Stablecoins and short-term funding markets

December 22, 2025

Abstract

The rapid growth of stablecoins – crypto-assets aiming at keeping a stable value – has generated a sizeable demand for short-term dollar-denominated assets. Stablecoin issuers hold these assets to back their tokens and manage their peg. This paper shows that an increase in the demand for stablecoin tokens caused additional commercial paper (CP) issuance, when tokens were backed by CP. This suggests CP issuers catered to the demand emanating from stablecoins' backing. Our results highlight a new and more general link between crypto-assets, conventional financial markets, and short-term debt issuers.

JEL: G14, G23, G29.

1 Introduction

The booms and busts in the development of crypto-assets raise questions about their potential interactions with the economy, and in particular to what extent the volatility of crypto-assets may affect traditional financial markets. Stablecoins hold a specific place among crypto-assets, as they are designed to keep their value stable against a fiat currency, and as their issuers connect – via their balance sheet – crypto and traditional money markets. The largest stablecoins – Tether (USDT) and USD Coin (USDC) – are issued respectively by Tether and Circle, two centralized entities who manage a peg vis-a-vis the US dollar by holding short-term dollar-denominated assets in reserves.[1] This paper explores the consequences of this new source of demand on short-term funding markets.

The market capitalization of stablecoins pegged to the US dollar has soared from 5 billion in January 2020 to 150 billion US dollars in May 2022 and surpassed 200 billion US dollars in 2025.[2] In such a short period of time, stablecoin issuers have become a non-negligible category of investors: their demand for reserve assets was first focused on the commercial paper (CP) market in 2020-2021, when they reportedly held around 4% of the USD-denominated CP market outstanding at the peak. Since then, the reallocation of their reserves toward Treasury bills has gained growing attention. As of December 2024, Circle and Tether reported holdings in US T-bills representing respectively 14 billion USD and 94 billion USD, over an amount outstanding of US T-bills of 6,186 billion USD – 1.7% of this amount.[3]

Therefore, can we detect demand pressure from stablecoin issuers on the assets they hold in reserve? What type of lessons can be drawn from the early experience of CP backing and disinvestment ? If any, has this new source of demand had a price impact, led to substitution between their holders, and/or modified the supply of these assets?

To quantitatively answer these questions, we assess the causal impact of the demand for

[1] Other types of stablecoin, albeit smaller, also exist and will be briefly discussed in section 2.

[2] Source: DefiLlama

[3] Source: Tether attestation reports and Circle Fund USDXX T-bills holdings, scaled by T-bill outstanding https://fiscaldata.treasury.gov/datasets/monthly-statement-public-debt/summary-of-treasury-securities-outstanding

reserve assets from stablecoin issuers on the commercial paper market. We use CP market as our laboratory for three reasons. First, at the peak, Tether and Circle reportedly held up to 50 billion USD of CP, the largest footprint ever of stablecoin issuers in a single asset class, placing Tether on par with the largest US prime money market funds.[4] Second, focusing on CP also allows us to exploit the stated heterogeneity among stablecoin reserve asset policies: the third largest issuer of USD-pegged stablecoin at the time, Binance, never backed its BUSD stablecoin with CP, Circle ceased abruptly to hold CP to back USDC, and Tether decreased its CP holdings gradually. Third, CP are a significant source of short-term funding globally, for US and non-US financial intermediaries and non-financial corporations, and from the firms' perspective issuing more short-term claims would increase their exposure to rollover risk.

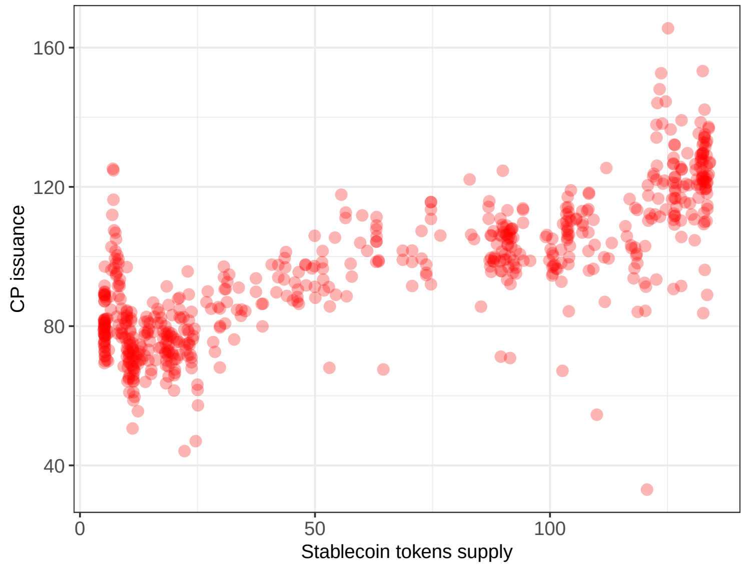
Our identification strategy consists of tracking changes in circulating tokens, i.e., tokens held by the public and that are declared to be backed by stablecoin issuers. An increase in circulating tokens is the consequence of the inflows of dollars by investors exchanging them for stablecoin tokens. Such inflows must be mirrored by the same increase in reserve assets.[5] Our identification assumption is then that changes in these inflows of dollars (or outflows) constitute a plausible exogenous source of changes in the demand for reserve assets. We argue that this assumption is reasonable for three main reasons. First, the demand for stablecoin tokens is unrelated to CP market conditions, as it reflects primarily the adoption of crypto assets and decentralized finance in general. Second, investors' demand for stablecoin tokens is independent of the will of the stablecoin issuers themselves, as the latter don't control the amount or the timing of the dollar inflows or outflows they receive. Third, investors were not even aware of the composition of reserve assets of major stablecoin issuers prior to mid-2021,

[4]This is also one order of magnitude larger than the share reportedly held in other asset classes during the same period. As of June 30, 2021, Tether and Circle self-reported T-bill holdings amounting to 15.3 bn USD and 3.3 bn USD, respectively. The holdings by BUSD were below 10 bn USD. These add up to 28.3 bn USD at maximum, representing less than 0.7% of the T-bill outstanding at the time (4273 bn USD).

[5]There is another more trivial reason behind this choice: we do not observe, up to recently and in a reliable fashion, the high frequency, granular holdings of stablecoin issuers. However, such observations, while useful, would raise an endogeneity issue.

and stablecoin issuers do not pay interest to stablecoin investors, which means these investors would not buy stablecoins for the purpose of indirectly investing in the underlying reserve assets.[6]

Figure 1: Total issuance of CP and stablecoins circulating



Note: The x-axis stands for circulating tokens in USDT and USDC; y-axis stands for the total issuance of CPs of any maturity, rating and issuer type, denominated in US dollars. Both series are in billion and each dot relates to a working day from Jan 2019 to end-June 2022. Source: Federal Reserve Board, Messari.

From a bird's eye view, Figure 1 suggests that higher demand for stablecoin tokens is associated with higher CP issuance. However, this correlation might well be spurious due, for instance, to time trends or omitted variables. We address these empirical challenges by investigating this relationship in first difference, controlling for potential confounding factors between January 2019 and June 2022, making sure to specifically control for the Covid crisis period and notably for the Federal Reserve's intervention in the CP market. We also confirm our causal interpretation by a number of econometric exercises, including the exploitation of the stated cross-sectional and time-dimension heterogeneity in the reserve assets policy of the three largest stablecoins.

Our main contribution is to show a significant and positive impact of the demand for

[6] Holding stablecoins can be indirectly remunerated through depositing in lending platform of decentralized finance.

stablecoins on the issuance of CP but no economically significant impact on CP rates. The combination of these two results suggests that CP issuers catered to the additional demand. This short episode of high intensity of CP purchases by stablecoin issuers from 2020 to mid-2022 demonstrates the importance of the asset composition of stablecoin issuers and the ability of the short-term funding market to absorb additional demand. To further understand how the CP market absorbed the demand, we then show that CP issuers could easily predict the demand from stablecoin issuers by observing simple on-chain data. More precisely, we show that the predicted increase in circulating tokens raises the issuance of CP, in a two-stage least squares approach, using the delay between the demand for stablecoins, the resulting mints of new tokens, and the actual increase in circulating tokens.

Our findings have implications for our understanding of the reserve assets policy of the largest stablecoin issuers. A lot of speculation surrounded the backing of main stablecoin issuers. Before 2021, the existence and composition of the reserves held by stablecoin issuers were unverifiable and undisclosed. From mid-2021 onward, following a lawsuit filed against Tether, stablecoin issuers started to publish attestation reports on the broad composition of their reserve assets – reports having themselves been called into question.[7] Indirectly, our results can be seen as reverse engineering the backing strategy of stablecoin issuers by trying to detect their impact on reserve assets. Overall, our results broadly support the attestation reports, in the sense that they suggest Tether and Circle effectively purchased CP around the times they indicated. The stated share of CP at their asset side also lies within the confidence bands of our results – albeit the coefficients we find suggest either an over-investment in CP of stablecoin issuers, or an over-reaction of CP issuers when facing higher demand.

Our findings also contribute to the ongoing debate about whether stablecoins qualify as

[7]According to Bloomberg (2021) (https://www.bloomberg.com/news/features/2021-10-07/crypto-mystery-where-s-the-69-billion-backing-the-stablecoin-tether), no significant New-York based CP dealers have ever confirmed that they have dealt with Tether among their clients. We see three main possibilities: either CP dealers did not want to disclose Tether was their customer, or Tether was the client of a not-central CP dealer, or Tether was using an intermediary to hide its identity. Our findings are however corroborated by recent information published by Coindesk disclosed under the Freedom of Information Law, see https://www.coindesk.com/policy/2023/06/21/reviewing-the-tether-documents/

money. For instance, BIS (2025) argues that "stablecoins fall short on the three key tests for money," one of which is the elasticity test. While the report emphasizes that stablecoin issuers cannot create coins at will – as issuance requires prior payment from holders – we argue that an equally important aspect of the elasticity test is the issuer's ability to adjust its reserve portfolio in response to shifts in demand without incurring significant losses or operational constraints. Our finding that CP issuers accommodate the additional demand generated by stablecoins suggests that such reserve assets are relatively well-suited for this role, as their supply appears sufficiently reactive to absorb fluctuations in stablecoin demand, thereby allowing stablecoin issuers to respond seamlessly to changes in demand – a key requirement of the elasticity test. However, this result may depend on the specific subsample we study, characterized by modest stablecoin fluctuations and ample market liquidity associated with the Federal Reserve's policy stance.

Finally, we run additional tests to confirm the causal interpretation of our results. First, Circle and Tether announced that they would stop — completely or gradually — using commercial paper as reserve assets in the course of Summer 2021.[8] Our results, when introducing interactions with time fixed-effects, are broadly consistent with these announced reserve asset policy changes. This suggests that stablecoin issuers have effectively reduced their CP purchases when they said so and also that our results effectively come from their reserve asset policy and not something else. Second, we find that changes in BUSD tokens in circulation do not cause any change in the CP market, consistent with Binance not purchasing CP. Third, we show that euro-denominated CP have not been affected by changes in USDC and USDT circulating tokens. All these results confirm that the positive and significant impact we identify is effectively linked to the backing of stablecoins, highlighting a new type of link between crypto-assets and conventional financial markets. We show this link has been alive for one particular class of assets — commercial paper — during a specific episode — from 2020 to 2022. Consistent with our causal interpretation and the exclusion of CP from sta-

[8]See Section 2.2 for more details

blecoins' holdings, this link has disappeared but going forward may appear again for other asset class, depending on the evolution of the size of the stablecoin market and reserve assets policy, in particular on T-bills, as suggested by the recent findings of Ahmed and Aldasoro (2025).

Our paper contributes to a nascent literature assessing the interlinkages between crypto-assets and traditional markets and their importance in a macro-finance and financial stability perspective: (Karau, 2021; Benigno and Rosa, 2023; Aldasoro et al., 2024; Vuković et al., 2025). It also relates to several strands of literature more specifically focused on stablecoins.

First, our paper contributes to the understanding of strategies implemented by stablecoin issuers to maintain their peg, from a theoretical and empirical perspective (Frost et al., 2020; Lyons and Viswanath-Natraj, 2020; Gorton and Zhang, 2021; Kozhan and Viswanath-Natraj, 2021; Li and Mayer, 2021; Gorton et al., 2022; D'Avernas et al., 2022; Bertsch, 2023; Charoenwong et al., 2022) and the link between crypto-assets and stablecoins (Makarov and Schoar, 2021; Griffin and Shams, 2020; Saggu, 2022). Stablecoins may affect traditional finance through different channels.[9] Caramichael and Liao (2022) show how depending on the composition of the stablecoin reserve assets, stablecoins impact banking intermediation. Garratt et al. (2022) suggest theoretically that tying up safe and liquid assets in stablecoin backing may reinforce shortages of safe assets for banks' regulatory requirements, for instance. Aldasoro et al. (2024) explore the impact of crypto and monetary policy shocks on MMF and stablecoin inflows, finding little evidence stablecoin play a safe asset role in crypto market. We focus instead on the demand emanating from crypto markets and test the impact on conventional money market.

Our paper is the first, to the best of our knowledge, to outline a mechanism connecting crypto-assets and short-term funding markets through asset-backed stablecoin balance sheets and to empirically test it using the CP market. A subsequent paper by Kim (2022) and a

[9] Other studies have examined crashes of stablecoin experiments and the dynamics of runs (Adams and Ibert, 2022; Uhlig, 2022; Liu et al., 2023; Anadu et al., 2023). A number of institutional publications focus on the financial stability risks posed by stablecoins, mainly on these episodes of runs(G7, 2019; ECB, 2020; Arner et al., 2020; IMF, 2021; US, 2021)

more recent paper by Ahmed and Aldasoro (2025) find an impact of stablecoin inflows on T-bill yields.

Second, our investigation borrows from the liquidity premium literature, where CP rates are usually exploited to measure the liquidity premium (Krishnamurthy and Vissing-Jorgensen, 2012; Sunderam, 2015; Nagel, 2016). Kacperczyk et al. (2021) study the production of short-term safe assets and how CP issuers anticipate and adjust contemporaneously to an additional demand. Facing increasing demand, firms may strategically issue more of this type of debt. Our results crucially show that the CP issuers were able to adjust their issuance to cater to the new demand emanating from stablecoins. This has consequences for their exposure to rollover risk and, ultimately, for financial stability (Stein, 2012; Carlson et al., 2016).

The remainder of the paper is organized as follows. Section 2 documents the stablecoins' demand for commercial paper. Section 3 describes our empirical strategy. Section 4 presents our results and discusses the mechanism. Section 5 concludes.

2 Stablecoins' demand for commercial paper

In this section, we document the rapid rise of asset-backed stablecoins from 2020 to 2022 and its potential impact on the demand for US-denominated commercial paper, one of the reserve assets held by large stablecoin issuers to back their tokens during this growing phase.

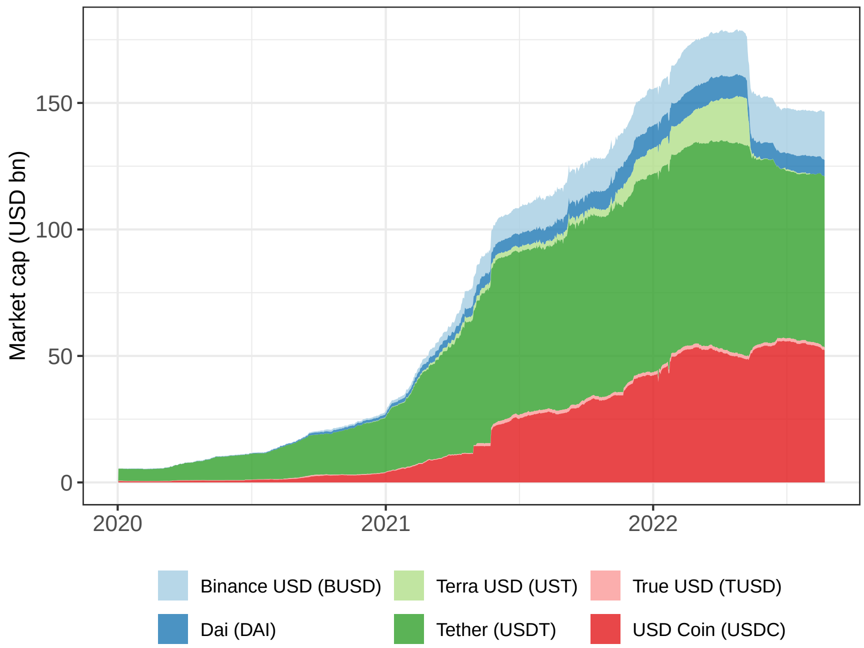
2.1 The rapid rise of asset-backed stablecoins

While the first stablecoin projects emerged in the mid-2010s with the publication of several whitepapers,[10] their development took off in the last couple of years. In January 2020, the market capitalization of stablecoins was just below 5 billion USD. Within two years, they reached almost 200 billion USD. The crash of TerraUSD, in May 2022, put a halt on this growth but had a somehow limited impact on the capitalization of the other stablecoins.

