Are Stablecoins the Money Market Mutual Funds of the Future?

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Abstract

This paper is the first to provide a comprehensive comparison of two financial instruments: stablecoins and money market mutual funds (MMFs). We observe similar reserve asset backing for fiat reserve backed (FRB) stablecoins and MMFs, similar importance of sponsor support, and the same negative association between macroeconomic indicators and peg deviations. Both instruments serve as short-term facilities for investors to park funds and their primary market microstructure is similar. However, FRB stablecoins exhibit larger dispersions from the dollar peg, significantly higher volatility, and a lack of transparency in their market infrastructure. Larger FRB stablecoins show reduced volatility compared to their smaller counterparts, with peg deviation drivers more closely resembling those of MMFs. We conclude that FRB stablecoins demonstrate remarkable similarities to MMFs and have the potential to become the MMFs of the future.

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"I have no intention to ban them [stablecoins], but, stablecoins are like money market funds, they're like bank deposits, but they're, to some extent, outside the regulatory perimeter and it's appropriate that they be regulated […] same activity, same regulation."

J. Powell, Sep 2021, Testimony before the House Financial Services Committee

1 Introduction

From January 2020 to December 2022, the global cryptocurrency market, dominated by Bitcoin and Ethereum, approximately quadrupled in size. Over the same period, the total market capitalization of the fourteen largest stablecoins increased from around $6 billion to $138 billion, a 23-fold increase. Stablecoins are a category of crypto assets that aim to maintain a stable value relative to a specified currency, asset, or basket of assets, and they are commonly denominated in US dollars. In December 2022, the three largest stablecoins – Tether (USDT), USD Coin (USDC) and Binance USD (BUSD) – account for more than 90% of the stablecoin market. All three claim to be fully fiat reserve backed (FRB), meaning each issued coin is backed 1:1 by reserve assets, generally cash or high-quality liquid assets that can be considered cash equivalents. These asset holdings connect the global cryptocurrency market with the traditional finance system.

The Financial Stability Board (FSB) emphasizes the potential threat that crypto assets pose to the global financial system. Among other structural features of stablecoins, the FSB highlights the maturity- and liquidity mismatches revealed by the balance sheets of stablecoin issuers. For example, liquidity transformation measures the ratio of less liquid assets held by financial intermediaries that are funded through short-term liabilities.[2] Together with credit intermediation, maturity transformation, and leverage, liquidity transformation is one aspect the FSB utilizes to categorize financial intermediaries into the Narrow Measure sub-group of financial assets. The sub-group is part of the Non-Bank Financial Intermediation (NBFI) sector and poses a risk to financial stability through their bank-like activity but absence of bank-like regulation.

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[2] Global Monitoring Report on Non-Bank Financial Intermediation 2022, FSB, accessed 27 February 2023, https://www.fsb.org/2022/12/global-monitoring-report-on-non-bank-financial-intermediation-2022/.

Money market mutual funds (MMFs) are one of the largest categories of entities within the Narrow Measure. MMFs are open-end mutual funds, meaning that investors can invest or redeem from the fund at any time. MMFs bridge short-term financing and lending by connecting entities with excess cash and entities with short-term financing needs. Shareholders of MMFs consider their investment as short-term, deposit like, and highly liquid. Bouveret et al. (2022) see a similarity in MMFs and stablecoins regarding their liquidity transformation activities.

Global regulators have pursued legislation to regulate stablecoins and crypto assets more broadly. For example, in June 2022, the European Parliament provisionally agreed on the markets in crypto assets (MiCA) bill, requiring stablecoin issuers to provide adequate minimum liquidity.[3] Martino (2022) analyzes the regulation, while also comparing it to MMF regulation. He finds that MiCA does well in terms of investor protection and regulatory competition but does not sufficiently emphasize financial stability. Moreover, Martino suggests that stablecoins should be regulated similarly to MMFs, using MMF regulation after the Global Financial Crisis (GFC) as a blueprint.

Other legislation is lagging. For example, the US and Australia drafted, but have not passed any bills as of December 2022. In February 2023, the US Securities and Exchange Commission (SEC) announced that emerging technologies and crypto assets are one of their examination priorities for 2023.

The rapid growth of stablecoins in recent years and their similarity to MMFs suggest the need for a detailed comparison between the two. Our paper is the first to offer such a comparison, potentially helping investors and regulators to better understand the benefits and risks of stablecoins. We focus on the US market, as the large majority of stablecoins are pegged to the US dollar. Additionally, more than half of the roughly $9 trillion global assets under management by MMFs in 2022 are held in the US.[4]

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[3] Digital finance: agreement reached on European crypto assets regulation (MiCA), European Council of the EU (30 June 2022), https://www.consilium.europa.eu/en/press/press-releases/2022/06/30/digital-finance-agreement-reached-on-european-crypto assets-regulation-mica/.

[4] International Investment Funds Association, accessed 6 October 2022, https://cdn.ymaws.com/iifa.ca/resource/collection/A083042C-98D9-4EED-9E00-58CA5D1A3BF3/IIFA_-_Worldwide_Open-End_Fund_Report_-_Q1_2022.pdf.

Our results reveal comparable reserve asset backing for FRB stablecoins and MMFs, similar importance of sponsor support, and the same negative association between macroeconomic indicators and peg deviations. Both instruments serve as cash management tools for investors, and their primary market microstructures are alike. However, differences emerge concerning the extent of dispersions from the peg, volatility, and transparency in market infrastructure. Larger FRB stablecoins show increased similarity to MMFs due to reduced volatility compared to their smaller counterparts, with peg deviation drivers more closely resembling those of MMFs.

The remainder of the paper is structured as follows. Section 2 provides an overview on the existing literature. Section 3 describes the data collection process and summarizes the institutional background of both financial instruments. Section 4 includes the empirical analysis with subsections on descriptive statistics, peg deviations, volatility, and correlation. Lastly, Section 5 summarizes our main findings and draws conclusions.

2   Literature Review

Until 2020, the stablecoin literature mostly addressed the connection to crypto assets – primarily Bitcoin and Ethereum. The primary focus was on cryptocurrencies' response to movements in the stablecoin market and vice versa, addressing price discovery and market efficiency (Ante et al., 2021; Griffin & Shams, 2020). Additionally, Baur and Hoang (2021) and Lyons and Viswanath-Natraj (2023) find that stablecoins act as a safe haven in the crypto sphere despite the link between the volatility of the largest cryptocurrency, Bitcoin, and stablecoins (Grobys et al., 2021; Hoang & Baur, 2021; Lyons & Viswanath-Natraj, 2023).

The growing variety of stablecoins has also triggered research into differences in design. Catalini et al. (2022) describe the categorization of stablecoins as a spectrum ranging from centralization to decentralization in the following order: backed by fiat currency, backed by cryptocurrency, and backed by investment tokens corresponding to an algorithmic approach. They find that, during stressed market conditions, price stability decreases in the same order. Gadzinski et al. (2023) account for the protocol architecture of stablecoins and show that stablecoins' price dynamics do not depend on the respective protocol design.

Bullmann et al. (2019) differentiate stablecoins based on three dimensions: the accountability of issuers, the decentralization of responsibilities and the asset by which its value is supported. Moreover, they describe how stablecoin issuers either create new coins when there is excess market demand or withdraw coins from circulation when there is demand contraction putting upward or downward pressure on the secondary market price (see also Catalini and de Gortari (2021)). In addition to the intervention by the stablecoin issuer, Lyons and Viswanath-Natraj (2023) identify arbitrageurs as a complementary decentralized mechanism to stabilize the peg.

Arbitrageurs take advantage of peg deviations in the secondary market. The primary market price is fixed to one unit of account under the assumption that the stablecoin issuer honors redemption requests of investors. Whenever a stablecoin trades at a discount in the secondary market, arbitrageurs buy stablecoins on the respective exchange and sell them in the primary market at par to the issuer. If the secondary market price differs between exchanges, arbitrageurs can also employ cross-exchange arbitrage. Conversely, if the stablecoin trades at a premium in the secondary market, arbitrageurs may buy stablecoins at par in the primary market and sell them in the secondary market. Ma et al. (2023) find that while more efficient arbitrage increases price stability of stablecoins, it also increases run risk, as sellers gain a greater first-mover advantage.

Both the stablecoin issuer and the arbitrageur in the secondary market can exert upward or downward pressure on the price. Kwon et al. (2021) introduce a trilemma for stablecoin issuers, identifying two sources of downward and one source of upward price instability, showing that each stablecoin by design carries at least one source of price instability. The two sources for downward price instability are moral hazard of the operating entity and poor financial performance of the entity, along with its exposure to external market risk. Upward price instability, on the other hand, is caused by limited coin supply.

Furthermore, Kwon et al. conduct a global survey in 34 countries to assess the general public's perception of the trilemma. Surprisingly, they find that FRB stablecoins are perceived as less stable than their crypto collateralized counterparts, with moral hazard of the issuing entity being the driver behind the results. In the absence of both mandatory audits and the obligation to distribute gains from reserve assets to holders, the issuer of FRB stablecoins might invest in riskier or less liquid assets to increase profitability.

Bruce et al. (2022) focus on legal aspects of stablecoins and question whether the relationship between a coin holder and reserve assets in the form of currency held in a bank account is a deposit. Wilmarth (2022) suggests that stablecoins should be regulated as securities to protect investors and markets and designated as deposits to bring issuers and distributors within the perimeter of regulators. Liao and Caramichael (2022) argue that tokenization of financial markets may further drive growth in stablecoin usage.

Awrey (2020) was the first to mention MMFs in the context of stablecoins, differentiating good and bad money. Good money refers to the monetary liabilities of banks and MMFs, while bad money is privately issued debt, such as stablecoins. The comparative advantage of good money stems from the regulatory framework it's built upon.

Subsequent research focuses on private money creation, specifically privately issued debt (Gorton, Ross, et al., 2022; Gorton & Zhang, 2021; Li & Mayer, 2020, revised 2022; Liao & Caramichael, 2022). While these studies draw brief comparison between stablecoins and MMFs, they acknowledge differences. Gorton & Zhang refer to the contractual relationship between stablecoin issuer and holder, arguing that most stablecoins could be deposits based on past logic applied by the US Department of Justice (DoJ). They further argue that coin holders do not have "[…] the prospect of obtaining gains directly from holding those coins […]" (Gorton & Zhang, 2021, p. 12). Liao and Caramichael (2022) state that "[…] the behaviors of [these] public stablecoins are unique and differentiated from prime MMFs […]." It is worth mentioning that they solely refer to times of market distress.

Research comparing investor behavior and fund flow patterns during crisis periods yields interesting results. Anadu et al. (2023) find similar flight-to-safety patterns among MMF and stablecoin holders during different run periods. Oefele et al. (2024) focus on the March 2023 banking crisis in the US and show that most FRB stablecoins and prime MMFs experience outflows in times of distress and that the largest FRB stablecoin and MMFs advised by the largest market players show capital inflows.

In the absence of regulation requiring regular audits of FRB stablecoins' reserve assets, stablecoins are subject to research questioning their existence (Barthelemy et al., 2021; Kim, 2022). Kim (2022) uses instrumental variables estimation to find a causal link between the crypto market and the traditional finance system, specifically the markets for commercial paper and Treasury bills. He shows that the fast-growing stablecoin sector created excess demand for

commercial paper and Treasury bills, with the yield of both instruments decreasing following a one standard deviation increase in the issuance of USDT and USDC.

In addition to the academic literature, organizations like the Bank for International Settlements, the International Monetary Fund, the FSB, and several central banks emphasize the increasing interconnectedness between crypto markets and the traditional finance system.

3 Data and Institutional Background

This section describes the data collection process, categorization, market infrastructure, microstructure, legal environment, and monetary and financial characteristics of stablecoins and MMFs.

3.1 Data

Our stablecoin sample comprises a total of six FRB stablecoins. We retrieve daily prices (open-high-low-close) as well as trading volume from a total of nine centralized cryptocurrency exchanges from CoinAPI.[5] Our analysis uses the aggregated volume-weighted price over all exchanges that offer a trading pair with the USD for the respective stablecoin. The exception to this is the price analysis provided in Section 3.3. In addition, we retrieve the market capitalization for the stablecoins in our sample from Coinmarketcap.[6] The sample period starts 1 January 2020 and ends 31 December 2022. Table 1 provides a summary of our stablecoin sample, including an indication of reserve assets held by each coin.

