

BIS Papers

No 141

Will the real stablecoin please stand up?

by Anneke Kosse, Marc Glowka, Ilaria Mattei and
Tara Rice

Monetary and Economic Department

November 2023

JEL classification: E42, E58, G23, G28, O33.

Keywords: cryptoassets, stablecoins, digital
innovation, financial stability, payment systems.

The views expressed are those of the authors and not necessarily the views of the BIS.

This publication is available on the BIS website (www.bis.org).

© *Bank for International Settlements 2023. All rights reserved. Brief excerpts may be reproduced or translated provided the source is stated.*

ISSN 1682-7651 (online)

ISBN 978-92-9259-705-4 (online)

Will the real stablecoin please stand up?¹

By Anneke Kosse, Marc Glowka, Ilaria Mattei and Tara Rice

Abstract

This paper provides an overview of the evolution of the stablecoin market over the past decade and examines whether stablecoins have stayed true to their name in terms of being “stable”. By classifying stablecoins into four distinct types, we show that, while stablecoins backed by fiat currency, commodities or other cryptoassets have generally been less volatile than traditional cryptoassets, not one of them has been able to maintain parity with its peg at all times. This is irrespective of a coin’s size or type of backing. Moreover, there is currently no guarantee that stablecoin issuers could redeem users’ stablecoins in full and on demand. For these reasons, the stablecoins in circulation today do not meet the key criteria for being a safe store of value and a trustworthy means of payment in the real economy. The analysis in this paper also highlights some significant data gaps. More data are required to better understand the uses and users of stablecoins. Without such data, it is difficult to ascertain the risks of stablecoins to the smooth functioning of payment systems and financial stability more broadly.

JEL classification: E42, E58, G23, G28, O33.

Keywords: cryptoassets, stablecoins, digital innovation, financial stability, payment systems.

¹ We thank Iñaki Aldasoro, Alberto Di Iorio and Peter Wierts for their valuable comments and Anamaria Illes for excellent research assistance. The views expressed in this paper are those of the authors and do not necessarily reflect those of the BIS.

Introduction

Cryptoassets have experienced strong growth over the past decade and their technology is seen as an innovation in banking and payments.² Cryptoassets are digital assets issued by the private sector that depend primarily on cryptography and distributed ledger or similar technology.³ They have historically been marketed as new forms of money that can be used to directly send payments between users without going through a financial institution. While the first known cryptoasset was created in the 1980s,⁴ they did not capture the general public's attention until a few years after Bitcoin was introduced in 2009.

The purported benefits of cryptoassets have yet to be realised: their price volatility made them popular for speculation or illicit activities, rather than as a means of making payments.⁵ Bitcoin, like some other cryptoassets, has been susceptible to flash crashes, or sudden steep price declines.⁶ Thus, as cryptoasset prices are apt to fluctuate constantly and abruptly, the concept of a stablecoin was created. Stablecoins are a subcategory of cryptoassets that aim (or claim) to maintain a stable value relative to a specified peg.⁷ One of the first was Tether, in 2014. Within a decade of the first stablecoin launch, the number of "active" stablecoins, ie those having a positive market capitalisation, grew to above 60, with Tether, USD Coin and Binance USD being the most prominent ones to date.

Given their claim to provide a stable alternative to other cryptoassets, stablecoins have a greater potential to become a widely used method of payment, store of value and unit of account. Yet, despite the lauded benefits, stablecoins have experienced significant turbulence, especially in 2022 and early 2023. In the first half of May 2022, the crypto ecosystem was shaken up by the crash of various cryptoassets, including Terra's stablecoin TerraUSD, the third largest stablecoin at the time. A few months later, in November, the centralised crypto exchange FTX filed for bankruptcy and March 2023 saw the collapse of Silicon Valley Bank, a lender and custodian to many crypto service providers. These events had a discernible impact on the cryptoasset market, and they brought the growth of the stablecoin market to a halt.

These developments have added urgency to authorities' efforts to address the potential risks posed by stablecoins, as distinct from those presented by other types of cryptoasset.⁸ In addition, central banks have stepped up their monitoring work to

² See for example Arner et al (2020) and IMF (2023a).

³ See FSB (2020).

⁴ See <https://scweb.sce.uhcl.edu/yang/teaching/csci5234WebSecurityFall2011/Chaum-blind-signatures.PDF>.

⁵ See G7 (2019).

⁶ See FSB (2018).

⁷ See FSB (2020).

⁸ In July 2022, the Bank for International Settlements' Committee on Payments and Market Infrastructures (CPMI) and the International Organization of Securities Commissions (IOSCO) published guidance on the application of the Principles for financial market infrastructures (PFMIs) to stablecoins that are widely used for payments. In October 2022, the Financial Stability Board (FSB) published a proposed framework for the international regulation of cryptoasset activities, and in December, the Basel Committee on Banking Supervision (BCBS) issued a prudential standard for the treatment of banks' exposures to cryptoassets.

further understand the implications of stablecoins and some central banks have intensified their work on central bank digital currencies (CBDCs).⁹ A clear and data-driven understanding of the relevance and performance of stablecoins is critical for authorities and other policymakers when assessing these risks and taking appropriate measures.

This paper seeks to provide an overview of how the stablecoin market has evolved in recent years and assesses whether stablecoins have stayed true to their name in terms of preserving a stable value. The literature on stablecoins is growing. This includes research on their price dynamics, the functioning (or failure) of their price stabilisation mechanisms, and the effect of transparency on their backing.¹⁰ Our paper adds to this work by assessing a unique data set compiled from public and private data sources. A common approach has been to focus on the largest stablecoins. In this paper, we look at the stablecoin market more broadly, covering 68 stablecoins. Our descriptive analysis shows how the various sources of data can be combined and used to monitor the latest status of the stablecoin market and which indicators can be derived from these to better understand the performance and potential risks of stablecoins. We classify stablecoins into four distinct categories and shed light on the following questions:

- Are stablecoins able to maintain parity with their peg?
- Are stablecoins stable?
- How are stablecoins backed?
- What are stablecoins used for?

This paper is structured as follows. Before diving into these four key questions, we first explain what stablecoins are and define the four categories. What follows is a short description of our data and an overview of market developments since the first stablecoins surfaced about a decade ago. After answering the four key questions, we discuss the regulatory responses to date, and what more authorities could do to address the potential risks of stablecoins to the safety of payments and the stability of the financial system more broadly.

What are stablecoins?

The objective of stablecoins is to maintain a stable value relative to a specified peg. As such, stablecoins intend to offer a solution to the price volatility that afflicts other cryptoassets, potentially making them more attractive as a means of payment or store of value.¹¹ This peg can be one specific asset or a basket of assets. As such, their issuers claim that stablecoins can be redeemed at par with the value of the relevant

⁹ See Kosse and Mattei (2023).

¹⁰ See for example Lyons and Viswanath-Natraj (2023) and Ahmed et al (2023) and references therein.

¹¹ See for example Baughman et al (2022).

peg.¹² To date, the majority of stablecoins have been pegged to a single asset, most typically sovereign currencies, such as the US dollar or euro, but also commodities such as gold or another cryptoasset.

Stablecoins may use various approaches to maintaining parity with their peg.¹³ At a high level, a distinction can be made between the following four types of stablecoin based on *whether* they claim to hold a pool of reserve assets to back their value (ie whether they are collateralised or not), and if so, *the type* of these reserve assets:

- *Fiat-backed stablecoins*: stablecoins that claim to be backed by assets denominated in a fiat currency. Examples include Tether and USD Coin.
- *Crypto-backed stablecoins*: stablecoins that claim to be backed by other cryptoassets. Examples include Dai and Frax.
- *Commodity-backed stablecoins*: stablecoins that claim to be backed by commodities. Examples are PAX Gold and Tether Gold.
- *Unbacked stablecoins*: stablecoins that do not claim to be backed by any reserves, but rather seek to maintain a stable value through, for instance, algorithms or protocols.¹⁴ Examples include TerraClassicUSD and sUSD.

Note that fiat-backed, commodity-backed and crypto-backed stablecoins are sometimes also defined as collateralised stablecoins, with the first two referred to as “off-chain collateralised” and the latter “on-chain collateralised” stablecoins.¹⁵

The type of reserves held by the backed stablecoins are generally of the same denomination as the stablecoins’ pegs. For example, fiat-backed stablecoins pegged to US dollars generally claim to be backed by US dollar-denominated assets, while those tracking the gold price commonly hold a reserve of gold. However, the denomination of stablecoin reserves might differ from that of the peg.

Data and scope

The analysis in this paper is based on data compiled from public and private data sets, sourced mainly from CoinGecko, CCData and the stablecoins’ individual websites. In scope are only those cryptoassets that:

¹² The redemption possibilities of users are subject to the stablecoins’ redemption policies. As also discussed in ECB (2022), users may be subject to redemption thresholds, fees and limits, which may constrain them from redeeming their stablecoins at any given moment and at par value to the peg. For example, for Tether, the minimum redeemable amount is USD 100,000 and users would have to pay a redemption fee of 0.1%, and a one-time verification fee of USD 150 (see <https://tether.to/en/fees/>).

¹³ See Baughman et al (2022), Bullmann et al (2019) and ECB (2020).

¹⁴ This category includes stablecoins that aim to maintain parity with their peg by matching the demand and supply of the stablecoins. Such stablecoins are commonly referred to as algorithmic stablecoins. However, since some of the other types of stablecoin considered in this paper also use algorithms, for example some of the crypto-backed stablecoins, we avoid using the term “algorithmic stablecoins”.

¹⁵ See Baughman et al (2022).

- claim to provide a stable value;
- indicate a peg; and
- have a positive market capitalisation according to CoinGecko.

The data set is based on the status as of 30 September 2023 and contains information on 68 stablecoins, 20 of which are fiat-backed, 28 crypto-backed, seven commodity-backed and 13 unbacked.¹⁶ Annexes 1 and 2 provide further details on the stablecoins and key indicators presented in this paper.

A brief chronical of the stablecoin market

Market capitalisation of stablecoins

It took several years before stablecoins obtained significant traction (Graph 1).

The first stablecoin (BitUSD) was issued in July 2014, and five years later the total market capitalisation had grown to roughly five billion US dollars. It was not until the start of the Covid-19 pandemic that the market capitalisation started to rise steeply (Graph 1.A, event a). This has been attributed to the turbulence in the traditional financial markets following the Covid-19 outbreak and the sharp decline of the price of Bitcoin, which led investors to turn to stablecoins.¹⁷ Over the course of two years, the market capitalisation grew more than ninefold,¹⁸ and in March 2022, it was more than 35 times higher than at the onset of the pandemic.

