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Introduction

The market capitalization of stablecoins has grown exponentially in recent years with the growing adoption of cryptocurrencies - from US$5 billion in 2019 to over US$180 billion at its peak in 2022 (DeFillama, 2023). These assets mimic traditional currencies with a tokenized version on the blockchain. Different models of stablecoins exist, each with its unique stabilizing mechanisms and collaterals to maintain its pegged values.

Given the nature of stablecoins, any deviations from its peg of $1 should be ideally arbitraged. In particular, with the proliferation of spot, futures, and lending markets in the space, the efficacy of the stablecoin mechanism can be examined through the lens of covered interest parity (CIP) - which posits that the interest rate differential between two currencies in the money markets should balance with the differential between the forward and spot exchange rates.

A growing literature in traditional finance has critically examined the persistence of CIP deviations for global currencies. They note that these deviations emerged following the upheaval during the 2008 Global Financial Crisis due to primary reasons such as regulatory barriers and international balances in investment demand (Du et al, 2017; Cerutti, 2019). Yet, the study of stablecoins through this fundamental law has remained relatively nascent, notably with Eichengreen et al (2023) evaluating the devaluation risk of these markets, Franz and Valentin (2020) examining the impacts of High-Frequency Trading firms on the CIP of BTC markets in 2018.

Therefore, this study provides one of the first systematic studies on the failure of CIP of the 3 largest stablecoins by market capitalization - Tether (USDT), USD Coin (USDC), and Binance USD (BUSD). It shows that CIP deviations were persistent and wider in the Decentralized Finance (DeFi) environment, when compared with lending protocols such as AAVE and Venus. For instance, USDT had an average deviation of 0.068% when paired with Treasuries, and a higher level at 0.073% with AAVE. This disconnect potentially highlights the nascency of the DeFi sector.

Contrary to the patterns observed in traditional finance literature, deviations appear to not follow a seasonal trend, possibly due to the absence of regulatory constraints and quarterly reporting requirements (Du et al, 2017). However, despite this, their equilibrium appears to be influenced by their perceived stabilities and ability to facilitate redemptions. As such, these factors were empirically examined to understand their impact on deviations. It was found that heightened risk appetites, often spurred by significant events, can severely disrupt investor confidence. This was illustrated with the collapse of cryptocurrency exchange FTX between November 2 and 11, 2022, and the USDC depeg between March 10 and 18, 2023. During these periods, a notable surge in deviations was observed, prompting investors to seek refuge in safer alternatives, away from the affected stablecoins.

The study also looks at how changes in the transaction costs on a blockchain influence the extent of these deviations, which can be interpreted as greater frictions and thus, inertia to engage in arbitrage activities. Finally, these interest-rate disconnects were also evident with

the different term structures of Treasuries, against the stablecoins due to the rise in duration risks. Of particular interest is the launch of USDC-USDT perpetual futures markets on platforms like Binance, which have led to improved liquidity and subsequently facilitated more efficient price discovery processes. This, in turn, has contributed to narrower and more idiosyncratic deviations ever since.

CIP deviations implicate different economic actors in the blockchain space. For issuers of these stablecoins, maintaining the peg to its underlying assets is crucial to build user trust and the utility of these tokens. Persistent deviations could signal underlying problems in liquidity, market sentiment or operational issues, prompting issuers to adjust their strategies. In fact, the USDC depeg crisis marked a significant turnaround in the stablecoins, given the lack of transparency in the real time reserve management practices of the stablecoins. As for investors and participants in the DeFi markets, CIP deviations also introduce additional considerations and risks. Understanding the drivers of these deviations and their implications for asset pricing and risk management is essential for informed decision-making when lending and trading with these stablecoins.

The paper proceeds as follows: Section 2 provides the background of stablecoins, the types of markets to support their financial activities and introduces the concept of CIP mechanisms; Section 3 covers the data used; hypotheses are developed in Section 4, while Section 5 examines these predictions from an empirical perspective and Section 6 provides policy recommendations to enhance the efficiency of stablecoin markets.

Background Information

This section introduces the definition of a stablecoin, describes the cryptocurrency spot and derivatives market and the mechanism for CIP arbitrages.

Stablecoins

Stablecoins are forms of digital assets whose value is pegged to financial instruments such as currencies, commodities, or potentially algorithmically regulated. They act as a vehicle for financial activities on a blockchain by providing price stability for users to utilize. To maintain a stable peg, most stablecoins are usually backed by major fiat currencies (i.e. USD) as collateral. In this study, USDT, USDC, and BUSD will be studied as they have the largest market capitalization and are widely adopted in the ecosystem.

Coin	Symbol	Collateral
Tether	USDT	85.7%: Cash & Cash Equivalents 1.92%: Bitcoins (Tether, 2023)
USD Coin	USDC	100% backed by Cash & Cash Equivalents

		(Circle, n.d.)
Binance USD Coin	BUSD	* *Ethereum:* 100% backed by Cash & Cash Equivalents (Paxos, 2024) * *BNB Chain:* Maintained by Binance. (Nicolle & Shen, 2023)

Table 1: Collateral backing each stablecoin - USDT, USDC, BUSD

Historical Performance

Polize et al (2023) highlighted the root causes for depeg events of stablecoins which can be interpreted as the inherent risks involved. These can be broadly categorized into the following:

1. **Market Volatility:** Stablecoins are designed to maintain a stable value, often pegged to a fiat currency or a basket of assets. However, sudden and significant price fluctuations in the underlying assets and reserves can lead to challenges in maintaining the peg. This was observed from the downfall of Terra where over 90% of its algorithmic stablecoin, USTC was collateralized by Bitcoin (Liu et al, 2023)

2. **Management of Reserves**: Stablecoins typically require reserves to ensure that they can honor redemptions and maintain their peg. Inadequate management of reserves, such as insufficient backing or poor investment decisions, can result in a stablecoin losing its pegged value. Stablecoins such as USDT and USDC publish monthly to quarterly attestation reports which highlight a breakdown of its reserves.

3. **Loss of Confidence**: Confidence is crucial for stablecoins. If users and investors lose confidence in the stability of a stablecoin, they may start redeeming their holdings, causing a chain reaction that can lead to further instability. Negative news, security breaches, or doubts about the issuer's transparency can contribute to a loss of confidence. Following the failure of Silicon Valley Bank (SVB) in March 2023, it was reported that Circle, the company behind USDC held US$3.3 billion in deposits at the bank (Sandor, 2023). This ignited a flight to safety, causing a massive outflow and fall in USDC’s circulating supply as the stablecoin rapidly de-pegged to a low of US$0.81 over the weekend.