[10] https://www.wsj.com/articles/BL-MBB-23780

Figure 2 shows the evolution of market capitalization of the main largest stablecoins. The four largest stablecoins are Tether (USDT), USD Coin (USDC), Binance USD (BUSD) and Dai (DAI) issued respectively by Tether Ltd, Circle/Paxos, Binance and MakerDAO, are all pegged to the US dollar.[11] USDT and USDC concentrate by far the market capitalization.

Figure 2: Stablecoins' market capitalization



Note: This figure reports the evolution of the 6 largest stablecoins by market capitalization as of October 2021. Latest observation: 2022-08-22. Market capitalization is the circulating supply times the market price. Source: Messari.

The fast-growing adoption of stablecoins is linked to their multiple purposes in crypto markets. Their stability properties allow them to play the role of a store of value in crypto markets. Stablecoins also fuel the development of Decentralized Finance (DeFi) as collateral locked in smart contracts or borrowed to build leveraged positions. Stablecoins have also acquired a central role in the crypto market as a medium of exchange: data from the main crypto exchanges suggest that a majority of transactions are settled with a stablecoin, as

[11] The three largest stablecoins promise redeemability at par of their tokens against US dollars. Tether states *"All Tether tokens are pegged at 1-to-1 with a matching fiat currency (e.g., 1 USDT = 1 USD) and are backed 100% by Tether's reserves."*. Similarly, Circle claims *"Every digital dollar of USDC on the internet is 100% backed (...) so that it's always redeemable 1:1 for U.S. dollars"*.

noted by Gensler (2021).[12] As such, the development of stablecoins is linked to the growth of crypto markets in general. See for instance Arner et al. (2020); Adachi et al. (2022); Caramichael and Liao (2022) for an extensive review.

Finally, and more importantly for this paper, the three leading stablecoins have all in common the same stabilization strategies: the issuer holds US-denominated assets to back the value of the issued tokens.[13] The dominance of asset-backed stablecoins means that their rapid growth should be linked to an increase in demand for reserve assets by stablecoin issuers.

2.2 Commercial paper as reserve assets

Little was known until mid-2021 on the composition of these reserve assets. The backing itself was unverifiable and subject to a number of controversies and rumors. On April 25, 2019, the New York Attorney General filed a lawsuit against Tether Ltd and its parent companies iFinex and Bitfinex, questioning the reality of the 1:1 backing of USDT tokens, at all times between 2018 and 2019. Tether reached an agreement in February 2021 and committed to issue regular independent audit reports on its reserve assets.[14] Tether started to disclose some information in July 2021, certified by an independent accountant.[15]

To the surprise of many, the first attestation report published by Tether showed that USDT tokens were reportedly mainly backed by Commercial Paper (CP) and Certificates of Deposits (CD) denominated in US dollars, and not by cash (See Figure 3).[16] As of June 2021, Tether Holdings Limited reported a holding of 31 USD bn of CP/CDs. At the time, this *de facto* would have placed Tether on par with the largest Prime money funds in terms of CP holdings (Abate, 2021). By comparison, one of the largest money market funds, the

[12] Figure 6 in appendix shows that 2/3 of transaction volumes between Sept 2020-Sept 2021 are concentrated between stablecoins and other crypto-assets on exchange platforms.

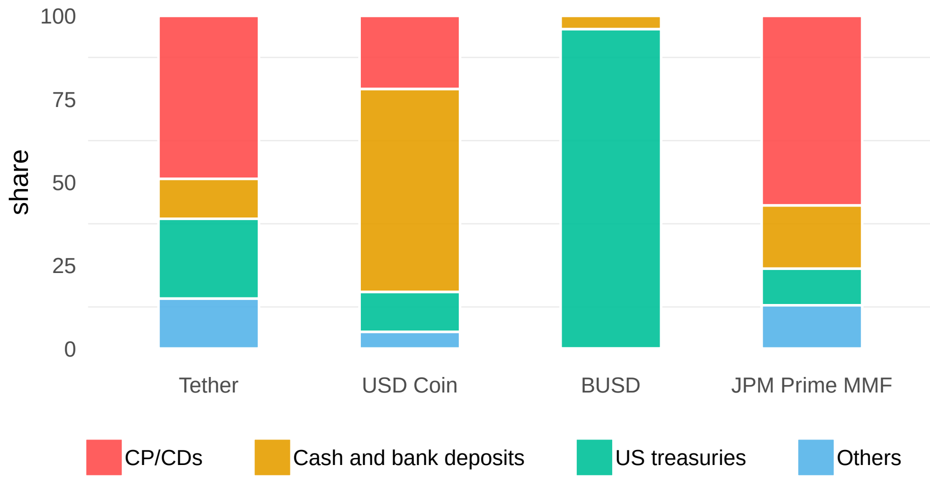
[13] Section A.1 in Appendix details the different stabilization strategies

[14] https://ag.ny.gov/press-release/2021/attorney-general-james-ends-virtual-currency-trading-platform-bitfinexs-illegal

[15] https://tether.to/wp-content/uploads/2021/08/tether_assuranceconsolidated_reserves_report_2021-06-30.pdf

[16] In section B.1 in Appendix we provide a primer on this important short-term funding market.

Figure 3: Stablecoins' reserve assets reported composition and comparison with JP Morgan Prime Money market funds allocation



Note: Source: Circle (composition as of May 28, 2021), Tether (composition as of June 30, 2021), JPM Prime MMF (composition as of March 31, 2022). 13% of USDC reserves is composed of Yankee CDs; the split between CD and CP is unknown for Tether. For BUSD, we take the first available report, issued in January 2022. Before that, independent accountants reported that the reserve assets of BUSD were mainly held in cash deposits with US-regulated depository institutions.

"JPMorgan Prime Money Market Fund" has about 75 USD bn of assets under management, invested at 25% in CPs, 30% in CDs, and 15% in US Treasuries.[17]

Soon after, Circle (USDC) issued an independent accountant report that reported USDC tokens were backed at 61 % by cash and securities with an original maturity less than or equal to 90 days, at 22% by commercial paper issued in the US or abroad ("Yankee CDs").[18] Binance USD, the third largest stablecoin, has been from its inception regulated by the New York State Department of Financial Services. Unlike the two former stablecoins, its first reserve assets composition report in January 2022 showed that 96% of its reserves were held in US Treasuries and T-bills.

Since 2021, the composition of reserves has however significantly changed, on the back of vivid controversies about the liquidity and credit risk taken with CPs.[19]

[17] https://am.jpmorgan.com/us/en/asset-management/adv/products/jpmorgan-prime-money-market-fund-morgan-4812a2702#/portfolio

[18] https://www.centre.io/hubfs/pdfs/attestation/Grant-Thorton_circle_usdc_reserves_07162021.pdf

[19] Rumours also suggested that Tether holdings were concentrated in Chinese CP. See also

Notably, in 2021, Circle announced that it would cut its CP holdings: *"Circle, with the support of Centre and Coinbase, has announced that it will now hold the USDC reserve entirely in cash and short-duration US Treasuries. These changes are being implemented expeditiously and will be reflected in future attestations by Grant Thornton." (Aug 22, 2021)*

Tether announced a gradual reduction of CP holdings shortly after. While USDC was reportedly not backed anymore by any CP from September 2021, Tether has adopted a smoother CP reduction. In June 2022, Tether CTO Paolo Ardoino declared: *"Tether also reduced its commercial paper exposure from 45B to 8.4B and is set to phase it out in full in the coming months. All the expiring CP have been rolled into US Treasury bills, and we'll keep going till CP exposure will be 0."*

Based on available attestation reports, demand for CP emanating from stablecoins would have peaked around 40 billion dollars in mid-2021, compared to a market outstanding of 1089 billion dollars, ie. 3.6% of the market outstanding.

As a comparison, US Flow of Funds data show stablecoins' CP holding would have been on par with private pension funds, for instance, and represented almost one-fifth of the size of money market funds holdings.[20] In terms of variation between 2019 and 2021, the reported increase in Tether holdings is sizable compared to the other sectors, and roughly half of the decline in MMF CP holdings over the period, see Figure 8.

This paper implicitly verifies and exploits this cross-section and time-varying heterogeneity in the reserve assets held by stablecoin issuers to analyze the impact of the rise in stablecoins on the CP market.

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https://www.bloomberg.com/news/features/2021-10-07/crypto-mystery-where-s-the-69-billion-backing-the-stablecoin-tether. CFTC considered that CP holdings contributed to misrepresenting the nature of the 1:1 backing promised by Tether to the tokens' holders: *"Tether misrepresented to customers and the market that Tether maintained sufficient U.S. dollar reserves to back every USDT in circulation with the "equivalent amount of corresponding fiat currency" held by Tether and "safely deposited" in Tether's bank accounts."* https://www.cftc.gov/PressRoom/PressReleases/8450-21

[20]By contrast, the stablecoin holdings of Treasury bill could stand for around 0.4 % of the outstanding as of June 30, 2021, suggesting a lower issue share compared to the one for CP.

3 Empirical strategy

In this section, we first present a simple accounting model of reserve assets (3.1) that guides then our econometric specifications and our empirical strategy (3.2).

3.1 A toy-model of stablecoin issuers' reserve assets

Assuming that the stablecoin issuer keeps its portfolio share of CP constant over time, the stablecoin issuer should purchase CP whenever new tokens circulate and when CP previously held mature and need to be rolled-over. Let's assume that a stablecoin issuer seeks to keep a constant fraction δ of its reserve assets in CP, in any point of time CP holdings by stablecoin issuer should be equal to $\delta\ Tokens_t$, where $Tokens_t$ stands for the amount of tokens in circulation. If we denote by D_t the quantity of CP purchased by the stablecoin issuer at date t and by d the share of the date-$t-1$ CP holding that matures at date t, basic accounting leads to:

$$\underbrace{\delta\ Tokens_t}_{\text{CP holding at date } t} = \underbrace{(1-d)\ \delta\ Tokens_{t-1}}_{\text{CP holding that does not mature at date } t} + \underbrace{D_t}_{\text{Date-t purchases}}. \tag{1}$$

which can be rewritten as follows:

$$D_t = \delta Tokens_t - (1-d)\delta Tokens_{t-1}. \tag{2}$$

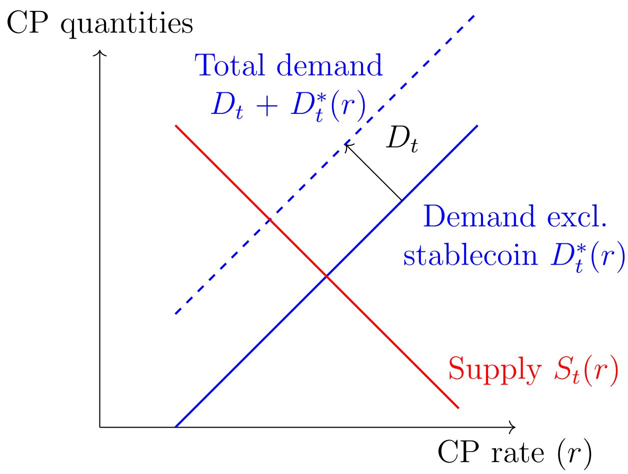
Equation (2) predicts that purchases should depend positively (negatively) on current (past, respectively) tokens in circulation. Since stablecoin issuers report a large share of CP with a maturity lower than a week ($d \to 1$), at a daily frequency, purchases of CP by stablecoin issuers should be approximately proportional to tokens in circulation.

The impact of the purchases from stablecoin issuers (D_t) on the CP market critically depends on the reaction of CP issuers and other CP investors. Assume that the supply of new CP (S_t) is downward-sloping with CP rates, r, and the demand from all investors but stablecoin issuers (D_t^*) is upward-sloping with CP rates. The market clearing condition on the CP market

$$S_t(r) = D_t + D_t^*(r), \tag{3}$$

then predicts a rise in CP issuance and a fall in CP rates when stablecoin issuers purchase more CP. Figure 4 shows the standard impact of a rise in demand on the equilibrium CP rates and quantities.

Figure 4: Impact of stablecoin demand on CP rate and issuance



Note: These stylized demand and supply curves are consistent with linear downward-sloping supply and linear upward-sloping demand excluding stablecoins. In this case, an increase in the demand for CP from stablecoin lowers CP rate and increases CP issuance.

Whether rates or quantities react more or less depends on the price elasticity of demand and supply. More formally, the marginal reaction of CP issuance to a rise in D_t depends on $\frac{\partial S_t}{\partial D_t} = \frac{S_t'(r)}{S_t'(r)-(D_t^*)'(r)} \in [0,1)$ and rates depend on $\frac{\partial r_t}{\partial D_t} = \frac{1}{S_t'(r)-(D_t^*)'(r)} < 0$.[21] With words, if suppliers are strongly price-elastic ($|S'|$ is high), they will substantially issue more, and rates will only slightly decrease. On the contrary, if they are weakly price-elastic ($|S_t'|$ is low), quantities will not adjust, and rates will decrease more. In this latter case, the extra demand from stablecoins substitutes for the existing demand from the rest of the economy. Regarding

[21]These first derivatives are obtained by taking the first derivative of equation (3) with respect to r.

the demand side, the impact on rates (on quantities) will tend to be larger in absolute terms if the demand is less price elastic, that is if the demand curve is steep ($(D_t^*)'$ is high).

Naturally, this model is highly stylized and could be refined in several meaningful ways. In particular, additional demand shifters—ranging from private actors such as money market funds (MMFs) to public interventions like the Federal Reserve's asset purchases—could be incorporated to examine how other sources of demand respond to, and potentially interact with, changes in demand from stablecoin issuers. The primary purpose of this model, however, is to provide a disciplined framework to motivate our empirical strategy. In the empirical analysis, we do not estimate the structural parameters of this model. Instead, we estimate reduced-form ordinary least squares (OLS) regressions to recover estimates of derivatives $\frac{\partial S_t}{\partial D_t}$ and $\frac{\partial r_t}{\partial D_t}$. These estimates reflect the total equilibrium effects of a demand shock on prices and quantities, rather than the underlying structural demand and supply elasticities.

3.2 Empirical strategy

The above accounting model predicts that the issuance of new CP (the rates of CP) should increase (decrease, respectively) with the stablecoin demand for CP (D_t). To test these predictions, we run the two following baseline regressions, which we discuss in detail later on, in particular on the choice of these particular specifications in difference:

$$\Delta S_t = \alpha + \beta * \Delta Tokens_t + Controls_t + FE_t + \epsilon_t; \tag{4}$$

$$\Delta(r_{CP_{m,t}} - r_{f_{m,t}}) = \alpha + \beta * \Delta Tokens_t + Controls_t + FE_t + \epsilon_t. \tag{5}$$

The first regression tests whether stablecoin demand affects CP issuance. S_t is the daily issuance at date t of all or a subset of CP, split by maturity, issuer, or credit rating. Δ denotes the daily difference operator. $\Delta Tokens_t$ is the daily change in circulating tokens of USDT, USDC, or the sum of the two.[22] Specification (4) is consistent with (2) in difference

[22]For Mondays, the difference is between Friday and Monday. While this treatment of weekend is immate-

when $d = 1$. The lagged variation of stablecoin circulating tokens —that should theoretically matter for $d << 1$ — are not significant so we do not keep it in our benchmark regression.[23] According to the accounting toy-model we expect a positive β coefficient if stablecoin issuers effectively back their tokens by holding CPs as reserve assets. The magnitude of the coefficient β depends on the price elasticity of the supply curve and the demand curve addressed by other categories of investors (Figure 4).