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[5] Source: https://www.coinapi.io.

Exchanges: Binance US, Bitfinex, Bitstamp, Bittrex, Cexio, Coinbase, Gemini, Kraken and Okcoin.

[6] Source: https://coinmarketcap.com.

Table 1: Stablecoin sample descending by market capitalization as of 31 December 2022. Reserve assets as of 30 December 2022. See Appendix A for sources.

Name & Ticker	Market Capitalization	Reserve Assets
Tether (USDT)	$66,242,103,758	58.5% US Treasury Bills, 11% Money Market Funds, 7.9% Cash & Bank Deposits, 4% Other Investments, 8.7% Secured Loans, 4.5% Reserve Repo Agreements, 5.1% Corporate Bonds, Funds & Precious Metals, 0.1% Non-US Treasury Bills
USD Coin (USDC)	$44,540,806,740	53% Circle Reserve Fund Assets (BlackRock sponsored MMF with Ticker USDXX), 23.5% US Treasury Securities, 23.5% USD Cash
Binance USD (BUSD)	$16,695,767,094	23% US Treasury Bills, 74% US Treasury Debt Pursuant to Overnight Reverse Repo Agreements, 3% USD Cash
Pax Dollar (USDP)	$876,418,940	22% US Treasury Bills, 49% US Treasury Debt Pursuant to Overnight Reverse Repo Agreements, 29% USD Cash
TrueUSD (TUSD)	$755,145,448	US dollar balance held by US depository institutions, Hong Kong depository institution, and Bahamian depository institution includes USD cash, cash equivalents and short-term, highly liquid investments of enough credit quality that are readily convertible to known amounts of cash.
Gemini USD (GUSD)	$597,865,583	47% Cash Deposits, 20% Money Market Funds, 33% US Treasury Bills

Table 2 presents a summary of the MMF sample. The sample combines two datasets: DataStream and the open MMF dataset provided by the SEC.[7] We match both datasets manually by comparing the name field of DataStream to the combination of series- and class name for the SEC database. We retrieve daily prices, monthly total net assets (TNA) as well as adjusted and unadjusted dividends from DataStream. The total net assets of each unique series identifier equal the sum of the total net assets for the share classes within, while the daily price per series identifier is the mean over all share classes. The breakdown of total net assets by type in Table 2 shows government MMFs are by far the largest category with $3.8 trillion.

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[7] Source: https://www.sec.gov/open/datasets-mmf.

Table 2: Summary of MMF sample by type. Total net assets in billion USD and aggregated as of 30 December 2022.

Type	Number of MMFs	Number of Investment Advisors	Total Net Assets
Government	130	57	3,766
Prime	47	22	524
Tax-Exempt	46	18	98
Total	**223**	**59**	**4,388**

The open MMF dataset aggregates the information from monthly disclosures via N-MFP filings, including descriptive details such as registrant, class name, series name & identifier, investment advisor and sub-advisors. The sample period aligns with our stablecoin sample.

To put the size of our MMF sample into context, we compare it to the weekly MMF asset data provided by the Investment Company Institute (ICI) for US MMFs. As of the end of December 2022, our MMF sample covers 92% – equivalent to $4.39 trillion – of all US MMFs.

3.2   Categorization

Issuers of stablecoins and MMFs can be categorized into different types primarily based on the assets backing the coins and shares.

The SEC defines three types of MMFs based on the fund's investments. Government MMFs invest in government securities, including cash, US Treasury bills, and other financial securities issued or guaranteed by the US government, with at least 99.5% invested in these assets. Tax-exempt municipal security MMFs may invest in securities from a single state or multiple municipalities. Prime MMFs invest in riskier assets such as Repurchase Agreements, Commercial Paper, Certificates of Deposit and Time Deposits of banks.

For stablecoins, we adopt a widely used categorization (Catalini et al. (2022); Grobys et al. (2021); Harvey et al. (2021)) of three types based on the underlying assets and stability mechanisms used.

First, stablecoins backed by assets denominated in fiat currency, primarily in US dollar. The reserve assets for this type of stablecoin cover a range like that of MMFs, including cash, corporate debt, and Treasury bills (see Table 1). We categorize this type as fiat reserve backed

(FRB) stablecoins. As of December 2022, three FRB stablecoins have a direct link to MMFs, with USDT and GUSD partially backed by MMF shares as reserve assets. USDC collaborated with BlackRock in May 2022 to establish a government MMF, holding approximately half of its reserve assets.

Second, stablecoins backed by crypto reserves, known as crypto collateralized stablecoins. These stablecoins differ not only in their underlying assets but also in terms of scalability and decentralization. Issuers of crypto collateralized stablecoins can manage operations in a more decentralized manner, using smart contracts to automate reserve operations, and do not rely on centralized custodians to hold the underlying asset (Catalini et al., 2022).

Third, stablecoins that are neither backed by fiat reserves nor any collateral, generally referred to as algorithmic stablecoins.[8] Algorithmic stablecoins rely on smart contracts to adjust the quantity of stablecoins through issuance and buybacks, using a rebase- or seigniorage algorithm to maintain the peg. These stablecoins typically involve a pegged cryptocurrency with a floating price to absorb short-term volatility.[9] The absence of an underlying reserve asset may explain the significant number of algorithmic stablecoin projects that have failed, including Basis Cash, Empty Set Dollar, and the notable example of TerraClassicUSD (USTC) in 2022.

Our categorization for stablecoins and MMFs is summarized in Figure 1. Design options unique to crypto collateralized and algorithmic stablecoins preclude direct comparison with MMFs. The key difference is the absence of a direct connection to money markets, stemming from the lack of fiat reserve backing through money market instruments. Therefore, by definition, crypto collateralized and algorithmic stablecoins cannot evolve into future MMFs. Consequently, the subsequent comparison exclusively focuses FRB stablecoins and all MMFs.

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[8] Makarov and Schoar (2022) use a broader definition of algorithmic and consider crypto collateralized stablecoins as equally algorithmic.

[9] For a detailed explanation of this process see: Baughman et al. (2022), *The stable in stablecoins*, FEDS Notes, (16 December 2022), https://www.federalreserve.gov/econres/notes/feds-notes/the-stable-in-stablecoins-20221216.html.

		Categorization				
Stablecoins		Fiat reserve backed			Crypto collateralized	Algorithmic
MMFs	Retail	Government	Tax-exempt	Prime		
	Institutional		Tax-exempt	Prime		

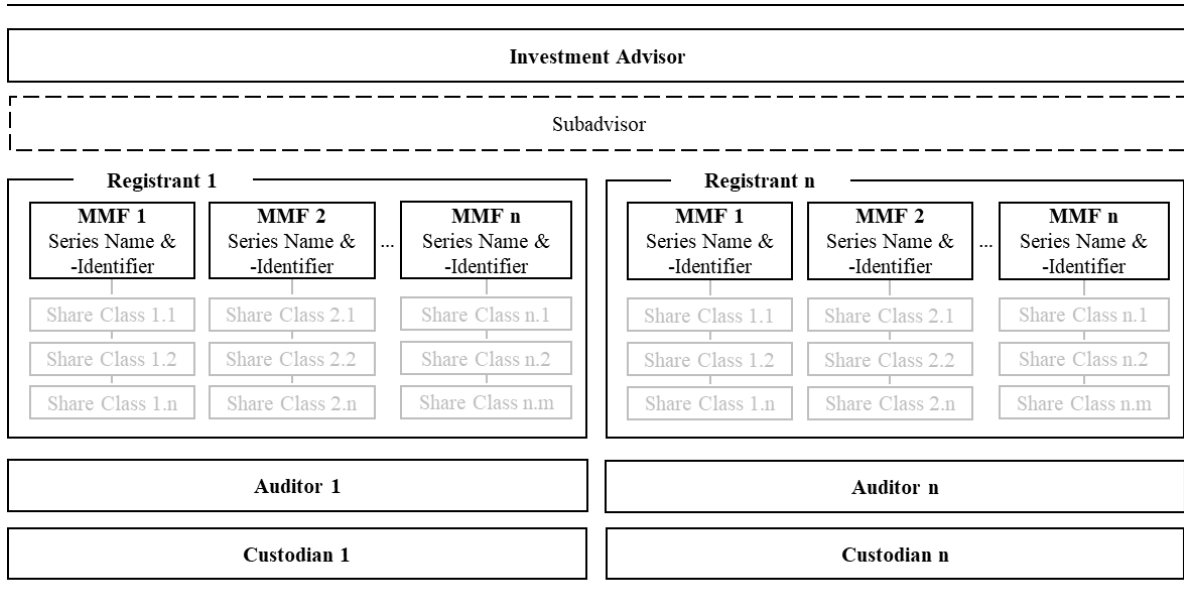**Figure 1: Overview on MMF and stablecoin categorization**

Figure 1 underlines an important difference between both instruments: while stablecoins lack differentiation between retail and institutional investors, such differentiation exists for MMFs. Notably, some MMFs are only accessible to institutional investors.

Given the similarity of reserve assets between both instruments, we apply the SEC categorization for MMFs to FRB stablecoins. Our analysis reveals that USDC, BUSD, USDP and TUSD align closely to government MMFs. Conversely, USDT – the incumbent in the stablecoin market – and GUSD are closer to prime MMFs. Within the sample of stablecoins USDT is backed by the riskiest assets.

3.3 Market Infrastructure

MMFs are issued by a registrant that is backed by an investment advisor, typically referred to as the MMF's sponsor. Additionally, they often have one or more subadvisors, which are typically subsidiaries of the sponsor. Investment advisors may act as sponsors for multiple registrants and may group several MMFs under one registrant. Each MMF is designated with a series name and a unique series identifier. These series can be divided into share classes, identified by a distinct ticker symbol.

In the US, Section 17 (f) of the Investment Company Act (ICA) addresses the custody of securities held by MMFs. We summarize the market infrastructure for MMFs in Figure 2.

Investment Advisor

Subadvisor

Registrant 1

MMF 1 Series Name & -Identifier	MMF 2 Series Name & -Identifier	...	MMF n Series Name & -Identifier
Share Class 1.1	Share Class 2.1		Share Class n.1
Share Class 1.2	Share Class 2.2		Share Class n.2
Share Class 1.n	Share Class 2.n		Share Class n.m

Registrant n

MMF 1 Series Name & -Identifier	MMF 2 Series Name & -Identifier	...	MMF n Series Name & -Identifier
Share Class 1.1	Share Class 2.1		Share Class n.1
Share Class 1.2	Share Class 2.2		Share Class n.2
Share Class 1.n	Share Class 2.n		Share Class n.m

Auditor 1

Auditor n

Custodian 1

Custodian n

Figure 2: Market infrastructure around MMFs. Dashed objects are optional.

The separation of funds held by the registrant and management by the sponsor is a defining characteristic of mutual funds. Morley (2014) identifies three common features of this separation of funds and managers. First, economies of scope and scale enable sponsors to manage multiple funds simultaneously, thereby reducing administrative costs. Second, precision in risk tailoring ensures that fund investors are exposed only to the risks associated with their investment. This separation shields investors from risk stemming from other lines of business of the sponsor. Third, exit rights are crucial, allowing investors to redeem their shares at the respective NAV daily under consideration of trading deadlines. This mechanism allows investors to express their preferences through withdrawals rather than control rights.

Fisch (2015) builds on the separation of funds and managers to argue for the beneficial effects of sponsor support. Mechanisms of sponsor support include leveraging the sponsor's reputation or purchasing reserve asset at a premium over their market value (Parlatore, 2016). Throughout history, sponsor support proved to be a commonly used stability mechanism. Brady et al. (2012) show that non-contractual sponsor support for prime MMFs was frequent and

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significant during the period from 2007 and 2011. However, it's important to note that sponsor support is voluntary under SEC regulation.[10]

The market infrastructure for FRB stablecoins, as summarized in Table 3, exhibits considerable heterogeneity. Issuers enjoy significant flexibility due to the current absence of comprehensive regulation. From the sample of stablecoins, Paxos Trust Company and Gemini Trust Company are headquartered in New York, making them subject to the Virtual Currency Guidance issued by the New York Department of Financial Services (NYDFS) in June 2022, becoming effective in September 2022.[11]

The issuing entities of USDC and TUSD are incorporated in Massachusetts and the British Virgin Islands, respectively. As of January 2023, neither jurisdiction has implemented comparable guidance. USDT is issued by Tether Holdings Limited, a company based in Hong Kong.