4. **Regulatory Uncertainties:** Stablecoins operate within a regulatory environment that can change or evolve. Uncertainties regarding legal and regulatory compliance can pose a risk to stablecoins. If regulatory authorities impose restrictions or guidelines that impact the operations of stablecoins, it can lead to de-pegging events. After the SEC’s threat of legal action against Paxos for the sale of BUSD as an unregistered security, the issuer announced that it would stop mining new BUSD tokens. Coupled

with other regulatory issues on the crypto exchange, Binance, the circulating supply of the stablecoin has fallen by over 90% to just under US$2 billion today (Liu, 2023).

Figure 1 shows a brief overview of the historical performance of the price of the 3 largest stablecoins, alongside the price deviations of each concerning the US dollar. The major depeg can be observed for USDC in March 2023.

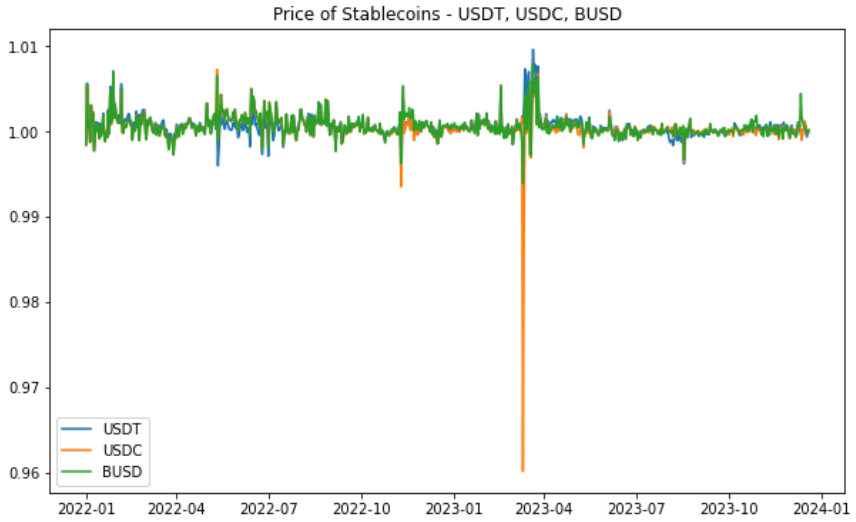


Figure 1: Historical Performance of USDT, USDC, BUSD

Covered Interest Parity Derivations (CIP)

By comparing traditional money market interest rates andlending rates on AAVE/Venus (DeFi lending protocol), significant deviations from CIP exist even after hedging for exchange rate risk using the perpetual futures.

Definition of CIP and Basis Trades

If the stablecoin market were truly frictionless where market participants could exploit arbitrage opportunities, then the following should hold:

$$CIP = i_{synthetic\ dollar\ rate} - i_{dollar\ rate\ (Treasuries\ or\ AAVE/Venus)}$$

$$i_{synthetic\ dollar\ rate} = \frac{f_t}{s_t}(1 + i_{stablecoin}),\ where\ interest\ rates\ are\ annualised$$

The sign of the CIP reflects the direction where a negative value suggests a ‘negative dollar basis' - direct dollar funding is cheaper than synthetic dollar funding which works by borrowing from Treasuries or lending protocols and swapping it into dollars.
The synthetic dollar rate will be reconstructed using the interest rates from the perpetual futures market as the major stablecoins lack traditional futures and options contracts.

Understanding the CIP Arbitrage Mechanism

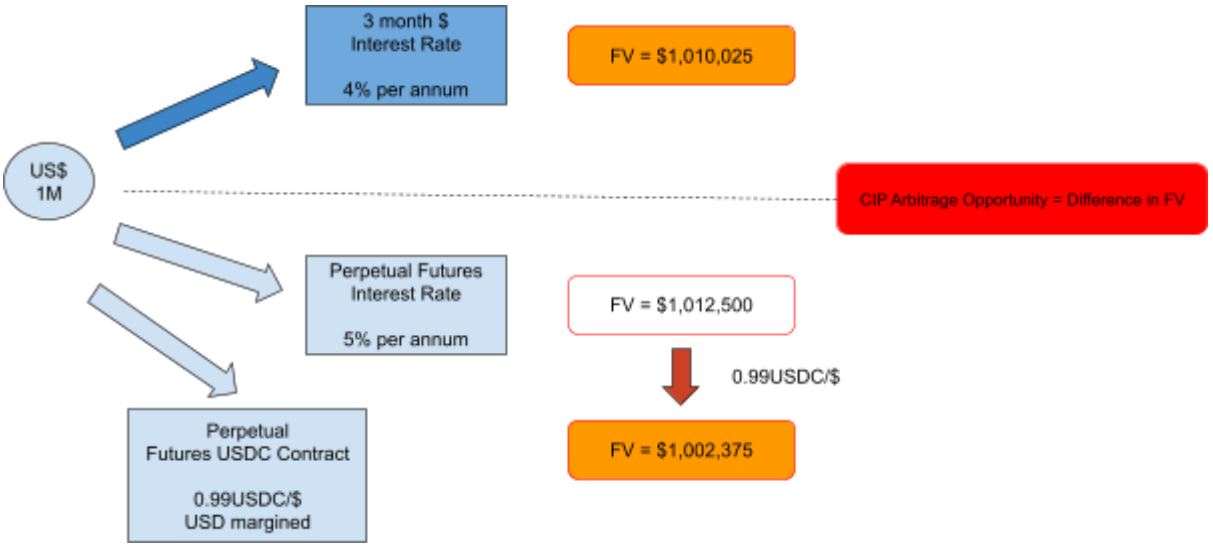


Figure 2: CIP Arbitrage Between Lending and Perpetual Future Markets of Stablecoins

Perpetual Future Markets

To calculate the CIP deviations for stablecoins, this will require the spot and future price of the asset, alongside the interest rates. However, as these stablecoins are used as mediums of value, there were no existing traditional futures contracts for USDT, USDC, and BUSD. As a result, the perpetual futures contracts were used, unique in the cryptocurrency markets.

First introduced by Bitmex (BitMEX, n.d.), perpetual futures contracts enable investors to adopt long and short positions and receive funding payments accordingly. Perpetual futures are types of derivative contracts without expiry, that allow traders to speculate on the price of the asset. It enables them to conduct basis trades (perpetual - spot) and also arbitrage between the futures market and lending-borrowing rate (i.e. using funding). Funding rates can be thought of as periodic payments made to futures contract holders based on the difference between the perpetual contract price and the index price, ensuring that both prices are tracked closely together. The funding rate is updated in 8-hour intervals on Binance and every hour on Bybit.

- **Positive Funding:** Occurs when the future is trading at a premium compared to spot. The long positions will pay a funding fee to short positions.
- **Negative Funding**: Occurs when the future is trading at a discount compared to spot. The short positions will pay a funding fee to long positions.