The second regression tests whether stablecoin demand affects CP rates. The dependent variable is the change in CP spread against the risk-free rate of the same maturity, i.e. either the Effective Fed Funds rate for the short maturities between 1 and 4 days or the OIS rate for longer CP maturities. According to the above toy-model, we expect a negative β coefficient. The absolute size of the coefficient should reflect the price-elasticity of the supply and is likely to be small if issuers cater to additional demand in a flexible manner. On the contrary, we expect a large negative coefficient if the supply is almost fixed or predetermined.

Choice of specifications The reasons why we choose these specifications in contemporaneous first difference are threefold.

First, CP issuance and stablecoin circulating tokens are both non-stationary (neither in level nor in log-level). To solve this issue, we consider the equation (2) in first difference. Indeed, standard unit root tests show that variables in first difference are stationary.[24]

Second, to get a causal impact of stablecoin on the CP market, we need to make sure that the demand from stablecoin D_t does not respond to CP rates (as it is assumed in the toy-model). Indeed, CP rates may affect issuers' allocation to CP. We provide two main responses to this important causality issue. First, circulating tokens are not a choice of the issuers but result from the decision of investors to invest in stablecoins. The decision to

rial for the CP variable as the CP market is inactive during the weekend, stablecoin circulating tokens may vary during the weekend.

[23]Results with $\Delta Tokens_{t-1}$ are presented in last column of Table 15 in Appendix

[24]We run multiple robustness checks to exclude that our results are biased by the presence of outliers (see Table 24) or that we capture common trends even in the first difference: Table 22 shows the main specification in log-difference and Table 21 shows it with month-year fixed effects.

invest in stablecoins is unlikely to be caused by CP market. Investors did not know the existence of CP in the stablecoins' reserve assets until at least summer 2021. In addition, stablecoin issuers do not pay any interest on their tokens, so holding stablecoin tokens is not an indirect way to invest in CP. With granular data on the CP holding by stablecoin issuers, we would run a two-stage least square setup as follows. We would first regress the change in CP purchase ΔD_t on $\Delta Tokens_t$. Then we would regress CP issuance change on instrumented CP purchase change. Due to the lack of precise CP holding data, we directly take the circulating tokens and not the predicted demand of CP. This specification is often referred to as the "reduced form IV". Second, we show in Section 4.2 that our main results hold only when and if stablecoin issuers hold CP as reserve assets.

Third, that CP issuers react to a contemporaneous increase in the demand from stablecoin issuers may appear surprising and requires either information about incoming demand or the ability to adapt to demand in a very flexible manner. We dig further into this question in Section 4.3 and show that the demand from stablecoin is largely predictable. In addition, the fact that CP issuers flexibly accommodates the demand is a result reminiscent of other papers on CP. For instance, Kacperczyk et al. (2021) show that CP issuers were able to anticipate the residual and unsatisfied demand for safe assets at government auctions and adjusted CP issuance contemporaneously accordingly.

Control variables Even if we believe there is no reverse causality issue in this setup, it may be the case that both CP market and stablecoin growth are driven by common determinants. To solve this standard problem, we include three sets of controls to deal with plausible confounding factors. All are taken in first difference. First, we include controls related to monetary policy: accommodative monetary policy and large excess liquidity, for instance, might increase both the demand for CP and cash to be placed in stablecoins. To capture these factors, we control for the Effective Fed funds, Excess reserves[25], and the CPFF holdings. Second, risk appetite might affect both the demand for crypto, for stablecoins, and

[25]Weekly-frequency controls, as reserves, are linearly interpolated at a daily frequency.

for CP. We use the Nasdaq and VIX for that purpose. Third, a usual control in the liquidity premium literature is the quantity of safe assets. We use the Log(Debt/GDP) ratio in this respect. GDP is fixed at its January 2019 level. All controls are taken from Fred database, and daily data on the US sovereign debt come from the US Treasury.[26] We use the total debt available to the public, ie. net of intra-governmental holdings.

We also control for the daily change in the total net assets of 5 representative Prime MMFs partly invested in CP, from Lipper database.[27] The rationale is to control for any correlated demand from usual CP investors. Finally we control for weekday fixed effects to capture intra-week seasonality patterns.

Data sources On top of the aforementioned sources for control variables, data on daily CP issuance are those provided by the Federal Bank of New York. We present these data in lengths in Appendix B.2. Regarding the crypto data, we use the data provided by the data provider Messari on the quantity of tokens in circulation. We explain how these data are constructed in Appendix A.3.[28] All in all, our data sample goes from Jan 2, 2019, to June 30, 2022, at a daily frequency. We keep business days in which the CP market is open, and we drop two dates from the sample: Dec 31, 2020 and Apr 19, 2019, two outliers in terms of CP reported by the Federal Reserve (the second date being Good Friday in 2019).[29] Our sample covers the sheer growth period of the stablecoins, the Terra crash that occurred in May 2022, and the subsequent short-lived but unusual deviations of Tether price from its peg.

[26] https://fiscaldata.treasury.gov/datasets/debt-to-the-penny/debt-to-the-penny

[27] Following Abate (2021), we take the Total net assets of the largest CP holders in Prime MMFs: JP Morgan Prime Money Market Fund, Schwab Value Advantage Money Fund, Fidelity Money Market Fund, BlackRock Money Market Portfolio, Invesco Liquid Assets Portfolio. As of 2021, these 5 Prime MMF concentrated around half of the total net assets of Prime MMF.

[28] We also check the robustness of our results using on-chain data in Table 19 for the two main used blockchains. The construction of these data are described in Appendix A.3 and A.4.

[29] For rates but not for issuance quantities, there may be missing data for certain maturities or categories. No imputation is done.

4 Results

This section presents our main results. We begin by showing that an increase in circulating stablecoins leads to a rise in commercial paper (CP) issuance, while having no significant effect on CP rates. We then reinforce this finding by demonstrating that these effects are present only when the stablecoin is backed by CP holdings, which strengthens the case for a causal interpretation of our baseline estimates.

Next, we address potential concerns regarding the contemporaneous nature of this relationship. Specifically, we show that the timing of CP purchases relative to stablecoin inflows is consistent with a causal mechanism, as a large portion of these inflows can be anticipated by observing simple, publicly available on-chain data. Finally, we present a series of robustness checks, including the addition of further control variables and the use of an alternative dependent variable based on verifiable on-chain data, to confirm the stability of our main results.

4.1 Baseline results

Table 1 reports the results for the two baseline specifications given in equations (4) and (5).

CP issuance The first two columns report the impact of a change in USDT and USDC circulating tokens on the variation of CP issuance. For both tokens, the coefficient of interest is positive and significantly different from zero suggesting a significant impact of stablecoins on CP issuance.[30]

In terms of magnitude, our results suggest a strong reaction of CP issuance to stablecoins: a 1 bn variation in stablecoin circulating tokens is associated with a 1.9 bn variation in CP issuance (column 1 of Table 1). In principle, one may expect this coefficient to be close

[30] In Appendix, we provide the detailed table with estimated coefficients also for the controls (see Table 15). Weekday fixed effects are strongly significant and point to a CP issuance cycle that peaks on Mondays and fades progressively. The inclusion of these time fixed-effects reduces our coefficient of interest, suggesting that both tokens issuance and CP issuance are intra-week seasonal.

Table 1: USDT, USDC tokens, CP issuance and rates

This table reports the estimated coefficient of variation in circulating tokens, for both USDT and USDC. In columns 1 and 2, the dependent variable is the daily change in total CP issuance, expressed in billion USD. Δ Tokens is the daily change in tokens circulating supply in billion. In column 3 to 5, the dependent variable is the daily variation of the spread between 1-day CP of each category and the risk-free rate . Controls include variations in excess reserves, effective fed funds rate, Fed CP purchases, log(Debt/GDP), Nasdaq, VIX, and Top 5 MMF total net assets. Days of the week are included in the fixed effects to capture intra-week seasonality. Significance levels are denoted: *** at 1%, ** at 5% and * at 10%. Newey-West standard errors with a lag of 5. 95% confidence intervals shown in brackets. In the online appendix, table 16 gives the breakdown for all maturity buckets provided by the Federal Reserve.

	Δ Issuance		Δ Rate		
	All mat.		Fin. AA	Non-fin. A2P2	ABCP AA
	(1)	(2)	(3)	(4)	(5)
Δ Tokens USDT+USDC	1.913**				
	[0.6309; 3.195]				
Δ Tokens USDT		1.753*	0.0073	-0.0549	-0.1890
		[-0.0250; 3.530]	[-0.0665; 0.0811]	[-0.4939; 0.3841]	[-0.5361; 0.1582]
Δ Tokens USDC		2.167**	0.0809	-0.2295	-0.1898
		[0.3377; 3.996]	[-0.0751; 0.2368]	[-0.8711; 0.4120]	[-0.6694; 0.2899]
Controls	✓	✓	✓	✓	✓
Weekday-FE	✓	✓	✓	✓	✓
Observations	865	865	865	865	865
R^2	0.15482	0.15490	0.00775	0.07060	0.01406

to the share of CP in the reserve assets composition (δ in our model). First, it has to be noted that the reported share of CP in reserves lies in the confidence intervals reported in Table 1: According to the first attestation report published by Tether, the fraction of CP in the reserve assets was about 0.5 as of June 2021. Our estimates indirectly support the claim stablecoins were effectively backed by CP, and we cannot statistically exclude that the attestation reports were accurate in the share of CP backing. In terms of economic significance, stablecoin demand for CP only contributes to a very modest share of daily CP issuance, according to our estimates. A one-standard-deviation increase in the variation of circulating stablecoin tokens (that is, 0.47 bn additional circulating tokens) is associated with an increase of $1.91 * 0.47/11.4 = 0.08$ standard deviation in CP issuance. A slightly different log-difference specification (see Table 22) shows that a 1% increase in circulating tokens raises the issuance of 1-day to 4-day CP by 0.65%. We also show that our results hold with month-fixed effects, discarding further any time-related drivers common to stablecoins (Table 21).

In appendix, we further decompose our baseline result by CP maturities, issuer and rating (see Table 4 and in the online appendix Table 16 for a more granular breakdown). For both USDC and USDT tokens, the stronger impacts are found for shorter maturities (less than 4 days for USDT and from 5 to 80 days for USDC). Results however suggest that the impact on CP issuance operates on different categories for USDT and USDC: for the former, the impact is significant for financial and AA-rated ABCP; for the latter, the impact is concentrated on non-financial CP and AA-rated ABCP.

We also find supportive evidence in favor of an asymmetric impact of changes in circulating tokens. See Table 17 in Appendix in which we split between positive and negative variations. We find no effect from the reduction of USDC circulating tokens on CP issuance and, for USDT, only a significant impact on financial AA issuance. By contrast, an increase in circulating tokens is statistically significant for both USDC and USDT, for all maturities, and specific maturity/issuer/credit rating buckets. This asymmetry suggests that stablecoin issuers quickly purchase CP when the circulating tokens increase, but do not reduce —or with sluggishness– their CP holding when the circulating tokens decrease. This sluggish reaction could result from the near-impossibility of selling CP on a secondary market.[31]

Finally, Table 15 in Appendix shows the result for specifications including $\Delta Tokens_{t-1}$. As predicted by the accounting toy model and equation (2) in difference, we find negative impact associated to lagged circulating token changes, even if non-significant. These results comfort our interpretation of our results. Conditionally on these results, we can back out the implied structural parameters shown in Table 2.

These computations suggest a higher daily rollover of Tether's CP holding compared to Circle's one. Even if very uncertain, these results are consistent with stronger impacts for

[31]In the accounting toy-model, it is as if D_t has to be positive. As a consequence, if the circulating tokens $Tokens_t$ falls below non-maturing CP ($(1-d)Tokens_{t-1}$), the ratio of CP over reserve assets automatically exceeds the target δ.

Table 2: Indirect inference of structural parameters δ and d.

	USDT	USDC
δ	1.86	2.38
$-(1-d)\delta$	-0.26	-1.24
Implied d	0.86	0.48

shorter maturities for USDT than USDC.

Commercial paper rates Turning to CP interest rates, Table 5 reports the estimation of equation 5 for 4 different maturities and issuer/ratings of CP. The left-hand side variable is the first difference in CP spread, expressed in bps, computed as CP rates of each maturity minus the corresponding OIS rate, similar to Nagel (2016). While most of the coefficients are negative, only one is statistically significant at a 5% confidence level, leaving little evidence supporting a connection between stablecoins and CP rates. If anything, the magnitude of the coefficients is low: if we focus on the only significant result at a 5% level, our estimate suggests that a 1 bn change in USDT circulating tokens (which stands for more than 3 times the standard deviation) leads to half a basis point decrease of 2-week, AA-rated ABCP.

In the appendix, we show the same regression results, but with CP rates in level at the right-hand side, in Table 23. This is not our preferred specification as stochastic trends might introduce spurious correlation. However, introducing controls once at a time is instructive on the source of variance in CP rates and allows us to compare our results to the literature. Column (1) —without any control variables— would point to a strongly significant, negative correlation between the change in stablecoins' circulating tokens and CP rates, echoing one of the key findings by Kim (2022). The magnitude of this coefficient is, however, very large as every 1 bn change in USDT (USDC) stablecoins circulating tokens would be associated with a 78 bps (50 bps, respectively) reduction in 3-month, AA-rated, financial CP rates. In fact, CP rates are highly correlated with risk-free rates, as can be seen in Figure 10. Hence, controlling for the risk-free rate of the same maturity and the effective Fed funds rate logically dwarfs the previous coefficient and reduces its statistical significance, as can be seen in column (2). We then replicate the specification of Nagel (2016), with the same set of controls, adding Log(Debt/GDP) and VIX,[32] in column (3). Stablecoins cease to have a statistical significance for CP rates, which suggests that the stablecoins do not change the determinants of CP rates outlined in the liquidity premium literature. Our results also suggest that the strong impacts found by Kim (2022) on rates may be due to omitted control variables.

The absence of effect on CP rates may reflect that CP spreads were already historically compressed over the period (see Figure 10), set aside a temporary stress period in March 2020, rapidly tackled by the Federal Reserve intervention. Therefore, this result may turn out to be specific to our sample, characterized by exceptionally ample liquidity and low CP spreads.

Finally, the significant impact of stablecoin on quantities but not on rates suggests that CP issuers adjust quantities in response to demand.[33] CP issuers cater a significant share of additional demand from stablecoin issuers, to the point we cannot detect price reaction to demand change. But, as explained above, it may be a feature peculiar to our specific sample with ample reserves and almost no spread between riskfree rate and CP rates.

4.2 Inspecting the mechanisms

In this subsection, we confirm the causal interpretation of our baseline results in two ways, by exploiting the cross-sectional and time heterogeneity in the reserve asset policy stated by the three largest stablecoins.

Time-heterogeneity in reserve assets policy Important to our econometric exercises, the cross-sectional and time heterogeneity in reserve asset policy described in section 2.2

[32] Alternatively, we use a daily series of market sentiment from Buckman et al. (2020) Federal Reserve Bank of San Francisco FRBSF Economic Letter 2020-08, April 6, 2020.

[33] In a complementary exercise, we use the part of CP issuances explained by stablecoin inflows as an instrument and find little evidence of an impact on money market rates as a whole, see Online Appendix, Table 26.

appears exogenous to CP market conditions. The changes in reserve asset policy intervene in a period in which risk-free rates and CP spreads are relatively constant, see Fig 10, and on the wake of regulatory pressure and public push-back regarding the backing of stablecoin tokens by CP, see Fig. 11.[34] We therefore do not base our empirical strategy on attestation reports or communication by stablecoin issuers but on less manipulable on-chain data of stablecoins in circulation. CP backing has been widely criticized and the object of many rumors on the back of a lack of transparency about the risks of these assets. This led Circle and Tether to divest from the CP market, policy steps that are the decision of the two stablecoins' issuers and arguably unrelated to the CP market. Importantly, these decisions were not caused by a change in the CP rates or other rates. They especially took place before the first Fed's rate hike on March 2022.[35] If stablecoin issuers effectively changed their reserve asset policy as they communicated, our experiment may test whether the relationship between circulating tokens and CP issuance exists only *when* CP are reportedly used as a reserve asset.