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[10] Investment Company Act of 1940 §270.2a-7 Money market funds, (1940). https://www.ecfr.gov/current/title-17/chapter-II/part-270/section-270.2a-7.

[11] *Virtual Currency Guidance*, NEW YORK DEPARTMENT OF FINANCIAL SERVICES (8 June 2022), https://www.dfs.ny.gov/industry_guidance/industry_letters/il20220608_issuance_stablecoins.

Table 3: Market infrastructure of fiat reserve backed stablecoins. See Appendix A for sources.

Ticker	Issuer	Jurisdiction	Parent	Custodian	Exchange
USDT	Tether Limited	Hong Kong, HK	iFinex Inc.	Undisclosed. Among others, Deltec Bank & Trust, Capital Union	Bitfinex
USDC	Centre Consortium (backed by Circle and Coinbase)	Massachusetts, US and California, US	Circle Internet Financial Limited and Coinbase	BNY Mellon, Citizens Trust Bank, Customers Bank, NY Community Bank, Signature Bank, Silicon Valley Bank[12], Silvergate Bank[13], US Bancorp	
BUSD	Paxos Trust Company (in partnership with Binance)	New York, US		BMO Harris Bank, Customers Bank, Signature Bank, Silvergate Bank, State Street Bank and Trust Company	(Binance)
USDP	Paxos Trust Company	New York, US		BMO Harris Bank, Customers Bank, Signature Bank, Silvergate Bank, State Street Bank and Trust Company	itBIT
TUSD	Techteryx Limited	British Virgin Islands (BVI)		Silvergate Bank, Signet, Fist Digital Trust, Prime Trust, BitGo	
GUSD	Gemini Trust Company	New York, US		State Street Bank and Trust Company, Signature Bank, Silvergate Bank, Oppenheimer & Co. Inc., Goldman Sachs Asset Management	Gemini

Several FRB stablecoins are associated with a cryptocurrency exchange either directly operated by the issuer or its parent company. These exchanges facilitate stablecoin trading pairs, such as BUSD/USDT, effectively bridging transactions between stablecoins.

USDT is the largest stablecoin by market capitalization, yet it exhibits the least transparency in market infrastructure within our sample. The issuer of USDT operates outside of the US regulatory perimeter and does not disclose information about the custodians of its underlying reserve assets. Additionally, the issuer's parent company, iFinex Inc., registered in the British Virgin Islands, also owns the cryptocurrency exchange Bitfinex.

This affiliation of the stablecoin issuer or its parent company with a cryptocurrency exchange bears additional risks. Figure 3 shows that USDT demonstrates greater stability on Bitfinex, the parent exchange, compared to other exchanges. Moreover, the trading volume on Bitfinex

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[12] Silicon Valley Bank (SVB) was at the heart of the March 2023 Bank Crisis. It's parent company, SVB Financial Group, filed for Chapter 11 bankruptcy in a federal court in New York on 17 March 2023.

[13] Silvergate Capital Corporation announced on 8 March 2023 to voluntarily liquidate Silvergate Bank.

relative to six other exchanges notably increases from May to August in 2022. The price discrepancies among exchanges violates the law-of-one-price principle, which arbitrageurs in traditional financial markets typically eliminate almost instantaneously. Our findings echo those of Makarov and Schoar (2019), who identify enduring and recurring deviations in Bitcoin prices across different exchanges.
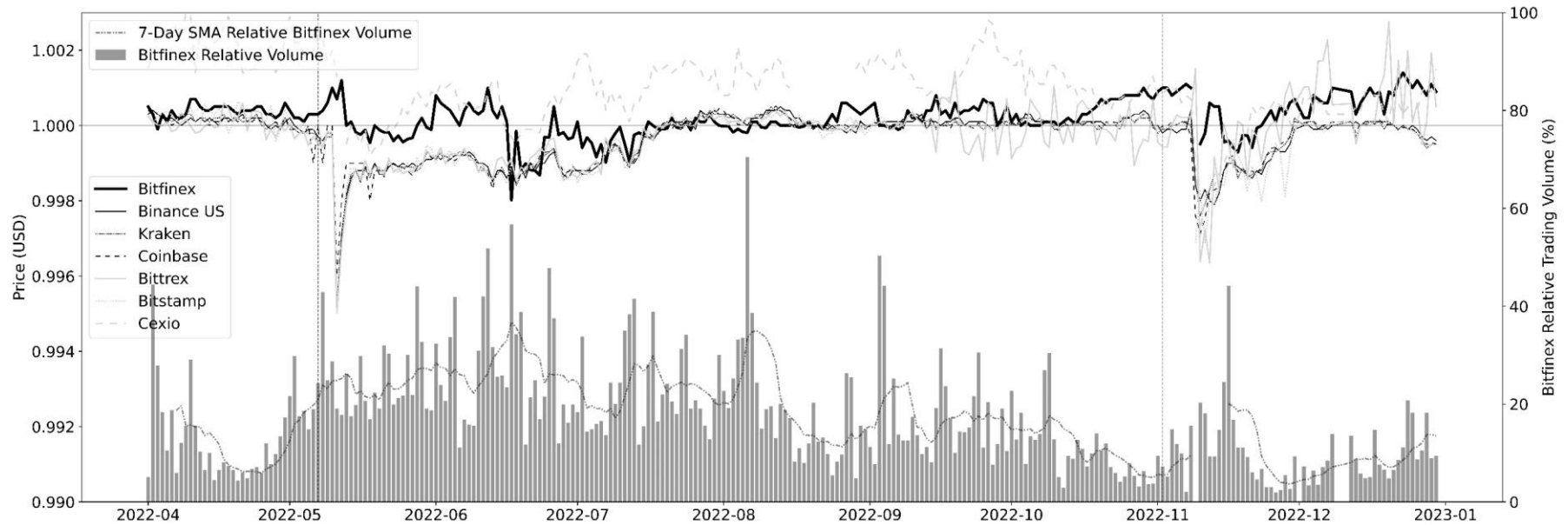
Figure 3: Daily closing prices for the trading pair USDT/USD on seven different exchanges and relative trading volume on Bitfinex in percent. Horizontal line equals 1 USDT/USD. Vertical dotted lines equal TerraUSD and FTX collapse, respectively. Exchanges in dashed lines indicate minor trading volume on average below two percent per day over the sample period. Data source: coinapi.io. Sample period: 1 April 2022 to 31 December 2022.

3.4   Market Microstructure

Investors holding MMF shares trade their shares in the primary market, directly with the issuing entity or through authorized intermediaries, primarily banks. Purchase and redemption requests submitted before to the cut-off time are processed on the same business day, reflecting MMFs' open-ended investment structure. Holders of MMF shares are charged operating expenses, and sometimes also transaction expenses depending on the backing investment advisor. Minimum investment thresholds vary based on fund categories or share classes, and redemptions can be temporarily suspended as defined in Rule 2a-7(c)(2)(i) of the ICA of 1940.

Stablecoins can be traded in both primary and secondary market. The process for redemptions and purchases directly with the issuer is consistent across all stablecoins, with no notice periods mentioned in their terms and conditions. All stablecoins in our sample allow redemptions directly with the issuer.[14] However, Tether Limited, within our stablecoin sample, imposes charges for fiat deposits and redemptions. Fiat deposits carry a fee of 0.1%, while fiat redemptions incur expenses equivalent to the greater of $1,000 US dollar or 0.1% of the trade value.[15] This asymmetric fee structure for fiat redemptions is interpreted as a mechanism to discourage direct redemptions and incentivize trading in the secondary market. Additionally, Tether Limited charges a one-time account verification fee of $150 US dollar for primary market participation, contrasting with other FRB stablecoin issuers who provide free account verification.

The issuers of USDT and TUSD reserve the right to delay or suspend wire submissions or redemption requests, while the issuer of USDC also reserves the right to change, suspend or delay transactions. Paxos and Gemini do not address the suspension of redemptions in their terms and conditions.

Secondary market trading for stablecoins is facilitated by cryptocurrency exchanges. We focus on trading pairs from stablecoins to USD, as only those allow a redemption to fiat currency.[16]

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[14] USDC Terms, https://www.circle.com/en/legal/usdc-terms. Tether Legal, https://tether.to/en/legal/. Paxos US dollar-Backed Stablecoin Terms and Conditions, https://paxos.com/2019/03/29/usdp-terms-conditions/. Gemini Dollar, https://www.gemini.com/legal/user-agreement#section-gemini-dollar. Truecoin Terms of Use, https://www.trusttoken.com/terms-of-use. All accessed 28 February 2023.

[15] Tether Fees, accessed 28 February 2023, https://tether.to/fees/.

[16] Additional arbitrage opportunities might exist through triangular cross-rates. For example, an arbitrageur of GUSD could use a combination of cross-rates like GUSD/USDT and USDT/USD instead of GUSD/USD.

Figure 4 displays the number of exchanges offering trading in stablecoins each day in our sample. As the largest FRB stablecoin by market capitalization, USDT also has the largest secondary market, with seven exchanges. As of December 2022, USDT accounts for approximately 57% of trading volume by pair denomination in the global cryptocurrency market, reflecting its significant role in cryptocurrency trading. USDC, another widely adopted stablecoin, can be exchanged to USD on a maximum of six exchanges since the end of 2021. In contrast, all other stablecoins in our sample average trading on less than three exchanges per day.
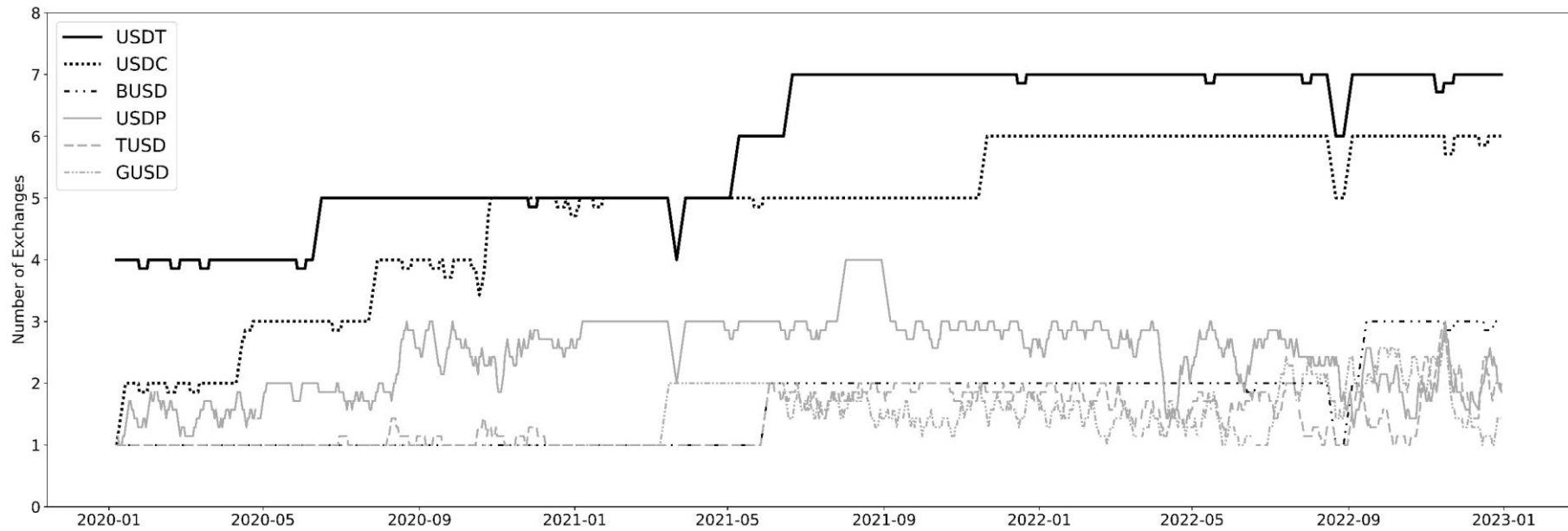
Figure 4: Number of cryptocurrency exchanges offering a trading pair between the respective stablecoin and the US dollar. We use the 7-day rolling average to soften the impact of single days when trading pair data is not available for an exchange. Data source: coinapi.io. Sample period: 1 January 2020 to 31 December 2022.