Basis Trading and CIP Arbitrage across lending markets

Using the example of positive funding, a trader can long 1 perpetual futures contract and short the spot of the equivalent trade. This will be done by depositing the equivalent dollars worth of the asset as collateral into either Treasuries or a DeFi lending protocol to borrow 1 unit of the asset. The trader then sells the asset in the spot market at the price and deposits

it once again to earn interest. When he/she closes the futures contracts and pays a funding rate, they will do the opposite to buy 1 unit of the asset in the spot market and close the borrowing transaction, paying the net interest.

Theoretically, the interest rates should be equalized across the currencies after hedging using the perpetual futures contract. Should the absolute deviation be more than 0, this reflects inefficiencies in the stablecoin markets and presents an arbitrage opportunity.

Interest Rates

Apart from Treasuries found in traditional financial markets, investors can also source liquidity from lending protocols on the blockchain. These DeFi platforms facilitate the lending and borrowing of digital assets through smart contracts without a central intermediary. AAVE, one of the largest protocols with nearly US$7 billion, enables borrowers to obtain liquidity by locking up collateral in a smart contract, and in return, they pay interest to the lenders. This creates a dynamic marketplace for liquidity, with interest rates determined by the utilization percentage of the market.

It is important to note that the arbitrage between DeFi interest rates and funding rates on centralized exchanges involves transaction costs (i.e. gas), given the need to move capital on the blockchain. Gas is a measure of the amount of ether (ETH) a user pays to transact on the Ethereum network where it is paid to the block proposers for inclusion.

Data

A panel of the 3 stablecoins was constructed, consisting of:

- **Market Information:** Trading volumes, spot and perpetual futures prices, and funding rates were extracted from individual exchanges - Binance and Bybit.
- **On-chain Information:** The circulating supply of the stablecoins on the blockchain was extracted using the Defillama API (DeFiLlama, n.d.). This consisted of digital assets on Ethereum, Tron, Polygon, and Binance Smart Chain where the stablecoins are predominant.

Interest Rates

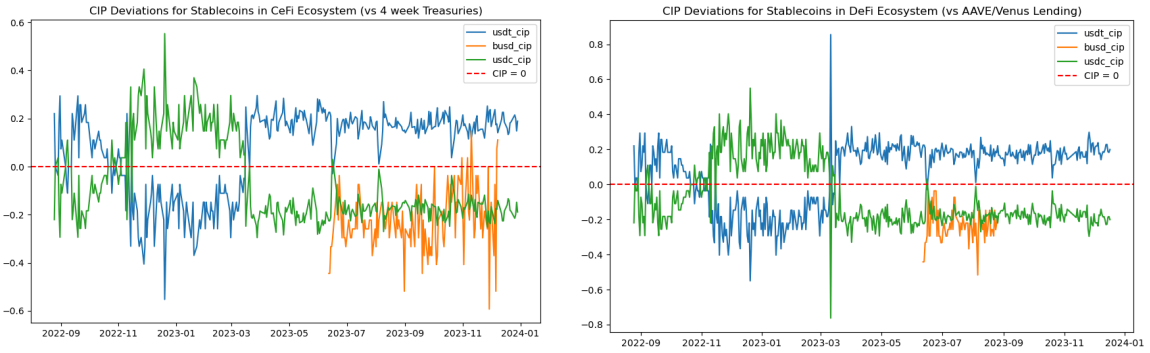
For DeFi interest rates, historical borrowing rates on AAVE for USDT and USDC were gathered using Dune Analytics, and Venus Protocol for BUSD using the Defillama API (DeFiLlama, n.d.). As for Treasuries, the 4-week, 8-week, and 13-week rates were retrieved. (US Department of the Treasury, n.d.). All interest rates have been annualized.

Evolution of CIP Deviations

A paradigm shift can be observed where the CIP inverted twice for both stablecoins - USDC and USDT in November 2022 and March 2023. These coincided with the FTX Collapse and USDC depeg respectively. This change is a result of the supply and demand imbalances within the stablecoin market, with the surge in demand for either stablecoin as this paper will

point out in the later sections. In the meanwhile, BUSD has been largely trailing with a positive CIP across the ecosystems - possibly due to the limited liquidity in the markets for BUSD as circulating supply fell, resulting in higher borrowing costs. It is important to note that the BUSD-USDT perpetual futures market was only launched from June 12, 2023, and Binance subsequently ceased support for BUSD on December 15, 2023 (Wright, 2023).

4 week Treasuries | **AAVE Lending Protocol**



	USDT		USDC		BUSD	
	Average	**Spread**	**Average**	**Spread**	**Average**	**Spread**
4 week Treasuries (CeFi)	7.28	17.2	-7.27	17.2	-22.3	12.8
AAVE/Venus (DeFi)	6.82	18.2	-6.98	18.0	-23.6	9.36

Figure 3 and Table 2: Historical CIP Deviation of Stablecoins versus 4-week Treasuries or AAVE/Venus Lending Markets. Table 2 highlights the descriptive statistics (mean and spread/standard deviation) of CIP deviations for each stablecoin, in basis points.

Why does CIP fail to hold?

These deviations contravene the assumption of a frictionless financial market. As such, this section hypotheses factors that can plausibly explain the patterns visualized:

(1) Periods of crisis severely undermine the confidence in the stablecoin ecosystem, influencing investor behaviors under heightened uncertainties.

(2) The convenience yield theory persists with high transaction costs on a blockchain, presenting benefits to hold the underlying assets (i.e. Treasuries) rather than the associated stablecoin perpetual futures.

(3) Time Effect of stablecoins plays a role where longer-term structures of Treasury bills increase greater uncertainty and thus, widen the CIP deviations.

Crisis Periods

In traditional financial markets, CIP held quite closely before the 2008 Great Financial Crisis. However, the relationship crumbled since then where significant deviations existed for these 'riskless' opportunities. This observation was similarly reported after 2 crises in the cryptocurrency markets spooked investors. Each of these adversely impacted a stablecoin, sparking devaluation and run risks.

a. **FTX Collapse:** The FTX collapse marked the failure of a major cryptocurrency exchange which led to a severe collapse in market confidence. It sparked an outflow in USDT given its alleged affiliations with its market-making firm, Alameda Research (Allison, 2022). As a result, market participants flocked to USDC. This event also likely led to increased CIP deviations as they assessed the heightened counterparty and liquidity risks.
b. **USDC Depeg**: The de-pegging of USDC following the collapse of Silicon Valley Bank is another critical case where traditional banking sector issues spilled over into the cryptocurrency markets (Sandor, 2023). This dented confidence in USDC, as the circulating supply halved within a month.