Circle announced complete disinvestment from CP in August 2021, effective in September 2021, see Appendix A.2. We may then expect that our coefficient of interest for USDC becomes insignificant in 2021H2 and 2022H1. Tether also stated it would start to reduce its holding by stopping purchasing new CP from summer 2021 when the holding was around 45 bn \$. In June 2022, the CP holding of Tether was less than 9 bn \$. We thus could expect that the significance of the coefficient of interest will change after 2022H1.

We regress our main specification in difference with semester fixed-effects and report the coefficient of interest for each semester. In Table 6, we show the results for USDT and USDC for different categories and maturities. We find that the changes in circulating USDC tokens have no significant impact from 2021H2 onward and from 2022H1 for USDT.[36] These results are consistent with Circle's announcement and with a more gradual disinvestment of Tether from the CP market. These findings also confirm that the channel through which stablecoin

[34]For instance, a Bloomberg article from Oct 2021 questioned the reality of these CP holdings.

[35]For Circle, the reduction to zero of the CP holdings took place in August 2021, that is, even before any upward repricing of the US yield curve.

[36]For the sake of the exposition, we only show the estimates from 2021H1 to 2022H1.

tokens affect the CP issuance is through the effective demand from the stablecoin issuers and not through another channel.

Falsification tests Finally, we perform two falsification tests to confirm that our benchmark findings effectively result from the backing of stablecoin issuers.

First, we exploit an institutional difference in the reserve asset composition of Binance USD (BUSD), the third largest stablecoin with 20 billion USD of market capitalization at its peak instead of USDT or USDC. At the difference of Tether and USD Coin, BUSD reserve assets have never comprised CP[37]. Table 7 shows no statistical significance for the coefficient of BUSD tokens on CP issuance, no matter the category or the rating. This sanity check further confirms that there are no omitted confounding factors that would link stablecoins *in general* and the CP market. This further confirms the causal interpretation of our baseline results on USDT and USDC.

Second, we check that stablecoin only affects CP likely purchased by stablecoin issuers. To this aim we replace USD-denominated CP by EUR-denominated CP that are not, as far as we know, held by stablecoin issuers (and in any case would not help in maintaining a peg vis-a-vis the US dollar) but otherwise can be considered as close substitute. Table 8 shows no significant impact of changes in either USDC, USDT or BUSD tokens.

4.3 Timing and persistence of the impact

In this subsection, we discuss the timing and persistence of the estimated impact. We show that changes in circulating tokens are predictable by the public using a two-stage least-square approach. We then investigate the persistence of the impact using a local projection method.

[37]As shown in BUSD attestation reports, under the regulation of the New York State Department of Financial Services (NYDFS). BUSD reserves include cash accounts in US depository institutions, US Treasury bills with a maturity of less than 90 days and *"overnight loans secured only by US Treasury securities".We cannot, however, entirely exclude that an explicit reserve asset composition out of CP offers an ideal placebo as the market capitalization of BUSD, for instance, was also smaller than USDC and USDT.*[38]

Timing of purchases and CP market reaction Our regressions establish a contemporaneous effect of changes in circulating tokens on CP issuance, that is, CP issuers would have been able to cater to additional CP demand the same day an increase in circulating tokens is reported.

First, this result is reminiscent of Kacperczyk et al. (2021), who show CP issuers adapt almost instantaneously to information about the demand for short-term safe assets. In particular, they show that the Monday auction of the French Treasury gives information about the unsatisfied demand for short-term safe assets. This information is known to CP issuers when they decide on their CP issuance for that day.

Second, we show that the CP demand from stablecoins is partially predictable by CP issuers. While the public was not aware of the holding of CP by stablecoin issuers prior to the first publication of attestation reports mid 2021, the CP issuers (or some brokers) were likely to be aware of the existence of this category of investors. Indeed, the CP held by stablecoin issuers had to be bought to someone, and there is no or little CP secondary market. Therefore, CP issuers may have timed the issuance depending on their best expectations of the demand from stablecoin issuers. From the analysis of the blockchain, we construct a variable that predicts the changes in circulating tokens. Then, we regress the CP issuance change on the predicted circulating tokens change.

For this exercise, we focus on Tether and show "mints" and "burns" of USDT tokens predict well the future USDT circulating tokens. The underlying idea is that when Tether faces or anticipates a rise in demand, it has to mint new tokens to maintain the peg and accommodate the demand. This mint is observable before the actual increase in circulating tokens, and hence before the potential purchase of CP by Tether. That being said, minting is Tether's decision and may be less exogenous than circulating tokens, our right-hand side variable in the baseline specifications. Our purpose here is to show that CP issuers can effectively calibrate their issuance based on available information, including the likely demand from stablecoin issuers.

We collect on-chain data on the issuance of new tokens (mints) and their destruction (burns) for Ethereum and Tron blockchains. For the first blockchain, we collect data on all the transactions of the address allowed by the Tether smart contract (contract address is: 0xdac17...) to issue or remove a new token (issuer address is: 0xc6cde7...).[39] We then construct a time series of the total supply on Ethereum (first at a block level) by summing the outflows from minus the inflows to this address. We then redo the same operation on the Tron blockchain using the Trongrid API. For Tron, we take together the issuer address (THPvaU...) and the blackhole address (T9yD14N...). We then add the supply time series for these two blockchains to create the total supply on these two blockchains. Notice that the circulating tokens (and total supply) on these two blockchains represent more than 95% of the total circulating tokens at the end of our sample. Finally, the daily supply change is computed as the change between the current day at 9:00 AM New York time (UTC-5) and the last working day at the same hour. This way we ensure that the change in supply is effectively observable by CP issuers in real time.[40]

Information about mints and burns is easily accessible, even with a low level of understanding of blockchains, by following whale alerts accounts on Twitter[41] that track the large transfers of USDT, and in particular from addresses known to be linked to the creation of USDT tokens (in particular those listed above).

Figure 12 gives real-life examples of how mints raise first the balance of USDT tokens on the Tether Treasury address and how this new supply is progressively absorbed by the market in the form of an increase in circulating tokens (reducing the balance of Tether treasury in the chart). We also notice that mints are infrequent and of a standard rounded size (in June 2019 around 100 million, larger later on). These stylized facts reinforce the likelihood that CP issuers may pay attention to and monitor these mints and burns to predict actual demand

[39] In section A.4, we specify the exact addresses and contracts used.

[40] The mint/burn variable is strongly correlated with changes in USDT tokens (around 0.6) but only weakly with leads and lags.

[41] This account has more than 2.2 million of followers (as of end of 2022) and is known to affect Bitcoin prices (Saggu, 2022)

from Tether.

More formally, we use this predictability in a two-stage least-square (2SLS) approach. We focus on USDT and modify the baseline equation (4) by replacing the change in USDT circulating tokens by its predicted value based on past mints and burns. As indicated in Table 19, the first stage in 2019-2021 has a 70% of R2 and largely passes the F-test rule-of-thumb (109). Table 19 reports the OLS and 2SLS estimations for two periods, 2019-2021 and 2021-2022, as we expect a link in the former period and not in the latter. Columns (1) and (4) show that the coefficients of OLS and 2SLS are significant and not statistically different from each other. On the contrary, columns (5) and (8) show no significant impact post-summer 2021, as expected. The results from the 2SLS show that the predicted circulating tokens cause a change in CP issuance, confirming that the contemporaneous impact is plausible: CP issuers can anticipate the demand and hence can issue larger amounts when anticipating larger demand.

Persistence of the impact To assess the persistence of the impact of stablecoin on the CP market, we estimate the local projection of our baseline equation.

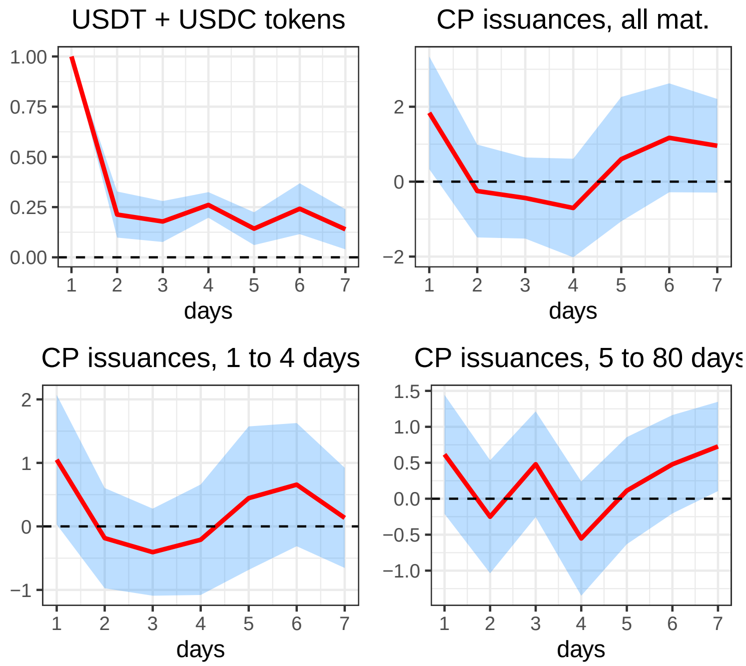
Figure 5 reports the impulse response functions corresponding to a 1 billion change in stablecoin circulating tokens. Two main observations are in order. First, the impact on the CP issuance is very short-lived and its statistical significance fades out in one day. Second, we find a positive auto-correlation in changes of circulating tokens (upper left quadrant). At the same time, CP issuance tends to decrease the following days after an increase.

4.4 Robustness

In this subsection, we check the robustness of our results by running several alternative empirical specifications.

First, we consider two alternative specifications to take into account possible time trends that remain even after differencing our variables of interest. We report in Table 21 a specifi-

Figure 5: Impulse response for a 1bn stablecoin token shock



Note: Impulse responses computed following the local projection approach of Jordà (2005), based on first-difference equation 4. Blue areas denote 90 percent confidence bands. Time period in days.

cation with month-year fixed effects, such that the estimates result from intra-month impact of stablecoin changes. We also include a specification in log-difference (see Table 22). Log-difference should reduce the risk of capturing the change in the scale of stablecoin tokens in circulation over time.

Second, we consider an alternative specification to take into account potential doubts about the quality of the time-series published by Messari. We hence replace our main right-hand side variable in Table 19 using directly mints/burns variable (defined in section 4.3).

Third, we make sure that our results are robust to include additional control variables that may affect both the demand for crypto and the CP market. We verify in Table 20 that controlling for Bitcoin return and momentum, and one-day lagged CP rates — using the 1-day maturity CP rate issued by financials rated AA, one of the largest volumes of CP — does not change our results.

Fourth, we conduct multiple robustness checks to account for large variations in the circulating tokens data. In Table 24, we first add a dummy variable equal to 1 when the z-score of the stablecoin variable is greater than 3 (column 1) and winsorize our data at 2.5% (column 2). To account for possible seasonality at a monthly level (we already control for weekday seasonality through fixed effects) we add a dummy variable equal to 1 for the last day of the month. Finally, we re-estimate specification 4 with the Huber estimator by iterated re-weighted least squares (IRLS), sometimes called robust estimator (see column 4 of table 24) and with a quantile regression (column 5), (with tau=0.5 ie. the median).

All specifications overall confirm the magnitude and statistical significance of our results.

5 Conclusion

In this paper, we highlight a new type of connection between stablecoins and short-term funding markets that was first alive for the commercial paper market. We demonstrate that an increase in the demand for stablecoins caused an increase in the issuance of CP. Our causal interpretation is supported by the exploitation of time-varying and cross-sectional heterogeneity in the reserve assets policy of main stablecoin issuers, exogenous from short-term funding market conditions. This result suggests that the other sources of demand for CP did not fully substitute for new demand from stablecoin issuers, and confirms CP issuers strategically time their issuance to meet higher demand for short-term safe assets. Going forward, other short-term safe assets with different supply elasticities may experience instead price impacts due to the growing footprint of stablecoin issuers in these markets.

Beyond what we learn from this particular interaction between stablecoins and the CP market, we can draw three broader policy implications, important for regulators, monetary policy and financial stability authorities.

First, regulation on crypto-assets like stablecoins may well reduce the probability of runs and limit their consequences. Still, the connection we establish in this paper is likely to operate under any regulation scheme. By requiring greater transparency on their asset side, or by influencing the type of reserve assets that stablecoins can hold, regulation may simply displace this connection from one asset class to another. Recent papers on MMFs show that fully transparent and Treasury-only money market funds may have an adverse impact on bond liquidity in times of stress, for instance (Ma et al., 2022). The increased transparency of stablecoins might also result in greater competition between them to hold the most liquid assets, which might have unintended consequences in terms of scarcity of safe assets Garratt et al. (2022).

Second, and relatedly, our paper contributes to the ongoing debate about whether stablecoins qualify as money (BIS, 2025), particularly regarding issuers' ability to scale supply up or down to maintain the peg without triggering costly price impacts or fire sales during large inflows, outflows, or substitutions between stablecoins with different reserve strategies. Our findings suggest that, so far, CP issuers have accommodated this additional demand. However, the absence of significant effects on CP rates to date should not be assumed to persist, especially in the face of larger, abrupt demand shifts or a substantial expansion of stablecoin issuance. Central banks and regulators should therefore consider measures to safeguard the financing of the real economy from volatility in stablecoin reserve asset demand while preserving the necessary elasticity of stablecoin supply. Possible avenues include: (i) granting stablecoin issuers access to central bank liquidity facilities; (ii) requiring a significant portion of reserves to be held in bank deposits — while acknowledging the associated trade-offs; (iii) harmonizing reserve asset requirements across stablecoins to reduce financial stability risks from substitution effects; and (iv) exploring a wholesale central bank digital currency (CBDC) as a reserve or settlement asset for stablecoin transactions. Notably, the EU's MiCA regulation and the GENIUS Act in the US already address aspects of (ii) and/or (iii), marking important steps in this direction.

Third, the connection between stablecoins and the CP market also highlights one implication of issuing central bank digital currency (CBDC). Depending on the exact design, CBDC could become either a public substitute for stablecoins or reserve assets held by stablecoins.

An open question for future research is hence to understand how coexisting stablecoins and CBDC could change the connection between crypto markets, financial markets, and the real economy.

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TABLES

Table 3: Summary statistics

Statistic	N	Mean	St. Dev.	Pctl(25)	Median	Pctl(75)
Δ Tokens USDT+USDC	867	0.137	0.466	−0.001	0.013	0.150
Δ Tokens USDT	873	0.074	0.375	0.000	0.000	0.043
Δ Tokens USDC	867	0.064	0.304	−0.002	0.002	0.059
Δ Tokens BUSD	674	0.025	0.152	−0.008	0.000	0.030
Mints/Burns USDT	801	0.080	0.571	0.000	0.000	0.015
Δ CP issuance All mat.	873	0.022	11.390	−6.313	−0.433	5.238
Δ CP issuance 1d to 4d	873	0.018	7.652	−3.889	−0.564	3.667
Δ CP issuance 5d to 80d	873	−0.000	6.495	−3.578	0.068	3.706
Δ CP issuance >80d	873	0.005	2.511	−1.534	−0.075	1.605
Δ CP issuance Fin. AA	873	−0.005	2.079	−0.962	0.020	0.970
Δ CP issuance Non-fin. AA	873	−0.003	3.380	−1.862	−0.132	1.304
Δ CP issuance Non-fin. A2P2	873	0.002	1.525	−0.676	−0.036	0.645
Δ CP issuance ABCP AA	873	0.006	2.442	−1.323	0.013	1.402
Δ CP spread Fin. AA O/N	873	−0.002	1.208	0	0	0
Δ CP spread Non-fin. AA O/N	871	−0.014	9.555	−1	0	1
Δ CP spread Non-fin. A2P2 O/N	873	−0.006	8.115	−1	0	1
Δ CP spread ABCP AA O/N	873	−0.005	10.755	0	0	0
Δ CP spread Fin. AA 90d	621	0.377	9.603	−2.700	0.000	2.200
Δ CP spread Non-fin. AA 90d	536	−0.180	12.305	−1.200	−0.005	1.092
Δ CP rate Non-fin. A2P2 90d	586	0.527	17.456	−3.737	0.130	3.945
Δ CP spread ABCP AA 90d	852	−0.072	5.718	−1.355	−0.040	1.173
Δ Excess reserves	873	1.745	16.219	−5.530	1.634	9.134
Δ Fed CP purchases	873	0.000	0.200	0.000	0.000	0.000
Nasdaq (daily var. in %)	873	0.072	1.665	−0.588	0.161	0.909
VIX	873	0.006	2.474	−1.020	−0.200	0.750

Table 4: USDT, USDC and CP issuances by maturity, issuer and rating

This table reports the estimated coefficient of variation in circulating tokens, for both USDT and USDC for different categories of CP. Controls include variations in excess reserves, effective fed funds rate, Fed CP purchases, log(Debt/GDP), Nasdaq, VIX, and Top 5 MMF total net assets. Days of the week are included in the fixed effects to capture intra-week seasonality. Significance levels are denoted: *** at 1%, ** at 5% and * at 10%. Newey-West standard errors with a lag of 5. In the online appendix, table 16 gives the breakdown for all maturity buckets provided by the Federal Reserve.