We show the trading volume of the stablecoin/USD trading pairs in Table 4**Error! Not a valid bookmark self-reference.**. USDT, USDC and BUSD, the top three FRB stablecoins (Top3 FRB), exhibit significantly larger mean daily volumes across all exchanges analyzed. Additionally, BUSD is predominantly traded on a single exchange, Binance. The two smallest FRB stablecoins by market capitalization, TUSD and GUSD, demonstrate a mean daily trading volume to USD of less than $0.1 million. Moreover, their USD trading pairs were available on only one exchange until mid-2021.

Table 4: Descriptive table for daily volume traded for the trading pair stablecoin/USD. The three columns to the right indicate the percentage of days in the sample period when one exchange handles 75%, 90%, respectively 95% of the trading volume. Source: coinapi.io. Note: Figures are in million USD. Sample period: 1 January 2020 to 31 December 2022.

	Obs	Daily Volume (USD Trading Pair)				Daily Volume on one exchange >		
		Mean	SD	Min	Max	75%	90%	95%
USDT	1,091	196	193	0.9	2,100	2%	0%	0%
USDC	1,091	18	21	0	312	65%	22%	12%
BUSD	1,090	2.2	4.1	0	61	98%	94%	91%
USDP	1,088	0.3	0.6	0	8.7	70%	48%	38%
TUSD	1,074	0.1	2	0	2.2	97%	92%	86%
GUSD	896	0.02	0.04	0	0.6	88%	78%	70%

3.5 Legal Environment

In the United States, MMFs are regulated by the SEC under Rule 2a-7 of the ICA of 1940, which governs the organization of companies offering their own securities to public investors. The latest amendment to the MMF regulatory framework in 2021 marks the third within eleven years, prompted by research following the COVID-19 market turmoil. However, there remains controversy over whether these regulations effectively address underlying issues (Anadu et al., 2022; Li et al., 2021).

Investors primarily use MMF shares for cash management rather than investment purposes (Ondersma, 2013). They receive compensation for the risk of a potential runs on MMFs in the form of a monthly dividend reflecting short-term interest rates (see Table 5). The monthly dividend payment is based on the performance of the underlying reserve assets. Within our sample of MMFs, the average monthly dividend paid is 0.04%.

MMFs emerged in the late 1970s, their popularity in the US driven by interest rate caps on bank deposits due to Regulation Q. Thus, the comparison to bank deposits was inherent to their emergence, prompting regulators to classify the relationship between holder and issuer of this new financial instrument. The classification aimed to determine whether MMFs should be considered deposits under Section 21(a) of the Glass-Steagall Act of 1933. US authorities decided that there is no debtor-creditor relationship between MMFs and their shareholders, who are considered owners of the fund.[17]

In 2008, the Lehman Brothers bankruptcy triggered the liquidation of the Reserve Primary Fund, a prime MMF with over $60 billion in total net assets. The proceeds from liquidating the remaining reserve assets were distributed pro rata to shareholders. The protracted liquidation commenced with an initial distribution of $26 billion in October 2008. Finally, each shareholder recovered 98% of their individual investment after the final distribution in January 2010.[18] While the Reserve Primary Fund became a creditor of Lehman Brothers bankruptcy estate, investors in the fund did not compete with external creditors for the funds' reserve assets.

Stablecoins emerged in 2014 with the primary use case of facilitating cryptocurrency trading. Hoang and Baur (2021) found a high correlation between trading volumes of stablecoins and the largest cryptocurrency, Bitcoin, underlining the importance of stablecoins in crypto trading. Stablecoins also enable market participants to transfer funds between exchanges (Bullmann et al., 2019; Lyons & Viswanath-Natraj, 2023) and to hold funds in the crypto space rather than in fiat currency. Furthermore, stablecoins are the backbone of decentralized trading and lending, accounting for almost half of the liquidity available on decentralized exchanges.[19]

Stablecoin issuers do not distribute capital gains obtained from holding reserve assets to coin holders. Therefore, holders of FRB stablecoins do not have the prospect of directly benefiting from holding them. Gorton and Zhang (2021) suggest that potential gains realized from holding

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[17] Locating Stablecoins within the Regulatory Perimeter, Harvard Law School Forum on Corporate Governance (5 August 2021), https://corpgov.law.harvard.edu/2021/08/05/locating-stablecoins-within-the-regulatory-perimeter/.

[18] Press Release, Reserve Primary Fund Distributes Assets to Investors, SEC (29 January 2010), https://www.sec.gov/news/press/2010/2010-16.htm.

[19] Adachi et al. (2022), *Stablecoins' role in crypto and beyond: functions, risks and policy*, MACROPRUDENTIAL BULLETIN VOL. 18, ECB (2022), https://www.ecb.europa.eu/pub/financial-stability/macroprudential-bulletin/html/ecb.mpbu202207_2~836f682ed7.en.html.

a stablecoin and selling it for a profit in the secondary market are not linked to the stablecoin issuers investments but rather depend on movements in the broader cryptocurrency market.

Despite the absence of direct compensation, stablecoin holders have the opportunity to actively manage their holding in order to achieve a return. Gorton, Klee, et al. (2022) interpret the option for stablecoin holders to lend out their coins to leveraged traders in crypto markets as an indirect compensation for the run risk they face. This process, known as staking, involves looking up stablecoins for periods ranging from 30 days to several months, which diminishes the staking incentive despite high lending rates. [20]

Recent literature on stablecoins explores the fundamental nature of the relationship between stablecoin issuers and holders, and whether these instruments should be considered deposits, securities, or both. Gorton and Zhang (2021) address these questions by referencing the Glass-Steagall Act and the history of MMFs. They conclude that, with the potential exception of USDT, the relationship between FRB stablecoin issuers and holders constitutes a debt contract. As a result, if the FRB stablecoin issuer faces bankruptcy, holders would become creditors.

The terms and conditions outlined by the FRB stablecoin issuers vary significantly. Bruce et al. (2022) identify a spectrum ranging from reserve assets likely being the property of the investors to reserve assets being property of the stablecoin issuer. If the issuer faces bankruptcy, the latter scenario would mean investors' redemption rights become claims against the bankruptcy estate. However, there is substantial uncertainty regarding whether reserve assets would be included in the bankruptcy estate. If included, investors would likely be classified as unsecured creditors with low chances of recovering their investments.

3.6   Monetary and Financial Characteristics

This section analyzes whether MMFs and stablecoins qualify as money and as financial assets.

MMF shares are classified as broad money under the definition of the Organization for Economic Co-operation and Development (OECD). Broad money, unlike narrow money, measures money supply beyond fiat currency in circulation and overnight deposits, including

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[20] Staking Methods: Soft and Hard Staking Explained, accessed 31 January 2023, https://university.cex.io/staking-methods-soft-and-hard-staking-explained/.

longer-dated deposits, repurchase agreements, debt securities up to two years, and MMF shares.[21] The contractual obligation of MMFs to allow redemptions for cash on a daily basis and their regulatory treatment as marketable securities under the ICA qualify them as financial assets. Thus, MMF shares can be categorized as (broad) money and financial asset.

Independent of being debt or equity contract (see section 3.5), FRB stablecoins are financial assets under IAS 32 definition.[22] They are either classified as equity instrument of the stablecoin issuer or as contractual right to receive cash upon redemption. For the question whether FRB stablecoins are money or money-like, we refer to Passinsky (2024), who applied money theories to cryptocurrencies like Bitcoin and concluded that they are neither money under the commodity nor the credit theory. Unlike Bitcoin, FRB stablecoins act as a unit of account, a central function of money under the credit theory. The unit of account characteristic is inherent in stablecoins' design and solution to the high volatility of native protocol asset prices. Therefore, FRB stablecoins can be defined as money under the credit theory and as a financial asset.

By analyzing the USDT trading volume to fiat currency, to cryptocurrency and to other stablecoins, we further assess if FRB stablecoins' primary trading purpose is related to fiat currency or cryptocurrency.[23] FRB stablecoins can be viewed as less money-like if most trading is to and from cryptocurrency, and more money-like if most trading is to and from fiat currency. The former is based on the idea that FRB stablecoins are used as a medium of exchange for non-money cryptocurrencies while the latter is based on the idea that FRB stablecoins are used as a medium of exchange for narrow money fiat currencies.
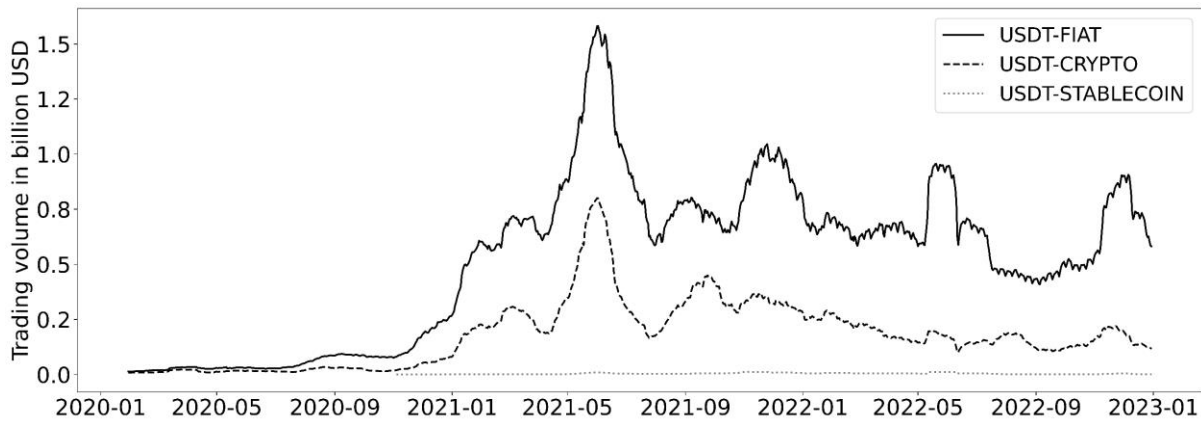
Figure 5 shows the 30-day moving average of the USDT trading volume.

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[21] OECD, Broad Money (M3), accessed on 5 June 2024, https://data.oecd.org/money/broad-money-m3.htm#indicator-chart. Note: The US deviates from the OECD standard with the Feder Reserve allocating retail MMF shares to M2.

[22] IAS 32 defines a financial asset as any asset that is cash, an equity instrument of another entity, a contractual right to either receive cash or another financial asset from another entity, or to exchange financial assets or liabilities with another entity under conditions that are potentially favorable to the entity. See International Accounting Standards Board (IASB). (2009). International Accounting Standard 32: Financial Instruments: Presentation, accessed on 10 June 2024, https://www.ifrs.org.

[23] We analyze the non-directional trading volume of USDT as the largest FRB stablecoin. Trading volume is retrieved from coinapi.io for the nine centralized exchanges listed in section 3.1. The fiat category includes EUR, GBP, USD, JPY, CAD, and CHF. The crypto category includes BTC, ETH, BNB, XRP, ADA, DOGE, MATIC, SOL, LTC, and TRX. The stablecoin category includes USDC, BUSD, TUSD, GUSD and DAI.

Figure 5: Tether (USDT) non-directional trading volume to and from fiat currency, cryptocurrency and other stablecoin. We show the 30-day moving average to smoothen the highly volatile daily observations. Sample period: 1 January 2020 to 31 December 2022.

Over the sample period, most USDT trading volume involves fiat currencies. This indicates that FRB stablecoins primarily serve as vehicle currency bridging the cryptocurrency market and the traditional financial market. The higher trading volume of USDT with fiat currency compared to cryptocurrency suggests FRB stablecoins have money-like status beyond the cryptocurrency market.