Most of the growth was driven by a strong increase in the market capitalisation of Tether. Tether was launched in 2014. While it quickly became the largest stablecoin, it started to gain traction only in 2021. Many other stablecoins were also launched during the pandemic: the total number of active stablecoins grew from 13 at the beginning of 2020 to 40 at the end of 2021. Initially, the stablecoin market consisted mainly of fiat-backed stablecoins. However, various stablecoins that entered the market over the course of 2021 were crypto-backed or unbacked stablecoins. In April 2022, fiat-backed stablecoins accounted for around 80% of the total stablecoin market in terms of market capitalisation.

The growth of the stablecoin market came to a halt in the first half of May 2022 when the crypto ecosystem was shaken up by the crash of various cryptoassets.

Among these was Terra's (unbacked) stablecoin "TerraUSD", the third largest stablecoin at the time (Graph 1.A, event b). TerraUSD's collapse was caused by its inability to redeem users' holdings at par. The TerraUSD crash caused unbacked stablecoins to lose almost all of their value. It also undercut the market capitalisation of fiat-backed and crypto-backed stablecoins. Overall, by the end of September 2022, the total market capitalisation of stablecoins had shrunk by more than a fifth to \$151.4 billion.

¹⁶ The classification of stablecoins into the four categories is based on the authors' best efforts based on publicly available information.

¹⁷ See for example ECB (2020).

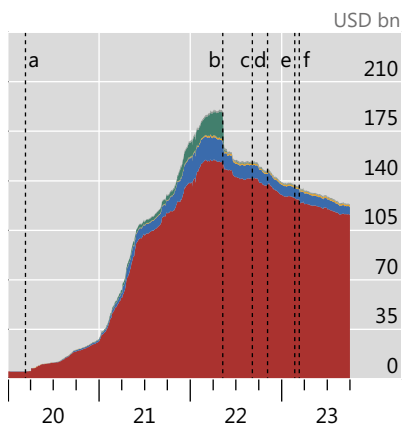
¹⁸ Total market capitalisation grew 946% from 1 January 2019 to 31 December 2020.

The stablecoin market continued to shrink into 2023. Between April 2022 and the end of January 2023, the total capitalisation of the stablecoin market had shrunk by more than 25% to \$138 billion. While much of the fall was triggered by the TerraUSD collapse, the bankruptcy filing of FTX, a major crypto exchange, in November 2022, accelerated the declining trend, although not as strongly as the May turmoil (Graph 1.A, event d). These events contributed to a contraction in the demand for other cryptoassets, which in turn reduced the demand for stablecoins, as stablecoins are heavily used as a bridge to facilitate trading in cryptoassets.¹⁹ In fact, the total market capitalisation of other cryptoassets fell more sharply than that of stablecoins, resulting in a de facto increase in the share of stablecoins in the total crypto market from 9% at the beginning of April 2022 to 13% at the end of January 2023.

Stablecoin market developments

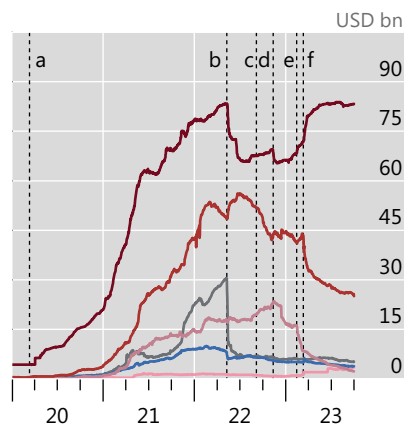
Graph 1

A. Composition of market capitalisation of total stablecoin market



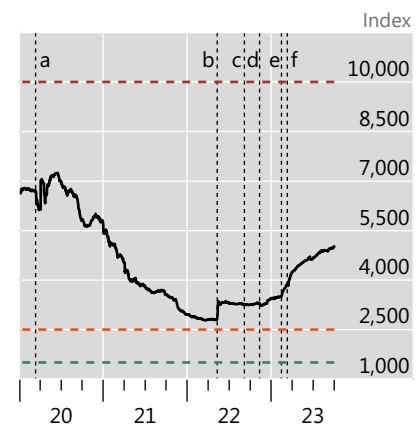
Top 20 stablecoins:
 (A) Fiat-backed
 (B) Crypto-backed
 (C) Commodity-backed
 (D) Unbacked
 Stablecoins outside the top 20

B. Market capitalisation of top five stablecoins¹



(A) Fiat-backed: Tether, USD Coin, Binance USD, TrueUSD
 (B) Crypto-backed: Dai
 Total of all other stablecoins

C. Herfindahl-Hirschman Index (HHI) of stablecoin market²



HHI
 Thresholds:
 Competitive
 Moderately concentrated
 Highly concentrated

^a On 11 Mar 2020, WHO declares the Covid-19 to be a pandemic. ^b On 9 May 2022, TerraUSD and Luna collapse. ^c On 5 Sep 2022, Binance announces that it will stop trading USD Coin on its exchange. ^d On 11 Nov 2022, FTX files for bankruptcy. ^e On 13 Feb 2023, Paxos announces that it will stop issuing Binance USD tokens in the United States. ^f On 10 Mar 2023, the Federal Deposit Insurance Cooperation (FDIC) announces the bankruptcy of SVB.

¹ Top five stablecoins as of 30 September 2023. ² According to the standards set by the US Department of Justice, a market with an HHI of less than 1,500 is considered a competitive marketplace, an HHI between 1,500 and 2,500 is moderately concentrated and an HHI greater than 2,500 is highly concentrated. The highest value is 10,000.

Sources: CoinGecko; authors' calculations.

Throughout the 2022 market turmoil, Tether remained the largest stablecoin in circulation (by market capitalisation), despite facing the largest loss of all fiat-backed stablecoins (Graph 1.B). Between the beginning of May and the end of July 2022, Tether lost 21% of its market capitalisation. By contrast, the

¹⁹ For instance, in March 2022, Tether accounted for around 65% of all trading on cryptoasset trading platforms (ECB (2022)).

second largest stablecoin, USD Coin, saw its market capitalisation grow after the TerraUSD crash, while that of the third largest, Binance USD, remained unaffected. Similarly, the bankruptcy of FTX in November 2022 resulted in a sharp drop in the market capitalisation of Tether, while that of USD Coin and Binance USD remained relatively unchanged. This suggests that investors may have had more confidence in USD Coin and Binance USD maintaining a stable value over this turbulent period than in Tether.²⁰ Shortcomings in its redemption possibilities and the opacity of Tether's reserve composition may have contributed to this.²¹ Tether, for example, publishes its reserves information every quarter, while USD Coin and Binance USD do so monthly (see also below).

The movements of USD Coin and Binance USD in subsequent months were strongly affected by targeted interventions of crypto exchanges. After Binance's announcement on 5 September 2022 that it would stop trading USD Coin (issued by Circle) on its exchange (Graph 1.A, event c), the market capitalisation of USD Coin fell by \$5.1 billion over a period of one month, while that of Binance USD (issued by Binance itself in partnership with Paxos) rose by \$1.7 billion. The opposite occurred on 13 December 2022, when Binance had temporarily paused USD Coin withdrawals as investors' concerns about the stability of Binance's business had grown.²² On the next trading day, the market capitalisation of Binance USD fell by \$3.2 billion, while that of USD Coin increased by \$2.6 billion. The market capitalisation of Binance USD continued to decline after the announcement of Paxos on 13 February that it would stop issuing Binance USD tokens in the United States as of 21 February 2023 (Graph 1.A, event e) at the request of the New York Department of Financial Services.²³

In March 2023, the stablecoin market was hit by the closure of Silicon Valley Bank (SVB). On 10 March 2023, the Federal Deposit Insurance Cooperation (FDIC) announced the bankruptcy of SVB (Graph 1.A, event f).²⁴ As Circle, the issuer of USD Coin, held US dollar reserves with SVB, investors started to redeem their USD Coin stablecoins. Consequently, USD Coin faced an outflow of \$5.8 billion (14%) over the course of one week. By contrast, the market capitalisation of other stablecoins such as Tether rose, suggesting that investors then perceived the latter to be safer.²⁵

Market concentration and top 10 stablecoins

In the past, the stablecoin market became progressively less concentrated, but the turmoil in 2022 reversed that trend (Graph 1.C). Until 2020, the number and size of stablecoins was limited. However, soon after the start of the Covid-19 pandemic, many new stablecoins were launched and quickly gained market share. As

²⁰ IMF (2023b) shows that, during episodes of stress, stablecoin (as well as money-market funds (MMF)) investors run from riskier stablecoins to safer ones.

²¹ See also ECB (2022). For a deeper analysis on the role of reserve transparency and public disclosure on stablecoin run risks, see Ahmed et al (2023).

²² See for example: Crypto exchange Binance temporarily halts USDC stablecoin withdrawals (cnbc.com): <https://www.cnbc.com/2022/12/13/crypto-exchange-binance-temporarily-halts-usdc-stablecoin-withdrawals.html>.

²³ See Paxos (2023).

²⁴ See FDIC (2022).

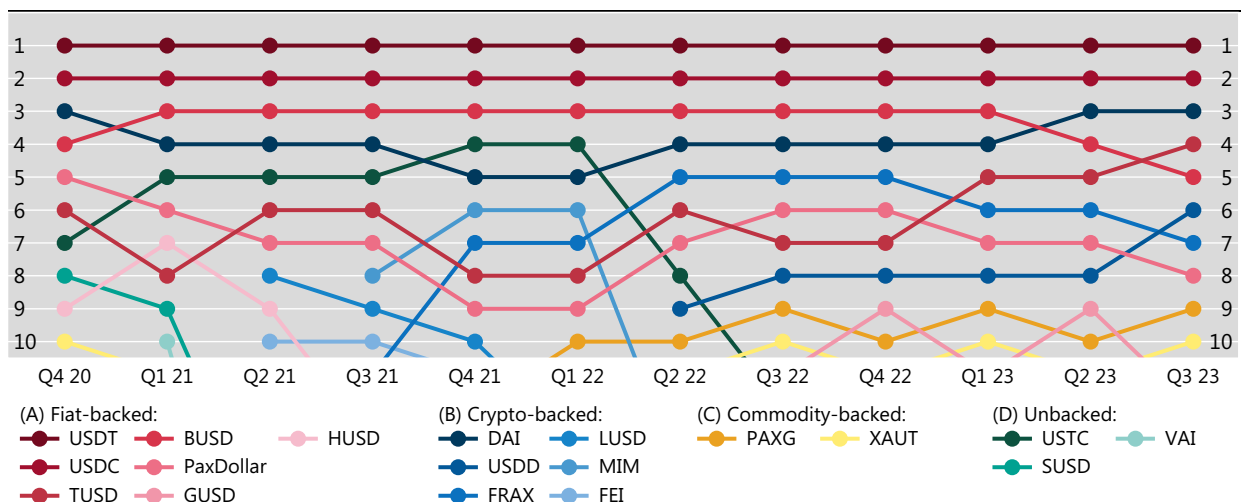
²⁵ This run and flight-to-safety dynamics in stablecoins is argued to be similar to that observed in the MMF industry (IMF (2023b)).

a result, the market concentration as measured by the Herfindahl-Hirschman-Index (HHI)²⁶ persistently declined. This decline came to an end in May 2022, as the collapse of TerraUSD marked the start of a steady increase in the concentration of the three largest stablecoins Tether, USD Coin and Binance USD (all fiat-backed).