As a result, market participants demanded a higher risk premium for holding these assets as seen in the interest rate differentials and reversal in deviations. For instance, the USDC crisis marked visible reversals in CIP deviations for both USDC and USDT (Figure 3). It suggests that the relationship between interest rates and forward exchange rates has changed, and synthetic dollar rates (which are derived from perpetual futures) have fallen below Treasuries (indicating a potential flight to safety).

Studies in traditional markets have also shown that markets take time to normalize and for parity conditions to be restored. In the cryptocurrency market, the relatively lower liquidity and higher volatility can exacerbate this effect, leading to a prolonged recovery period, thus, leading to the persistent deviations observed.

Prediction #1 : (i) CIP deviations widen when a stablecoin undergoes a specific period of crisis. (ii) CIP deviations shrink for its competitors given the increase in their demand as a safe haven. (iii) The CIP deviations post-crisis exhibit a long recovery period, suggesting the lack of maturity in these nascent markets.

Inconvenience Yield - Transaction Frictions

The next hypothesis builds on the concept of 'convenience yield' in traditional financial markets, where the benefits of holding an asset are balanced against the costs and frictions of transacting it (Omura and Ist, 2014). In the context of blockchain ecosystems, transaction frictions arising from gas on Ethereum exist. It represents both a cost and a potential source of delay in executing transactions. In particular, during periods of heightened activity, gas

costs can escalate significantly, imposing notable transaction frictions. These could deter market participants from engaging in arbitrage activities, essential for maintaining CIP. As a result, it diminishes the convenience yield of engaging in arbitrage, leading to slower market adjustments which distort the CIP.

In the context of the DeFi environment, the implications of higher transaction costs will potentially render the arbitrage non-viable between the funding and interest rates on lending protocols. Consequently, the narrower profit margins lead to widened disparities in rates between the markets, resulting in more negative CIP deviations.

Prediction #2: Higher transaction costs result in wider CIP deviations for stablecoins in the DeFi environment.

Term Structures

Both Treasuries and perpetual futures possess different term structures - the former is well defined with yields typically increasing with maturity in today's contango markets, the latter does not have maturity where the funding rates can change based on immediate market conditions, independent of a time-to-maturity concept. As such, investors can capitalise on the spread between the risk-free rates from Treasuries and the risk-adjusted returns from holding a leveraged position in the perpetual futures market.

Prediction #3: Longer-term securities are likely to see more persistent and wider deviations in CIP.

Intuitively, this prediction is based on the increased duration risk from longer-term securities as their value will fluctuate more in response to changes in interest rates. The longer the term structure, the greater the cost of hedging of perpetual futures, and thus, the basis should theoretically become more negative to justify the higher costs with these positions.

Empirical Testing

In this section, the paper empirically tests the predictions based on the previous section to observe if stablecoins adhere to the conventional CIP theory.

(a) Flight to Safety / Stress Events

The implications of each crisis were empirically examined to understand their implications on these deviations. The impulse response functions (IRFs) were calculated using a vector autoregression model for both events and modeled on both Cefi and Defi ecosystems. The baseline equation is as follows for the time horizon h (h = [0, 10]) in days.

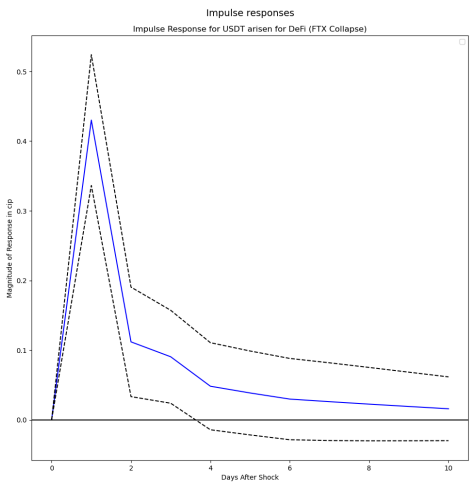
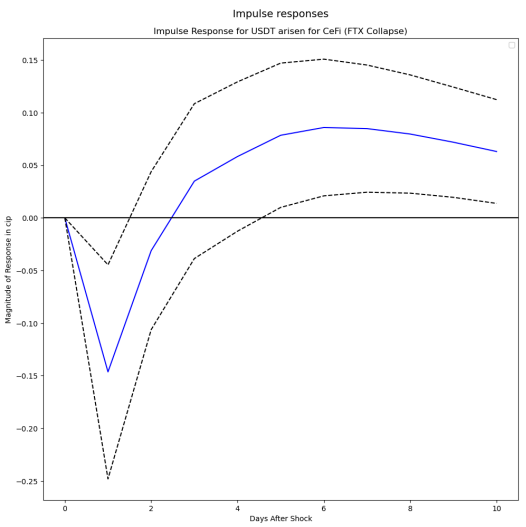
$$\Delta y_{i,t\ h} = \alpha_h + \beta_{h\,(L)} X_{i,t-2} + Y_{i,h} shock_{i,t} + \epsilon$$

Where y represents the CIP deviation, shock refers to the crisis which is represented with a dummy variable, and X is a vector of controls, including the daily spot and perpetual trading volume, market volatility, and interest rates. These are at a daily frequency and isolated to be within the specific periods identified:

- **FTX Collapse:** 2 November - 11 November 2022
- **USDC Depeg:** 10 March - 18 March 2023

The IRFs illustrate the system's response to a one-unit shock in the dummy variable, indicating the magnitude and duration of the effects over time. The analysis focuses on the specific crisis periods identified for the FTX Collapse and USDC Depeg events, providing insights into how these shocks influence the deviations from CIP within the defined time frames. BUSD was not included in the tests as the stablecoin perpetual futures were only launched on June 13, 2023, which was before these events.

FTX Collapse

	4 weeks Treasuries	**AAVE Lending Protocol**
USDT		

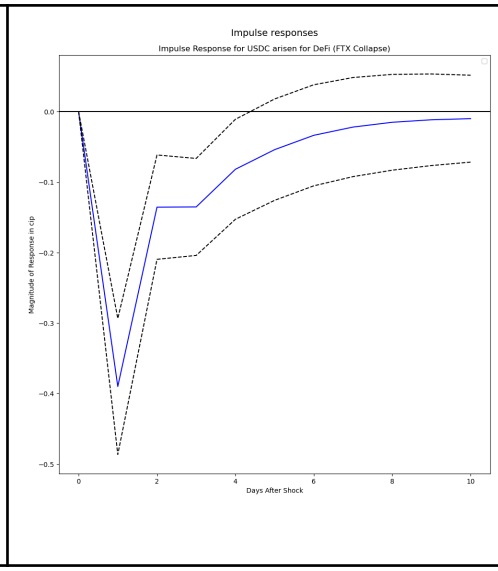
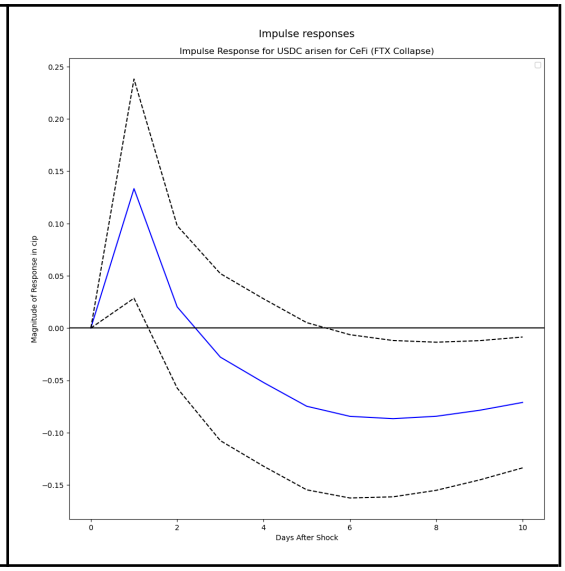
USDC		