FRB stablecoins and MMFs are both financial assets and show money-like qualities. In the absence of centrally issued fiat money, FRB stablecoins are the most money-like instrument in cryptocurrency markets. However, from a broader global perspective, they possess fewer money-like qualities than MMFs which are defined as broad money.

4 Empirical Analysis

In this section, we investigate time series data for peg deviations and apply a regression model to identify drivers of peg deviations for both MMFs and FRB stablecoins.

4.1 Descriptive Statistics

Table 5 summarizes the descriptive statistics for samples of stablecoins in Panel A and MMFs in Panel B.

Table 5: Descriptive statistics for fiat reserve backed stablecoins in Panel A and MMFs by category in Panel B. Stablecoin prices and volume are from coinapi.io, market capitalization from coinmarketcap.com. MMF data from DataStream. Note: Volume, market capitalization, total net assets in billion USD; prices and dividends in USD. Sample period: 1 January 2020 to 31 December 2022.

	Obs	Mean	Std. Dev.	Min	Max
Panel A: Fiat Reserve Backed Stablecoins[24]					
Open	6,330	0.9999	0.0062	0.9000	1.1999
High	6,330	1.0028	0.0313	0.9555	1.9841
Low	6,330	0.9980	0.0072	0.7807	1.0500
Close	6,330	0.9997	0.0068	0.8141	1.1988
Volume Traded	6,576	11.8046	27.5200	0.0002	315.5510
Market Capitalization	6,576	13.6114	22.4695	0.0037	83.2359
Panel B: MMFs[25]					
Total Net Assets	173,529	17.3061	38.1243	0.00004	281.1826
Price	25,056	1.0003	0.0004	0.9929	1.0015
Dividend Rate[26]	29,283	0.0003	0.0006	0	0.0131
Government					
Total Net Assets	100,719	26.0241	46.9949	0.0001	281.1826
Dividend Rate	18,493	0.0003	0.0006	0	0.0131
Prime					
Total Net Assets	36,792	8.5101	16.8064	0.0001	161.2298
Price	20,358	1.0003	0.0004	0.9980	1.0015
Dividend Rate	6,210	0.0004	0.0006	0	0.0035
Tax-Exempt					
Total Net Assets	36,018	1.9123	3.1192	0.00004	18.4045
Price	4,698	1.0003	0.0004	0.9929	1.0011
Dividend Rate	4,580	0.0003	0.0005	0	0.0028

Not all MMFs have a floating NAV. In their 2014 amendment to Rule 2a-7 of the ICA of 1940, the SEC imposed several restrictions, including liquidity fees, redemption gates and the requirement of a floating NAV on institutional prime and tax-exempt municipal MMFs. These funds must use mark-to-market pricing for all underlying reserve assets and to update their

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[24] The raw data before price aggregation contains 18,950 daily price observations over multiple exchanges. We drop 22 observations with daily high prices exceeding 2.0 and 14 observations with daily low prices below 0.7.

[25] Descriptive statistics on prices for all MMFs exclude government MMFs and retail prime and retail tax-exempt MMFs, as they are not required to have a floating NAV. We use a proxy to identify institutional and retail MMFs. Prime and tax-exempt MMFs showing a mean price over all share classes of $1 USD over the entire sample period are assumed to be retail MMFs.

[26] Dividend Rate equals unadjusted dividend rate on share class level, rather than per series.

share price daily after market close.[27] The amendment addresses the issue that investors in those funds have historically made the heaviest redemptions during times of market stress.

For MMFs with a floating NAV only one price per day is published, thus, Panel B shows one price per day with a mean of $1.0003.[28] Both the price range and standard deviation for MMFs are much smaller than those of FRB stablecoins. The mean for total net assets of prime MMF is $8.5 billion with a maximum of $161.2 billion and a standard deviation of $16.8 billion. This is compared to an average market capitalization of $13.6 billion and a maximum of $83.2 billion and a standard deviation of $22.5 billion for FRB stablecoins. Hence, prime and tax-exempt municipal MMFs and FRB stablecoins are similar in size. While the overall market size of the latter is only a fraction of the market for MMFs, it indicates that the size of individual stablecoins surpassed a critical value. The minimum price for all MMFs in Panel B is $0.9929, with a large gap between the minimum value and the second lowest value, $0.9980.

Table 6: Price range for MMFs and fiat reserve backed stablecoins. The table reports the frequency distribution of peg deviations allocated to six categories. MMF data is based on DataStream, stablecoin data on coinapi.io. Note: Percentages are rounded to integers. Sample period: 1 January 2020 to 31 December 2022.

Interval	Price Range	MMF		FRB SC	
		Obs.	% of total	Obs.	% of total
1	P <= 0.9900	0	0%	130	2%
2	0.9900 <= P < 0.9975	1	0%	507	8%
3	0.9975 <= P < 1.0000	5,066	20%	2,349	37%
4	1.0000 <= P < 1.0025	19,989	80%	3,015	48%
5	1.0025 <= P < 1.0100	0	0%	249	4%
6	P >= 1.0100	0	0%	80	1%
	Total	**25,056**	**100%**	**6,330**	**100%**

Table 6 compares the frequency distribution for prices of MMFs and FRB stablecoins. The column for all MMFs shows only one observation outside the center intervals 3 and 4. In contrast, FRB stablecoins show a larger dispersion around the peg, with 10% of observations in intervals 1 and 2 and 5% in intervals 5 and 6.

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[27] Investment Company Act of 1940 §270.2a-7 Money market funds, (1940). https://www.ecfr.gov/current/title-17/chapter-II/part-270/section-270.2a-7.

[28] Prices for share classes within one series identifier might differ, hence, we use an average price over all share classes within a series.

Figure 6 shows the frequency distribution of prices within $0.0025 of par. The comparison of both histograms reveals further differences between the instruments. MMF prices tend to deviate upward from the peg, resulting in a positively skewed distribution. FRB stablecoins, in contrast, are more dispersed within the observed price interval and do not show the positive skewness of MMF prices.
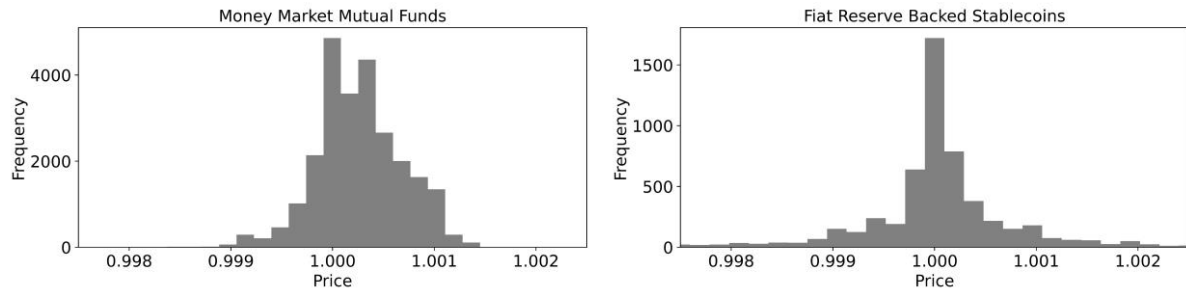
Figure 6: Frequency distribution histograms for intervals 3 and 4 of Table 6. Sample period: 1 January 2020 to 31 December 2022.

Figure 7 shows that the density plots for the individual FRB stablecoins differ substantially. Two of the Top3 FRB stablecoins by market capitalization, BUSD and USDC, are much more likely to have a secondary market price close to their peg value. The density plot for the largest FRB stablecoin by market capitalization, USDT, reveals similarities to MMFs in terms of positive skewness and a mean price above the peg value.
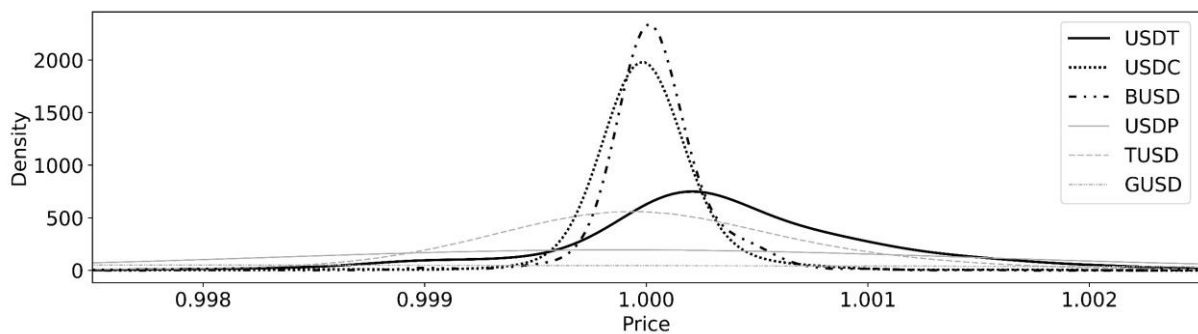
Figure 7: Kernel density estimation (KDE) plot for fiat reserve backed stablecoins. Scott's Rule is used to calculate the estimator bandwidth. Source: coinapi.io. Sample period: 1 January 2020 to 31 December 2022.

Finally, Table 7 demonstrates that the mean prices of FRB stablecoins differ substantially from the those of MMFs.

Table 7: Difference in means for MMFs, fiat reserve backed (FRB) stablecoins and the three largest fiat reserve backed stablecoins (Top3 FRB). The price variable compares the average daily price over all share classes of a MMF with the daily closing pricing of stablecoins. The significance of the difference in means is computed with t-tests. Prior to the t-test we perform a variance-comparison test for each of the pairs. Due to the results of the variance-comparison test we drop the assumption of equal variances for the t-tests. *** indicates statistical significance at the 1%-level.

	MMF	FRB SC	TOP3 FRB SC	Difference	
	(1)	(2)	(3)	(1 - 2)	(1 - 3)
Price	1.0003	0.9997	1.0001	0.0005***	0.0001***

4.2 Peg Deviations

Figure 8 shows the mean monthly peg deviations for MMFs (Panel A), FRB stablecoins (Panel B) and the subsample of the Top3 FRB stablecoins (Panel C). We use daily closing prices for both MMFs and FRB stablecoins. The monthly time series of peg deviations includes two bars per month: upward deviations and downward deviations, split into those larger or smaller than $.005 deviations, equalling half a percent. This split indicates the threshold for when MMFs are "breaking-the-buck", meaning investors cannot redeem the shares for one unit of currency, and there is no market mechanism to push the price back (Birdthistle, 2010).