	Maturity				Issuer/Rating			
	All mat. (1)	1d to 4d (2)	5d to 80d (3)	>80d (4)	Fin. AA (5)	Non-fin. AA (6)	Non-fin. A2P2 (7)	ABCP AA (8)
Δ Tokens USDT	1.753*	1.432**	-0.0305	0.3506*	0.1706*	0.2749	0.0563	0.3397**
	(0.9057)	(0.7290)	(0.4148)	(0.1858)	(0.0973)	(0.3597)	(0.0737)	(0.1571)
Δ Tokens USDC	2.167**	1.264	1.016**	-0.1137	0.0078	0.4742*	0.1450**	0.2654*
	(0.9319)	(0.8708)	(0.5070)	(0.1809)	(0.1864)	(0.2755)	(0.0692)	(0.1400)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Weekday-FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	865	865	865	865	865	865	865	865
R^2	0.15490	0.22979	0.17755	0.07205	0.07433	0.45650	0.04815	0.11656

Table 5: CP interest rates, in spread against the risk-free rate, first difference in bps

This table reports the estimation of Equation 5, for USDT and USDC tokens. The dependent variable is the first difference of the spread between the CP rates of each maturity/issuer/credit rating bucket, and the risk-free rate of the same maturity, expressed in bps. We take the Effective Fed Funds rate for the O/N and the corresponding OIS for the 7-day, 2-week and 3-month CP rates. Δ Tokens USDT is the daily change in circulating tokens, in billion of tokens. Significance levels are denoted: *** at 1%, ** at 5% and * at 10%. Newey-West standard-errors are shown in parentheses. The uneven observation numbers by category is due to missing data, as CP especially for longer-term maturities are not issued every day.

	O/N				1-week			
	Fin. AA	Non-fin. AA	Non-fin. A2P2	ABCP AA	Fin. AA	Non-fin. AA	Non-fin. A2P2	ABCP AA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ Tokens USDT	0.0252	-0.0475	-0.6278	-0.4182	-1.462	-0.3919	-0.9919	-0.2373
	(0.0452)	(0.2364)	(0.6455)	(0.3949)	(1.061)	(0.4219)	(0.7164)	(0.3453)
Δ Tokens USDC	0.0867	-0.1696	-0.3040	-0.2367	-0.2301	-0.6127*	-0.5349	-0.0681
	(0.0825)	(0.2058)	(0.3485)	(0.2610)	(0.2647)	(0.3441)	(0.3840)	(0.2768)
Weekday-FE	✓	✓	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Observations	863	861	863	863	593	627	860	862
Adjusted R^2	-0.00601	0.00328	0.05771	0.00552	0.08360	0.00203	0.10769	0.05519
	2-week				3-month			
	Fin. AA	Non-fin. AA	Non-fin. A2P2	ABCP AA	Fin. AA	Non-fin. AA	Non-fin. A2P2	ABCP AA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ Tokens USDT	-0.4272	-0.2334	-0.8774	-0.5579**	-1.556	-1.346	-1.388	-0.3711
	(0.7410)	(0.6330)	(0.6900)	(0.2758)	(1.221)	(0.9075)	(1.271)	(0.3873)
Δ Tokens USDC	0.0590	0.0512	-0.2424	0.0141	-0.1259	-0.5067	-1.008	-0.6260*
	(0.2613)	(0.3818)	(0.3593)	(0.2476)	(0.7497)	(1.135)	(0.8229)	(0.3416)
Weekday-FE	✓	✓	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Observations	293	598	860	802	611	533	580	842
Adjusted R^2	0.02721	0.01893	0.06055	0.01957	0.12215	0.04170	0.09900	0.02298

Table 6: Semester-interacted estimation

This table reports the time-varying estimated coefficient of variation in circulating tokens for Tether (USDT) and USD Coin (USDC). Coefficients are shown only for 2021 and 2022, for the sake of readability. The dependent variable is the daily variation in CP issuance, expressed in billion USD, for different categories of maturity, issuer and credit rating. Controls include, as before, variations in excess reserves, effective Fed funds rate, Fed CP purchases, log(Debt/GDP), Nasdaq, VIX, Top5 MMF total net assets and end-of-month dummy. Significance levels are denoted: *** at 1%, ** at 5% and * at 10%. Newey-West standard-errors are shown in parentheses with a lag of 5.

	Maturity				Issuer/Rating			
	All mat. (1)	1d to 4d (2)	5d to 80d (3)	>80d (4)	Fin. AA (5)	Non-fin. AA (6)	Non-fin. A2P2 (7)	ABCP AA (8)
Δ Tokens USDT × 2021H1	4.070**	2.496**	0.7936	0.7803*	0.2137	0.5807	0.0746	0.6718**
	(2.048)	(1.120)	(0.9611)	(0.4364)	(0.2238)	(0.4478)	(0.1467)	(0.3108)
Δ Tokens USDT × 2021H2	1.494	3.135**	-1.359	-0.2817	0.0233	1.077	0.2743	0.2940
	(1.535)	(1.532)	(1.079)	(0.4857)	(0.1590)	(0.8707)	(0.2460)	(0.3168)
Δ Tokens USDT × 2022H1	-0.7109	-0.3471	-0.4229	0.0591	0.1881	-0.2678	-0.1161	0.0834
	(1.171)	(0.8102)	(0.4352)	(0.3004)	(0.2365)	(0.4312)	(0.1382)	(0.3268)
Δ Tokens USDC × 2021H1	3.413**	1.833	1.603***	-0.0228	0.2361	0.1402	0.1126**	0.3672***
	(1.327)	(1.326)	(0.3184)	(0.2305)	(0.3103)	(0.1784)	(0.0512)	(0.0861)
Δ Tokens USDC × 2021H2	0.5150	-0.1305	0.7266	-0.0811	-0.3114	0.9480	0.1413	0.1175
	(2.343)	(2.266)	(1.770)	(0.4137)	(0.3164)	(0.8055)	(0.2477)	(0.5016)
Δ Tokens USDC × 2022H1	-1.466	-0.1587	-0.5678	-0.7391	-0.3218	0.9273	0.1523	0.0456
	(2.871)	(1.850)	(1.184)	(0.5744)	(0.6966)	(0.6319)	(0.3212)	(0.5190)
Semester	✓	✓	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Weekday-FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	865	865	865	865	865	865	865	865
R^2	0.16916	0.23993	0.18743	0.08447	0.09172	0.46713	0.05542	0.13065

Table 7: Falsification test with BUSD

This table reports the estimated coefficient of variation in circulating tokens of BUSD. The dependent variable is the daily variation in CP issuance, expressed in billion USD, for different categories of maturity, issuer and credit rating. Δ Tokens BUSD is the daily change in circulating tokens, in billion of tokens. Controls include, as before, variations in excess reserves, effective fed funds rate, Fed CP purchases, log(Debt/GDP), Nasdaq, VIX and Top5 MMF total net assets. Lag denotes lagged circulating tokens as additional control. Significance levels are denoted: *** at 1%, ** at 5% and * at 10%. Newey-West standard-errors are shown in parentheses with a lag of 5.

	Maturity				Issuer/Rating			
	All mat. (1)	1d to 4d (2)	5d to 80d (3)	>80d (4)	Fin. AA (5)	Non-fin. AA (6)	Non-fin. A2P2 (7)	ABCP AA (8)
Δ Tokens BUSD	3.309	3.090	-0.3714	0.5909	0.3721	0.6967	0.1618	0.0826
	(3.916)	(2.516)	(1.707)	(0.7074)	(0.5084)	(0.8047)	(0.4487)	(0.4705)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Weekday-FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	674	674	674	674	674	674	674	674
R^2	0.15566	0.21518	0.21576	0.08659	0.07605	0.47743	0.03433	0.14042

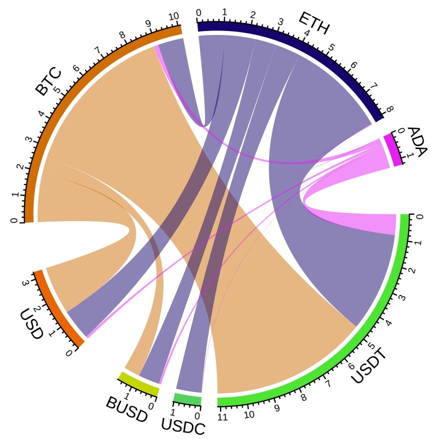
Table 8: Falsification test with EUR-denominated CP

This table reports a falsification exercise, with the dependent variable being the daily variation in EUR CP issuance (STEP data from the ECB), expressed in billion EUR. Δ Tokens is the daily change in circulating tokens, in billion of tokens. Controls include, as before, variations in excess reserves, effective fed funds rate, Fed CP purchases, log(Debt/GDP), Nasdaq, VIX and Top 5 MMF total net assets. We add EURUSD to account for foreign exchange effect. Significance levels are denoted: *** at 1%, ** at 5% and * at 10%. Newey-West standard-errors are shown in parentheses with a lag of 5.

	Δ Step	
	(1)	(2)
Δ Tokens USDT+USDC	-0.1131	
	(0.2157)	
EURUSD	-0.5753	-1.652
	(1.802)	(2.195)
Δ Tokens USDT		-0.2715
		(0.1690)
Δ Tokens USDC		0.1872
		(0.3026)
Δ Tokens BUSD		0.5853
		(0.6716)
Controls	✓	✓
Weekday-FE	✓	✓
Observations	859	669
R^2	0.01970	0.03440

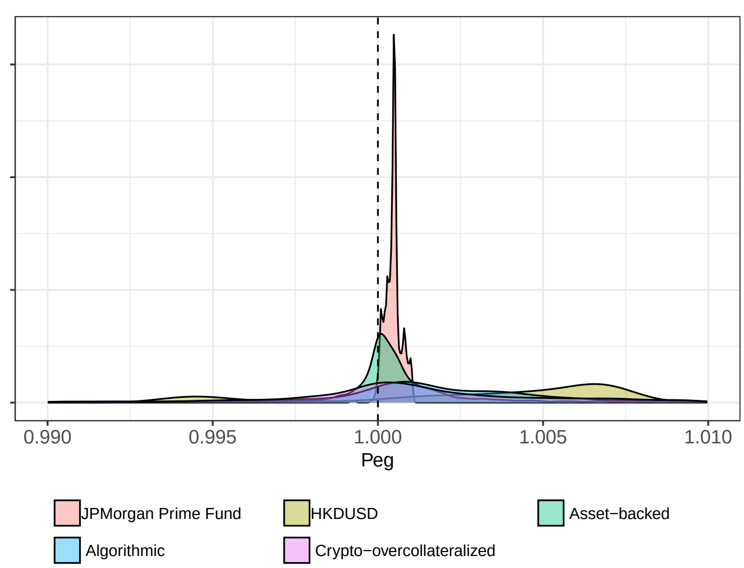
FIGURES

Figure 6: Average traded volumes between the 3 largest crypto (BTC, ETH, ADA) and 3 largest stablecoins (USDT, USDC, BUSD) in terms of market capitalization and the US dollar, in USD bn



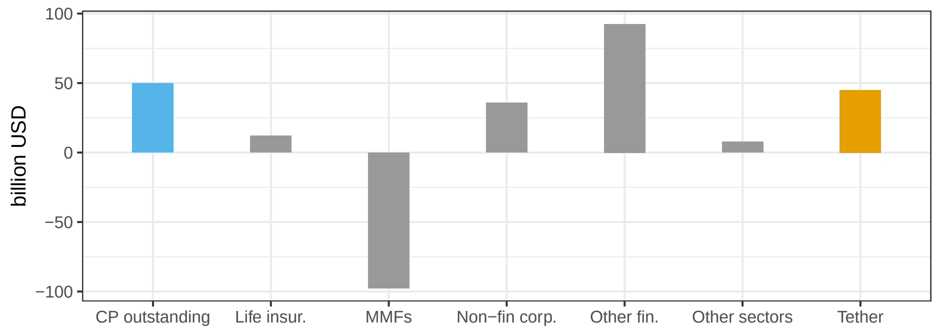
Note: Average daily volumes between pairs, over one year (Sept 2020-Sept 2021) based on Cryptocompare API data, which states they aggregate transaction data for each pair traded on about 70 exchanges. All volumes amount converted in US dollars. The chords' width reflects the volume traded in each pair, in billion USD.

Figure 7: Dispersion of exchange rates against the US dollar: Prime MMF share, pegged fiat currency (HKD), selected stablecoins by pegging strategy



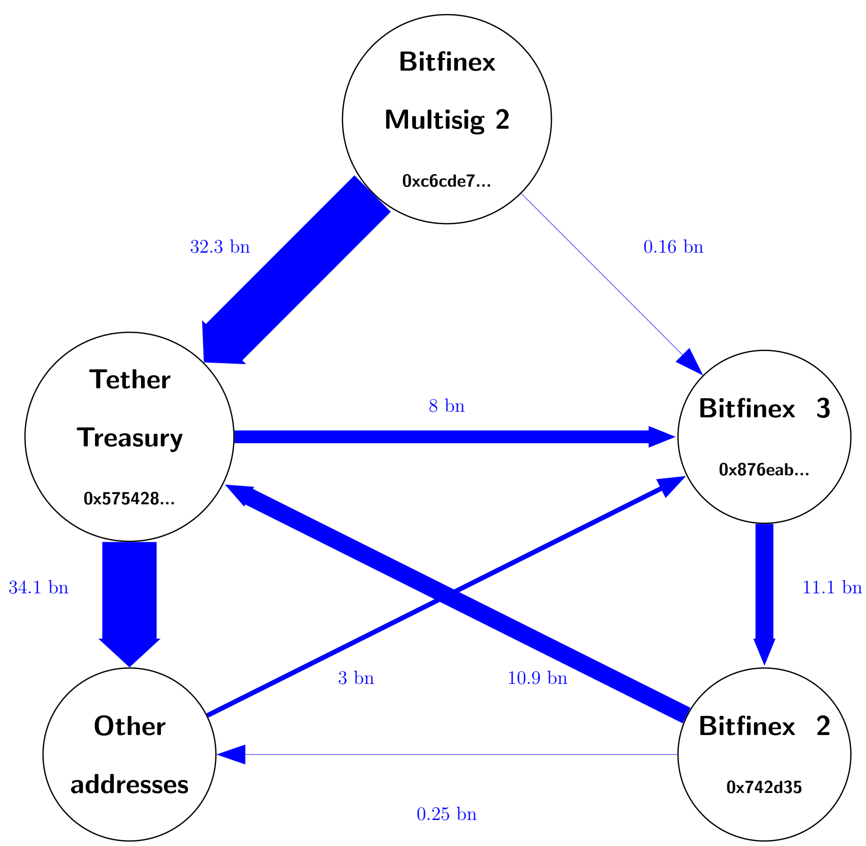
Note: Density plot of the daily end-of-day exchange rates data from Bloomberg, Messari, from January 2020 to August 2022. HKD is expressed in deviation from its mean over this period. Distribution trimmed to the [0.99-1.01] interval. Asset-backed: USDT, USDC, BUSD ; Algorithmic: UST ; Crypto-overcollateralized: DAI.

Figure 8: Change in total CP outstanding and holdings, 2019-2021 and change of Tether reported CP holdings for comparison



Source: Flow of funds, Table L.209. By accounting, grey bars (change in holdings) sum to the blue bar (change in outstanding). Tether shown for comparison – possibly comprised in the "Other financial" category. "Other sectors" comprise the other Flow-of-funds sectors, including rest-of-the-world. We report a potential Tether's change in CP holdings of 45 bn USD based on a Tether's CTO declaration, P. Ardoino, on June 2022 (Appendix A.2).