At the end of 2022, the three largest stablecoins accounted for 92% of the total stablecoin market. The market concentration continued to increase in 2023 as Tether gained further dominance due to the loss of market capitalisation of USD Coin and Binance USD. By the end of September 2023, Tether accounted for 68% of the total stablecoin market.

Ranking of top 10 stablecoins by market capitalisation

Graph 2



BUSD = Binance USD; DAI = Dai; FEI = Fei USD; FRAX = Frax; GUSD = Gemini Dollar; HUSD = HUSD; LUSD = Liquity USD; MIM = Magic Internet Money; PaxDollar = Pax Dollar; PAXG = PAX Gold; SUSU = sUSD; TUSD = TrueUSD; USDC = USD Coin; USDD = USDD; USDT = Tether; USTC = TerraClassicUSD; VAI = Vai; XAUT = Tether Gold.

Sources: CoinGecko; authors' calculations.

Despite the dominance of Tether, the stablecoin market is dynamic. Although the two largest stablecoins have not changed their relative positions since the start of 2021, the market capitalisation of each has been in flux. Moreover, the ranking of the smaller stablecoins has also shifted (Graph 2). Different factors might have contributed to investors favouring one stablecoin over another, such as the degree of transparency about the availability and quality of reserve assets, price volatility, the interventions of crypto exchanges, and regulatory responses.²⁷

Are stablecoins stable?

Stablecoins that are backed by fiat currency, commodities or other cryptoassets generally fulfil at least one of their often-mentioned claims – being less volatile than traditional cryptoassets such as Bitcoin (Graph 3). Of the four stablecoin categories, fiat-backed stablecoins have generally displayed the lowest volatility

²⁶ See Annex 2 for more details on the calculation of the HHI.

²⁷ See for example IMF (2023b) and Ahmed et al (2023).

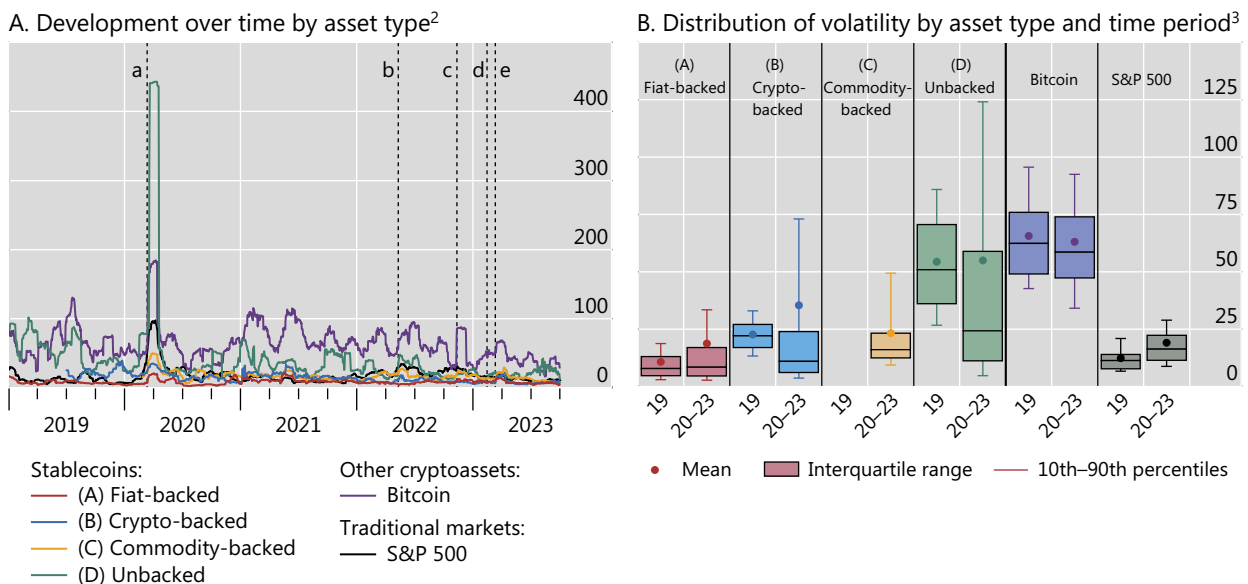
(Graph 3.B).²⁸ Over the past three years, they were less volatile than the S&P 500. Price fluctuations have been highest for unbacked stablecoins. In fact, the price deviations of unbacked stablecoins have shown similarities with or in some periods even exceeded that of other (non-stablecoin) cryptoassets. The market capitalisation of unbacked stablecoins is, however, at low levels since the events in May 2022. At the end of September 2023, they made up much less than 1% (0.2%) of the total market capitalisation of stablecoins.

The market turmoil in early November 2022 had a significant negative impact on the price volatility of all types of stablecoins. At the aggregate level, the price volatility of crypto-backed stablecoins decreased in the fourth quarter of 2022. At the same time, the volatility of fiat-backed stablecoins increased, surpassing that of crypto-backed stablecoins (Graph 3.A). Note however that, regardless of the stablecoin type, the highest consecutive daily price volatilities were observed in the period right after the outbreak of the Covid-19 pandemic.

Closing price volatility¹

In percentage points

Graph 3



^a On Mar 2020, WHO declares the Covid-19 to be a pandemic. ^b On 9 May 2022, TerraUSD and Luna collapse. ^c On 11 Nov 2022, FTX files for bankruptcy. ^d On 13 Feb 2023, Paxos announces that it will stop issuing new Binance USD tokens. ^e On 10 Mar 2023, Silicon Valley Bank fails.

¹ Based on closing prices as defined by CoinGecko, ie the prices at 00:00 UTC. ² The volatility of stablecoins is indicated as the median within each backing category. ³ For 2023, data are shown up to the end of September.

Sources: CoinGecko; authors' calculations.

The price volatility of stablecoins is coin-specific (Graph 4). When aggregating data by type of stablecoin, as in Graph 3, individual differences are lost. The dispersion in price volatility is smallest among the commodity-backed stablecoins, which is caused mainly by the limited number of coins within this category (Graph 4). The fiat-backed stablecoins follow next. Yet, as more fiat-backed

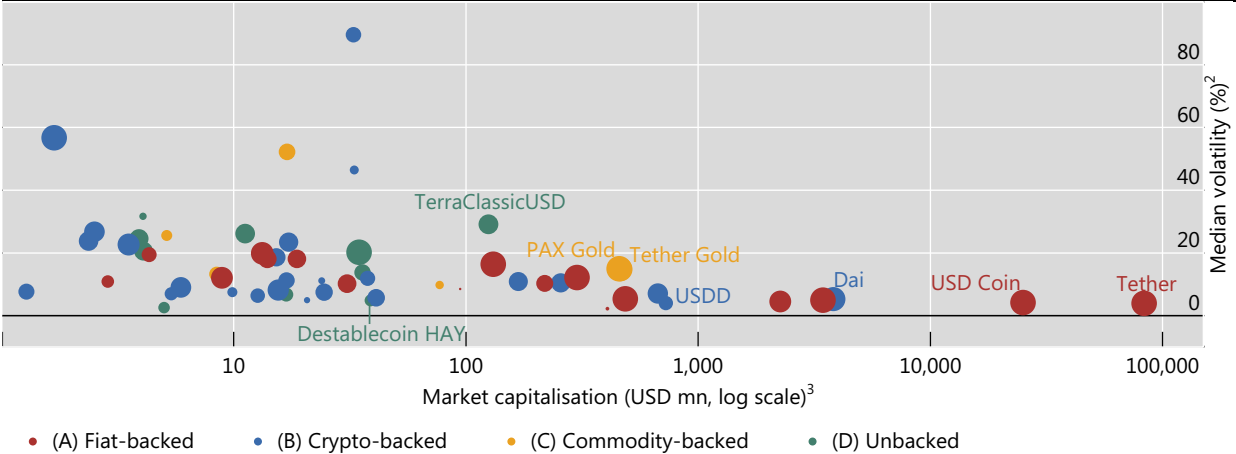
²⁸ See Annex 2 for more details on the volatility indicators used in this paper.

coins were launched after 2019, the dispersion in daily price fluctuations has grown and become more skewed over time.

Stablecoins that have a higher price volatility tend to be younger, ie they have been in the market for less time (Graph 4). The five largest stablecoins as of end of September 2023 were active for at least three years and among the 10 stablecoins with the lowest median price volatility.²⁹ With growing market capitalisation, stablecoin trading becomes more liquid, dampening price fluctuations. Nevertheless, one of the oldest stablecoins (Tether) had an average daily price volatility of about 2 percentage points between end-September 2022 and end-September 2023. This shows that to date, no stablecoin has been able to meet an important prerequisite of becoming a safe store of value – guaranteeing full price stability.

Volatility in relation to market capitalisation and number of active days by backing category¹

Graph 4



¹ Each circle represents a stablecoin, and the size is proportional to its number of active days. The number of active days is the number of days since the coin entered the database and has a positive market capitalisation. ² The median volatility for each stablecoin was calculated based on the daily volatility between 1 Jan 2019 and 30 Sep 2023. The daily volatility is computed as the annualised 30-day moving standard deviation of daily returns based on the closing prices as defined by CoinGecko, ie the prices at 00:00 UTC. The circles of PAX Gold and Tether Gold are overlapping, with PAX Gold having a slightly smaller market capitalisation and a higher median volatility. ³ Market capitalisation as of 30 Sep 2023. For reasons of clarity and comprehensibility, the distances between the individual market capitalisations were reduced by using a log transformation.

Sources: CoinGecko; authors' calculations.