Figure 4: Impulse Response Function of the FTX Collapse

During the FTX collapse, the implied rate by perpetual funding was higher for USDC than the Treasuries rate. This meant that it became more expensive to borrow dollars through the funding markets, while the converse occurred for USDT - relatively cheaper to obtain.

The observation could be attributed to the difference in perception of both stablecoins - a surge in demand for USDC, driving up implied rates, while investors fled from USDT based contracts. It arose due to concerns over counterparty risks given the ties between Tether and FTX's market-making firm - Alameda Research. Thus, it led to a flight in quality where investors were concerned about the creditworthiness of USDT and chose a safer alternative in Treasuries. As a result, concerns about the industry contagion contributed to the 3% drop in USDT value across major exchanges, briefly touching 93 cents on Kraken exchange (Maiwa, 2022). However, markets rationalized the collapse and the differential was gradually arbitraged nearly 6 days after the crisis.

In the DeFi ecosystem, deviations jumped t + 1 from the day of the collapse for USDT and sharply fell for USDC. Similar to the above, a plausible explanation could be the significant changes in liquidity provider behaviours in AAVE as they withdrew from USDT pools due to perceived risks. This decreased the supply of available USDT, increasing the costs of direct borrowing, as observed in Figure 5. However, interest rates for USDC on AAVE remained flat as minimal deposits were added.

Instead, a plausible explanation could be that market participants rotated to USDC off-chain, likely on centralized exchanges. The lineup coincided with changes in interest rates on the decrease in supply of USDT, as USDC gained traction with a surge in its market capitalization, post FTX collapse. Therefore, it became more expensive to borrow USDC from AAVE instead of synthetic dollar funding through perpetual futures.

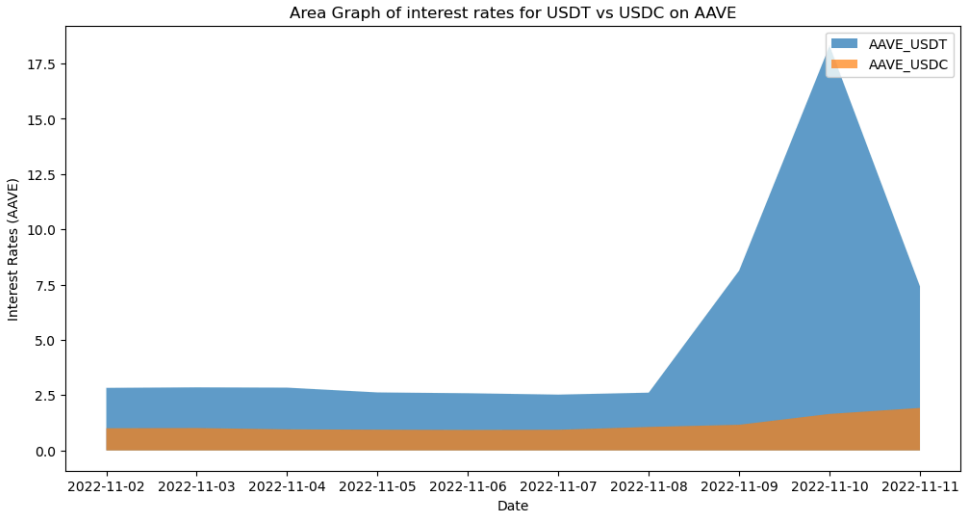
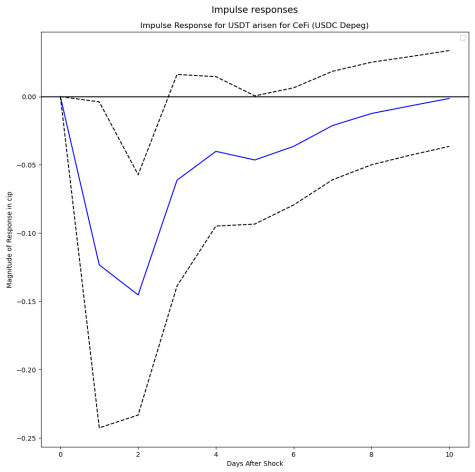
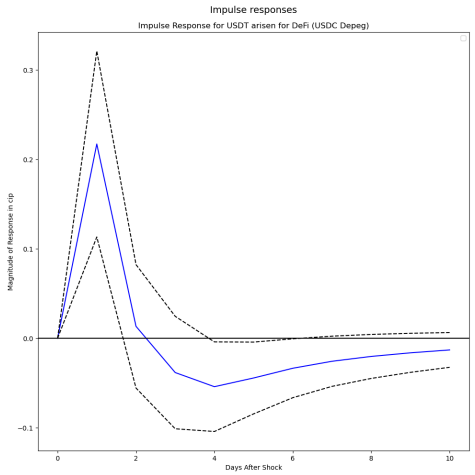


Figure 5: Changes in Interest Rates for USDT versus USDC on AAVE near the FTX Collapse (November 2, 2022 to November 11, 2022)