Panels A and B show that the peg deviation patterns differ greatly. FRB stablecoins consistently exhibit downward peg deviations throughout the entire sample period. On average, each FRB stablecoin closes below the peg value on more than ten days each month. In contrast, MMFs usually close at a premium for most trading days each month. For the first half of the sample period, each MMF trades below its peg value on fewer than three days per month on average.
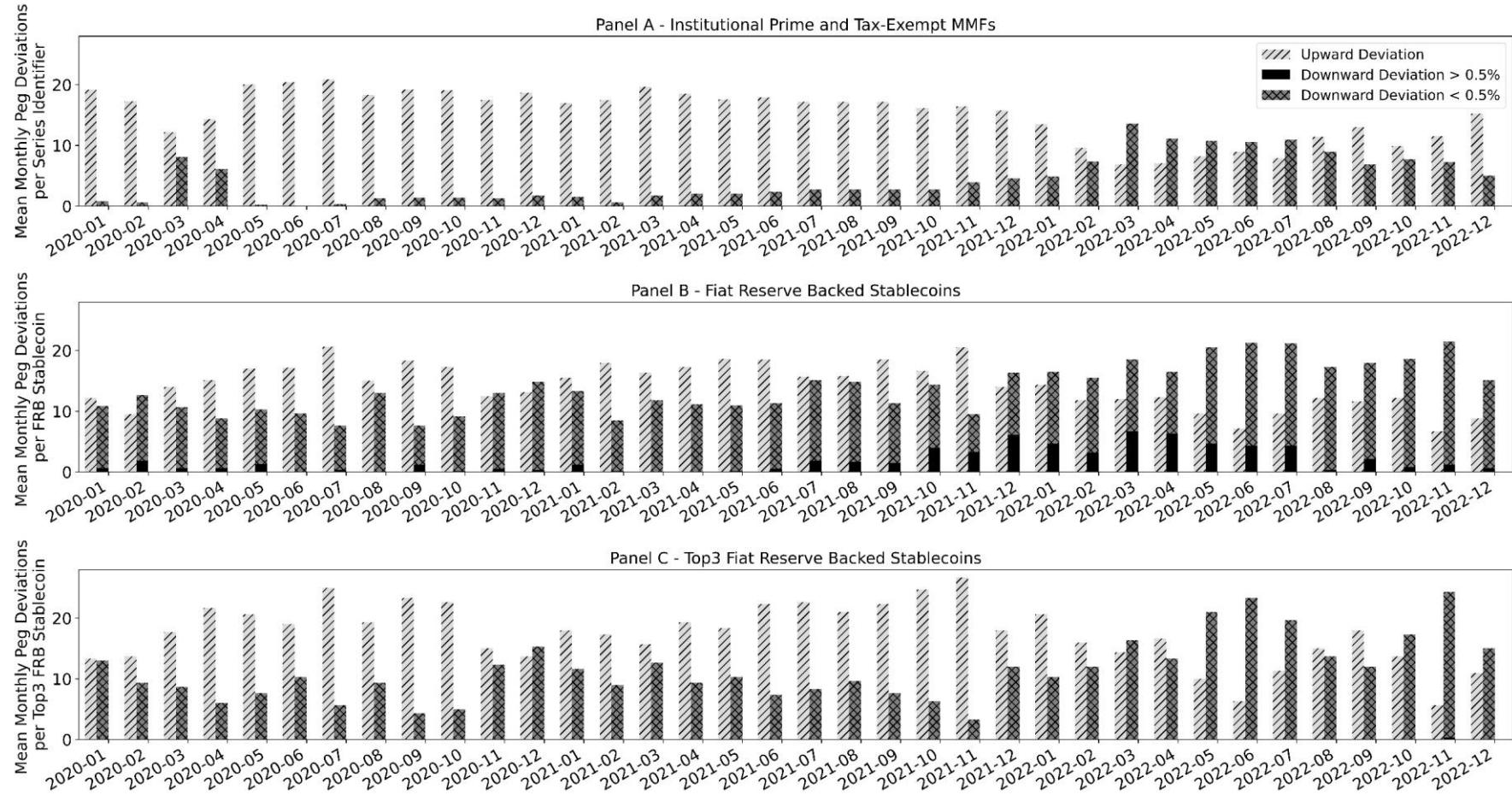
Figure 8: Mean monthly peg deviations for MMFs (Panel A), fiat reserve backed stablecoins (Panel B) and the three largest fiat reserve backed stablecoins - USDT, USDC and BUSD - (Panel C). MMF: Based on average price of all share classes per series identifier. Source: DataStream. Stablecoins: Based on average volume-weighted close price over all exchanges covered. Source: coinapi.io. Sample period: 1 January 2020 to 31 December 2022.

Beyond this rather general observation, there are two additional observations. First, the large dispersion for small FRB stablecoins is mirrored in the average number of downward peg deviations larger than 0.5%. Comparing Panel B and Panel C shows that the latter more often close at a premium than their smaller counterparts. Furthermore, large FRB stablecoins on average do not break-the-buck. Second, in March 2020, when COVID-19 was declared a pandemic, only the MMF sample shows a temporary increase in downward peg deviations, while stablecoins do not. MMF peg deviations also show a similar reaction in response to the Russian invasion of Ukraine in February 2022. Once again, FRB stablecoins do not show such a clear reaction to the geopolitical events. In contrast, the collapse of TerraUSD in May 2022 and FTX in November 2022 are only reflected in the peg deviations of FRB stablecoins. MMF peg deviations remain unaffected by the exogenous shock within the crypto market. The differing peg deviation patterns around the events suggest that these financial instruments respond differently to exogenous shocks.

To test this interpretation more formally, we use a linear regression to identify drivers of peg deviations and a logistic regression to identify drivers of upward and downward peg deviations separately.[29] We account for the magnitude of the deviations by running staggered models for the logistic regression with deviations ranging from peg deviations greater than 0.1% to greater than 0.5%. Table 8 shows all variables and their sources.

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[29] We include the results of the logistic regression for the absolute values in Appendix B. Due the limited economic implications resulting from the small coefficients we choose to differentiate between upward and downward peg deviations in the logistic regression analysis.

Table 8: Overview of dependent and independent variables of the regression analysis.

Category	Variable	Description	Source
Dependent variable	*peg_dev*	Peg deviation (scaled by factor 10,000)	As stated in section 3
Control variable	*log_size*	Log total net assets for MMFs. Log market capitalization for stablecoins.	As stated in section 3
Independent Variables			
Crypto market	*crypto_s*	Dummy variable indicating days in the sample period when e.g., cryptocurrency exchanges got hacked, stablecoins failed etc.	Several sources. See table in Appendix C
	btc_ret	Bitcoin daily percentage return	coinmarketcap.com
	btc_lvol	Bitcoin daily log volume	coinmarketcap.com
	eth_ret	Ethereum daily percentage return	coinmarketcap.com
	eth_lvol	Ethereum daily log volume	coinmarketcap.com
Global risk and uncertainty	*log_gpr*	Log Geopolitical Risk Index[30]	https://www.matteoiacoviello.com/gpr.htm on March 07, 2023
	log_epu	Log Economic Policy Uncertainty Index	https://www.policyuncertainty.com/us_monthly.html
Macroeconomic	*t5yifr*	US 5-year forward inflation expectation rate	Federal Reserve Bank of St. Louis, [T5YIFR], retrieved from FRED, Federal Reserve Bank of St. Louis; accessed 24 May 2023.
	t10yie	US 10-year breakeven inflation rate	Federal Reserve Bank of St. Louis, [T5YIFR], retrieved from FRED, Federal Reserve Bank of St. Louis; accessed 24 May 2023.
	us2yt	US 2-year treasury bill interest rate	DataStream
	us10yt	US 10-year treasury bill interest rate	DataStream
	msci_ret	MSCI World daily percentage change	DataStream
	s&p_ret	S&P500 daily percentage change	DataStream

In line with our interpretation of peg deviations, we divide the independent variables in three categories: crypto market, global risk and uncertainty, and macroeconomic. Table 9 shows the results for pairwise correlations. Due to high pairwise correlations, we drop the independent variables for daily S&P500 returns, inflation expectations based on the 10-year breakeven inflation rate, and the interest rate for 10-year US Treasury bills. Furthermore, we exclude Ethereum returns and volume due to pairwise correlations beyond 0.8 with Bitcoin returns and volume. Hence, we use a total of nine independent variables including size as a control variable. We show the estimation results of the regressions in Table 10.

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[30] Caldara, D., & Iacoviello, M. (2022). Measuring Geopolitical Risk. *American Economic Review*, *112*(4), 1194-1225. https://doi.org/10.1257/aer.20191823

The inclusion of all variables in the analysis for MMFs reveals that both geopolitical risk and economic policy uncertainty are highly significant drivers of MMF share prices. Particularly positive changes of geopolitical risk negatively affect MMF share prices.

Our results also validate the significant impact of scandals in crypto markets on prices of FRB stablecoins. In addition, Bitcoin trading volume is highly significant.

The results further identify size as a statistically significant driver of FRB stablecoin prices and MMF share prices. Inflation expectations serve as a statistically strong and equally influential factor in determining the prices of both instruments, resulting in price declines as inflation expectations increase. Short-term interest rates also display a negative relation with the prices of the Top3 FRB stablecoins and MMFs.

Monetary theory suggests that an increase in inflation leads to monetary tightening with higher interest rates, causing a decline in the market price of fixed-income instruments held in MMF portfolios. Consequently, the price of MMF shares decreases due to the daily mark-to-market pricing. This explains the negative effect of increasing inflation expectations and interest rates on MMFs prices.

In contrast, FRB stablecoin prices are determined by supply and demand in the secondary market, not by mark-to-market pricing. Their association to riskier cryptocurrencies and the rising opportunity cost of holding a non-yielding financial asset in a regime of rising inflation expectations and rising interest rates imply decreasing investor demand. This explains the decreasing price.

When focusing on fund flows instead of prices, research indicates that monetary policy tightening leads to deposit outflows (Drechsler et al., 2017) and MMF inflows (Xiao, 2020) due to the relatively slower adjustment of deposit interest rates compared to the yield of fixed-income instruments underlying MMF shares. This suggests rebalancing from deposits to MMFs.

Evaluating the flow of funds for FRB stablecoins during monetary tightening is less straightforward. While there may be a rebalancing from volatile cryptocurrencies to stablecoins or to fiat currencies, academic research does not provide evidence on such rebalancing. Moreover, because trading volume is non-directional, we cannot identify the direction of flows and are thus unable to close this gap in the literature.

Interestingly, peg deviations of FRB stablecoins are sensitive to inflation expectations regardless of their size, while interest rates exert a greater influence on peg deviations of the Top3 FRB stablecoins compared to their smaller counterparts. Notably, the models including all variables for the Top3 FRB stablecoins and MMFs show identical goodness-of-fit.

Table 9: Pairwise correlation of independent variables. This table presents pairwise correlation coefficients for all independent variables of the regression analysis. Bold numbers represent statistical significance at the 5%-level.

	t5yifr	t10yie	us2yt	us10yt	msci_ret	s&p_ret	log_gpr	log_epu	crypto_s	btc_ret	eth_ret	btc_lvol	eth_lvol
t5yifr													
t10yie	**0.96**												
us2yt	**0.48**	**0.43**											
us10yt	**0.68**	**0.63**	**0.95**										
msci_ret	0.02	-0.01	-0.04	-0.04									
s&p_ret	0.01	-0.01	-0.04	-0.03	**0.97**								
log_gpr	**0.40**	**0.47**	**0.49**	**0.51**	0.01	0.02							
log_epu	**-0.63**	**-0.64**	**-0.33**	**-0.47**	**0.10**	**0.10**	**-0.25**						
crypto_s	0.05	0.02	0.06	**0.07**	-0.01	0.01	-0.02	0.00					
btc_ret	**-0.10**	**-0.11**	-0.07	**-0.09**	**0.43**	**0.41**	-0.06	**0.09**	-0.08				
eth_ret	-0.07	**-0.07**	-0.05	-0.06	**0.42**	**0.41**	-0.04	0.05	-0.07	**0.85**			
btc_lvol	**0.11**	**0.07**	**-0.19**	-0.05	0.00	0.00	**-0.11**	-0.03	0.04	0.01	-0.02		
eth_lvol	**0.31**	**0.31**	**-0.26**	**-0.07**	-0.03	-0.02	-0.05	**-0.19**	0.01	-0.06	-0.02	**0.81**	

Table 10: Effect of macroeconomic, global risk and uncertainty and crypto market related variables on prices of fiat reserve backed stablecoins, the Top3 fiat reserve backed stablecoins and MMF shares. This table shows multiple linear regression estimates for which the dependent variable is the daily peg deviation (calculated as closing price t_1 – closing price t_0). Column (1) shows results for macroeconomic variables only. Column (2) and (3) for global risk and uncertainty variables only, respectively crypto-market related variables only. Column (4) uses all independent variables. We control for size (measured by total net assets for MMFs and market capitalization for fiat reserve backed stablecoins) in all columns. t-Statistics are reported in parentheses. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

