)	(0.041)	(0.127)	(3.096)	(35.524)	(137.561)	(1.084)	(5.095)
Observations	593	593	577	577	597	597	516	516
Number of stablecoins	34	34	34	34	34	34	34	34
Month FE	NO	YES	NO	YES	NO	YES	NO	YES
Overall R2	0.710	0.734	0.742	0.765	0.818	0.863	0.0392	0.323

*Note: the table report the panel regression estimation for which the dependent variable is one of the four measures of price stability introduced in the methodology section. The explanatory variables are a set of dummy variables that identify PCurBoard and PCenBank stablecoins. PComBank stablecoins dummy is excluded and serves as a baseline. The control variable includes the bitcoin average monthly return and the average change (delta) trading volume from the previous to the actual month for the bitcoin, the length in days since the introduction of the stablecoin, and the average monthly volume traded for each stablecoins. Robust standard error in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

4.2 Collateral used

One way to maintain price stability against a currency for stablecoins is to retain funds or other assets that can be claimed back from stablecoins holders, reducing the amount in circulation without affecting the actual price. These funds can be fiat money, other type of financial asset (such as money market funds shares, government bond, or other liquid assets) or crypto assets. The characteristic of having some form of collateral belongs to two of our types of stablecoins, namely the *PCurBoard* and the *PComBank. PCenBank* stablecoins rely on an algorithmic mechanism that aim to stabilize the price only matching the demand and supply of coins. However, the volume traded for this last category is far lower compared to the other two (see Figure 4). We expect in this analysis that Fiat money and commodities collateralized stablecoins performs better in terms of price stability in our sample. We estimate a dynamic panel regression including three types of collateral-related dummy, namely the Fiat Collateral, the Gold collateral, and the Algorithmic collateral. We use as a baseline the crypto-assets collateral group, since it appears to display the worse performance on average among the group (see Figure 4).

Column (1) and (2) of Table 4 shows the results of the panel regression with the two measures of return volatility used in the analysis. The coefficient related to Fiat Money collateral is negative

and significant in both models, thus stablecoins with this type of collateral experienced less return volatility in our sample. The results for Gold collateral is significant only for the first specification, albeit the sign is negative for all models. As in the previous analysis, the Δ Bitcoin volume traded is positive and statistically significant: the volatility of stablecoins could be affected by an intensification of trading in bitcoins.

Table 4: Price stability and collateral

	(1)		(2)		(3)		(4)	
	Average Monthly SD of returns (Y)		Average Rolling 15 days SD of returns (Y)		Average Monthly SD Deviation from PEG(Y)		Average Monthly Half-Life (Y)	
Lag (1) Y	0.7687***	0.7723***	0.6957***	0.7329***	3.4387***	3.5615***	0.0529***	0.0516***
	(0.031)	(0.030)	(0.050)	(0.031)	(0.484)	(0.482)	(0.007)	(0.010)
Fiat Collateral	-0.0100**	-0.0096*	-0.2036*	-0.1469*	-32.8078	-7.9573	0.3088	-0.3867
	(0.005)	(0.005)	(0.105)	(0.079)	(33.048)	(15.071)	(1.088)	(1.467)
Gold Collateral	-0.0091*	-0.0088	-0.1889	-0.1372	-53.1799	-6.6226	2.5156*	2.3239**
	(0.005)	(0.006)	(0.121)	(0.096)	(33.020)	(17.642)	(1.303)	(1.172)
Algorithmic Collateral	-0.0023	-0.0024	-0.1072	-0.0297	-29.4982	41.5548*	6.8956***	7.3077**
	(0.005)	(0.005)	(0.115)	(0.095)	(30.602)	(21.926)	(2.469)	(2.899)
Bitcoin average monthly return	-0.0079	-0.0755	-0.0539	-18.8608	-7.8710	211.9868	-3.1046	-17.049***
	(0.008)	(0.064)	(0.111)	(11.775)	(8.717)	(197.205)	(3.516)	(2.810)
Δ Bitcoin volume traded	0.0098**	0.0424	0.1202**	3.7456*	-14.7539**	-72.1327*	6.8300	0.8128
	(0.004)	(0.031)	(0.049)	(2.114)	(6.388)	(40.497)	(5.941)	(3.038)
Length	-0.0000	0.0000	-0.0000	0.0000	-0.0074	0.0392	0.0024***	0.0026***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.023)	(0.036)	(0.001)	(0.001)
Average Monthly Volume traded	0.0000	-0.0001	0.0001	-0.0028	-0.0127	-1.8926	-0.0945**	-0.0777
	(0.000)	(0.000)	(0.001)	(0.004)	(0.030)	(1.551)	(0.038)	(0.059)
Constant	0.0130**	0.0003	0.2625*	4.0795	53.3077	-97.0275	-1.6679	-10.023***
	(0.006)	(0.043)	(0.135)	(3.014)	(35.531)	(140.097)	(1.111)	(3.662)
Observations	593	593	577	577	597	597	516	516
Number of stablecoins	34	34	34	34	34	34	34	34
Month FE	NO	YES	NO	YES	NO	YES	NO	YES
Overall R2	0.710	0.734	0.742	0.765	0.818	0.862	0.0393	0.323