USDC Depeg

	4 week Treasuries	AAVE Lending Protocol
USDT		

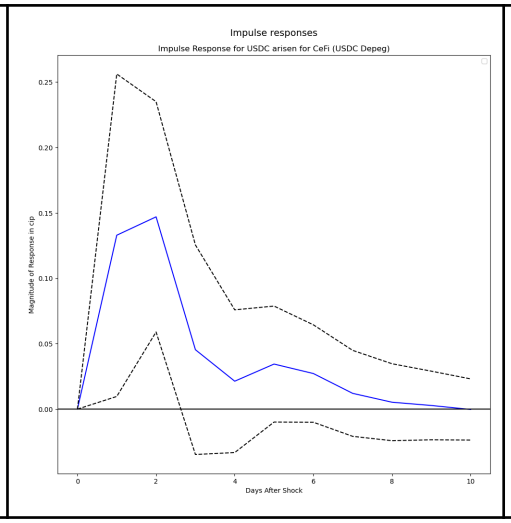
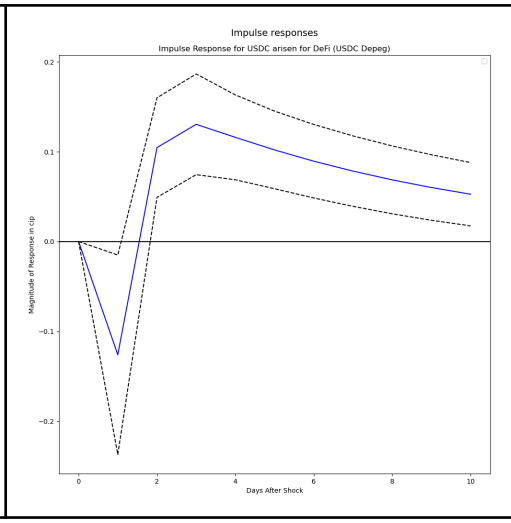
USDC		

Figure 6: Impulse Response Function of the USDC Depeg

The stress test on USDC following the downfall of SVB witnessed a pronounced rise in the deviations, indicating increased market uncertainties. These persisted till t + 2, which aligned with the period when Coinbase temporarily halted USDC conversions due to the weekends, disrupting the arbitrage process and causing price discrepancies (Nelson, 2023). This initial shift in deviations was notable in CeFi, reflecting a broader trend of liquidity outflow from markets and a swift erosion of risk appetite during the crisis. It was only till t + 4, after the weekends that the arbitrage window gradually narrowed as conversions resumed and the FDIC (2023) announced that all deposits at SVB would be fully guaranteed.

Once again, the reverse phenomenon occurred to USDT as it exhibited greater resilience during this crisis with its negative deviations. It was likely that investors flocked to the stablecoin, away from USDC, building demand for USDT and thus, raising the implied rates.

In the meanwhile, deviations became more negative in DeFi, specifically concerning AAVE lending rates, compared to Treasuries. This divergence could be attributed to the sudden spike in interest rates for USDT with greater demand for the stablecoin. As a result, direct dollar funding from AAVE pools was cheaper than the perpetual funding.

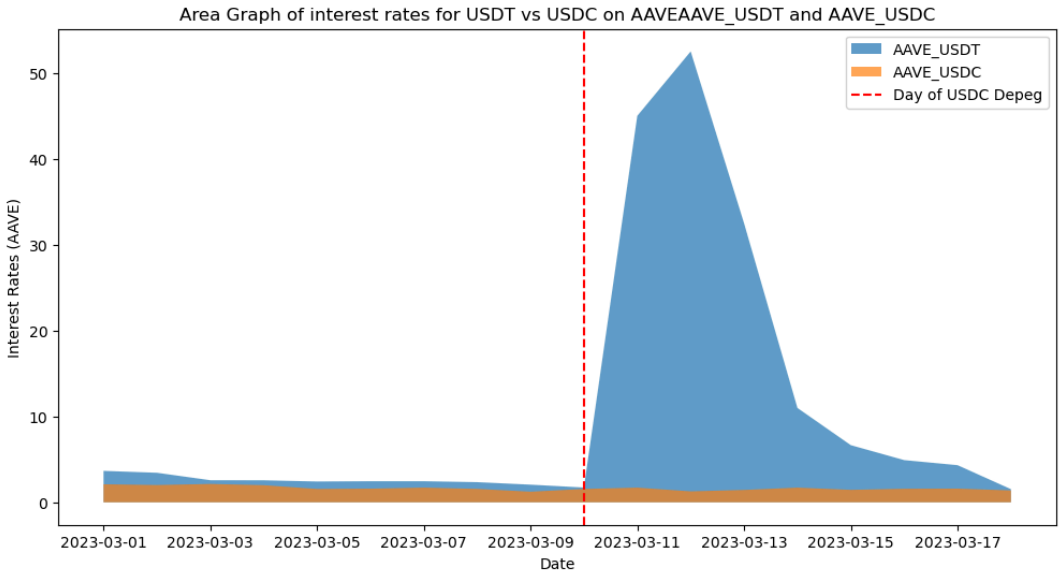


Figure 7: Changes in Interest Rates for USDT versus USDC on AAVE near USDC Depeg (March 1, 2023 to March 17, 2023)

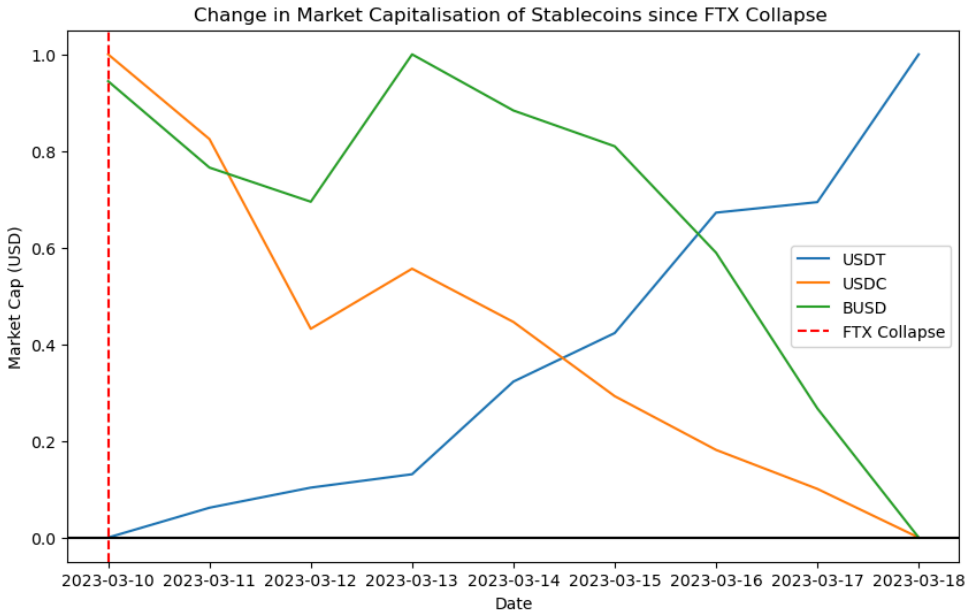


Figure 8: Changes in Market Capitalisations of USDT, USDC, BUSD near USDC Depeg (March 1, 2023 to March 17, 2023)

Across the 2 crises, these findings support Prediction 1 where the stablecoins recorded a wide deviation immediately post event. For the unaffected stablecoins, they were perceived as safe havens where investors flocked to them as an alternative, causing a negative deviation. CIP deviations were quicker to recover in the CeFi environment, relative to DeFi which is intuitive given the perceived stability in traditional financial markets. This adds to the perception that DeFi lending protocols lack the maturity to regain investor confidence.