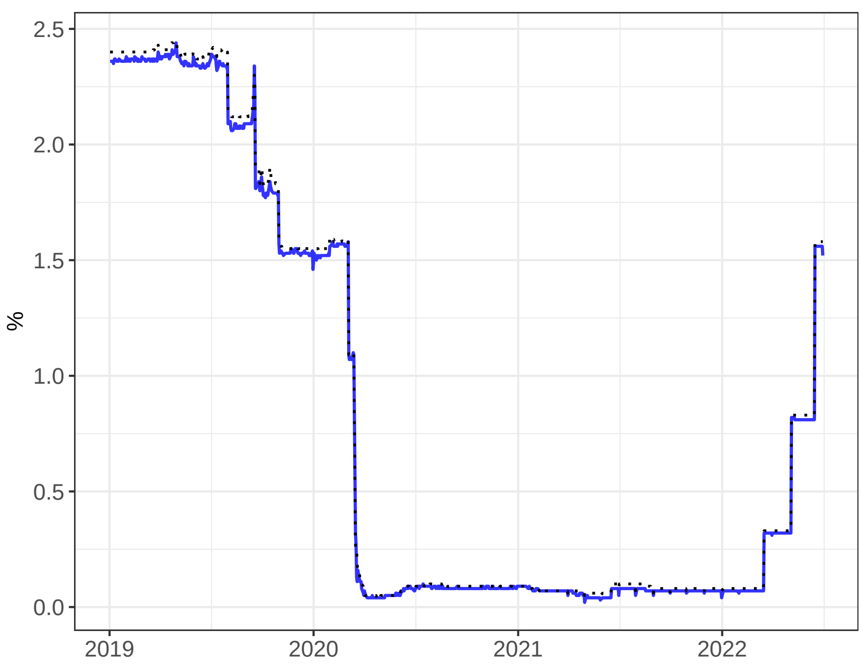
Figure 9: Major net flows of Tether on the Ethereum blockchain



Source: Etherscan (Contract: 0xdac17f958d2ee523a2206206994597c13d831ec7); authors' computations

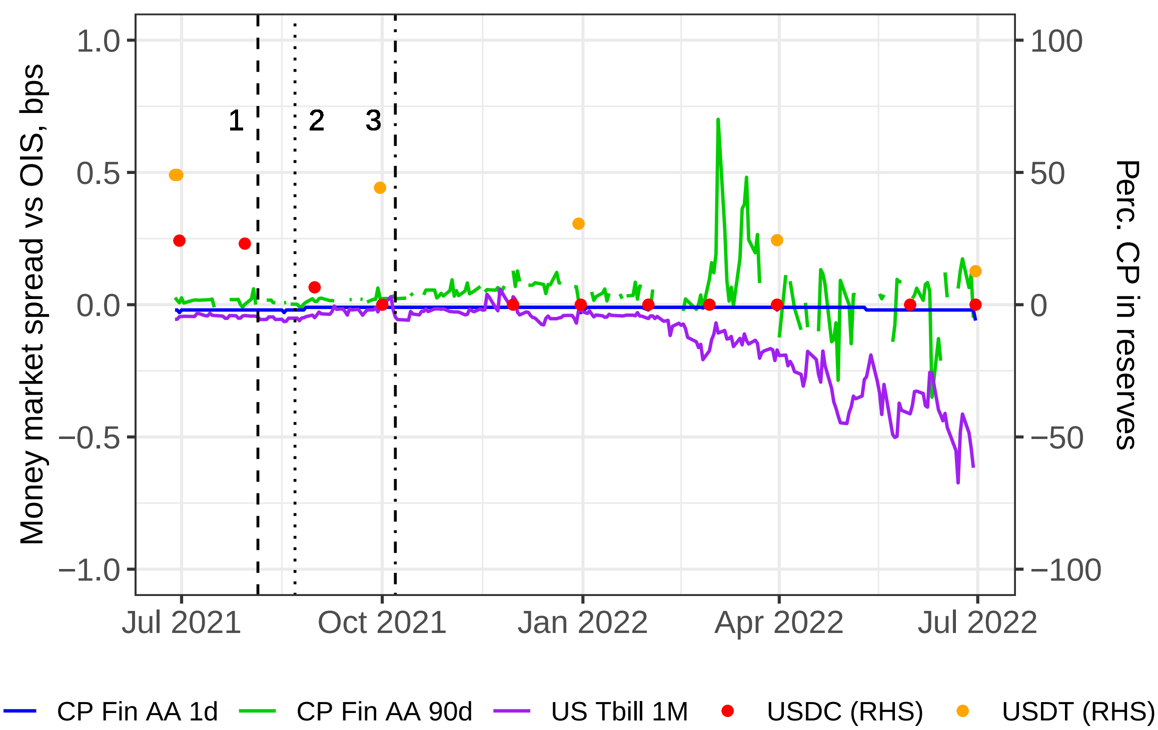
Note: Net flows in bn of USDT tokens between the first registered transactions to 19, June 2022. The aggregate inflows toward Tether Treasury are positive and coincide with an end-of-sample balance around 1 bn of tokens.

Figure 10: CP rate (1d Fin AA) (dotted) and Effective fed funds rates (plain)



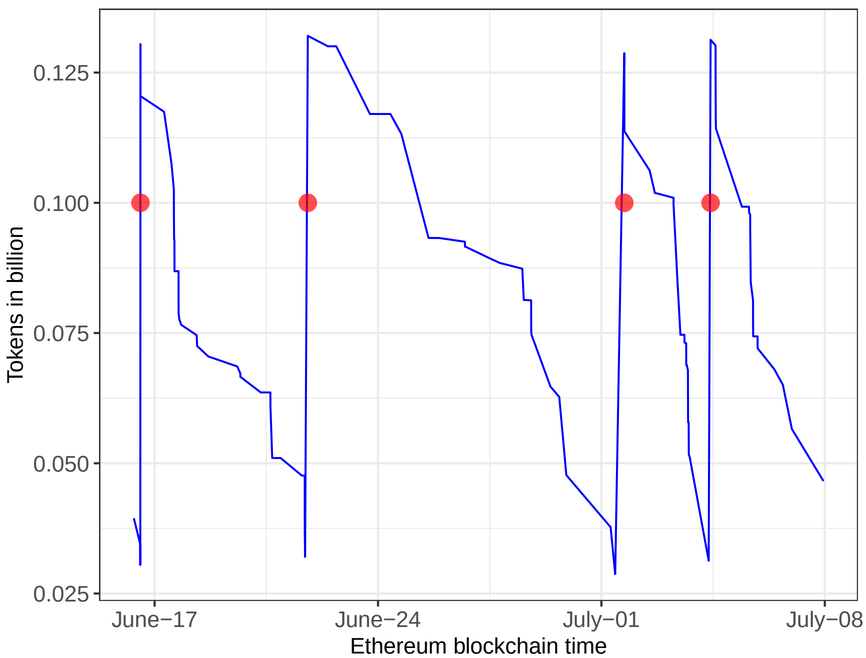
Source: Fred database.

Figure 11: Share of CP in reserve audits and money market spreads



Note: (1) 5 Aug 2021: First publication of Tether's reserves audit (2) 22 Aug 2021: Circle declares it will stop CP backing (3) 7 Oct 2021 Bloomberg article "Anyone Seen Tether's Billions". Money market rates are expressed in spread vs the OIS of the same maturity.

Figure 12: Example of mints (red dots) and Tether treasury balance (blue line)



Note: This graph shows the balance in USDT tokens of the Tether Treasury account on the Ethereum blockchain (Addr: 0x575...). Red dots correspond to "mints" authorized by the Multisig address (0xc6c...). Source: Etherscan.

APPENDIX

A Stablecoins: data, facts, and figures

This appendix section is organized as follows. First, we give an overview of the different stablecoins and emphasize the dominance of asset-backed stablecoins. Then, we provide for information about reserve assets composition. Finally, we describe data sources for stablecoin data.

A.1 Stabilization strategies and the dominance of asset-backed stablecoins

Different strategies have been implemented to stabilize stablecoins' value, with an uneven success that can be empirically measured (Mizrach, 2022), and theoretically grounded (D'Avernas et al., 2022; Bertsch, 2023). Achieving a peg with the US dollar echoes different types of arrangements and historical experiences in traditional finance and central banking. In the context of stablecoins, three main strategies have been implemented, both by centralized stablecoins issuers and decentralized autonomous organizations.

The first strategy, similar to MMFs and currency boards, relies on holding reserve assets denominated in US dollars in counterpart of tokens issued, and promising redemption at par. The second strategy relies on the over-collateralization of crypto-assets locked via a smart contract, in charge of issuing stablecoins' tokens and managing the appropriate quantity of collateral to maintain the peg (and eventually automatically liquidate collateral positions to ensure it). The third strategy relies on providing incentives for arbitrageurs to defend the peg, in a way similar to foreign exchange interventions.

Table 9 summarizes the strategies adopted by different stablecoins and whether they are issued by a centralized institution or by a decentralized smart contract.

The three largest stablecoins (USDT, USDC and BUSD) are all asset-backed. Their

Table 9: Major stablecoins and their stabilization policy

Stablecoin project	Governance	Asset-backed	Algorithmic
Tether (USDT)	centralized	real assets	no
Circle (USDC)	centralized	real assets	no
Binance (BUSD)	centralized	real assets	no
DAI (DAI)	decentralized	crypto-assets[(1)]	partially[(2)]
TerraUSD (UST)	decentralized	no	incentivized intervention

Note: (1) crypto-assets (including stablecoins) held in backing are not accepted at face value but with a haircut, a feature often nicknamed "over-collateralization". (2) *"The peg stability module (PSM) of the DAI stablecoin was introduced on December 18, 2020, as a solution to combat persistent peg-price deviations (...). Under the PSM, a smart contract enables users to swap the stablecoin USDC with DAI at a 1:1 rate without needing to create a vault and deposit collateral" (Kozhan and Viswanath-Natraj, 2021; Lyons and Viswanath-Natraj, 2020)*

dominance in terms of market capitalization can be linked to their peg performance and their ability to effectively meet redemptions. Figure 7 shows that the dispersion of exchange rates against the US dollar since July 2020 of asset-backed stablecoins has been very limited and comparable to the peg performance of other arrangements, like currency boards (see HKDUSD). On the contrary, algorithmic stablecoins exhibit the largest deviations, notably on the back of the crash of Terra USD in May 2022.

A.2 Reserve composition of USDT, USDC and BUSD

Reserves composition and attestation reports used in this paper can be found online:

- For Tether: `https://tether.to/en/transparency/#reports`
- For USD Coin: `https://www.centre.io/usdc-transparency`
- For BUSD: `https://paxos.com/busd-transparency/`

Table 10: Information on Circle's CP holdings

Publication date	Event	CP holding
2018-09-01	Creation of the first token	
2021-07-16	First breakdown of USDC reserve (Grant Thornton LLP)	4.9B as of May 28, 2021
2021-08-13	Breakdown of USDC reserve (Grant Thornton LLP)	6.1B as of June 30, 2021
2021-08-22	*"Circle, with the support of Centre and Coinbase, has announced that it will now hold the USDC reserve entirely in cash and short duration US Treasuries. These changes are being implemented expeditiously and will be reflected in future attestations by Grant Thornton."*	
2021-09-01	Breakdown of USDC reserve (Grant Thornton LLP)	6.7B as of July 30, 2021
2021-09-20	Breakdown of USDC reserve (Grant Thornton LLP)	1.8B as of August 31, 2021
2021-10-27	Breakdown of USDC reserve (Grant Thornton LLP)	0 as of September 30, 2021

Table 11: Information on Tether's CP holdings

Date	Event	Information on CP holding
2014-10-06	First issuance (on Omni blockchain)	
2018-01-22	First issuance on Ethereum blockchain	
2021-05-13	*"Today, Tether Holdings Limited made available a breakdown of the categories of assets forming the basis of Tether's issued token reserves at March 31, 2021. We will be releasing this breakdown on a quarterly basis for the next two years."* (First release of reserves breakdown by Tether Holding Limited)	approx. 20B as of March 31, 2021
2021-05-17	*"Tether's reserves show that cash, cash equivalents, and other short-term deposits and commercial paper make up 75% of a highly conservative and liquid reserve allocation. (...) Commercial paper makes up almost two thirds of the cash and cash equivalents and other short-term deposits and commercial paper. Commercial paper is short-term debt issued by corporations. The vast majority of the commercial paper we hold is in A-2 and above rated issuers. In order to ensure it has diversified exposure, Tether imposes limits on individual issuers and on regional exposure. These are in line with Tether's investment policy and industry practice. The commercial paper we hold is purchased through recognized issuance programmes. Accordingly, wild speculation that this includes commercial paper issued by crypto exchanges is absolutely false; no such commercial paper, if it exists, is held by Tether. No commercial paper purchased by Tether is issued by any affiliated entities."* (Stuart Hoegner, Blog post)	approx. 29B as of May 17,2021
2021-06-10	*"But this reported accumulation [of CP] has largely gone unnoticed on Wall Street, according to several of the biggest players in the market including bank traders, analysts and money market funds."*, Financial Times	
2021-08-06	First accountant's report published with the breakdown of reserve assets as of 30 June 2021 (Moore Cayman)	30.8B as of June 30, 2021
2021-12-03	Moore Cayman accountant's report	30.6B as of Sept. 30, 2021
2022-02-19	MHA Cayman accountant's report	24.1B as of December 31, 2021
2022-05-18	MHA Cayman accountant's report	20.1B as of March 31, 2022
2022-06-27	*"Tether also reduced its commercial paper exposure from 45B to 8.4B and is set to phase it out in full in the coming months.* ***All the expiring CP have been rolled into US Treasury bills, and we'll keep going till CP exposure will be 0****." (Tweet by Tether CTO P. Ardoino)*	8.4B as of June 27, 2022
2022-07-01	*"Currently, Tether has 8.4B of these [CP] holdings, of which 5B will expire on July 31. This will result in a significant reduction in commercial paper assets to a low of 3.5B, which is on track with* ***Tether's commitment to the community****. The goal remains to bring the figure down to zero. While both commercial paper and treasury reserves are commonly held liquid assets and cash equivalents, U.S. treasuries will now make up an even larger percentage of Tether's reserves." (Tether press release*)	3.5B as of July 31, 2022
2022-08-10	BDO auditors' report	8.4B as of June 30, 2022
2022-10-13	*"Tether announced that it has eliminated commercial paper from its reserves, replacing these investments with U.S. Treasury Bills (T-Bills). "* (Tether press release)	0 as of Oct. 13, 2022

A.3 Stablecoin data

The prime source of data comes from the smart contracts governing the issuance, transfer, and destruction of tokens. Each stablecoin has its own smart contract on each blockchain, where its code is publicly available. A specific field in the contract can be requested to get in real-time the total supply of tokens, ie. the total number of tokens "minted" less tokens "burnt".

However, not all of these tokens need to be backed: only those issued *and* in the hands of the public need to be. The concepts of "circulating tokens", "tokens in the hands of the public" or "free float" are often found with different definitions and computed according to different methodologies by crypto data providers. Coinmarketcap says for instance it excludes *"coins that are locked, reserved, or not able to be sold on the public market (...) that can't affect the price and thus should not be allowed to affect the market capitalization as well."*[42], and acknowledges that *"the network at large has no reliable knowledge of how much of the total supply is in active circulation, making the metric of circulating supply an imperfect approximation."* Coinmetrics also excludes for instance *"Supply in addresses that have been inactive for over 5 years; supply staked in a smart contract to partake in governance"*.[43]

On the opposite, for the purpose of our exercise, we need to isolate the amount of tokens that need to be backed by reserve assets, independently of whether the token is locked in DeFi or owned by inactive addresses. The total number of tokens minted less tokens burnt is already an approximation, and an extra step can be done to make sure to capture only tokens that command a backing by reserve assets, by subtracting the tokens held by the issuer's own addresses – or tokens that are said "authorized but not issued" when they never circulated. For the purpose of our analysis, we define therefore "circulating tokens" as tokens owned by all other addresses but those of the stablecoin issuer, as only these tokens need to be backed. The stablecoin issuer address is known, as it interacts with specific functions in the smart contract (eg. mint, burn), and as tokens must be sent to this address in case a coin holder asks for its redemption against US dollars.

We illustrate our definition of circulating tokens in the next two paragraphs for the two largest stablecoins.