	Fiat Reserve Backed Stablecoins				Top3 FRB Stablecoins				MMFs			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
t5yifr	-21.578***			-24.764***	-8.887***			-9.657***	-1.051***			-1.045***
	(-4.97)			(-4.57)	(-12.83)			(-11.75)	(-10.88)			(-8.50)
us2yt	-3.563***			-2.034*	-0.641***			-0.655***	-0.758***			-0.667***
	(-4.14)			(-2.13)	(-5.70)			(-5.26)	(-36.06)			(-28.68)
msci_ret	0.409			0.870	-0.160			-0.168	-0.016			0.044*
	(0.52)			(0.99)	(-1.58)			(-1.49)	(-0.85)			(2.10)
log_gpr		-10.388***		-3.739		-0.664*		0.785*		-1.799***		-0.915***
		(-4.89)		(-1.56)		(-2.25)		(2.54)		(-34.84)		(-15.84)
log_epu		7.956***		0.490		1.994***		-0.158		0.322***		-0.386***
		(3.88)		(0.20)		(6.94)		(-0.49)		(6.61)		(-6.42)
crypto_s			11.797	13.755*			-2.843**	-2.005*			-0.441**	-0.061
			(1.82)	(2.12)			(-3.20)	(-2.38)			(-2.67)	(-0.38)
btc_ret			0.047	-0.253			0.016	0.011			0.001	-0.028***
			(0.19)	(-0.90)			(0.45)	(0.29)			(0.18)	(-4.11)
btc_lvol			12.021***	12.187***			0.647	1.011**			0.090	-0.431***
			(4.41)	(4.27)			(1.74)	(2.74)			(1.31)	(-6.26)
log_size	1.487**	0.756	-0.218	1.655**	1.006***	0.102	-0.202**	1.007***	0.267***	0.255***	0.238***	0.266***
	(2.94)	(1.57)	(-0.48)	(3.28)	(9.60)	(1.18)	(-2.67)	(9.56)	(22.40)	(21.01)	(19.07)	(22.43)
Constant	14.895	-9.670	-289.654***	-265.763***	-2.850	-7.861**	-9.551	-28.635**	3.682***	7.458***	-1.314	20.248***
	(1.37)	(-0.51)	(-4.31)	(-3.71)	(-1.61)	(-2.62)	(-1.04)	(-3.07)	(18.05)	(18.81)	(-0.78)	(11.82)
N	4,329	4,329	4,329	4,329	2,231	2,231	2,231	2,231	23,808	23,808	23,808	23,808
Adj. R^2	0.016	0.010	0.005	0.021	0.110	0.027	0.008	0.116	0.103	0.072	0.015	0.116

Table 11: Effect of macroeconomic, global risk and uncertainty and crypto market related variables on downward peg deviations of fiat reserve backed stablecoins and MMFs. This table shows logistic regression estimates for which the binary dependent variable is 1 if the daily closing price is below the peg value. Column 1 for downward peg deviations independent of the deviation size. The following columns are for peg deviations >0.1% (column 2), >0.2% (column 3), >0.3% (column 4) and >0.5% (column 5). We control for size (measured by total net assets for MMFs and market capitalization for fiat reserve backed stablecoins) in all columns. t-Statistics are reported in parentheses. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. Note that in column (2) of the MMF sample, the dummy variable indicating crypto scandals (crypto_s) predicts failure perfectly, hence it is omitted, and 672 observations are not used.

	Fiat Reserve Backed Stablecoins					MMFs	
	(1)	(2)	(3)	(4)	(5)	(1)	(2)
t5yifr	1.133***	3.178***	5.118***	6.009***	5.483***	0.875***	-5.956***
	(6.97)	(11.78)	(14.56)	(14.85)	(12.28)	(9.87)	(-7.63)
us2yt	0.262***	0.129**	-0.092	-0.180**	-0.045	0.322***	1.860***
	(9.05)	(3.11)	(-1.84)	(-3.23)	(-0.73)	(23.08)	(7.20)
msci_ret	-0.022	-0.050	-0.062	-0.097	-0.050	-0.015	0.038
	(-0.81)	(-1.11)	(-1.09)	(-1.55)	(-0.73)	(-1.05)	(0.83)
log_gpr	0.089	0.386***	0.588***	0.840***	0.952***	0.782***	0.749*
	(1.26)	(3.49)	(4.59)	(6.00)	(6.02)	(20.19)	(2.07)
log_epu	0.075	-0.016	-0.176	-0.037	0.069	0.501***	4.177***
	(1.01)	(-0.14)	(-1.30)	(-0.25)	(0.41)	(11.84)	(7.28)
crypto_s	0.419*	0.304	-0.182	0.008	-0.151	0.026	0.000
	(2.14)	(1.10)	(-0.50)	(0.02)	(-0.34)	(0.26)	(.)
btc_ret	0.000	0.014	0.012	0.006	-0.007	0.008	-0.053*
	(0.01)	(1.00)	(0.72)	(0.32)	(-0.32)	(1.72)	(-2.07)
btc_lvol	-0.100	-0.571***	-1.104***	-1.452***	-1.165***	-0.057	0.816
	(-1.17)	(-4.11)	(-6.39)	(-7.41)	(-5.36)	(-1.21)	(1.49)
log_size	-0.176***	-0.750***	-1.015***	-1.114***	-1.014***	-0.050***	0.424***
	(-11.53)	(-23.28)	(-22.19)	(-20.85)	(-17.55)	(-6.28)	(4.65)
Constant	2.616	18.964***	32.756***	39.171***	29.597***	-8.115***	-48.385***
	(1.22)	(5.41)	(7.48)	(7.89)	(5.39)	(-6.84)	(-3.53)
N	4,329	4,329	4,329	4,329	4,329	23,808	23,136
Pseudo R^2	0.061	0.262	0.350	0.380	0.338	0.110	0.447

Table 12: Effect of macroeconomic, global risk and uncertainty and crypto market related variables on upward peg deviations of fiat reserve backed stablecoins and MMFs. This table shows logistic regression estimates for which the binary dependent variable is 1 if the daily closing price is above the peg value. Column 1 for upward peg deviations independent of the deviation size. The following columns are for peg deviations >0.1% (column 2), >0.2% (column 3), >0.3% (column 4) and >0.5% (column 5). We control for size (measured by total net assets for MMFs and market capitalization for fiat reserve backed stablecoins) in all columns. t-Statistics are reported in parentheses. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

	Fiat Reserve Backed Stablecoins					MMFs	
	(1)	(2)	(3)	(4)	(5)	(1)	(2)
t5yifr	-0.710***	-1.059***	-0.674*	-0.036	0.561	-0.822***	-0.972***
	(-4.42)	(-4.38)	(-2.15)	(-0.10)	(1.23)	(-10.88)	(-6.64)
us2yt	-0.298***	-0.517***	-0.548***	-0.640***	-0.604***	-0.310***	0.020
	(-10.13)	(-6.35)	(-4.70)	(-4.46)	(-3.37)	(-24.16)	(0.61)
msci_ret	-0.007	0.001	-0.000	0.004	0.032	0.016	0.029
	(-0.27)	(0.04)	(-0.00)	(0.08)	(0.45)	(1.29)	(1.32)
log_gpr	-0.097	0.146	0.255	0.248	-0.199	-0.635***	-0.215**
	(-1.38)	(1.21)	(1.56)	(1.33)	(-0.88)	(-18.54)	(-3.08)
log_epu	0.031	-0.025	-0.380*	-0.247	-0.311	-0.359***	0.403***
	(0.41)	(-0.21)	(-2.47)	(-1.39)	(-1.45)	(-9.89)	(5.33)
crypto_s	-0.412*	0.143	0.076	0.079	-0.010	-0.057	-0.193
	(-2.06)	(0.44)	(0.17)	(0.16)	(-0.02)	(-0.64)	(-0.89)
btc_ret	0.006	-0.003	-0.013	-0.024	-0.036	-0.008	-0.016
	(0.68)	(-0.23)	(-0.86)	(-1.39)	(-1.78)	(-1.92)	(-1.85)
btc_lvol	0.014	0.504***	0.804***	0.864***	1.072***	0.032	-0.706***
	(0.16)	(3.98)	(4.80)	(4.59)	(4.74)	(0.78)	(-8.42)
log_size	0.213***	-0.263***	-0.608***	-0.741***	-0.772***	0.150***	0.121***
	(13.84)	(-10.10)	(-15.34)	(-15.87)	(-13.65)	(22.86)	(7.08)
Constant	-2.810	-7.038*	-7.647	-8.707	-12.593*	5.864***	13.937***
	(-1.32)	(-2.20)	(-1.81)	(-1.84)	(-2.23)	(5.69)	(6.65)
N	4,329	4,329	4,329	4,329	4,329	23,808	23,808
Pseudo R^2	0.065	0.139	0.244	0.291	0.294	0.106	0.055

The results for the logistic regression, split in downward peg deviations (Table 11) and upward peg deviations (Table 12) and different magnitudes of peg deviations, yield four main findings.[31]

First, size matters for FRB stablecoins and MMFs. The probability of downward peg deviations for FRB stablecoins decreases with increasing size. While size is statistically significant for all variations of the outcome variable, with coefficients increasing from columns (1) to (3) and remain constant thereafter. This indicates the higher the market capitalization of a FRB stablecoin, the less likely it is to experience large downward peg deviations. The same holds for upward peg deviations.

Second, the probability of downward peg deviations for MMFs increases (decreases) significantly with an increase (decrease) in geopolitical risk. Additionally, economic policy uncertainty is a highly significant driver of downward peg deviations for MMFs. The results for the impact of geopolitical risk and economic policy uncertainty on upward peg deviations of FRB stablecoins confirm the results of the linear regression. Interestingly, the probability of downward peg deviations increases with rising geopolitical risk. The relationship is highly significant, with coefficients increasing from columns (1) to (5). Column (5) can be interpreted as showing the drivers that make FRB stablecoins "break-the-buck".

Third, an increase in inflation expectations significantly decreases the probability of downward peg deviations larger than 0.1% for MMFs. The result aligns with the common perception of MMFs as conservative short-term investments that are typically in high demand during periods of economic uncertainty. In the case of FRB stablecoins, higher inflation expectations correlate with an increased probability of downward peg deviations, irrespective of the deviation's magnitude. Notably, this effect is most pronounced for deviations surpassing 0.2%. Increasing inflation expectations result in downward pressure on stablecoin prices due to a decrease in investor demand. In a low-interest rate environment, the gap between the dividends earned from MMF shares and the absence of compensation for FRB stablecoins is narrower compared to a higher-interest rate environment, which typically coincides with an increase in inflation

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[31] Only 74 daily observations of MMF prices exhibit downward peg deviations larger than 0.1%. Since none of these deviations occur on days with a crypto scandal, the dummy variable is excluded from the logistic regression in column MMF (2) of Table 11.

expectations. This contrasting effect on both instruments highlights that investors perceive FRB stablecoins as less attractive when inflation expectations increase.

Lastly, comparing columns (1) to (5) of Table 11 shows that improvement of the logistic model over the null model increases with increasing magnitudes of downward peg deviations for both samples. The logistic model seems less suited to explain upward than downward peg deviations.

4.3 Volatility and Correlation

We examine the time series of peg deviations to identify any trends or clusters of volatility throughout the sample period. Figure 9 presents the rolling 30-day volatility in percent in Panel A and the correlation of log peg deviations in Panel B.[32]

Panel A shows that the volatility of MMFs and FRB stablecoins differs significantly. The rolling 30-day volatility for MMFs is close to zero, with only a temporary marginal increase around the outbreak of the COVID-19 pandemic in early 2020, underlining the stability of the MMFs. In contrast, FRB stablecoins show significantly higher volatility. The volatility of the Top3 FRB stablecoins continuously decreased over the first half of the sample period and remains largely stable thereafter, except for a peak in November 2022. We argue that this increase in stability is due to the larger number of exchanges participating in the secondary market for the trading pair stablecoin/USD of the Top3 FRB stablecoins (see Figure 4).

Panel B shows that log peg deviations for FRB stablecoins exhibit no significant positive or negative correlation with MMF log peg deviations during the observed period. This finding is supported by the non-significant unconditional Pearson correlation coefficient. There is a small but statistically significant negative correlation between the log peg deviations of the Top3 FRB stablecoins and MMFs. However, the effect size of -0.1 does not support the idea that daily log peg deviations of the Top3 FRB stablecoins and MMFs move in opposite directions.

