DEXploration: Unraveling Curve Finance Dynamics

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Abstract

This report offers a thorough analysis of Curve Finance, a prominent decentralized finance (DeFi) platform, with a focus on Automated Market Maker (AMM) strategies, vote-escrowed governance (veCRV), and the role of automation. Through comprehensive Exploratory Data Analysis (EDA), we dive into Curve's AMM logic, shedding light on its impact on the decentralized financial ecosystem. The Historical Evolution section analyzes significant events, examining their influence on trading volumes and liquidity dynamics, showcasing Curve Finance's resilience during market turbulence. The investigation into Trading Volume vs. Liquidity explores the intricate relationship between these two factors, considering elements such as news events and price movements. The Unusual Activities section scrutinizes instances of front-end attacks and vulnerabilities, contributing to the ongoing discourse on DeFi security. Lastly, the BIS Use Cases section explores the collaboration between central banking institutions and DeFi platforms, specifically Curve's AMM design in cross-border Central Bank Digital Currency (CBDC) projects. This section addresses associated benefits, challenges, and potential solutions, presenting a succinct yet insightful overview of Curve Finance's essential role in the evolving decentralized finance landscape

Keywords: Curve Finance, DEXES, Automated Market Maker (AMM), Decentralized Finance (DeFi)

Unraveling Curve Finance Insights

The landscape of decentralized finance (DeFi) has evolved dramatically, with platforms like Curve Finance playing a pivotal role in reshaping how financial transactions unfold. In this report, we embark on a comprehensive exploration of Curve Finance, a leading Automated Market Maker (AMM) in the DeFi realm. As we probe into its intricacies, from stablecoin expertise to innovative AMM logic, our journey extends beyond conventional boundaries. The subsequent section conducts an in-depth Exploratory Data Analysis (EDA), shedding light on essential aspects such as liquidity dynamics, vote-escrowed governance (veCRV), and the transformative impact of automation. Join us as we unravel the data-driven narrative, paving the way for a nuanced understanding of Curve Finance's disruptive influence on the decentralized financial landscape.

Historical Evolution

The historical evolution of Curve Finance is marked by significant events that shaped its trajectory and underscored the broader dynamics of the cryptocurrency market.

1. **Stablecoin Depegging Event: March 10–13, 2023**

The failure of three US banks — Silicon Valley Bank (SVB), Signature Bank, and Silvergate Bank — initiated a chain reaction with profound implications for stablecoins, notably USD Coin (USDC) and DAI. USDC experienced a 13% depegging below $1 after Circle, its issuer, confirmed holding $3.3 billion of cash reserves at SVB. Dependencies on Signature Bank and Silvergate Bank for USDC-to-fiat US dollar redemptions further exacerbated the situation.DAI's close correlation with USDC's value became evident, given that, at the time, USDC holdings represented over half of the collateral reserves backing DAI.

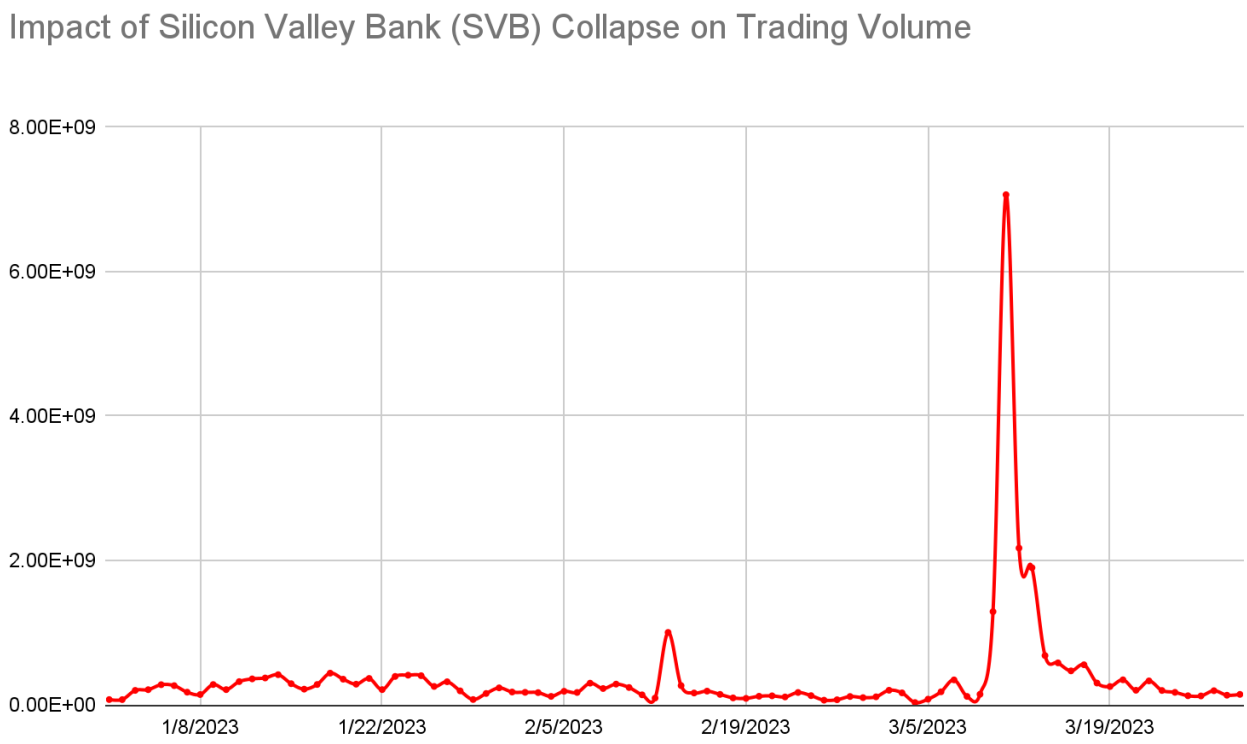
Recovery and Reserve Adjustments

Both stablecoins eventually recuperated to their peg levels post the Federal Reserve's confirmation of support for the banks' creditors. Subsequently, strategic reserve adjustments were made:

- USDC shifted its cash reserves primarily to Bank of New York Mellon.
- DAI diversified its reserves away from USDC, allocating significantly to multiple stablecoins and increasing real-world asset shares.

Implications

The event underscored the intricate balance between stability and market dynamics in the realm of stablecoins. Decentralized alternatives gained prominence as investors sought resilience during the crisis. During this incident, Curve recorded its highest-ever trading volume, reaching up to 7 Billion.



2. Impact on Curve Finance: UST Depegging Incident May 7th 2023 - May 11th 2023

Terra's UST, a stablecoin pegged to the US dollar, experienced a sudden depegging event, leading to substantial repercussions on Curve Finance.

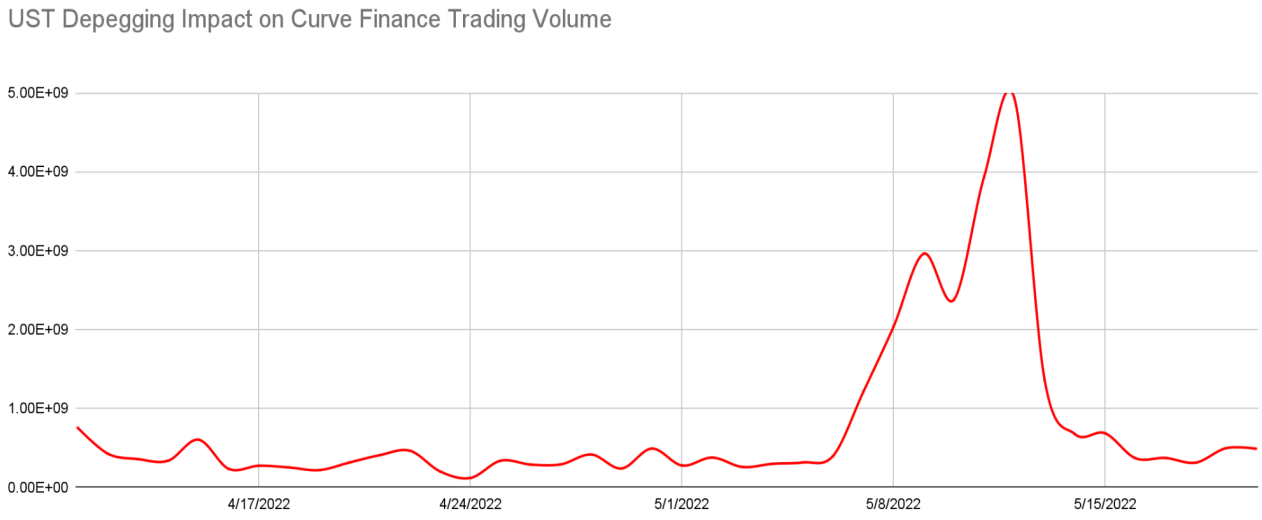
- ***Trading Volume Surge***

The UST depegging triggered a surge in trading volume on Curve Finance as traders sought liquidity and alternatives during the crisis.

- ***Liquidity Disruptions***

  The sudden outflow of UST from the Anchor Protocol significantly impacted liquidity and stability. Curve Finance, operating as a decentralized liquidity pool, played a pivotal role during this period.

With the peak trading volume at the time reaching around 4.9 billion.