*Note: the table report the panel regression estimation for which the dependent variable is one of the four measures of price stability introduced in the methodology section. The explanatory variables are a set of dummy variables that identify the collateral for each stablecoin. Crypto-assets collateral dummy is excluded and serves as a baseline. The control variable includes the bitcoin average monthly return and the average change (delta) trading volume from the previous to the actual month for the bitcoin, the length in days since the introduction of the stablecoin, and the average monthly volume traded for each stablecoins. Robust standard error in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

Column (3) of Table 4 complements the results shown in the previous analysis, where we underline that the algorithmic-stabilization mechanism is related with larger price deviation from the peg. Column (4) of Table 4 presents the results using the half-life as a dependent variable. In this case, we do find that also gold-related stablecoins might take more time to recover after a shock, as well as algorithmic collateralized stablecoins. In addition, we find that the Length variable is positive and statistically significant: a longer presence in the stablecoin market does not guarantee to be able to respond quickly to a shock, as demonstrated graphically in Figure 3, recalling that the first three stablecoins issued in the market were NuBits (Algorithmic collateral), bitCNY (crypto-assets collateral), and Tether (Fiat Collateral).

4.3 Licenses and Audit

Finally, we analyse the results of the panel regression where we include the dummies for License and Audit together with the set of control variables. Given that the market of stablecoins is to date not regulated, we would expect that some forms of reassurances, like a public authority issuing a license for these type of activities, or an external auditor that certify the actual availability of the collateral in exchange of the stablecoin, provides a "premium" in terms of price stability, reduced deviation from the peg, and a reduced half-life. Thus, we expect that all our dummy variables that identify the presence of a license or the availability of an external auditor, have a negative sign. We recall that almost all stablecoins that have a license are also audited, then these two characteristics goes together in our framework.

Table 5: Price stability and presence of license/external audit

	Average Monthly SD of returns (Y)		Average Rolling 15 days SD of returns (Y)		Average Monthly SD Deviation from PEG(Y)		Average Monthly Half-Life (Y)	
Lag (1) Y	0.7675***	0.7712***	0.6985***	0.7315***	3.4434***	3.5114***	0.0655***	0.0703***
	(0.030)	(0.028)	(0.046)	(0.029)	(0.483)	(0.520)	(0.011)	(0.009)
License/Audit	-0.0092***	-0.0087***	-0.1677***	-0.1379***	-40.7839**	-26.7457*	-2.1561	-2.9734
	(0.003)	(0.003)	(0.059)	(0.046)	(19.070)	(14.273)	(1.673)	(2.395)
Bitcoin average monthly return	-0.0078	-0.0709	-0.0520	-18.4735	-7.6477	233.2075	-2.6273	-10.0404*
	(0.008)	(0.061)	(0.110)	(11.670)	(8.582)	(200.139)	(3.330)	(5.287)
Δ Bitcoin volume traded	0.0095**	0.0318	0.1179**	3.4617*	-14.7642**	-78.3533**	6.7630	-7.2583
	(0.004)	(0.029)	(0.048)	(2.072)	(6.392)	(38.914)	(5.929)	(5.462)
Length	-0.0000	0.0000	-0.0000	0.0000	-0.0025	0.0415	0.0028	0.0032*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.017)	(0.043)	(0.002)	(0.002)
Average Monthly Volume traded	0.0000	-0.0001	0.0002	-0.0026	-0.0055	-1.8716	-0.1087	-0.0971*
	(0.000)	(0.000)	(0.001)	(0.004)	(0.027)	(1.821)	(0.070)	(0.055)
Constant	0.0113***	0.0095	0.2053**	4.2285	42.4660*	-83.8215	0.4544	-10.1304**
	(0.004)	(0.041)	(0.084)	(3.054)	(24.176)	(138.064)	(0.803)	(5.081)
Observations	593	593	577	577	597	597	516	516
Number of stablecoins	34	34	34	34	34	34	34	34
Month FE	NO	YES	NO	YES	NO	YES	NO	YES
Overall R2	0.710	0.734	0.743	0.765	0.833	0.857	0.0278	0.311