[42] See https://coinmarketcap.com/faq/

[43] https://coinmetrics.io/introducing-free-float-supply/

Circulating USDC tokens Circle allows a set of issuers to issue tokens on approved blockchains (Algorand, Avalanche, Ethereum, Flow, Hedera, Solana, Stellar, and Tron). These allowed-but-not-issued tokens are not considered circulating yet and hence are not backed. Authorized issuers can issue new tokens up to their allowance limit in exchange for USD.[44] Circle can freeze tokens owned by blacklisted addresses, if "it receives blacklisting requests from law enforcement agencies" (Circle report, March 2021). Frozen tokens are suppressed from circulating USDC and not backed. Finally, when a token is redeemed (or burnt), the token definitively disappears from the outstanding. Thus, the circulating USDC is the sum of tokens allowed that are neither frozen nor allowed-but-not-issued.[45]

Circulating USDT tokens Tether has a similar functioning but instead of relying on multiple issuers, Tether uses its own addresses to authorize and issue tokens.[46] Tether authorizes the issuance of tokens on an increasing number of blockchains: 13 different blockchains as of October 2022 (mainly on Tron, Ethereum, Solana and Omni). As for Circle, the tokens officially backed by Tether are authorized tokens less those that are authorized but not issued and those that are quarantined. To be more concrete, Figure 9 shows the major flows of USDT tokens on the Ethereum blockchain from the first token issued to June 2022. The circulating USDT tokens on the Ethereum blockchain correspond to all tokens not held by Tether Treasury or quarantined (not mentioned in the figure), that is, the sum of tokens flowing out of the Tether Treasury address minus those flowing in.

Time series While smart contracts are requestable in real-time and transactions recorded in public blockchains, building an exhaustive time series about circulating tokens can be quite complex, notably because of the amount of transactions to be retrieved and the multiple blockchains on which

[44] "USDC is fully backed by an equivalent amount of U.S. Dollar-denominated assets held by Circle with U.S. regulated financial institutions in segregated accounts apart from Circle's corporate funds, on behalf of, and for the benefit of, Users (the "Segregated Accounts"). This means that for every USDC issued by Circle and remaining in circulation, Circle will hold on behalf of Users either one U.S. Dollar ("USD") or an equivalent amount of USD-denominated assets in its Segregated Accounts (the "USDC Reserves"). USDC is not designed to intrinsically create returns for holders, increase in value, or otherwise accrue financial benefit to the USDC holder."

[45] USDC smart contract in the Ethereum blockchain is accessible here: https://etherscan.io/token/0xa0b86991c6218b36c1d19d4a2e9eb0ce3606eb48

[46] USDT smart contract on the Ethereum blockchain accessible here: https://etherscan.io/address/0xdac17f958d2ee523a2206206994597c13d831ec7

stablecoins are issued (8 for USDC and 13 for USDT). We proceed in two steps. For the sake of completeness and data availability, we use the time series provided by the crypto data provider Messari – as for instance in Uhlig (2022), Makarov and Schoar (2022). The "circulating supply" series reported by Messari match the authorized less not issued number of tokens computed for all blockchains and verifiable with the Tether API.[47] Second, we do multiple checks to verify that our results are not caused by errors in this time series (see subsection 4.4). In particular, we verify that we can confirm our results with data retrieved directly from the blockchains (see subsections 4.4 and 4.3). The advantage of using on-chain data is that we fully control the definition of the time series we construct compared to sometimes not-so-well-documented data by crypto-data providers.

A.4 Blockchain addresses

To build the mints/burns data series for Tether, we download all the transactions involving the following addresses:

- For the Ethereum blockchain: contract 0xdac17f958d2ee523a2206206994597c13d831ec7
  - The issuer address: 0xc6cde7c39eb2f0f0095f41570af89efc2c1ea828
- For the Tron blockchain: contract TR7NHqjeKQxGTCi8q8ZY4pL8otSzgjLj6t
  - The issuer address: THPvaUhoh2Qn2y9THCZML3H815hhFhn5YC
  - The blackhole address: T9yD14Nj9j7xAB4dbGeiX9h8unkKHxuWwb

Figure 12 uses the Tether treasury address on the Ethereum blockchain:
0x5754284f345afc66a98fbb0a0afe71e0f007b949

B Commercial paper: market and data

In this short appendix section, we first put forward some stylized facts about the commercial paper market. Then, we present the data used in the empirical exercises.

[47] https://app.tether.to/transparency.json

B.1 The commercial paper market

Commercial paper (CP) are short-term promissory notes issued by non-financial corporations, banks and other financial institutions. While the majority of CP outstanding is unsecured, around 25% is issued in the asset-backed commercial paper segment by financial institutions. Maturities are typically short and range from 1 day up to 270 days. There is no secondary market for CP: they are usually held to maturity and not traded after the issuance. The CP market plays a critical role in the money market as an important source of financial institutions' unsecured funding, as noted by Eren et al. (2020).

The Federal Reserve also stressed the importance of the CP market for the real economy to justify its intervention during the Covid-19 crisis: *"Commercial paper markets directly finance a wide range of economic activity, supplying credit and funding for auto loans and mortgages as well as liquidity to meet the operational needs of a range of companies. By ensuring the smooth functioning of this market, particularly in times of strain, the Federal Reserve provided credit that supported families, businesses, and jobs across the economy."*[48]

Table 12: Holders and Issuers of Commercial paper, 2021

Nonfinancial corporate business	253,5	138,2	Nonfinancial corporate business
State and local governments	81,1	134,9	U.S.-chartered depository institutions
Credit unions	0,3	60,4	Foreign banking offices in the U.S.
Property-casualty insurance companies	4,5	148,1	Issuers of asset-backed securities
Life insurance companies	41	41,3	Finance companies
Private pension funds	42,4	8,1	Holding companies
Public retirement funds	14,6	136,7	Other financial business
Money market funds	226,2		
Mutual funds	39,6		
Government-sponsored enterprises	4,7		
Security brokers and dealers	16,3		
Other financial business	226,9		
Rest of the world	138,3	421,7	Rest of the world
Total holders	1089,4	1089,4	Total issuers

Source: Flow of funds Table L.209, https://www.federalreserve.gov/releases/z1/20220909/html/l209.htm

Table 12 gives the breakdown in terms of holders and issuers of CP, from the Flow of Funds data, as of 2021.[49] First, while the bulk of CP issuers is financial institutions, a fraction is issued by

[48] https://www.federalreserve.gov/monetarypolicy/cpff.htm

[49] See also https://fred.stlouisfed.org/release/tables?rid=86&eid=147706#snid=147717

non-financial corporates. Second, the CP market is not only important for the short-term funding of US-domiciled institutions but also for foreign issuers: around 40% of the CP outstanding is issued by non-US institutions. Third, CP holdings appear concentrated in money market funds, other financial businesses, and non-financial corporates. MMFs are traditionally large holders of CP, in particular Prime MMFs, who hold mainly corporate short-term debt.

B.2 Commercial paper data

Data on commercial paper issuance and rates come from the Federal Reserve Board – derived from data supplied by DTCC (Depository Trust & Clearing Corporation). Data on issuance and rates are reported daily, based on CP of maturities of 270 days or less, directly issued or placed by dealers.[50]

We rely on breakdowns provided by the Federal Reserve. For instance, the reports aggregate in a bucket 'AA' commercial paper rated A1+ and A1 by Moody's Investors Service and Standard & Poor's.[51] Similarly, volume statistics for daily issuances are reported for 'Non-financials AA", "Non-financials A2/P2", "Financials AA" and "ABCP AA", as well as for the total market. As noted by the Fed, *"total market is not the sum of the four rate categories as there is additional issuance that does not fall in any of the rate categories"*. CP rates data are also reported for specific issuers and maturities (eg. rates for 90-day CP). We keep most of these categories unchanged for the analysis. We only group in the bucket "5d to 80d" the issuances reported by the Federal Reserve in 4 distinct maturities: 5-9 days; 10-20 days; 21-40 days and 41-80 days.

As the CP market experienced a period of stress following the Covid-19 crisis, we include as a control the purchases of CP conducted by the Federal Reserve. In March 2020, the Federal Reserve re-instated the Commercial Paper Funding Facility (CPFF)[52] to support the flow of credit to households and businesses. As detailed by Boyarchenko et al. (2021), the CPFF re-started purchases on March 17, 2020, focused on unsecured and asset-backed commercial paper rated A1/P1. CPFF ceased purchases on March 31, 2021.

[50] Sources and methodology: https://www.federalreserve.gov/releases/cp/about.htm

[51] "Programs with at least one 1 or 1+ rating, but no ratings other than 1" https://www.federalreserve.gov/releases/cp/about.htm'

[52] https://www.federalreserve.gov/monetarypolicy/cpff.htm

All in all, our data sample goes from Jan 2, 2019, to June 30, 2022, at a daily frequency. We keep business days in which the CP market is open, and we drop two dates from the sample: Dec 31, 2020 and Apr 19, 2019, two outliers in terms of CP reported by the Federal Reserve (the second date being Good Friday in 2019).[53] Our sample covers the sheer growth period of the stablecoins, the Terra crash that occurred in May 2022, and the subsequent short-lived but unusual deviations of Tether from its peg.

[53]For rates but not for issuance quantities, there may be missing data for certain maturities or categories. No imputation is done.

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Table 13: Unit root tests

This table reports the Augmented Dickey-Fuller test for the main right-hand side variables, in level, log-level and first difference. Alternative hypothesis is stationarity. Only delta log and first-differentiated variables pass the ADF test.

Variable	Dickey-Fuller	p-value
USDC Tokens	-0.8625	0.96
Log(USDC Tokens)	-2.5813	0.33
Δ Log(USDC Tokens)	-7.4563	**0.01**
Δ USDC Tokens	-7.9011	**0.01**
USDT Tokens	-1.3566	0.85
Log(USDT Tokens)	-0.0358	0.99
Δ Log(USDC Tokens)	-5.9798	**0.01**
Δ USDT Tokens	-5.5875	**0.01**
CP All. Mat.	-3.2927	0.072
Log(CP All. Mat.)	-3.5708	0.04
Δ Log(CP All. Mat.)	-14.043	**0.01**
Δ CP All. Mat.	-13.671	**0.01**
Rate Fin. AA 1d	0.47504	0.99
Δ Spread Fin. AA 1d	-12.832	**0.01**

Table 14: Spearman rank correlation matrix

This table reports the partial Spearman correlation matrix for the changes in circulating tokens of USDT, USDC and BUSD. Bold denotes the strongest correlation for each token.

	Δ Tokens USDT	Δ Tokens USDC	Δ Tokens BUSD
Δ Tokens USDT	1	-0.051	0.031
Δ Tokens USDC	-0.051	1	**0.177**
Δ Tokens BUSD	0.031	0.177	1
Δ Adresses BTC	0.124	**0.259**	0.117
Realized Profit BTC	**0.159**	0.235	0.081
Volatility BTC	0.081	0.169	0.060
Δ Gas price	0.018	-0.079	-0.003
Δ Nasdaq	-0.042	0.014	-0.057
Δ VIX	-0.021	0.093	0.088
Δ Excess reserves	0.132	0.071	-0.034
Δ 1m Tbill	-0.021	-0.022	-0.072
Δ Effective Fed Funds	-0.017	0.028	-0.046
Δ Spread CP Fin AA 1d	0.009	0.005	-0.007
Δ Spread CP Fin AA 90d	0.021	0.036	0.013

Table 15: Total CP issuances, USDT and USDC tokens

This table reports the estimation of the first column in Table 1 introducing controls at once. Column (4) adds the lag of change in circulating tokens. The dependent variable is the daily variation in CP issuance, expressed in billion USD, for all maturities/issuer/credit rating categories reported by the Federal Reserve. Δ Tokens USDT+USDC is the daily change in circulating tokens, in billion of tokens. Significance levels are denoted: *** at 1%, ** at 5%, and * at 10%. Newey-West standard errors are shown in parentheses with a lag of 5.

	All mat.			
	(1)	(2)	(3)	(4)
Δ Tokens USDT	2.308**	2.418**	1.753*	1.855*
	(1.039)	(1.098)	(0.9057)	(1.076)
Δ Tokens USDC	3.848**	3.752**	2.167**	2.375**
	(1.168)	(1.184)	(0.9319)	(0.9087)
Δ Tokens USDT (t-1)				-0.2612
				(0.7409)
Δ Tokens USDC (t-1)				-1.236
				(0.7899)
Δ Excess reserves		0.0016	0.0060	0.0056
		(0.0206)	(0.0196)	(0.0198)
Δ Eff. Fed funds rate		0.1668	0.1612*	0.1598*
		(0.1056)	(0.0946)	(0.0936)
Δ Fed CP purchases		0.3753	0.6546	0.6590
		(1.811)	(1.685)	(1.698)
Dummy: CP stress		0.8423	0.1471	0.1224
		(1.020)	(1.004)	(1.010)
Δ Nasdaq		0.2978	0.2286	0.2303
		(0.2702)	(0.2388)	(0.2406)
VIX		0.0233	0.0310	0.0302
		(0.0341)	(0.0360)	(0.0359)
Δ Log(Debt/GDP)		-611.4*	-683.7**	-689.8**
		(349.3)	(327.5)	(329.5)
Δ TNA Top-5 Prime MMF		-0.5138	-0.0205	-0.0515
		(0.4094)	(0.4129)	(0.4148)
Day = Monday			11.50***	11.46***
			(1.628)	(1.631)
Day = Thursday			5.907***	5.860***
			(1.339)	(1.348)
Day = Tuesday			9.345***	9.487***
			(1.208)	(1.233)
Day = Wednesday			3.309**	3.350**
			(1.157)	(1.161)
Observations	867	865	865	863
R^2	0.01528	0.03061	0.15490	0.15572

Table 16: USDT, USDC and CP issuances by raw maturity buckets

This table reports the estimated coefficient of variation in tokens supply, separately for USDT and USDC. The dependent variable is the daily variation in CP issuance, expressed in billion USD, for all the maturity buckets published by the Federal Reserve. Δ Tokens is the daily change in tokens circulating supply in billion. Controls include, as before, variations in excess reserves, effective fed funds rate, Fed CP purchases, log(Debt/GDP), Nasdaq, VIX. Significance levels are denoted: *** at 1%, ** at 5% and * at 10%. Newey-West standard-errors are shown in parentheses.

	All mat. (1)	1d to 4d (2)	5d to 9d (3)	10d to 20d (4)	21d to 40d (5)	41d to 80d (6)	>80d (7)
Δ Tokens USDT	1.754*	1.446**	-0.1183	0.0407	-0.0267	0.0774	0.3351*
	(0.8996)	(0.7246)	(0.3501)	(0.0979)	(0.1071)	(0.0787)	(0.1862)
Δ Tokens USDC	2.167**	1.268	0.6750*	-0.1425	0.2911**	0.1934*	-0.1175
	(0.9305)	(0.8689)	(0.3778)	(0.1409)	(0.1195)	(0.1053)	(0.1823)
Controls	✓	✓	✓	✓	✓	✓	✓
Weekday-FE	✓	✓	✓	✓	✓	✓	✓
Observations	865	865	865	865	865	865	865
R^2	0.15490	0.22954	0.23283	0.16704	0.06881	0.10134	0.06911

Table 17: Asymetric effect – USDT, USDC tokens and CP issuances by maturity, issuer and rating

This table reports the estimated coefficient of variation in circulating tokens, separately for positive and negative variation, both for USDT and USDC. The dependent variable is the daily variation in CP issuance, expressed in billion USD, for different categories of maturity, issuer and credit rating. $\Delta-$ Tokens USDT is the eventual negative daily change in circulating USDT tokens at date t, in billion. Controls include, as before, variations in excess reserves, effective fed funds rate, Fed CP purchases, log(Debt/GDP), Nasdaq, VIX and the total net asset of Top 5 MMF. Significance levels are denoted: *** at 1%, ** at 5% and * at 10%. Newey-West standard-errors with a lag of 5.