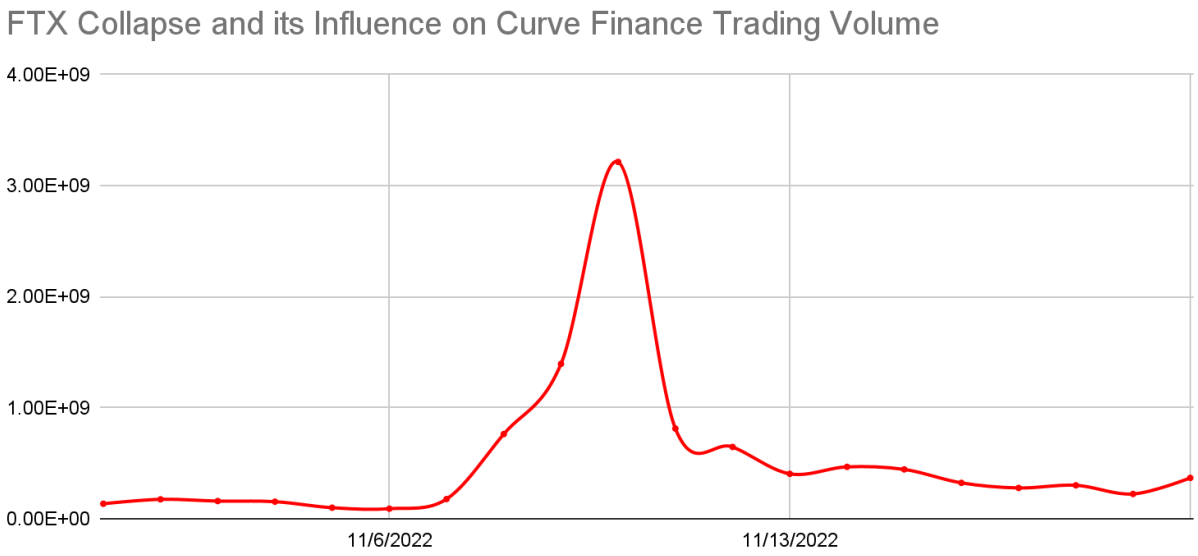


3. FTX Collapse

The collapse of FTX, a major cryptocurrency exchange, sent shockwaves through the crypto market and potentially influenced trading dynamics on platforms like Curve Finance. Some possible factors that influenced the Trading Volumes include

- Increased Volatility: The uncertainty and panic following the FTX collapse likely increased market volatility, leading to higher trading volumes.
- Shift to DeFi: The collapse highlighted risks associated with centralized exchanges (CeFi), potentially prompting a shift towards decentralized finance (DeFi) platforms like Curve Finance.
- Loss of Confidence: The event could have shaken investor confidence, prompting asset movements and contributing to increased trading volumes.

The incident resulted in a significant surge in trading volume on Curve Finance, reaching around 3.2 billion.



Unusual Activities Analysis

Front-End Attack: Aug. 9, 2022: Curve Finance faced a front-end attack on August 9, 2022. In this incident, a hacker manipulated the domain name system (DNS) entry for the protocol, redirecting users to a fake clone and approving a malicious contract. The attacker successfully stole over $570,000 from users who interacted with the fake frontend. The incident highlighted vulnerabilities in the system and

showcased the potential financial losses associated with such attacks. Curve Finance responded promptly by advising users to revoke any approvals or swaps made on curve.fi or curve.exchange during the affected period. The protocol assured users of identifying and fixing the source of the hack, reassuring the safety of other pools.

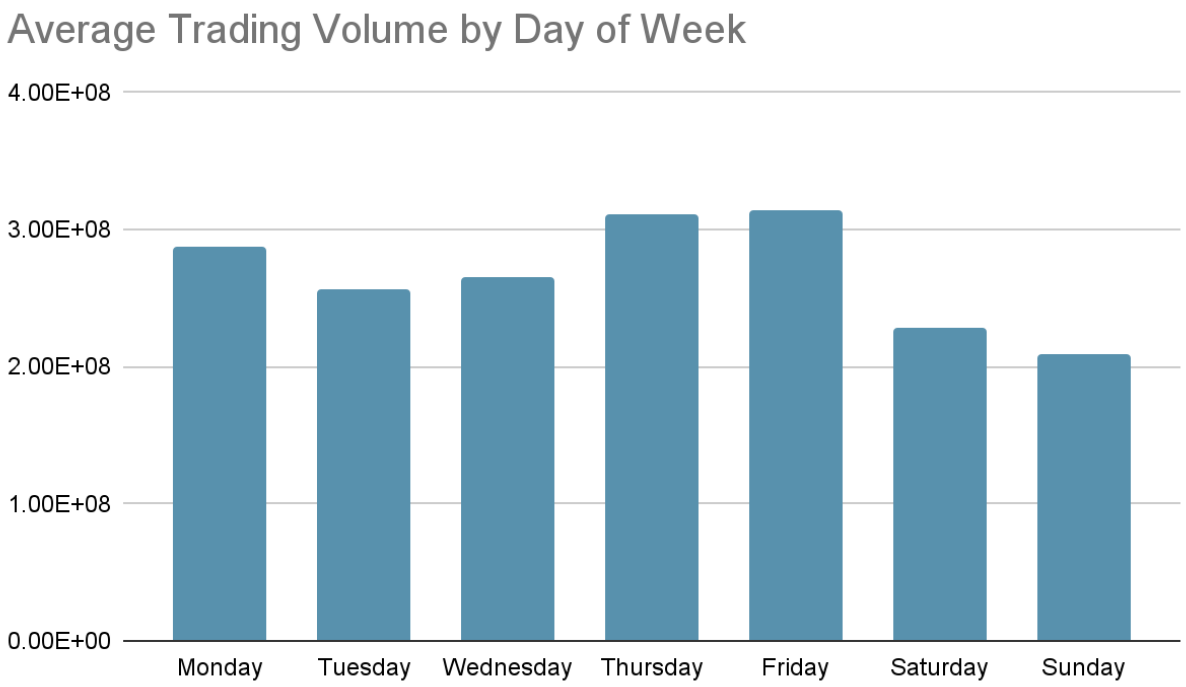
Reentrancy Vulnerability: July 30, 2021: On July 30, 2021, Curve Finance encountered a reentrancy vulnerability in several stable pools using Vyper. This vulnerability allowed attackers to manipulate stablecoin prices and drain funds from the pools. The attacker(s) reportedly made over $61 million in profit, impacting pools such as alETH-ETH, pETH-ETH, sETH-ETH, and BNB-based pools. The incident also resulted in a loss of 32 million Curve DAO tokens (CRV) from the swap pool. Curve Finance responded by advising users to revoke approvals or swaps made during the affected period and use curve exchange until the issue was resolved. The team assured users of identifying and fixing the vulnerability.