*Note: the table report the panel regression estimation for which the dependent variable is one of the four measures of price stability introduced in the methodology section. Our main variable of interest is a dummy that is equal to one if the issuer of the stablecoin is audited. The control variables include the bitcoin average monthly return and the average change (delta) trading volume from the previous to the actual month for the bitcoin, the length in days since the introduction of the stablecoin, and the average monthly volume traded for each stablecoins. Robust standard error in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

Column (1) and (2) of Table 5 displays the results of the panel regression related to the volatility of the returns. As expected, the signs of the coefficients are negative and highly significant, confirming that the presence of some external validator is negatively related to high volatility phenomenon. These characteristics seems to affect also the deviation from the peg, which has negative and significant sign (column (3) of Table 5. Finally, the half-life seems not to be affected by the presence of a license or audit. For the control variables, the considerations done in the previous analysis are still valid.

5. Conclusion

Design features of private stablecoins matter for their performance in terms of stability vis-à-vis fiat currency such as the US dollar. *PCurBoard* stablecoins are shown by our empirical analysis to enhance the stability performance of stablecoins, controlling for a variety of other factors that affect developments in prices of such assets. Perhaps reflecting this observation, *PCurBoard* stablecoins are growing fastest among the stablecoins considered in our sample.

The empirical part of this paper digs deeper into the issue of volatility and addresses the question what makes private stablecoins stable, where stability is assessed in terms of the exchange rate of stablecoins to fiat currency. We consider a variety of volatility measures as applied to the exchange rate between cryptocurrencies and the US dollar. We find strong evidence that *PCurBoard* stablecoins enhance the stability of stablecoins, after controlling for these various other factors. The paper also finds that *PCurBoard* stablecoins are relatively more important in terms of market capitalisation, and have grown fastest among the stablecoins considered in our sample.

Conceptually, these "currency-board-like" stablecoins involve establishing links to the publicly supported financial safety net. They thus benefit from the trust that comes with it. If these private digital assets are the ones that become more widely used among private crypto assets, central banks need not be overly concerned. Such stablecoins, do not compete with and substitute fiat currency but rather rely on it to establish trust. Consequently, considerations regarding a reduction in monetary policy efficiency would tend to be more limited.

By contrast, *PCenBank* and *PComBank* stablecoins, if widely accepted, would involve the creation of digital fiat money beyond current fiat money. They thus come somewhat closer to the idea of Hayek (1976) for types of money being privately created, and competing with public money. Our empirical analysis suggests that the odds of these types of stablecoins gaining wider acceptance is currently limited, given their substantial volatility vis-à-vis fiat currency. Thus, central banks may not need to be overly concerned regarding current developments in private tradeable stablecoins, as the latter are unlikely to quickly gain much market capitalisation and user bases to pose a threat to monetary as well as financial stability.

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Annexes

Annex 1. Licenses and Audit

Table 6: Licenses

Name	Symbol	License
Binance USD	BUSD	New York State Department of Financial Services (NYDFS)
CryptoFranc	XCHF	Swiss AML regulations
Gemini Dollar	GUSD	New York State Department of Financial Services (NYDFS)
PAX Gold	PAXG	New York State Department of Financial Services (NYDFS)
Paxos Standard	PAX	New York State Department of Financial Services (NYDFS)
STASIS EURO	EURS	EU Nation - Malta law.
Tether	USDT	Money Service Business (Hong Kong, China)
Tether Gold	XAUT	Money Service Business (Hong Kong, China)
TrueUSD	TUSD	Money Service Business (US),
USD Coin	USDC	Money Service Business (US),BitLicense (NY),E-Money Issuer (UK).
xEURO	XEUR	Operated by licensed financial institution Etna Development OÜ (Estonia).