(b) Inconvenience Yield

The implications of higher transaction costs (from gas) were further examined based on each stablecoin's predominant activity within the blockchains. The average gas fees for Ethereum were retrieved for USDT and USDC, while the gas fees for Binance Smart Chain were used for BUSD. A base linear regression was performed between the single independent variable of gas fees and the dependent variable on the CIP deviations. The mathematical equation is represented below:

$$\Delta y_{s,t} = \beta_0 + \beta_1 X_{s,t} + \epsilon,$$

Where y represents the CIP deviations, s refers to the stablecoin, and X refers to the gas fees of the respective blockchains. Given that gas fees are only applicable in the DeFi environment, the CIP deviations will be determined based on the prevailing interest rates for DeFi lending protocols.

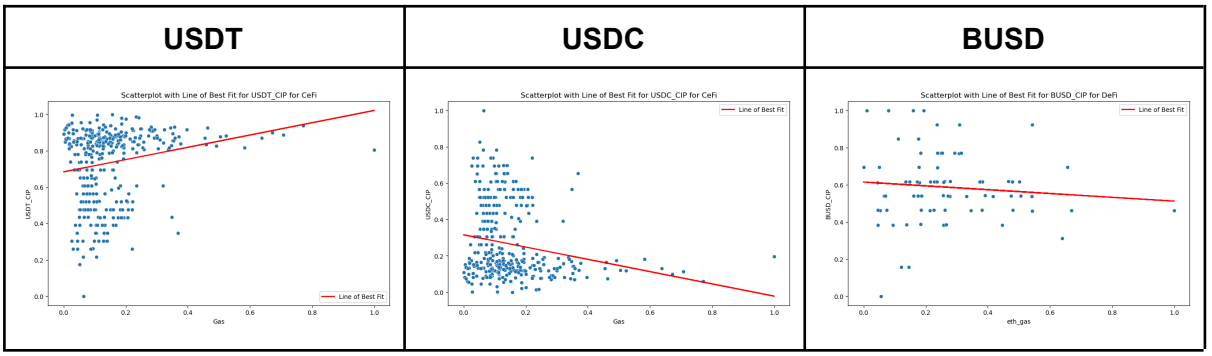


Figure 9: Changes in CIP deviations for stablecoins against the average daily gas. Ethereum gas was used for USDT and USDC, while BNB chain gas was used for BUSD based on their dominant circulating supplies.

The results reveal differing market preferences and trust across the spectrum of stablecoins. USDC recorded a negative correlation which implies that the returns from holding USDC are lower than holding it in lending protocols. This plausibly means that USDC could be perceived less favourably during these periods and suffer from a fall in demand, leading to the negative basis observed. Conversely, USDT appears to remain attractive with potential arbitrage opportunities, helping to keep the market more efficient and stable. The lack of a strong positive or negative correlation may reflect market uncertainty about BUSD's long-term position within the stablecoin ecosystem, possibly influenced by its lower market capitalization and usage compared to USDT and USDC.

Surprisingly, these findings are counterintuitive to the expected belief that USDC is a more stable source of value than USDT. As such, the same analysis was run, but based on 2 different datasets - pre and post-USDC depeg to observe for changes in the market behavior.

Comparing Pre and Post-Crisis

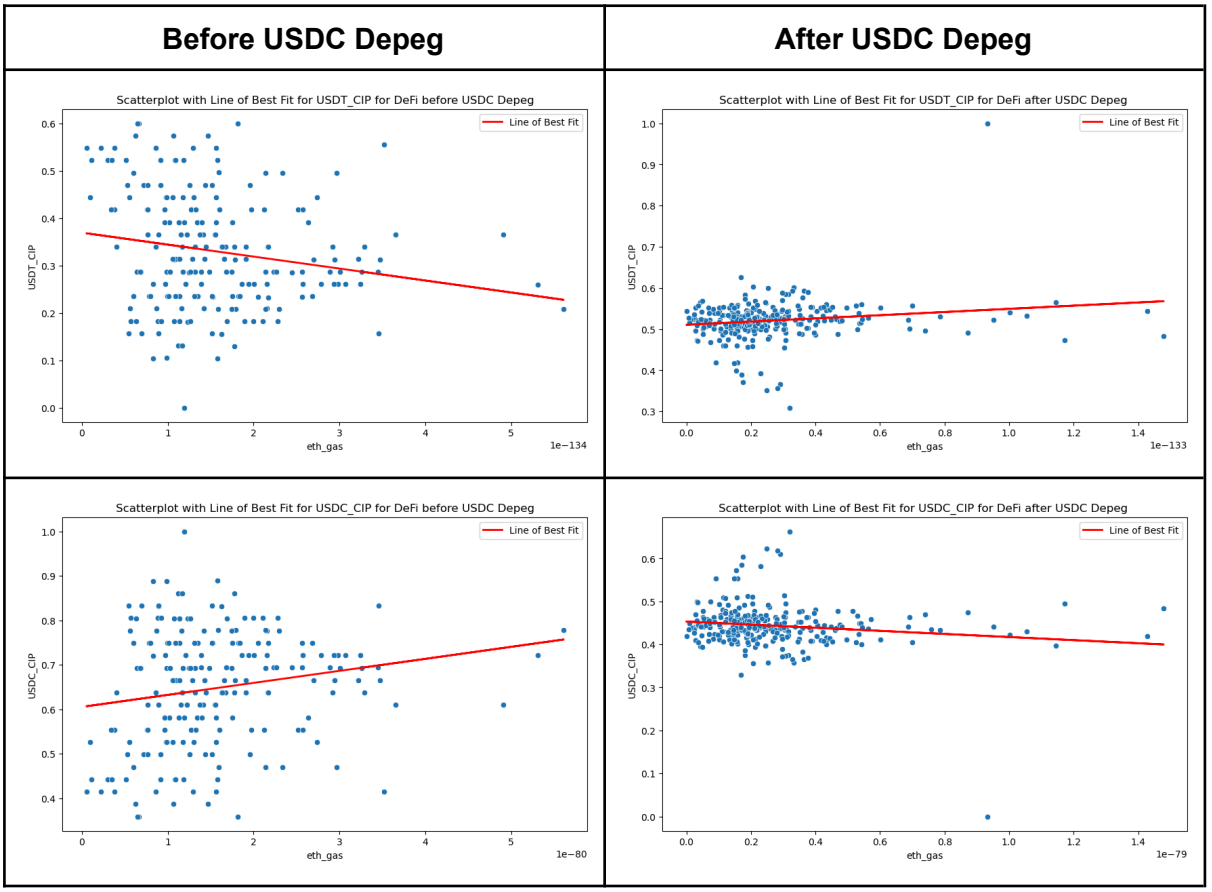


Figure 10: CIP deviations based on the magnitude of Gas (Before and After USDC Depeg)

Interestingly, the depeg event for USDC marked a significant inflection point for the stablecoins. Before the crisis, the positive correlation for USDC suggests that the market may have been more tolerant of higher gas fees due to sufficient returns from the lending protocols. However, following the event, the sign became negative, indicating a shift in market sentiment where investors seek to avoid transacting in higher gas environments.