Trading Volume Fluctuations

Our exploration reveals intriguing patterns into the temporal rhythms that govern user engagement. Days that had unusually high trading volumes due to real life events were removed to get a better understanding with outliers

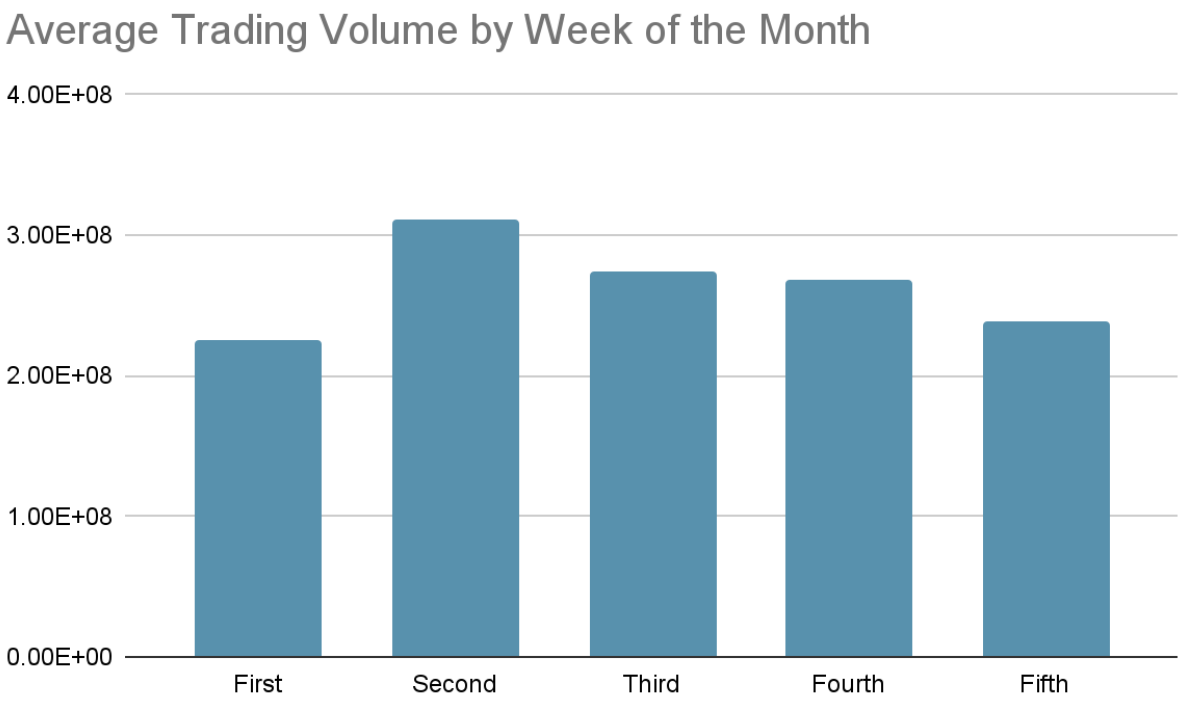
1. Trading Volume by Day of Week:

- Peak Days: Thursdays lead the pack in trading volume, followed by Mondays and Wednesdays. Tuesdays hold steady, while Fridays see moderate activity. Weekends have quieter trading which is a common trend in the financial markets.



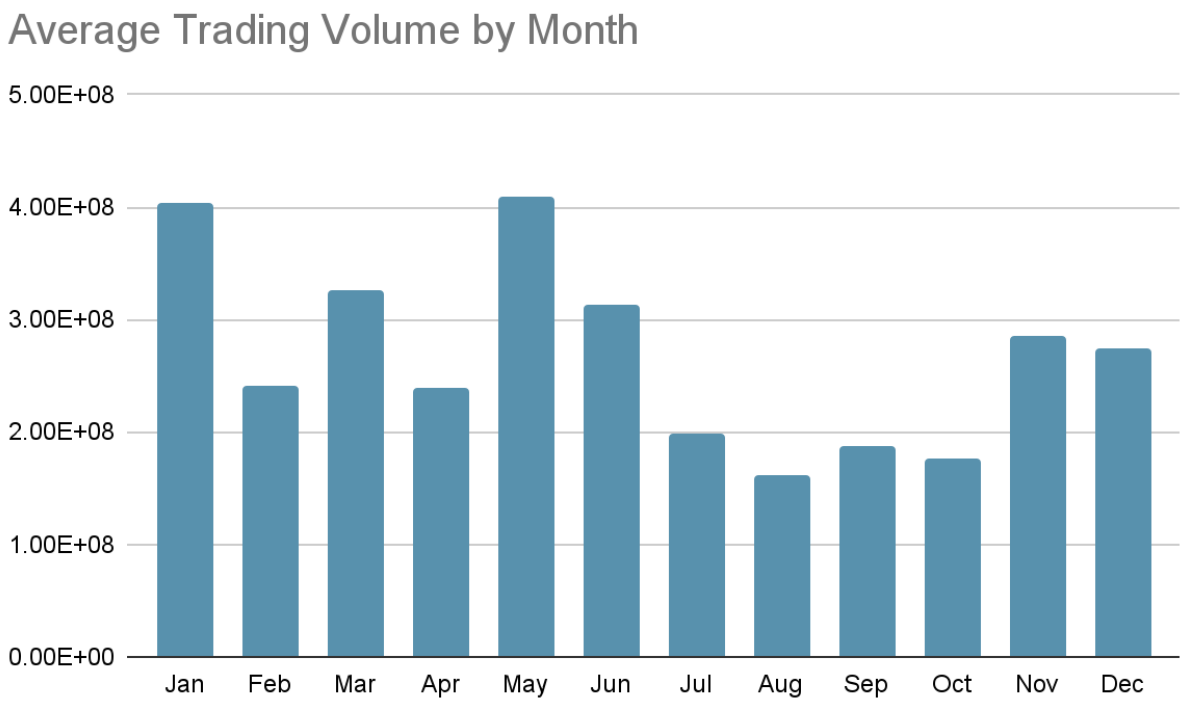
2. Trading Volume by Week of Month:

- Peak Weeks: Week two stands out, leading with the highest average trading volume. On the flip side, weeks one and five follow a quieter tempo.



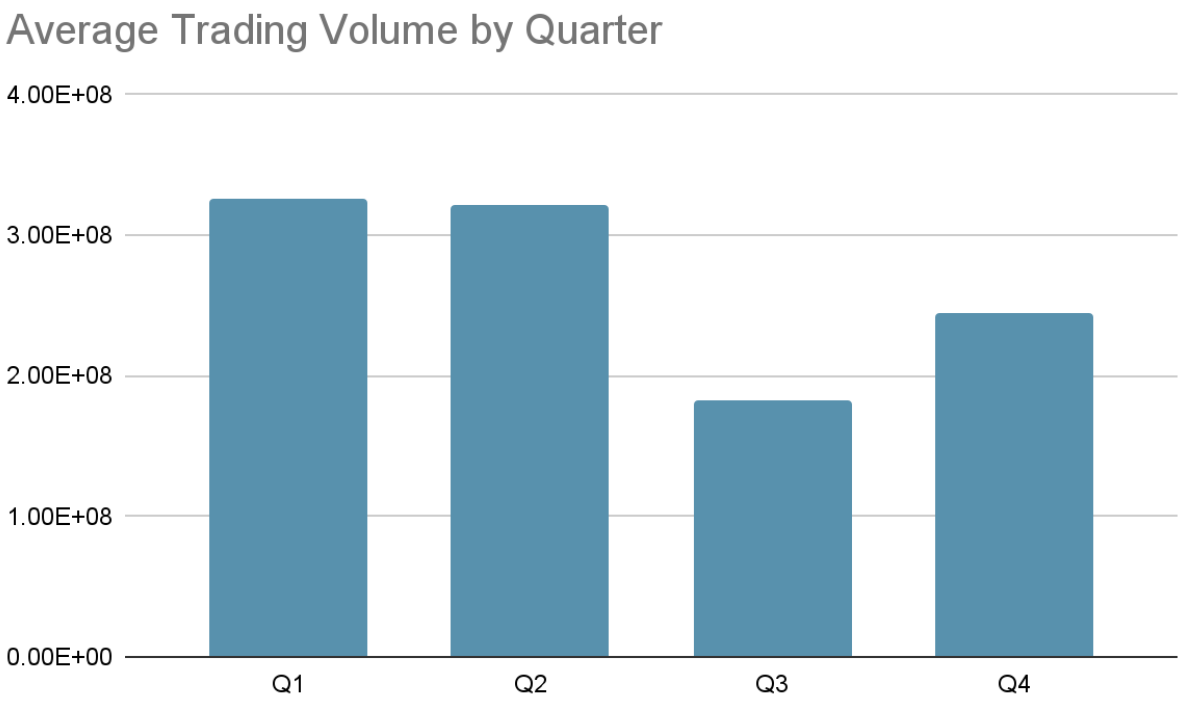
3. Trading Volume by Month:

- Peak Months: The annual calendar unfolds distinct chapters, with January and May taking center stage in the narrative of heightened trading volumes. Yet, the summer months of July and August hum a softer melody, marked by notably lower average trading volumes.



4***. Trading Volume by Quarter:***

- Quarterly Trends: Examining the quarterly landscape, we observe heightened trading volumes in the initial and middle quarters, juxtaposed with a subdued rhythm in the third quarter.