	Maturity				Issuer/Rating			
	All mat. (1)	1d to 4d (2)	5d to 80d (3)	>80d (4)	Fin. AA (5)	Non-fin. AA (6)	Non-fin. A2P2 (7)	ABCP AA (8)
Constant	-6.643***	-1.329*	-3.814***	-1.500***	-0.6883***	0.9274***	-0.4328**	-1.539***
	(1.236)	(0.7570)	(0.6978)	(0.2446)	(0.2016)	(0.2174)	(0.1654)	(0.2997)
$\Delta-$ Tokens USDC	-2.449	-1.828	0.6290	-1.250	-0.0268	0.2882	-0.0789	0.5182
	(5.827)	(3.905)	(2.374)	(0.9542)	(1.194)	(1.095)	(0.6683)	(1.111)
$\Delta+$ Tokens USDC	2.172**	1.239	0.9849*	-0.0516	0.0245	0.3011	0.1338**	0.2276*
	(1.005)	(0.9455)	(0.5711)	(0.2104)	(0.2036)	(0.2368)	(0.0638)	(0.1304)
$\Delta-$ Tokens USDT	0.5333	0.4910	-0.2680	0.3103	0.2329	-0.5159	-0.0516	0.2461
	(0.8827)	(0.9733)	(0.5798)	(0.2052)	(0.1535)	(0.3471)	(0.0640)	(0.2759)
$\Delta+$ Tokens USDT	2.529**	2.035**	0.1234	0.3714	0.1296	0.7926*	0.1259	0.4024**
	(1.284)	(0.7577)	(0.6606)	(0.2978)	(0.1524)	(0.4218)	(0.1062)	(0.2034)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Weekday-FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	865	865	865	865	865	865	865	865
R^2	0.15643	0.23161	0.17767	0.07287	0.07440	0.46072	0.04862	0.11671

Table 18: Total CP issuances, USDT and USDC tokens issuances – in levels

This table reports the estimation of the analogue of Equation 4, in level and log level, with the lagged dependent variable as a control. The dependent variable is the level and log level of CP issuance, expressed in billion USD, for all maturities/issuer/credit rating categories reported by the Federal Reserve. Tokens USDT+USDC is the daily circulating tokens, in billion of tokens. Controls are as described before, in level, aside Nasdaq which is expressed in daily growth. Significance levels are denoted: *** at 1%, ** at 5% and * at 10%. Newey-West standard-errors are shown in parentheses with a lag of 5.

	CP issuance				Log(CP issuance)	
	CP issuance				All. mat.	
	(1)	(2)	(3)	(4)	(5)	(6)
Tokens USDT+USDC	0.2361***	0.1994***				
	(0.0508)	(0.0570)				
Δ Tokens USDT+USDC			2.086**	1.803**		
			(0.6987)	(0.6490)		
Log(Tokens USDT+USDC)					0.1615***	0.1685***
					(0.0217)	(0.0334)
(CP issuance) (t-1)	0.4506***	0.4370***	0.5087***	0.4723***		
	(0.0443)	(0.0431)	(0.0428)	(0.0427)		
Log(CP issuance) (t-1)					0.3653***	0.3655***
					(0.0450)	(0.0451)
Time-trend		✓		✓		✓
Weekday-FE	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Observations	867	867	866	866	867	867
R^2	0.77299	0.77463	0.76521	0.77005	0.71336	0.71339

Table 19: 2SLS - Predicted changes in USDT circulating tokens

This table reports the estimation by OLS and 2SLS analogue to Table 1 for two different samples: 2019- June 2021 and July 2021-2022. Columns (1) and (5) give the simple OLS estimates. Columns (3-4) and (7-8) present the first and second stage of the 2SLS. In second stages, Δ Tokens USDT is predicted by the change in mints and burns by Tether a day before. Columns (2) and (6) are the 2SLS "reduced form", ie. where the change in mints and burns are directly the explanatory variable at the right-hand side. Controls are as before. Significance levels are denoted: *** at 1%, ** at 5% and * at 10%. Newey-West standard-errors are shown in parentheses.

	OLS (2019-2021)		2SLS (2019-2021)		OLS (2021-2022)		2SLS (2021-2022)	
	Δ CP	Δ CP	1S	2S	Δ CP	Δ CP	1S	2S
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ Tokens USDC	2.871**	2.695**	0.0175	2.592**	0.3498	-0.2717	-0.2787	-0.6404
	(1.157)	(1.045)	(0.0165)	(0.9945)	(2.290)	(2.212)	(0.2259)	(2.522)
Δ Tokens USDT	3.468**			5.898**	0.6580			-1.323
	(1.518)			(2.117)	(1.071)			(1.718)
Mints/Burns USDT		4.707**	0.7980***			-0.3621	0.2737**	
		(1.546)	(0.0569)			(0.4869)	(0.1000)	
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Weekday-FE	✓	✓	✓	✓	✓	✓	✓	✓
Standard-Errors	L=5		L=4		L=3			
Observations	661	591	591	591	204	204	204	204
Adjusted R^2	0.18376	0.21853	0.69957	0.20367	0.17773	0.17770	0.28434	0.17252
F-test	12.680	14.000	109.09	14.000	5.2746	5.2737	8.8098	5.2737

Table 20: USDT, USDC and CP issuances, CP rates and BTC returns in controls

This table is the analogue of Table 4 with CP interest rate, Bitcoin daily log-return and Bitcoin momentum, defined as the 7-day log-return, as controls. Other controls include, as before, variations in excess reserves, effective fed funds rate, Fed CP purchases, log(Debt/GDP), Nasdaq, VIX. Significance levels are denoted: *** at 1%, ** at 5% and * at 10%. Newey-West standard-errors are shown in parentheses with a lag of 5.

	Maturity				Issuer/Rating			
	All mat.	1d to 4d	5d to 80d	>80d	Fin. AA	Non-fin. AA	Non-fin. A2P2	ABCP AA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ Tokens USDT	1.740*	1.458**	-0.0824	0.3645*	0.1654*	0.2428	0.0616	0.3604**
	(0.9219)	(0.7410)	(0.4203)	(0.1857)	(0.0972)	(0.3677)	(0.0765)	(0.1593)
Δ Tokens USDC	2.108**	1.191	1.036**	-0.1192	-0.0111	0.4995*	0.1359*	0.2454*
	(0.9010)	(0.8418)	(0.5200)	(0.1848)	(0.1728)	(0.2840)	(0.0706)	(0.1412)
CP rate 1d Fin. AA	0.9143	0.6223	0.2875	0.0045	0.2557	-0.0743	0.0329	0.0624
	(0.6018)	(0.4278)	(0.2570)	(0.0558)	(0.1818)	(0.0538)	(0.0458)	(0.0886)
Δ BTC/USD	1.202	-1.763	-0.6671	3.632**	-0.1344	-2.785	0.5097	0.7449
	(9.280)	(5.504)	(5.111)	(1.832)	(1.565)	(2.005)	(1.266)	(2.824)
Momentum BTC/USD	0.3994	-0.4990	1.024	-0.1256	0.0967	0.5093	-0.0997	-0.3563
	(2.217)	(1.506)	(1.116)	(0.5359)	(0.3544)	(0.5335)	(0.2969)	(0.5077)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Weekday-FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	859	859	859	859	859	859	859	859
R^2	0.16548	0.23830	0.18134	0.07854	0.09572	0.45856	0.04921	0.11873

Table 21: USDT, USDC and CP issuances by maturity, issuer and rating – With Month FE

This table reports the estimated coefficient of variation in circulating tokens, for both USDT and USDC for different categories of CP, adding Month-Year FE (Jan-22, Feb-22...) Other controls include variations in excess reserves, effective fed funds rate, Fed CP purchases, log(Debt/GDP), Nasdaq, VIX, and Top 5 MMF total net assets. Days of the week are included in the fixed effects to capture intra-week seasonality. Significance levels are denoted: *** at 1%, ** at 5% and * at 10%. Newey-West standard errors with a lag of 5.

	Maturity				Issuer/Rating			
	All mat.	1d to 4d	5d to 80d	>80d	Fin. AA	Non-fin. AA	Non-fin. A2P2	ABCP AA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ Tokens USDT	2.376**	1.935**	0.0170	0.4236*	0.2342*	0.3599	0.0784	0.4963**
	(1.191)	(0.9684)	(0.5174)	(0.2293)	(0.1277)	(0.4401)	(0.0959)	(0.1910)
Δ Tokens USDC	2.567**	1.526	1.183**	-0.1425	0.0238	0.5842*	0.1539*	0.3539**
	(1.043)	(0.9780)	(0.5613)	(0.1923)	(0.2155)	(0.3154)	(0.0812)	(0.1587)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Weekday-FE	✓	✓	✓	✓	✓	✓	✓	✓
Month-Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	865	865	865	865	865	865	865	865
R^2	0.16392	0.24027	0.18176	0.07739	0.08181	0.46022	0.05416	0.12395

Table 22: Log difference: USDT, USDC and CP issuances by maturity, issuer and rating

This table is the analog of table 4 with Delta Log Tokens instead of first difference. Controls are otherwise unchanged and c include variations in excess reserves, effective fed funds rate, Fed CP purchases, log(Debt/GDP), Nasdaq, VIX, and Top 5 MMF total net assets. Days of the week are included in the fixed effects to capture intra-week seasonality. Significance levels are denoted: *** at 1%, ** at 5% and * at 10%. Newey-West standard errors with a lag of 5.

	Maturity				Issuer/Rating			
	All. mat.	1d to 4d	5d to 80d	>80d	Fin. AA	Non-fin. AA	Non-fin. A2P2	ABCP AA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ Log(Tokens USDT)	0.5301	0.6468**	0.0503	1.790**	0.4517	2.723	0.8248	0.6422
	(0.3642)	(0.3156)	(0.7167)	(0.8654)	(0.7466)	(2.138)	(0.5067)	(0.5208)
Δ Log(Tokens USDC)	0.2703*	0.2501	0.5314*	-0.2531	-0.0926	0.6036	0.2137	0.2835*
	(0.1582)	(0.1554)	(0.2775)	(0.4964)	(0.3683)	(0.7870)	(0.1747)	(0.1528)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Weekday-FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	865	865	865	865	865	865	865	865
R^2	0.14362	0.21890	0.17693	0.08247	0.06028	0.37038	0.06495	0.09277

Table 23: CP rates (Fin. 90d AA), in levels, and changes in USDT and USDC tokens

The dependent variable is the interest rate of CP issued by financial institutions, rated AA for a maturity of 90-days. Δ Tokens USDT+USDC is the daily change in circulating tokens of the two stablecoins, in billion of tokens. We introduce controls once at a time. In column (2), we introduce the US OIS 3-month of the same maturity. Column (3) corresponds to Nagel (2016)'s specification, with Effective funds rates, VIX and Log(Debt/GDP) as controls. Column (4) includes all of our controls, as before. Significance levels are denoted: *** at 1%, ** at 5% and * at 10%. Newey-West standard-errors are shown in parentheses with a lag of 5.

	Fin. AA			
	(1)	(2)	(3)	(4)
Δ Tokens USDT	-0.7832***	-0.0330**	-0.0008	0.0161
	(0.1055)	(0.0116)	(0.0101)	(0.0120)
Δ Tokens USDC	-0.4994**	-0.0400**	-0.0024	0.0008
	(0.1973)	(0.0197)	(0.0105)	(0.0118)
Eff. Fed funds rate		0.2506***	-0.0084	-0.1504
		(0.0638)	(0.1572)	(0.1936)
Swap OIS 3M		0.7499***	0.9560***	0.9918***
		(0.0741)	(0.1053)	(0.1287)
VIX			0.0148***	0.0167***
			(0.0040)	(0.0048)
Log(Debt/GDP)			-0.9236*	-1.516*
			(0.5133)	(0.8815)
Δ Nasdaq				0.0161**
				(0.0075)
Excess reserves				0.00001
				(0.00005)
Fed CP purchases				-0.0156***
				(0.0036)
Dummy: CP stress				-0.1848
				(0.1289)
Δ TNA Top-5 Prime MMF				0.0255
				(0.0192)
Weekday-FE				✓
Observations	709	708	707	707
R^2	0.09573	0.95953	0.97667	0.98134

Table 24: Robustness checks

This tables a series of robustness checks. Column (1) add a dummy for all observations of change in USDT+USDC tokens larger than 3 z-scores, computed on a 50-day rolling window. Column (2) winsorizes the right-hand side variable by 2.5% symmetrically. Column (3) add end-of-month dummies to take into account additional volatility these particular days. Column (4) reports the estimation of the robust OLS (Huber estimator), column (5) reports the results of a quantile regression in which we estimate the median instead of the mean.

	Z-score (1)	Winsor. (2)	EoM (3)	Rob.OLS (4)	Quant. Reg (5)
Δ Tokens USDT+USDC	1.346**	2.599**	1.073*	1.649***	1.716**
	(0.6722)	(1.175)	(0.5663)	(0.608)	(0.761)
I(z-score>3)	3.177*				
	(1.920)				
Controls	✓	✓	✓	✓	✓
Weekday-FE	✓	✓	✓	✓	✓
Observations	856	865	865	865	865
R^2	0.15864	0.15313	0.40362	–	–

Table 25: USDT, USDC and CP issuances by maturity, issuer and rating

This table is the analogue of Table 4 with market sentiment instead of VIX. We use we use a daily series of market sentiment from Buckman et al. (2020) Federal Reserve Bank of San Francisco FRBSF Economic Letter 2020-08, April 6, 2020. Significance levels are denoted: *** at 1%, ** at 5% and * at 10%. Newey-West standard-errors are shown in parentheses with a lag of 5.

	Maturity				Issuer/Rating			
	All mat. (1)	1d to 4d (2)	5d to 80d (3)	>80d (4)	Fin. AA (5)	Non-fin. AA (6)	Non-fin. A2P2 (7)	ABCP AA (8)
Δ Tokens USDT	1.857**	1.518**	0.0057	0.3331*	0.1828*	0.2577	0.0670	0.3772**
	(0.9299)	(0.7482)	(0.4244)	(0.1837)	(0.0995)	(0.3602)	(0.0758)	(0.1656)
Δ Tokens USDC	2.227**	1.302	1.047**	-0.1218	0.0394	0.4765*	0.1276*	0.2475*
	(0.9888)	(0.9450)	(0.4935)	(0.1764)	(0.1956)	(0.2680)	(0.0738)	(0.1401)
Δ CP EUR	0.2181	0.1905	0.0659	-0.0383	0.0013	-0.0478	0.0456**	0.1168**
	(0.2474)	(0.1797)	(0.1095)	(0.0356)	(0.0379)	(0.0437)	(0.0203)	(0.0480)
Market sentiment	-1.246	-0.8795	-0.5503	0.1840	-0.4459	0.0553	0.1599	0.0359
	(1.536)	(1.105)	(0.8279)	(0.3723)	(0.3336)	(0.3598)	(0.2071)	(0.3449)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Weekday-FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	865	865	865	865	865	865	865	865
R^2	0.15672	0.23278	0.17811	0.07320	0.07501	0.45741	0.05240	0.12692

Table 26: Impact of CP issuances on money market variables – OLS and IV

This table reports both the OLS and the IV estimation of the impact of change in CP issuance on money market variables. For CP rates, we take the rate of Financial AA CP at the 1-week maturity tenor, corrected by the OIS of the same maturity. Controls include, as before, variations in excess reserves, effective fed funds rate, Fed CP purchases, log(Debt/GDP), Nasdaq, VIX and Top 5 MMF total net assets. In the second panel, CP issuances are instrumented by the variation in USDC and USDT tokens. Significance levels are denoted: *** at 1%, ** at 5% and * at 10%. Newey-West standard errors. 95% confidence intervals shown in brackets.

			OLS		
	Δ Fin. AA 7d	Δ Tbill 1m	Δ SOFR	OIS-Tbill 1M	Δ Log ONRRP
	(1)	(2)	(3)	(4)	(5)
CP issuances	0.0871**	-0.0112	-0.0006**	-0.0002	-0.0133**
	(0.0436)	(0.0101)	(0.0002)	(0.0002)	(0.0067)
Controls	✓	✓	✓	✓	✓
Weekday-FE	✓	✓	✓	✓	✓
Observations	597	871	871	870	754
R^2	0.15717	0.15173	0.16282	0.17411	0.02696
			IV		
$\widehat{CP issuances}$	-0.1625	0.0329	-0.0002	-0.0154*	-0.0590
	(0.2093)	(0.0879)	(0.0009)	(0.0091)	(0.0547)
Controls	✓	✓	✓	✓	✓
Weekday-FE	✓	✓	✓	✓	✓
Observations	595	865	865	864	748
F-test 1st stage			12.175		