²⁹ See Annex 2 for the definition of "active days".

Do stablecoins maintain parity with their peg?

Maintaining the peg at the end of the day

Not one of the stablecoins assessed in this paper has been able to maintain their closing prices in parity with their peg.³⁰ At an aggregate level, backed stablecoins did a better job than unbacked stablecoins (Graph 5). The fiat-backed ones performed best: from January 2019 to September 2023, the median of the price-to-peg ratio for all fiat-backed stablecoins was exactly 1 in 94% of the days, compared with 77% and 50% of the days for crypto-backed and commodity-backed stablecoins, respectively. Fiat-backed stablecoins also show the smallest dispersion in daily deviations from the peg, while these deviations are largest for unbacked stablecoins (Graph 5.B).

The ability of stablecoins to maintain parity varies with the currency they are pegged to (Graph 6). Irrespective of the type of stablecoin, stablecoins that are pegged to the US dollar and the euro have been able to track their peg best. Those tying their prices to the price of other stablecoins, such as those pegged to USD Coin and Dai, generally face the largest deviations. Stablecoins pegged to the rupiah, Singapore dollar and Turkish lira occasionally experienced larger peg deviations than those pegged to the US dollar and euro. This could be caused by the fact that the former are usually backed by assets denominated in the currency of their peg, ie the rupiah, Singapore dollar and Turkish lira, which are generally more volatile than the US dollar and the euro.

The ability of stablecoins to maintain their pegs also differs across individual stablecoins, even within the same category (Graph 7). Only seven fiat-backed stablecoins have been able to keep their deviations from the peg below 1% for more than 97% of their life span. These include Tether and USD Coin. All other fiat-backed stablecoins temporarily lost their pegs more frequently and with much larger deviations. Yet, even Tether and USD Coin at times failed to keep their price within a 1% band around the US dollar: since 2020, Tether's maximum negative and positive end-of-day deviations from the peg were $-\$0.018$ (below the peg) and $\$0.012$ (above the peg), respectively. For USD Coin, the maximum deviation was $-\$0.034$ and $\$0.011$.

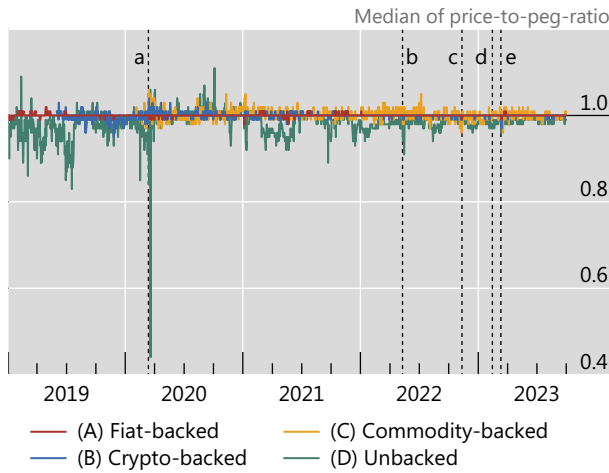
Not all unbacked stablecoins are equal. Unbacked stablecoins generally lost their pegs much more often than fiat-, crypto- and commodity-backed stablecoins, and their deviations were generally much larger than those of backed stablecoins. Nevertheless, some unbacked stablecoins perform better than others. For example, three unbacked stablecoins were able to keep their prices within a 1% band around their pegs for more than 80% of their life span. Other unbacked stablecoins saw their prices deviate from their pegs by more than 50% for more than 60% of their life span (Graph 7).

³⁰ Since cryptomarkets are open 24/7, stablecoins do not really have a closing price in the manner of traditional financial products. Throughout this paper, closing prices refer to the closing prices as reported by CoinGecko, which are the prices at 00:00 UTC. The advantage of using these prices is that it allows for a comparison across stablecoins at a fixed timestamp. See Annex 2 for more details on the calculation of stablecoins' deviations from their peg.

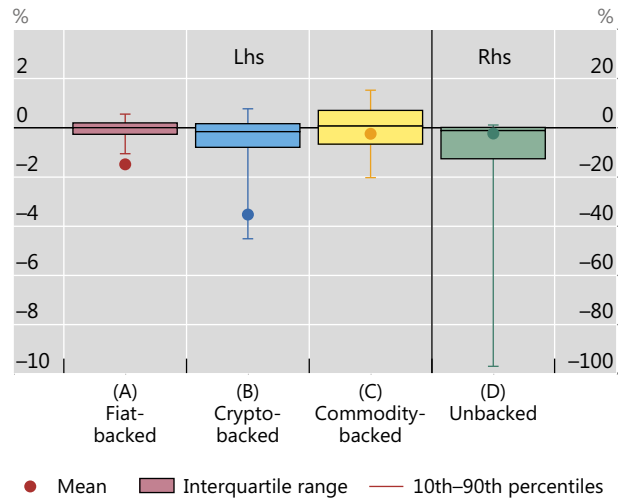
Comparison of the quality of stabilisation mechanism across stablecoin types

Graph 5

A. Price-to-peg ratio over time¹



B. Distributions of deviations of closing prices from peg²



^a On 11 Mar 2020, WHO declares the Covid-19 to be a pandemic. ^b On 9 May 2022, TerraUSD and Luna collapse. ^c On 11 Nov 2022, FTX files for bankruptcy. ^d On 13 Feb 2023, Paxos announces that it will stop issuing new Binance USD tokens. ^e On 10 Mar 2023, Silicon Valley Bank fails.

¹ The price-to-peg is calculated as the closing price (as defined by CoinGecko, ie the price at 00:00 UTC) in US dollars divided by the price of the peg in US dollars. Median value for each stablecoin type. ² The deviation from the peg is measured as the relative difference of the closing price (ie the price at 00:00 UTC) from the price of the peg multiplied by 100. Based on data from 1 Jan 2019 to 30 Sep 2023.

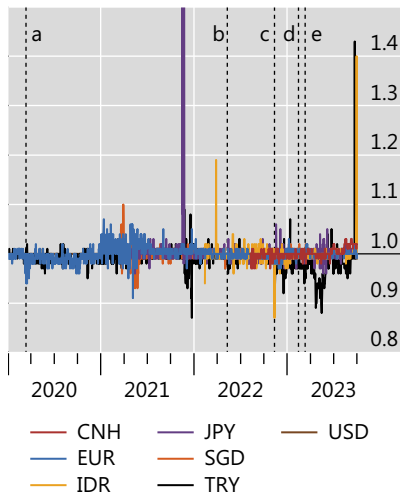
Sources: CoinGecko; authors' calculations.

Deviations from peg by stablecoin type and peg^{1,2}

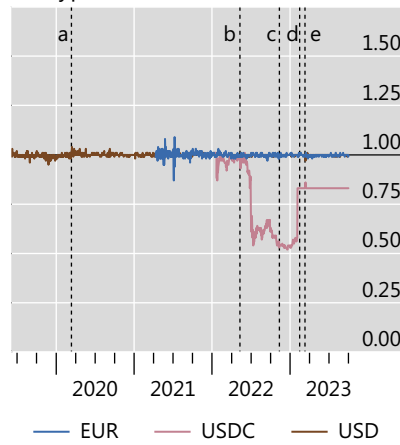
Median of price-to-peg-ratio

Graph 6

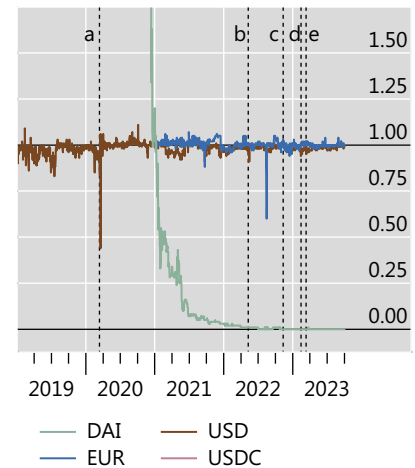
A. Fiat-backed



B. Crypto-backed



C. Unbacked



^a On 11 Mar 2020, WHO declares the Covid-19 to be a pandemic. ^b On 9 May 2022, TerraUSD and Luna collapse. ^c On 11 Nov 2022, FTX files for bankruptcy. ^d On 13 Feb 2023, Paxos announces that it will stop issuing new Binance USD tokens. ^e On 10 Mar 2023, Silicon Valley Bank fails.

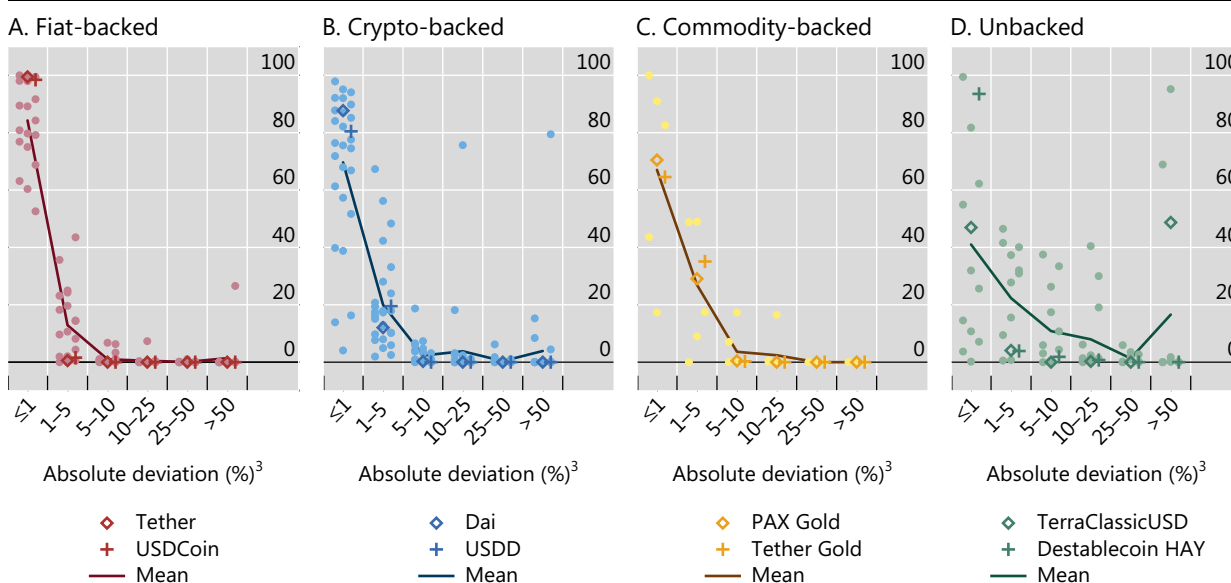
¹ The price-to-peg is calculated as the closing price (as defined by CoinGecko, ie the price at 00:00 UTC) in US dollars divided by the price of the peg in US dollars. Median value for each stablecoin type. ² The deviation from the peg is measured as the relative difference of the closing price (ie the price at 00:00 UTC) from the price of the peg multiplied by 100.