Overall Time Based Insights:

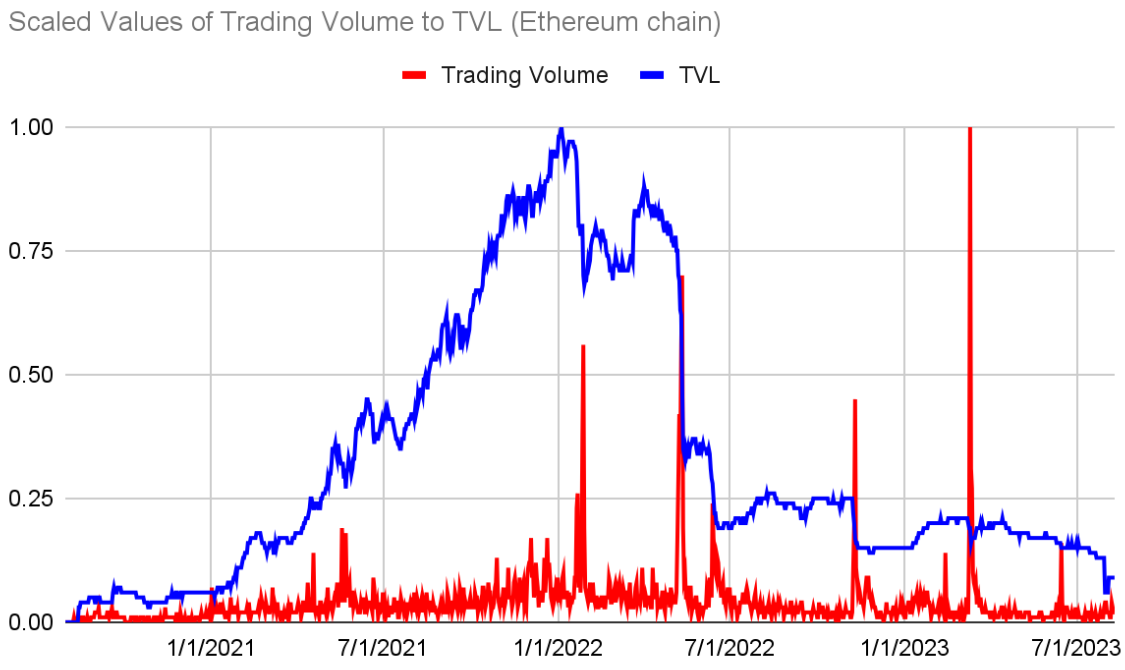
- Day and Time Peaks: Thursdays emerge as the crescendo, resonating with heightened trading activity during mid-week. This temporal symphony invites exploration into the nuances of user behavior.
- Seasonal Trends: January to May, with their vibrant crescendos, stand as symbols of heightened trading volumes, while the mellower tones of July and August invite reflection on the cyclical nature of market dynamics.

Trading Volume vs Liquidity (Dynamics)

1) ***Investigating the Factors that Impact Trading Volume:***

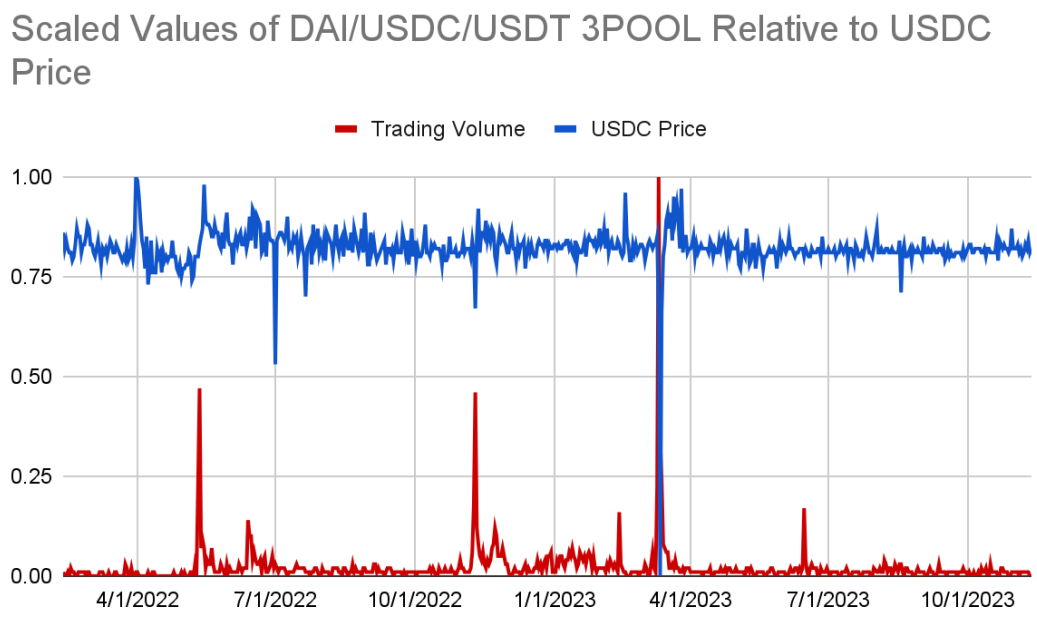
a) ***News and Events***: Significant news or events impacting market sentiment trigger increase trading activity. Events like the SVB Collapse and USY depegging lead to a substantial surge in trading volume.

b) ***Liquidity:*** High liquidity encourages more trading activity as orders can be executed quickly and cheaply. An intriguing observation emerges from the charts, revealing a negative correlation between trading volume and liquidity during heightened trading. This suggests that as trading volume increases, there is a concurrent decrease in liquidity. One plausible explanation for this phenomenon could be a substantial transfer of funds during periods of heightened trading activity, contributing to the observed decrease in liquidity.



c) ***Price Movements:*** Significant price changes attract more traders looking for profit opportunities or risk hedging. Higher volatility contributes to increased trading volume