We interpret the uncorrelated peg deviations of both instruments as stemming from the significantly different price discovery mechanisms they utilize. MMF share prices are subject

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[32] The analysis is repeated using rolling 7-day and 60-day windows, confirming the results obtained from the rolling 30-day window.

to daily updates by the issuer, whereas FRB stablecoin prices remain fixed to one unit of account in the primary market and experience fluctuations in the secondary market in response to supply and demand dynamics.
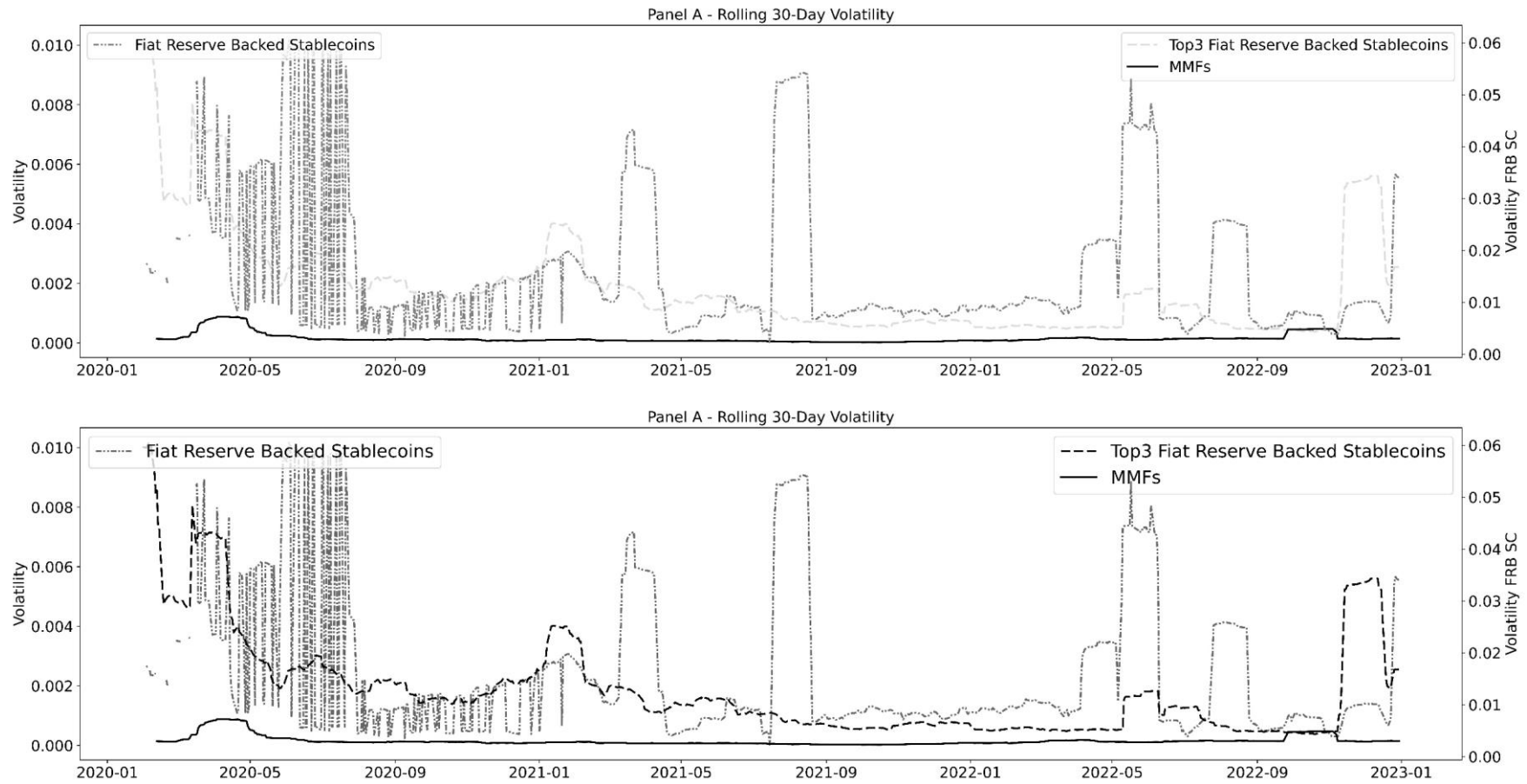
Figure 9: Rolling 30-day volatility (Panel A) and rolling 30-day correlation of daily log peg deviations (Panel B). Source: coinapi.io and DataStream. Sample period: 1 January 2020 to 31 December 2022.

5 Summary and Concluding Remarks

Our paper is the first to conduct a holistic comparison of stablecoins and money market mutual funds (MMFs), including the institutional background of both financial instruments. The analysis reveals that only fiat reserve backed (FRB) stablecoins are truly comparable to MMFs. This is because stablecoins outside this category are either unbacked or backed by crypto collateral, fundamentally altering the risk profile of these instruments.

The commonalities between FRB stablecoins and MMFs extend beyond their reserve assets. Both instruments are pegged to one unit of account and serve as short-term facilities to park funds. The market infrastructure is similar, with indirect support through an exchange associated with the stablecoin issuer acting as a stability mechanism for FRB stablecoins. This indirect support resembles the sponsor support for MMFs and can distort the secondary market price of stablecoins if the price on the affiliated exchange is higher than the prevailing secondary market price on all other exchanges.

The microstructure of the primary market in which both financial instruments are traded is largely identical, encompassing account verifications, redemption rights, and redemption suspensions.

Regression models using macroeconomic variables explain peg deviations of both instruments better than models relying on global risk and uncertainty or crypto indicators. Inflation expectations equally impact the prices of both instruments regardless of their size. The noticeably larger effect size for FRB stablecoin reflects their generally heightened volatility and substantially larger peg deviations. The effect size for the Top3 FRB stablecoins approaches that of MMFs, consistent with their decreasing volatility.

Despite these commonalities, our comparison also highlights several differences. First, FRB stablecoins fall short of the separation of funds and managers, which hinders the possibility of direct sponsor support. Unlike MMFs, where the investment advisor and the fund itself are distinct entities, allowing for sponsor support through outside assets or reserve asset purchases at a premium, FRB stablecoins do not have this advantage. The absence of separation is particularly critical if an issuer or its parent company faces bankruptcy, as claims from stablecoin holders are unlikely to be successful, leading to substantial losses or even the total loss of their investment.

Second, investors in MMFs expect compensation for the bank-like run risk they face through dividends. In contrast, stablecoins do not pay dividends and investors must actively manage and stake their holdings to achieve a return.

Third, FRB stablecoins exhibit less stability due to their price discovery mechanism relying on the secondary market, as opposed to MMFs' daily mark-to-market pricing in the primary market. Secondary market trading is distinctive to stablecoins. Our observation that larger secondary markets for FRB stablecoins, characterized by increased participation of exchanges, correspond to heightened stability underscores their favorable impact on stability.

It is noteworthy that the three largest FRB stablecoins exhibit greater similarities to MMFs compared to their smaller counterparts. The volatility of their peg deviations is much closer to those of MMFs, although still higher. Moreover, their peg deviations show a highly significant correlation with macroeconomic factors across all regression models. Short-term interest rates impact both MMFs and the three largest FRB stablecoins with nearly identical effect size.

FRB stablecoins possess many characteristics resembling MMFs. The decreasing disparities observed for the three largest FRB stablecoins suggest that they become more like MMFs with increasing market capitalization. The potential separation of stablecoin issuers and stablecoins through regulation could help protect investors from losses in the event of bankruptcies. The occurrence of mutual fund bankruptcies following the GFC validated the effectiveness of separating funds and managers as a successful mechanism for investor protection. The introduction of analogous regulations for FRB stablecoins would further increase the similarities between both instruments.

While significant differences continue to persist, FRB stablecoins have the potential to become the MMFs of the future if crypto markets continue to grow as an asset class.

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Appendix A

Sources for Table 1.

Name	Source
USDT	Tether Transparency, accessed 3 February 2023, https://tether.to/en/transparency/#reports.
	Press Release, Tether Banking Relationship Announced (1 November 2018), https://tether.to/en/tether-banking-relationship-announced/.
	Tether has held some reserves at Bahamas bank Capital Union, FINANCIAL TIMES (30 May 2022), https://www.ft.com/content/e4cb9a6e-cb29-4719-b6ee-33a5bf01945e.
USDC	Centre Monthly Attestations, accessed 3 February 2023, https://www.centre.io/usdc-transparency.
	Circle Blog USDC Providing Greater Transparency, accessed 1 March 2023, https://www.circle.com/blog/providing-greater-transparency.
BUSD	BUSD Transparency Reports, accessed 3 February 2023, https://paxos.com/busd-transparency/.
TUSD	TrueUSD Real Time Attestation, accessed 3 February 2023, https://real-time-attest.trustexplorer.io/truecurrencies.
USDP	Pax Dollar (USDP) Transparency Reports, accessed 3 February 2023, https://paxos.com/busd-transparency/.
GUSD	Gemini Dollar, accessed 3 February 2023, https://www.gemini.com/dollar.

Appendix B

Effect of macroeconomic, global risk and uncertainty as well as crypto market related variables on absolute peg deviation of fiat reserve backed stablecoins and MMFs. This table shows logistic regression estimates for which the binary dependent variable is 1 whenever the closing price is unequal 1. We control for size (measured by total net assets for MMFs and market capitalization for fiat reserve backed stablecoins) in all columns. t-Statistics are reported in parentheses. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

	Fiat Reserve Backed Stablecoins	MMFs
t5yifr	1.991***	-0.355**
	(5.70)	(-3.23)
us2yt_ry	-0.135	-0.097***
	(-1.66)	(-5.16)
msci_ret	-0.145**	0.003
	(-2.73)	(0.16)
log_gpr	-0.005	-0.110*
	(-0.03)	(-2.20)
log_epu	0.539**	0.095
	(3.27)	(1.83)
crypto_s	0.126	-0.107
	(0.24)	(-0.83)
btc_ret	0.032	-0.002
	(1.66)	(-0.34)
btc_lvol	-0.410*	-0.009
	(-2.00)	(-0.15)
log_size	0.259***	0.196***
	(6.39)	(25.11)
Constant	1.411	1.956
	(0.27)	(1.31)
N	4329	23808
Pseudo R^2	0.089	0.043

Appendix C

List with dates of scandals in the cryptocurrency market. Events range from stablecoin failures and the hacking of cryptocurrency exchanges to bankruptcies within the industry. Sources as listed in the last column. Sample period: 1 January 2020 to 31 December 2022.

Date	Event	Source
5 February 2020	Altsbit Exchange Hack	Hedgewithcrypto
19 April 2020	Lendf.me and Uniswap Exchange Hack	Hedgewithcrypto
29 June 2020	Balancer Exchange Hack	Hedgewithcrypto
11 July 2020	Cashaa Exchange Hack	Hedgewithcrypto
25 September 2020	KuCoin Exchange Hack	Hedgewithcrypto
1 December 2020	BTC Markets Exchange Hack	Hedgewithcrypto
8 December 2020	Basis Cash (BAC) Failure	FastCompany
21 December 2020	EXMO Exchange Hack	Hedgewithcrypto
23 December 2020	Livecoin Exchange Hack	Hedgewithcrypto
27 December 2020	Empty Set Dollar (ESD) Failure	Fast Company
6 April 2021	FEI Crash	Worldcoinstats
29 April 2021	Hotbit Exchange Hack	Hedgewithcrypto
16 June 2021	IRON Failure	FastCompany
10 August 2021	Poly Network Hack	Fintechmagazine
19 August 2021	Liquid Exchange Hack	Hedgewithcrypto
5 December 2021	BitMart Exchange Hack	Hedgewithcrypto
11 December 2021	AscendEX Exchange Hack	Hedgewithcrypto
17 January 2022	Crypto.com Exchange Hack	Hedgewithcrypto
9 May 2022	Terra	WSJ
12 June 2022	Celsius	WSJ
17 June 2022	Babel Finance	WSJ
27 June 2022	Three Arrows	WSJ
29 June 2022	Three Arrows	WSJ
5 July 2022	Voyager	WSJ
2 November 2022	FTX	WSJ
9 November 2022	FTX	WSJ
10 November 2022	FTX	WSJ
11 November 2022	FTX	WSJ
12 November 2022	FTX Unauthorized transaction	Hedgewithcrypto
13 November 2022	Binance halts USDC withdrawals	CNBC
28 November 2022	Blockfi	WSJ

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