Sources: CoinGecko; authors' calculations.

Frequency of deviations from peg by intensity and stablecoin type¹

As a percentage of days²

Graph 7



¹ Each dot represents the relative frequency of days when a stablecoin's closing price (eg the price at 00:00 UTC) was within each of the respective ranges of deviation from peg laid out on the x-axes. The two largest stablecoins by market capitalisation as of 30 Sep 2023 in each backing category are highlighted using different signs. ² Since the first price was observed. ³ The absolute deviation from the peg is measured as the relative difference of the closing price (eg the price at 00:00 UTC) from the price of the peg multiplied by 100.

Sources: CoinGecko; authors' calculations.

Maintaining the peg during the day

Intraday deviations from the peg might restrict the ability of stablecoins to serve as a means of payment. Price stability, measured by the closing price as discussed above, is an important prerequisite for stablecoins if they are to become a safe store of value. However, to serve as a medium of exchange, they must also be able to maintain their peg during the day: payees would only be willing to accept stablecoins in exchange for their goods or services if they have confidence that these stablecoins will maintain their value so that they can be reused in future purchases.

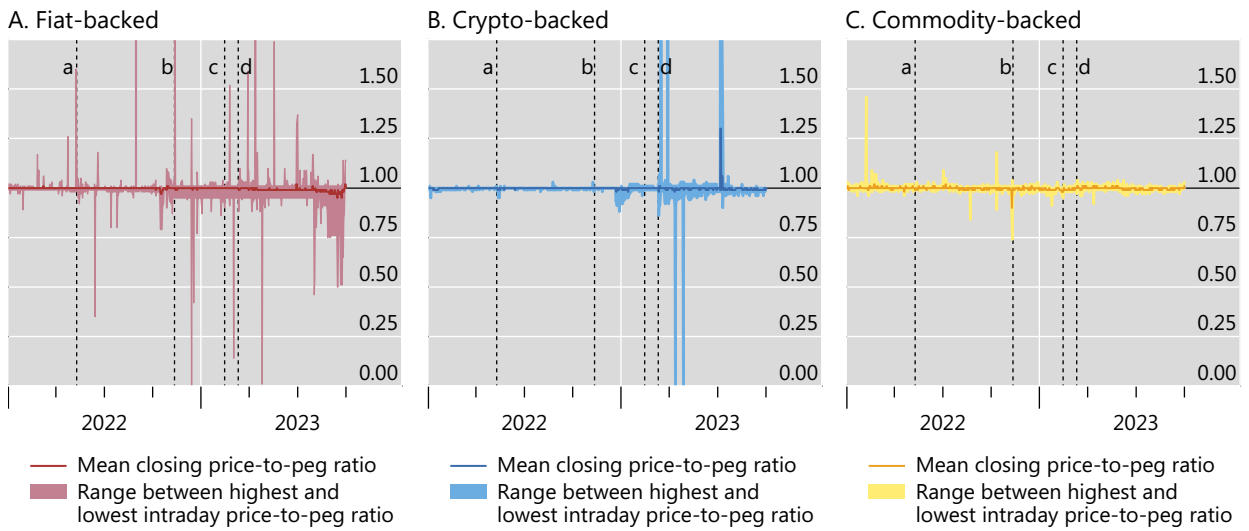
Irrespective of the type of stablecoin, the intraday prices of stablecoins differ from their closing prices. Graph 8 shows the distance between the highest and lowest intraday prices (both relative to their peg) within each stablecoin category. In 2022 and the first half of 2023, intraday peg deviations were most common for commodity-backed stablecoins. This may be driven by the inherent time lag in buying/selling the underlying commodities. The largest intraday deviations can be observed for fiat-backed stablecoins. By contrast, crypto-backed stablecoins had the smallest intraday deviations. These results should however be interpreted with caution: due to data limitations, the number of stablecoins assessed in Graph 8 is limited and the data are therefore sensitive to outliers or bias.³¹

³¹ Graph 8 is based on data for 12 fiat-backed, four crypto-backed and two commodity-backed stablecoins.

Interaction of intraday and closing prices¹

Intraday prices from 1 Jan 2022 to 30 Sep 2023; price-to-peg-ratio

Graph 8



^a TerraUSD and Luna collapse on 9 May 2022. ^b FTX filing for bankruptcy on 11 Nov 2022. ^c On 13 Feb 2023, Paxos announces that it will stop issuing new Binance USD tokens. ^d Silicon Valley Bank failure on 10 Mar 2023.

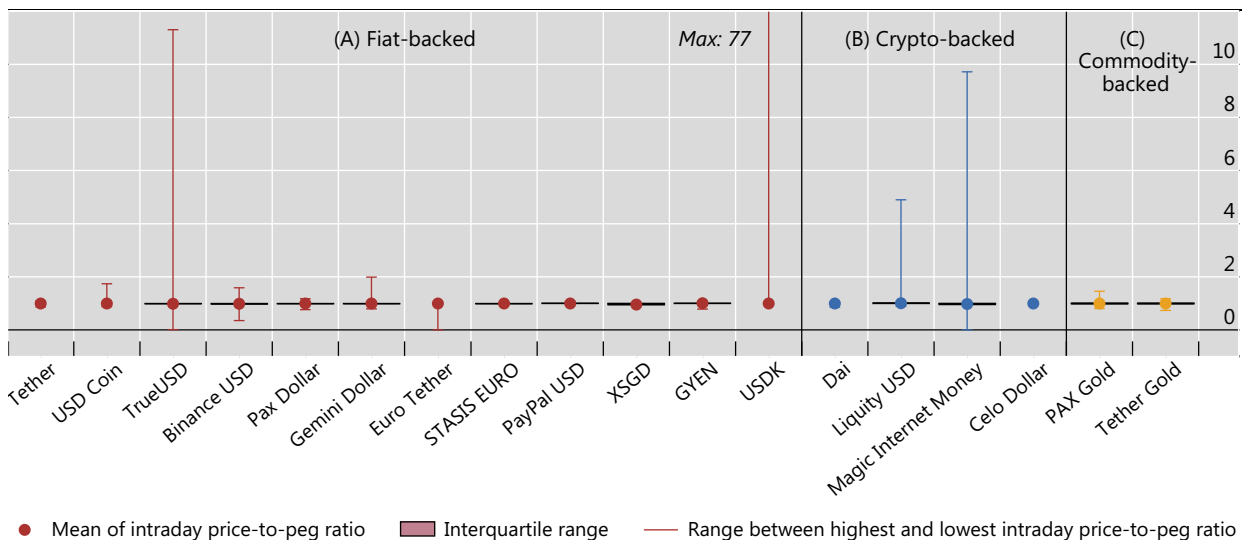
¹ Only stablecoins that are reported in CCData as trading against their peg and that have an absolute mean deviation from the peg below 5% are included in the graphs: 12 fiat-backed, four crypto-backed and two commodity-backed stablecoins.

Sources: CCData; authors' calculations.

Distribution of intraday prices by stablecoin¹

Intraday prices from 1 Jan 2022 to 30 Sep 2023; price-to-peg ratio

Graph 9



¹ Only stablecoins that are included in CCData as trading against their peg and that have an absolute mean deviation from the peg of less than 5% are included in the graphs.

Sources: CCData; authors' calculations.

Fiat-backed stablecoins had the largest intraday peg deviations, also at the individual coin level (Graph 9). Moreover, intraday deviations have generally been larger than fluctuations in the stablecoins' closing prices. For instance, since 2020, the maximum intraday deviation of Tether was 13% (below the peg) and 11% (above the peg). Nevertheless, the interquartile ranges of the stablecoins in Graph 9 show that extreme deviations from the peg were rare, both for fiat-backed and other stablecoin types. Other work also suggests that most stablecoins generally managed to regain parity after large intraday deviations.³²

How are stablecoins backed?

The degree of transparency on the asserted availability and composition of backing reserves varies by the type of stablecoin. At the end of September 2023, all issuers of the largest fiat-backed and commodity-backed stablecoins had published information about the composition of their backing reserves (Graph 10). By contrast, the majority of crypto-backed stablecoins are opaque on the size and breakdown of their reserves.³³

Only a few stablecoins publish their reserves on a daily or even more frequent basis. Two crypto-backed stablecoins, as well as TrueUSD (fiat-backed) make their backing information available daily, while USD Coin and Binance USD publish it on a monthly basis. Other stablecoins that publicly tally their reserve holdings, including Tether, generally do so less frequently, for example quarterly or semi-annually, or even on an ad hoc basis, such as Stasis Euro.

Fiat-backed stablecoins hold heterogeneous portfolios of assets. Based on the latest available reserve information from the 20 largest backed stablecoins, most fiat-backed stablecoins hold reverse repos, publicly issued debt securities and cash or cash equivalents, although to different degrees. Binance USD has the largest share of reverse repos (99%), followed by PayPal USD (96%), USD Coin (55%) and Pax Dollar (54%). Gemini Dollar holds the largest share of publicly issued debt paper (70%), followed by Tether, which increased its share from 44% (as reported in June 2022) to 65% (in June 2023). One fiat-backed stablecoin, Stasis Euro (a euro-pegged stablecoin), claims to be fully backed by cash or cash equivalents, and the reserves of First Digital USD also consist mainly of cash or cash equivalents (79%). That being said, for several stablecoins, including the third largest (TrueUSD), the backing reserves contain assets of which the exact type or maturity are either difficult to classify (eg secured loans) or not published at all.

Even where information is available, it is often unclear whether the published information has been audited. That is, it is often unclear whether the value, break-down, and sufficiency of reserves has been examined and attested to by an independent certified public accountant. Given the variability in their levels of detail, publication frequency and the form of publication, the reserve reports are clearly not based on a particular reporting standard. As a result, it is impossible to assess with any degree of confidence the quality of the underlying reserve assets of

³² See Duan and Urquhart (2023).