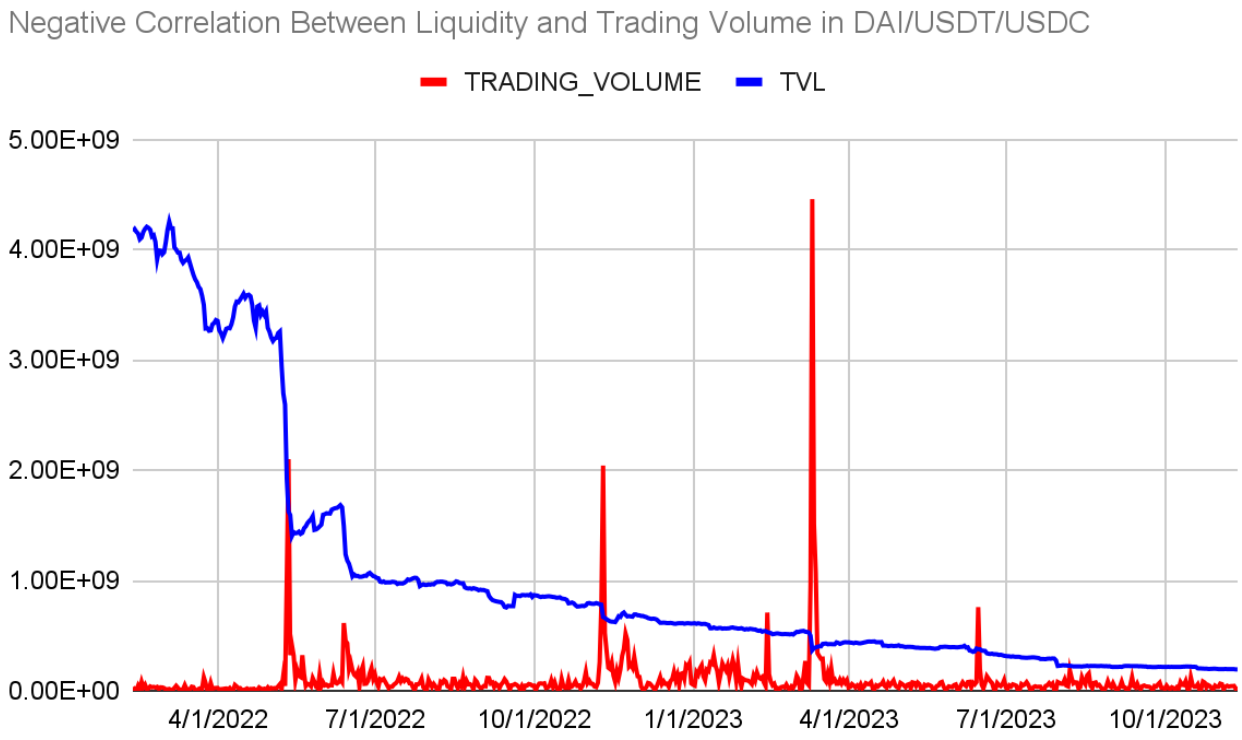
as traders react to price fluctuations. Which can be seen when the USDC token fell below its pegged value of one dollar.



2) Assessing how liquidity influences trading volume

The historical analysis of Curve Finance unveils a noteworthy inverse relationship between trading volume and liquidity. During heightened trading activity, there is a discernible decrease in liquidity, indicating a negative correlation. This phenomenon is attributed to substantial fund transfers during periods of elevated trading, leading to a depletion of the liquidity pool. Maintaining high liquidity is paramount for efficient market operation, ensuring swift and cost-effective trading with minimal price slippage. This correlation poses challenges in striking a balance between accommodating high trading volumes and sustaining adequate liquidity for a stable and positive user experience. To navigate this,

implementing dynamic liquidity provisioning strategies and offering incentives to liquidity providers during peak trading times are crucial measures for Curve Finance's stability and overall user satisfaction. It can be seen as a common occurrence in a pool and on a protocol(Eth mainnet) as a whole as shown earlier



veCRV Impact

The launch of veCRV on October 10, 2020, marked a transformative phase for Curve Finance and its user ecosystem. The vote-escrowed version of CRV, veCRV, brought about notable impacts:

Empowered Governance Participation: veCRV enabled users to actively engage in the governance of Curve Finance. By locking their CRV tokens into veCRV, users gained the ability to influence protocol decisions, such as introducing new pools, adjusting fees, and distributing rewards. This not only granted users a stronger voice in the platform's development but also aligned their interests with the long-term success of the protocol.

Enhanced Yields for Liquidity Providers: Liquidity providers holding veCRV experienced heightened rewards for supplying liquidity to Curve pools. The boost factor, linked to the amount and duration of veCRV locked, amplified yields by up to 2.5 times. This mechanism created a positive feedback loop, enticing more users to lock CRV, provide liquidity, and consequently increase trading volumes and fees generated by the protocol.

3. Increased Demand and Value for CRV: The launch of veCRV stimulated a surge in demand and scarcity for CRV. Users needed to acquire and lock CRV to access veCRV benefits, positively impacting the price and market capitalization of CRV. This scarcity also helped mitigate selling pressure from inflation. Additionally, veCRV holders enjoyed a share of the fees collected by the protocol, introducing an additional income stream and value proposition for CRV.