Note:Type of licenses when available. Source: Coinmarketcap and respective websites or whitepapers of single stablecoins.

Table 7: Audit

Name	Symbol	Audited
Binance USD	BUSD	Monthly
CryptoFranc	XCHF	Monthly
Gemini Dollar	GUSD	Monthly
HUSD	HUSD	Monthly
PAX Gold	PAXG	Monthly
Paxos Standard	PAX	Annually
STASIS EURO	EURS	Annually
Tether	USDT	Uncertain
Tether Gold	XAUT	Uncertain
TrueUSD	TUSD	Weekly, although only for entire portfolio backing different stablecoins
USD Coin	USDC	Monthly
USDK	USDK	Monthly

Note: frequency of audit. Source: Coinmarketcap and respective websites or whitepapers of single stablecoins.

Annex 2. Descriptive statistics of stablecoins returns

Table 8: Descriptive statistics of the Returns

Name	*Obs*	*Average Return*	*Standard deviation*	*Min*	*Max*
Pseudo-Currency-board stablecoins					
Binance GBP Stable Coin	399	-0.012%	1.102%	-3.482%	3.492%
Binance USD	346	-0.003%	0.454%	-1.638%	1.434%
CryptoFranc	426	0.020%	1.667%	-4.487%	4.374%
EOSDT	441	-0.010%	1.060%	-3.792%	2.913%
Gemini Dollar	695	-0.010%	1.232%	-5.635%	4.503%
HUSD	321	-0.005%	0.449%	-1.460%	1.340%
HonestCoin	21	0.013%	0.493%	-1.838%	0.870%
PAX Gold	340	0.020%	1.426%	-3.758%	4.589%
Paxos Standard	704	0.001%	0.413%	-1.330%	1.429%
StableUSD	572	0.016%	3.193%	-15.386%	16.657%
Tether	2,009	-0.002%	0.433%	-1.631%	1.733%
Tether Gold	206	0.006%	1.170%	-3.148%	4.136%
TrueUSD	909	0.001%	0.485%	-1.609%	1.651%
USD Coin	693	0.000%	0.476%	-1.687%	1.761%
USDK	399	-0.007%	0.826%	-3.405%	3.825%
Pseudo-Commercial-bank stablecoins					
Constant	531	0.650%	13.841%	-47.591%	110.926%
Dai	283	0.024%	1.241%	-3.553%	4.080%
EURBASE	315	-0.259%	7.077%	-43.449%	16.178%
QCash	263	-0.002%	0.602%	-1.774%	2.267%
STASIS EURO	763	0.002%	1.016%	-4.013%	3.114%
Single Collateral DAI	895	0.017%	1.635%	-5.465%	6.272%
USDJ	139	0.016%	0.611%	-1.639%	1.855%
USDQ	440	-0.092%	15.073%	-61.783%	63.288%
Universal Protocol Token	115	0.640%	13.915%	-32.545%	53.369%
bitCNY	2,149	-0.031%	3.322%	-14.800%	13.510%
cUSD Currency	179	-1.443%	58.927%	-182.426%	199.740%
USDx stablecoin	245	-0.006%	3.257%	-18.965%	19.871%
xEURO	381	0.067%	3.611%	-13.487%	25.634%
Pseudo-Central-bank stablecoins					
Anchor	296	0.003%	0.670%	-1.684%	1.863%
Brazilian Digital Token	409	0.033%	2.968%	-10.992%	12.763%
Neutral Dollar	347	-0.077%	2.080%	-12.167%	8.469%
Neutrino USD	214	0.010%	1.056%	-3.363%	3.346%
NuBits	2,168	-0.127%	8.033%	-30.669%	32.472%
Rupiah Token	342	0.028%	1.612%	-4.657%	7.453%
TerraKRW	229	-0.002%	0.526%	-1.591%	1.375%

Note: descriptive statistics of the returns. Source: authors' estimation on data from Coinmarketcap