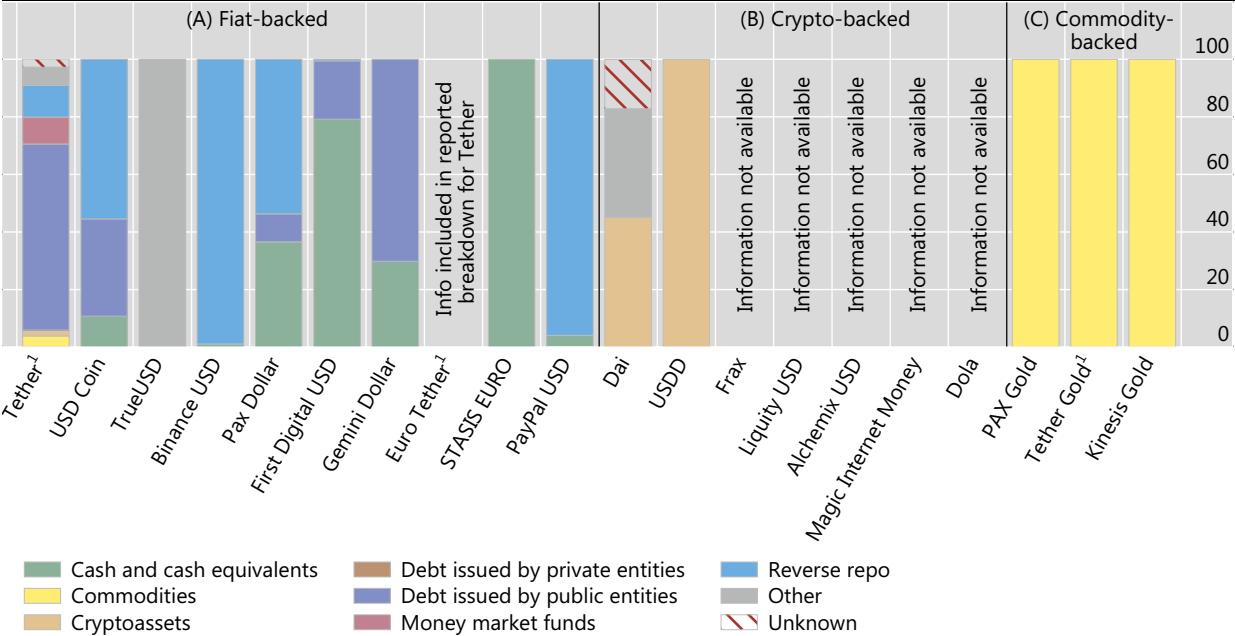
³³ Note that Tether started to provide financial records showing the backing of its stablecoins only in 2022, after it had been ordered to do so by a New York court.

many stablecoins. Due to this lack of clarity, it is unclear whether these stablecoins would be able to convert users' stablecoins at par on demand, and what the financial stability implications would be of a potential run.

Breakdown of reported reserves of the top 20 backed stablecoins

End-September 2023, as a percentage of total reserves

Graph 10



¹ Tether publishes only a consolidated reserves breakdown covering all its cryptoassets, including USD stablecoin (Tether), its euro stablecoin (Euro Tether) and Tether Gold. In this graph, we show the gold reserves of Tether Gold separately.

Sources: companies' websites; authors' calculations.

What are stablecoins used for?

A recent BIS survey shows that, to date, stablecoins are seldom used for payments outside the crypto ecosystem.³⁴ So what, then, are they used for? Earlier work suggests that stablecoins, given their attempt to maintain a stable value, are used as a medium of exchange within the cryptoasset ecosystem, mainly to facilitate cryptoasset trading by serving as a bridge between official currencies and cryptoassets.³⁵ Moreover, stablecoins have been documented as playing an

³⁴ See Kosse and Mattei (2023).

³⁵ See for example Baughman et al (2022), MacDonald and Zhao (2022), Aramonte et al (2021) and ECB (2022). Recent work by Liao et al (2023) argues for a distinction between so-called payment stablecoins (ie those fully backed by high-quality and liquid assets) and trading stablecoins, and they suggest that the former are increasingly used as a means of payment on public blockchains.

important role as liquidity providers in decentralised finance (DeFi).³⁶ However, as data on actual stablecoin usage are hard to obtain, it remains unclear for which types of DeFi services they are used, and how significant their DeFi use is relative to other purposes.³⁷ Other (anecdotal) evidence suggests for example that stablecoins are also used as a store of value to avoid high inflation and preserve purchasing power in times of crisis.³⁸

To offset the lack of detailed data on the uses and users of stablecoins and DeFi, data from crypto exchanges may provide clues. The data on users' trading of stablecoins is helpful but still lacks transparency. The ratio of trading volume to market capitalisation, also referred to as turnover, shows how often a stablecoin is traded (bought or sold) in exchange for fiat currency, relative to its market size. With exception of the spikes around the various crypto events, the turnover of all stablecoin categories has generally decreased since 2020 (Graph 11.A). This implies that the volume of purchases and sales of stablecoins has slowed and that users are increasingly locking their fiat money into stablecoins for a longer period of time. Due to a lack of detailed DeFi transaction data, it is unclear what is actually driving this. Is it because users are increasingly using their stablecoins for services within the DeFi ecosystem, are they just holding on to their stablecoins as a safe haven and to secure their value, or is it because investors see fewer opportunities for arbitrage?

Without question, the turnover of fiat-backed stablecoins surpasses that of any of the other three stablecoin types (Graph 11.B). In particular, fiat-backed stablecoins that have a higher market capitalisation and that are more "stable" (smaller dots) are generally more often traded (Graph 12). Out of all stablecoins, those that are better capable of maintaining a stable value and those that have a higher market liquidity are most attractive for users to buy and sell. The positive correlation with market liquidity may hint at the presence of network effects. More detailed data about stablecoin users, transactions and holdings are required to draw reliable conclusions about the actual usage of stablecoins.

³⁶ DeFi is an umbrella term commonly used to describe a variety of services in cryptoasset markets that aim to replicate some functions of the traditional financial system using distributed ledger or similar technology, see for example FSB (2023a). According to MacDonald and Zhao (2022), over half of the total assets deposited on DeFi platforms are stablecoins.

³⁷ ECB (2022) suggests that Tether and USD Coin are mainly used for other purposes in the cryptoasset ecosystem than DeFi, but it also acknowledges that this assessment is based on an approximation using partial data from only a selection of blockchains.

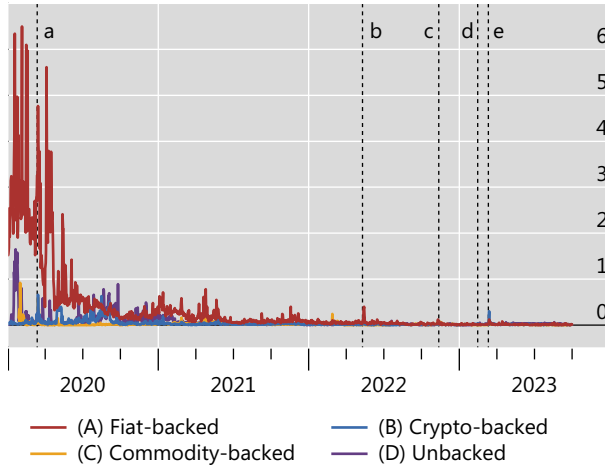
³⁸ See for example Chainalysis (2022) and Ardizzi et al (2023).

Turnover

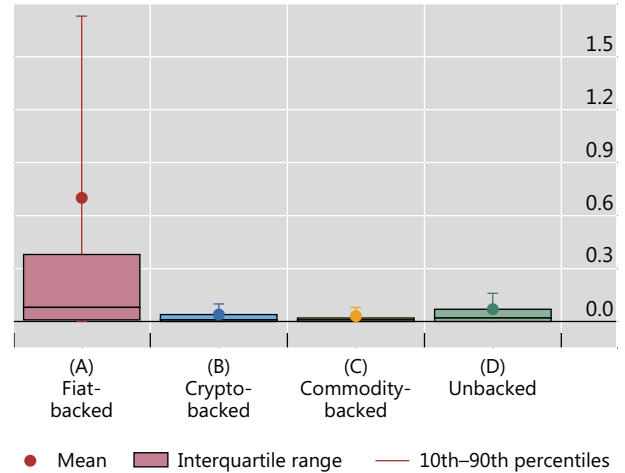
Daily volume-to-market capitalisation ratio

Graph 11

A. Developments over time



B. Distribution¹



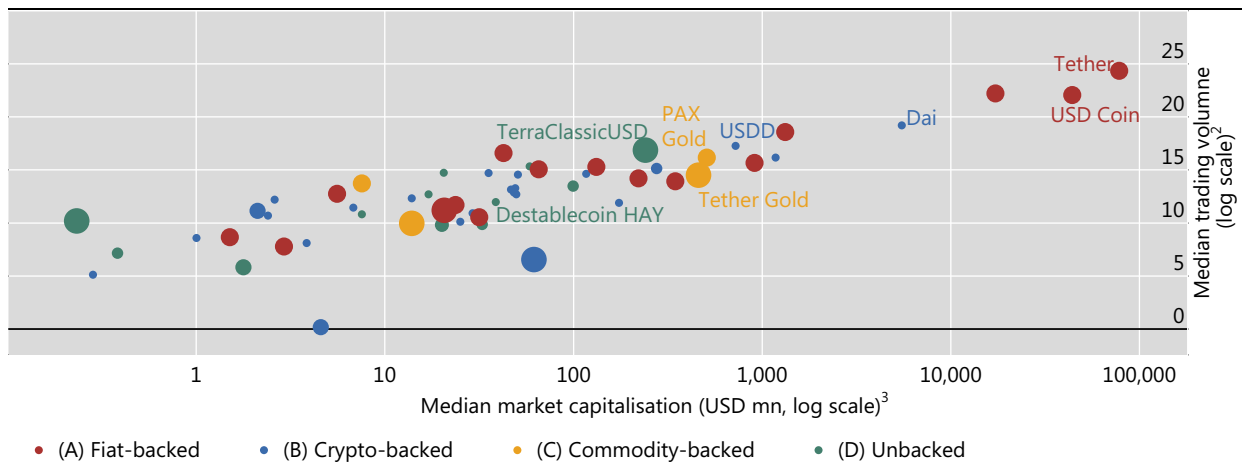
^a On 11 Mar 2020, WHO declares the Covid-19 to be a pandemic. ^b On 9 May 2022, TerraUSD and Luna collapse. ^c On 11 Nov 2022, FTX files for bankruptcy. ^d On 13 Feb 2023, Paxos announces that it will stop issuing new Binance USD tokens. ^e On 10 Mar 2023, Silicon Valley Bank fails.

¹ Based on data from Jan 2020 to Sep 2023.

Sources: CoinGecko; authors' calculations.