These results affirm Prediction #2 that larger gas costs tend to result in more deviant CIPs. Yet, there are two possible interpretations of this divergence. It is interesting to note that USDT appeared to have emerged as the preferred standard as the tokenized dollar. It is corroborated by the popularity of USDT since the depeg event as the market capitalization of USDT surpassed that of USDC which has fallen drastically. It could be possibly due to its broader acceptance and usage which might provide some insulation against the volatility.

(c) Time Effect

Interest rates in perpetual futures and lending protocols lack long-term structures as they fluctuate intra-day based on the activity due to speculative trading or news events. In comparison, Treasuries possess structured profiles with fixed maturity dates, available in different time horizons. Depending on the opportunity, market participants can strategize to arbitrage potential differentials, with short-term traders being active in markets with greater

volatility while longer-term investors have a strategic approach for a more stable and predictable environment. As such, the daily interest rates for the 4-week, 8-week and 13-week Treasuries were extracted from the US Department of the Treasury (n.d.)

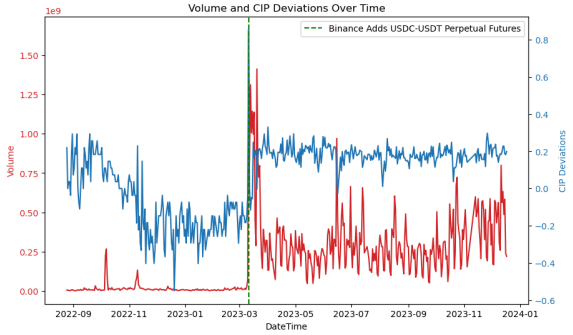
In general, the stablecoins reveal a gradual increase in absolute value of average CIP deviations when compared with longer term Treauries. This aligns with the prediction that there is higher duration risk incurred by investors. Yet, USDT and USDC showed similar patterns of fluctuation, with the differences in between the different time horizons moving closely together. In comparison, BUSD has more pronounced and volatile deviations from the higher average and standard deviations observed. This could indicate that the markets of the former 2 appear to have their costs more efficiently priced in across the different maturities. As for BUSD, due to its relatively low rate of adoption and lower trading volumes, the stablecoin thus experiences much wider CIP deviations than the other two.

	4 week Treasuries			**8 week Treasuries**			**13 week Treasuries**		
	USDT	**USDC**	**BUSD**	**USDT**	**USDC**	**BUSD**	**USDT**	**USDC**	**BUSD**
Mean	-7.452660	7.443289	22.334678	-7.454433	7.445057	22.337352	-7.455922	7.446544	22.339794
Spread	17.080805	17.082386	12.750203	17.088502	17.090085	12.751490	17.094859	17.096444	12.752815

Figure 11: Mean and Spread/Standard Deviation of CIP Deviations (in basis points) of Stablecoins versus Treasury Bills based on their maturity profiles

(d) Liquidity Profile and Price Discovery

Volume and CIP Deviations



Composition of Volume (Binance vs Bybit)

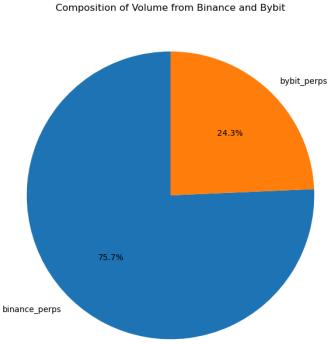


Figure 12: 12a. Changes in Trading Volume (Bybit + Binance) for USDC-USDT Perpetual Futures Market against the CIP deviations. 12b. Composition of Trading Volume (post USDC depeg) for Binance vs Bybit

However, a confounding factor could be the launch of Binance perpetual futures on March 12, 2023 during this period of uncertainty. Previously, the USDC-USDT perpetual futures market was only available on Bybit which had relatively lower volumes. Based on Figure 12b, it can be seen that 75.5% of perpetual trading volume occurs on Binance. As a result, this increased liquidity could disrupt the existing market dynamics by providing traders with more options for arbitrage and speculation. With more liquidity, arbitrageurs can execute larger trades without significantly impacting the market price, leading to a more efficient price discovery processes and stabilize prices. This is visible from the reduced idiosyncrasies in the deviations post depeg.

Policy Recommendations

Crises significantly distort the stablecoin market, with with observable changes in their behaviors. These are largely aligned with the initial findings on the potential economic stress faced by USDT and USDC. In particular, the DeFi environment, being a relatively nascent filed, appears to be more fragile than CeFi.The lack of maturity may result in less efficient market mechanisms, making DeFi more susceptible to large swings in response to market stressors.

Currently, these companies issue monthly attestations for users to verify their holdings and composition of the stablecoins. Duration risk arises because the amount of reserves held by these companies is only disclosed on a monthly basis. This lack of real-time information becomes particularly problematic during periods of crisis, such as when a stablecoin like USDC experiences depegging. In these scenarios, it is paramount for stablecoin issuers to instill confidence for these opportunities to be quickly realized. As such, a Proof of Reserve system can be adopted to enhance transparency for both on-chain and off-chain reserves.

One example of such a system is Chainlink's approach (Chainlink, n.d.), which leverages automated verification processes to provide immediate and continuous updates on collateralization data. In the system, data related to the reserves backing the stablecoin is collected from various sources and immediately projected on-chain. This ensures that stakeholders have access to up-to-date information about the stability and security of the stablecoin at any given time.

Conclusion

This paper sheds empirical insights into the trading behaviours of stablecoins and its relationships in influencing the CIP. The findings reveal notable deviations from CIP in the stablecoin market, suggesting that the mechanisms designed to maintain pegged values of stablecoins can be susceptible to inefficiencies. Factors such as shifts in investor confidence

following major market events, the variability of transaction costs on blockchain networks, and the mismatch between the dynamic nature of stablecoins and the fixed terms of traditional financial instruments like Treasuries, have all contributed to these deviations. However, the USDC depeg exerted a notable impact, which was more profound in the relatively nascent DeFi markets.

Moving forward, as the bridge between traditional finance and the realm of digital assets continues to strengthen, understanding these mechanisms and their implications becomes paramount. Thus, this research hopes to pave the way for more resilient and efficient stablecoin markets in the future.

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