Relation between market capitalisation, trading volume and deviation from peg¹

Graph 12



¹ Each circle represents a stablecoin, and the size is indicating its median absolute deviation from peg from 1 Jan 2022 to 30 Sep 2023. The deviation from the peg is measured as the relative difference of the closing price (eg the price at 00:00 UTC) from the price of the peg multiplied by 100. ² Median trading volume between 1 Jan 2022 and 30 Sep 2023. For reasons of clarity and comprehensibility, the distances between the individual trading volumes were reduced by using a log transformation. ³ Median market capitalisation between 1 Jan 2022 and 30 Sep 2023. For reasons of clarity and comprehensibility, the distances between the individual market capitalisations were reduced by using a log transformation.

Sources: CoinGecko; authors' calculations.

Gaps to be filled

As the introduction of stablecoins approaches its tenth anniversary, many questions remain unanswered. One thing is certain: a stablecoin that never breaks its peg has yet to emerge. The evidence suggests that, to date, not one of the current stablecoins assessed in this paper has been able to assure full price stability. This applies to all types of stablecoin, irrespective of their size or their type of reserve assets. Moreover, there is no guarantee that the stablecoin issuers have the assets required to be able to redeem the coins at all times. The lack of transparency regarding the availability and quality of these reserves may undermine trust in stablecoins' credibility and their ability to maintain their peg. For these reasons, the stablecoins we see today do not live up to their name, nor do they meet the key criteria for being a safe store of value or a trustworthy means of payment for the real economy.

To answer questions about the uses and users of stablecoins, significant data gaps must first be addressed. The analysis in this paper is based mainly on information from commercial data providers and stablecoins' websites. More granular data are required to better understand who uses stablecoins, for which activities and purposes, and how often. While blockchain transactions are, in theory, transparent, information on actual usage is difficult to obtain. Moreover, stablecoin issuers typically do not provide public information on the usage of their stablecoins. An important consequence of this data gap is that the true risks of stablecoins may be underestimated. Not only does this hamper authorities' ability to take informed decisions and develop evidence-based policies, but it also makes it difficult for them to intervene, if necessary, in the case of a run or other loss-of-confidence events that may harm consumers.

Appropriate regulation and supervision are essential, not only to serve as a legal basis for the collection of more detailed data, but also to prevent stablecoins from compromising the safety and efficiency of payments and the financial system more broadly. Important steps have already been taken in this direction. The Bank for International Settlements' Committee on Payments and Market Infrastructures (CPMI) and the International Organization of Securities Commissions (IOSCO) have been engaged in extensive international policy and standard-setting work on the regulation, supervision and oversight of stablecoin arrangements. CPMI-IOSCO issued in July 2022 their guidance on how to apply the CPMI-IOSCO Principles for financial market infrastructures (PFMI) to systemically important stablecoin arrangements. In addition, in July 2023, the Financial Stability Board (FSB) published revised high-level recommendations on the regulation, supervision and oversight of "global stablecoin" arrangements, while the Basel Committee on Banking Supervision (BCBS) issued a prudential standard for the treatment of banks' exposures to cryptoassets.³⁹ Jurisdictions are establishing regulatory frameworks for stablecoin arrangements. Some have passed comprehensive legislation that will come into force soon. To date, a few have chosen to ban crypto and stablecoins altogether. Others are at intermediate stages of policy development.

³⁹ For more details, see CPMI-IOSCO (2022); FSB (2023b); and BCBS (2022).

What the future could bring

Despite not being truly stable, stablecoins are still around, and new ones are still being issued.

In August 2023, PayPal announced the launch of a US dollar-denominated stablecoin, PayPal USD (PYUSD). By end-September 2023, PYUSD represented a tiny fraction (less than 0.1%) of the total stablecoin market. Nevertheless, given its brand recognition as a payment service provider, large customer base, and international regulatory experience, PYUSD may have greater potential than existing stablecoins to gain significant traction. This could lead to a surge in demand for use both within and outside of the crypto ecosystem. For this reason, the global regulatory community cannot afford to just let crypto “burn out”.⁴⁰ Continued monitoring with vigilance and future-proofing policy are in order, given the rapidly evolving and elusive nature of this market.

To address the challenges related to stablecoins, regulation alone may not be sufficient.

This paper covered a number of shortcomings but was not exhaustive in its reviews. Other shortcomings include aspects related to competition, consumer protection, data privacy and anti-money laundering/combating the financing of terrorism. Further, stablecoins could undermine the singleness of money and lead to a fragmented and fragile monetary system.⁴¹ To address these challenges in a holistic manner, regulation alone may not suffice. Moreover, not all jurisdictions will seek to regulate stablecoins. In fact, there are divergent policy approaches to stablecoins across jurisdictions: some jurisdictions have made it clear that they will not accept stablecoins because of the potential risks to monetary sovereignty, financial stability and seigniorage income; others choose to regulate stablecoins to address these risks, acknowledging the potential roles that stablecoins and their underlying technology could play in future payment ecosystems in their jurisdictions.

Complementary private or public sector efforts, such as improvements in existing payment infrastructures and exploration or the development of central bank digital currency (CBDC), may help to offer the legitimate benefits in payments and financial services that the public seeks.

For example, if the use of stablecoins is mainly driven by a demand for cheaper cross-border payments, similar benefits may be offered by interlinking today’s fast payment systems. If stablecoins are used for reasons of programmability and instant settlement, then CBDCs could satisfy this demand while offering the safety of central bank money. Further analytical work on the market structure of stablecoins, their stabilisation mechanisms and the key drivers for their adoption will provide a basis for robust policy work. Jurisdictions must move quickly to (i) work through international standard-setting bodies to continue to improve the guidance or standards on stablecoins, including on international cooperation; (ii) determine their policy stance (regulate or ban); (iii) if regulating, then act expeditiously to put in place a holistic regulatory framework, including the means to fill the substantial data gaps.

⁴⁰ See Cecchetti and Schoenholtz (2022).

⁴¹ See BIS (2023).

References

- Ahmed, R, I Aldasoro, and C Duley (2023): "Par for the course: Public information and stablecoin runs", working paper available at SSRN, September.
- Aramonte, S, W Huang and A Schrimpf (2021): "DeFi risks and the decentralisation illusion", *BIS Quarterly Review*, December.
- Ardizzi, G, M Bevilacqua, E Cerrato and A Di Iorio (2023): "Making it through the (crypto) winter: facts, figures and policy issues", *International Economics*, vol 76, no 3, August.
- Arner, D, R Auer and J Frost (2020): "Stablecoins: risks, potential and regulation", *BIS Working Papers*, no 905, November.
- Bank for International Settlements (BIS) (2023): "Blueprint for the future monetary system: improving the old, enabling the new", *Annual Economic Report 2023*, June, Chapter III.
- Basel Committee on Banking Supervision (BCBS) (2022): "Prudential treatment of cryptoasset exposures", December.
- Baughman, G, F Carapella, J Gerszten and D Mills (2022): "The stable in stablecoins", *FEDS Notes*, December.
- Bullmann, D, J Klemm and A Pinna (2019): "In search for stability in crypto-assets: are stablecoins the solution?", ECB, *Occasional Paper Series*, August.
- Cecchetti, S and K Schoenholtz (2022): "Let crypto burn", *Financial Times*, 17 November.
- Chainalysis (2022): "Latin America's Key Crypto Adoption Drivers: Storing Value, Sending Remittances, and Seeking Alpha", October, www.chainalysis.com/blog/latin-america-cryptocurrency-geography-report-2022-preview/.
- Committee on Payments and Market Infrastructures and the Board of the International Organization of Securities Commissions (CPMI-IOSCO) (2022): "Application of the Principles for Financial Market Infrastructures to stablecoin arrangements", July.
- Duan, K, and A Urquhart (2023): "The instability of stablecoins", *Finance Research Letters*, March.
- European Central Bank (ECB) (2020): "Stablecoins: Implications for monetary policy, financial stability, market infrastructure and payments, and banking supervision in the euro area", *Occasional Paper Series*, September.
- (2022): "Stablecoins' role in crypto and beyond: functions, risks and policy", *Macroprudential Bulletin*, September.
- Federal Deposit Insurance Corporation (FDIC) (2023): "FDIC Creates a Deposit Insurance National Bank of Santa Clara to Protect Insured Depositors of Silicon Valley Bank, Santa Clara, California", Press Release, 10 March, www.fdic.gov/news/press-releases/2023/pr23016.html.
- Financial Stability Board (FSB) (2018): "Crypto-asset markets: potential channels for future financial stability implications", October.
- (2020): "Regulation, Supervision and Oversight of 'Global Stablecoin' Arrangements, Final Report and High-Level Recommendations", October.

- (2023a): “The Financial Stability Risks of Decentralised Finance”, February.
- (2023b): “High-level Recommendations for the Regulation, Supervision and Oversight of Global Stablecoin Arrangements: Final report”, July.
- G7 Working Group on Stablecoins (G7) (2019): “Investigating the impact of global stablecoins”, October.
- International Monetary Fund (IMF) (2023a): “G20 Note on the Macroeconomic Implications of Crypto Assets”, February.
- (2023b): “Runs and flights to safety: are stablecoins the new money market funds?”, September.
- Kosse, A and I Mattei (2023): “Making headway – Results of the 2022 BIS survey on central bank digital currencies and crypto”, *BIS Papers*, no 136, July.
- Liao, G, T Hadeed and Z Zeng (2023): “Beyond speculation: payment stablecoins for real-time gross settlements”, working paper available on SSRN, June.
- Lyons, R and G Viswanath-Natraj (2023): “What keeps stablecoins stable?”, *Journal of International Money and Finance*, vol 131.
- MacDonald, C and L Zhao (2022): “Stablecoins and their risks to financial stability”, *Bank of Canada Staff Discussion Paper*, no 2022-20, November.
- Paxos (2023): “Paxos Will Halt Minting New BUSD Tokens”, press release, 13 February, <https://paxos.com/2023/02/13/paxos-will-halt-minting-new-busd-tokens/>.
- US Department of Justice (2010): “Horizontal Merger Guidelines”, August.

Annex 1: Key features of stablecoins in scope

Overview of stablecoins considered in this paper¹

Table 1

Name	Peg	Latest market capitalisation in USD mn (30 Sep 2023)	CoinGecko closing price (ie price at 00:00 UTC)		CCData intraday prices	
			First date	Number of observations	First date	Number of observations
(A) Fiat-backed						
BiLira	TRY	13.27	16 Dec 2019	1385		
Binance USD	USD	2259.98	17 Apr 2020	1262	17 Apr 2020	1262
CNH Tether	CNH	2.87	8 Aug 2022	419		
Euro Tether	EUR	218.05	29 Jul 2021	794	29 Jul 2021	794
First Digital USD	USD	406.57	5 Aug 2023	57		
GYEN	JPY	13.93	12 Mar 2021	933	21 Jun 2022	467
Gemini Dollar	USD	300.99	9 Oct 2018	1818	29 Oct 2018	1798
HUSD	USD	8.89	21 Apr 2020	1258		
Pax Dollar	USD	485.76	10 Oct 2018	1817	20 Sep 2021	741
PayPal USD	USD	94.31	9 Sep 2023	22	14 Sep 2023	17
STASIS EURO	EUR	131.00	22 Aug 2018	1866	23 Aug 2018	1865
Stably USDS	USD	0.00	22 Feb 2019	753		
Tether	USD	83267.97	1 Jan 2018	2099	01 Jan 2018	2099
TrueUSD	USD	3445.46	23 Mar 2018	2018	18 Apr 2018	1992
USD Coin	USD	25054.61	17 Oct 2018	1804	10 Jan 2019	1725
USDK	USD	0.47	17 Jul 2019	1537	17 Jul 2019	1537
VNX EURO	EUR	0.32	27 Sep 2023	4		
XIDR	IDR	4.31	12 Feb 2022	596		
XSGD	SGD	30.72	18 Mar 2021	927	07 Jul 2022	451
ZUSD	USD	18.71	12 Mar 2021	933		
(B) Crypto-backed						
Alchemix USD	USD	167.89	22 May 2021	770		
Celo Dollar	USD	5.92	3 Dec 2020	940	3 Dec 2020	1032
Celo Euro	EUR	15.26	11 Jul 2021	714		
Coin98 Dollar	USD	0.69	19 Sep 2022	285		
Dai	USD	3825.84	19 Nov 2019	1320	19 Nov 2019	1412
Dola	USD	37.64	1 Apr 2022	456		
Equilibrium EOSDT	USD	1.68	31 May 2019	1492	24 Nov 2020	1041
Fei USD	USD	17.21	3 Apr 2021	819		
Frax	USD	670.77	21 Dec 2020	922		
Liquity USD	USD	256.02	5 Apr 2021	817	17 Jan 2023	257
MAI	USD	24.47	14 Oct 2021	625		
Magic Internet Money	USD	40.99	25 Sep 2021	644	21 Dec 2022	284
Origin Dollar	USD	15.53	3 Oct 2020	1001		
Parallel	EUR	2.37	10 Apr 2021	812		

(continued)

Overview of stablecoins considered in this paper¹

R	USD	20.66	3 Jun 2023	28		
Sperax USD	USD	0.09	27 Jan 2022	520		
Statik	USDC	0.01	7 Jan 2022	540		
USD Balance	USD	726.35	10 May 2022	417		
USDD	USD	2.51	2 May 2022	425		
USDP Stablecoin	USD	5.38	28 Nov 2020	945		
Vesta Stable	USD	9.85	11 Aug 2022	324		
WEMIX Dollar	USDC	12.66	4 Feb 2023	147		
YUSD Stablecoin	USD	16.84	28 Apr 2022	429		
agEUR	EUR	33.03	30 Dec 2021	548		
dForce USD	USD	23.89	24 Mar 2023	99		
eUSD	USD	32.73	10 May 2023	52		
flexUSD	USDC	3.52	10 Mar 2022	478		
mStable USD	USD	167.89	16 Jul 2020	1080		
(C) Commodity-backed						
Comtech Gold	Gold	8.43	16 Jul 2022	442		
Kinesis Gold	Gold	76.96	28 Apr 2023	156		
PAX Gold	Gold	462.37	1 Aug 2020	1156	1 Aug 2020	1156
Tether Gold	Gold	456.47	27 Jan 2020	1343	18 Jun 2020	1200
VNX Gold	Gold	0.90	30 Sep 2023	1		
VeraOne	Gold	16.97	25 Mar 2022	555		
tGOLD	Gold	5.14	31 Jan 2023	243		
(D) Unbacked						
BOB	USDC	5.01	23 Sep 2022	373		
Basis Cash	DAI	0.11	30 Nov 2020	1035		
Bean	USD	35.83	23 Sep 2021	735		
Destablecoin HAY	USD	38.77	9 Sep 2022	387		
Djed	USD	4.06	10 May 2023	144		
SpiceUSD	USD	0.65	30 May 2022	489		
TOR	USD	16.82	27 Apr 2022	522		
TerraClassicUSD	USD	125.07	26 Nov 2020	1039	30 Sep 2021	731
USDX	USD	11.18	14 Nov 2020	1051		
Vai	USD	4.09	4 Feb 2021	969		
Zasset zUSD	USD	0.32	8 Sep 2021	753		
sEUR	EUR	3.90	13 Jan 2021	991		
sUSD	USD	34.64	7 Aug 2018	1881		

DAI = Dai; EUR = euro; IDR = rupiah; SGD = Singapore dollar; TRY = Turkish lira; USD = US dollar; USDC = USD Coin; JPY = yen.

¹ Data up to and including 30 Sep 2023.

Sources: CCData; CoinGecko; authors' calculations.

Annex 2: Technical annex

Herfindahl–Hirschman Index (HHI) of the stablecoin market

The HHI is used as an indicator of the concentration in the stablecoin market as it accounts for the relative sizes of the individual stablecoins. The HHI at a given date (d) is calculated by dividing the sum of the square of the market capitalisation (mc) of each stablecoin (s) by the square of the sum of the market capitalisation of all stablecoins at that given date:

$$HHI_d = \frac{\sum_{s=1}^n mc_{s,d}^2}{(\sum_{s=1}^n mc_{s,d})^2}$$

According to the standards set by the US Department of Justice (2010), a market with an HHI of less than 1,500 is considered a competitive market, an HHI between 1,500 and 2,500 suggests moderate concentration and a market with an HHI of 2,500 or greater is considered to be highly concentrated. HHI values can vary between 0 and 10,000.

Volatility of stablecoin prices

The historical volatility of stablecoins is calculated based on the daily closing prices provided by CoinGecko, which are the prices at 00:00 UTC. The volatility (v) of a stablecoin (i) is only calculated at a given trading date (d) if the following conditions are met:

- closing price (cp) of (i) is reported by CoinGecko and larger than 0;
- market capitalisation (mc) of (i) is reported and larger than 0;
- trading volume (tv) of (i) is not missing and larger than 0;

For the purpose of comparability, the volatility is also calculated for Bitcoin and Ethereum (as other cryptoassets) and S&P 500 (as an indicator of traditional financial instruments).

Throughout the paper, volatility is defined as the annualised standard deviation of daily returns and computed on the basis of a one month moving window, covering 30 trading days for the cryptoassets in scope (because these are traded 24/7) and 21 trading days for the S&P 500 (as this is traded during weekdays only). For stablecoins and other cryptoassets the formula is as follows:

$$v_{d,i} = \sqrt{365} \times \sqrt{\frac{1}{30} \sum_a^{d-30} \left(\frac{cp_{d,i} - cp_{d-1,i}}{cp_{d-1,i}} \times 100 \right)^2}$$

Deviations from peg

The deviation of the stablecoin prices from their pegs is calculated both using the closing prices provided by CoinGecko (eg the prices at 00:00 UTC) and the intraday prices (eg high and low prices at 00:00 UTC as observed in the last 24 hours) reported by CCData.

A few things to note:

- If stablecoins are denominated in another currency than that of their peg, their prices (both closing and intraday) are converted into the denomination of the peg using the relevant daily exchange rates. For instance, for a USD-denominated stablecoin that claims to be pegged to the euro, the daily USD-EUR exchange rates are used to convert its price into euros.
- For stablecoins that claim to be pegged to another asset (instead of another fiat currency), such as gold or another stablecoin, the daily closing prices of these assets are used as the peg value. For instance, the price of gold as expressed in US dollars is used as the value of the peg of stablecoins that claim to be pegged to gold.

To allow for a comparison across different types of stablecoins, the analysis is based on the price-to-peg-ratio. This price-to-peg-ratio ($ptpr$) on a given day (d) for a stablecoin (s) is calculated as the ratio of the stablecoin price (p) as denominated in the currency of the peg to the price of the peg ($pegp$):

$$ptpr_{d,s} = \frac{p_{d,s}}{pegp_d}$$

The daily deviation of the stablecoins' prices from their pegs in per cent ($devpeg$) is calculated as follows:

$$devpeg_{d,s} = \frac{p_{d,s} - pegp_d}{pegp_d} \times 100$$

Number of active days

The number of active days is based on the number of consecutive days since the first day a stablecoin had a market capitalisation larger than 0.

Previous volumes in this series

No	Title	Issue date
BIS Papers No 140	Central banks, macro-financial stability and the future of the financial system	October 2023
BIS Papers No 139	Digital safety nets: a roadmap	September 2023
BIS Papers No 138	Financial stability risks from cryptoassets in emerging market economies	August 2023
BIS Papers No 137	Building an integrated surveillance framework for highly leveraged NBFIs – lessons from the HKMA	July 2023
BIS Papers No 136	Making headway – Results of the 2022 BIS survey on central bank digital currencies and crypto	July 2023
BIS Papers No 135	The energy transition and its macroeconomic effects	May 2023
BIS Papers No 134	Global tightening, banking stress and market resilience in EMEs	April 2023
BIS Papers No 133	The two-regime view of inflation	March 2023
BIS Papers No 132	Information governance in sustainable finance	December 2022
BIS Papers No 131	Central banking after the pandemic: challenges ahead	December 2022
BIS Papers No 130	Pricing of climate risks in financial markets: a summary of the literature	December 2022
BIS Papers No 129	The role of non-bank financial institutions in cross-border spillovers	December 2022
BIS Papers No 128	Central bank digital currencies in Africa	November 2022
BIS Papers No 127	Historical monetary and financial statistics for policymakers: towards a unified framework	September 2022
BIS Papers No 126	Corporate digital identity: no silver bullet, but a silver lining	June 2022
BIS Papers No 125	Gaining momentum – Results of the 2021 BIS survey on central bank digital currencies	May 2022
BIS Papers No 124	The design of a data governance system	May 2022
BIS Papers No 123	CBDCs in emerging market economies	April 2022
BIS Papers No 122	The monetary-fiscal policy nexus in the wake of the pandemic	March 2022

All volumes are available on the BIS website (www.bis.org).