Trading Strategy

- **Maximize CRV rewards**: This strategy involves providing liquidity to the pools that have the highest CRV rewards, which are shown in the second column of the Curve UI. These rewards are based on the gauge weight, which is determined by the CRV holders' votes. The liquidity

provider can also boost their CRV rewards by locking some of their CRV tokens in the Curve DAO, which increases their voting power and their share of the rewards. This strategy can be lucrative if the CRV price appreciates over time, or if the liquidity provider sells their CRV tokens at opportune moments. However, this strategy also entails some risks, such as impermanent loss, volatility of CRV price, and high gas fees for depositing, withdrawing, and claiming rewards. To mitigate these risks, the liquidity provider should monitor the pool performance, the CRV price, and the gas fees regularly, and adjust their strategy accordingly. Some of the pools that have high CRV rewards are the **TriCrypto** pool, the **sETH** pool, and the **3pool**.

- **Minimize impermanent loss**: This strategy involves providing liquidity to the pools that have the lowest risk of impermanent loss, which is the loss of potential profit due to the divergence of the prices of the tokens in the pool. Impermanent loss is more likely to occur in pools that have volatile or correlated tokens, such as the BTC pools or the ETH pools. To avoid impermanent loss, the liquidity provider can choose to provide liquidity to the pools that have stable or pegged tokens, such as the stablecoin pools or the synthetic pools. These pools have low slippage and low volatility, which means the liquidity provider can earn consistent trading fees without losing much value. However, this strategy also has some drawbacks, such as lower CRV rewards, lower trading volume, and lower returns compared to other pools. To optimize this strategy, the liquidity provider should compare the different pools and their parameters, such as the fee factor, the amplification coefficient, and the swap fee. Some of the pools that have low impermanent loss are the **USDN** pool, the **sUSD** pool, and the **EURS** pool.
- **Leverage composability**: This strategy involves using the liquidity tokens (LP tokens) that the liquidity provider receives from Curve to earn additional rewards elsewhere in the DeFi

ecosystem. This is possible because Curve is compatible with many other protocols that offer various incentives and opportunities for liquidity providers. For example, the liquidity provider can stake their LP tokens in other platforms, such as Yearn, Convex, or Badger, to earn more yield and governance tokens. Alternatively, the liquidity provider can use their LP tokens as collateral to borrow or lend on other platforms, such as Aave, Compound, or Maker, to access more capital or leverage. This strategy can be very profitable if the liquidity provider can find the best combination of platforms and pools that suit their risk and return preferences. However, this strategy also involves more complexity and risk, such as smart contract risk, liquidation risk, and opportunity cost. To execute this strategy, the liquidity provider should do thorough research and due diligence on the different platforms and pools, and use tools such as Zapper or DeFi Saver to manage their positions. Some of the platforms that offer composability with Curve are **Yearn**, **Convex**, and **Badger**.

BIS USE CASES

1) ***What specific aspects of Curve's AMM design make it suitable for cross-border CBDC projects like Project Mariana?***

    a) Low Slippage and High Liquidity: Curve's AMM design, known for maintaining low slippage and high liquidity, is crucial for cross-border CBDC transactions. This ensures that transactions can be executed with minimal price impact, making it ideal for large-scale and frequent cross-border transactions.

b) Stablecoin Expertise:Curve's specialization in stablecoin trading aligns well with CBDCs, which are designed to maintain a stable value pegged to fiat currencies. The AMM's experience in handling stablecoins can contribute to the stability of cross-border CBDC transactions.

c) Automated Market Making: The automated nature of Curve's AMM provides a seamless and decentralized platform for cross-border transactions. This automation streamlines the exchange process, reducing the need for intermediaries and enhancing the overall efficiency of transactions.

2) How can using Curve's AMM technology enhance the efficiency and effectiveness of cross-border CBDC transactions?

a) 24/7 Availability: Curve's AMM operates on blockchain technology, allowing for continuous and 24/7 availability. This can significantly enhance the speed and efficiency of cross-border CBDC transactions, enabling transactions to occur at any time, overcoming traditional banking hours and delays.

b) Decentralization and Security:The decentralized nature of Curve's AMM, operating on blockchain, adds an extra layer of security to cross-border CBDC transactions. It reduces the risk of single points of failure and potential security vulnerabilities associated with centralized systems.

c) Cost-Effective Transactions: The low fees and efficient market-making strategies of Curve's AMM can contribute to cost-effective cross-border CBDC transactions. This is particularly significant for large-scale transactions, where traditional banking fees can be substantial.

3) Why is the collaboration between a central bank institution like BIS and a DeFi platform like Curve significant for the broader financial ecosystem?
    a) Innovation and Synergy: The collaboration signifies a synergy between traditional central banking institutions and innovative decentralized finance platforms. It brings together the stability and authority of central banks with the innovation and efficiency of DeFi, fostering an environment for technological advancements and financial innovation.
    b) Global Financial Inclusion: The collaboration has the potential to bridge the gap between traditional financial systems and the emerging decentralized financial landscape. This can contribute to global financial inclusion by leveraging the strengths of both worlds to create more accessible and efficient financial services.
    c) Knowledge Exchange: The partnership facilitates a two-way knowledge exchange. Traditional institutions can benefit from the technological expertise of DeFi platforms, while DeFi platforms can gain insights into regulatory frameworks and financial stability measures, fostering a more informed and balanced financial ecosystem.

4) What are the potential benefits and challenges associated with integrating Curve's AMM design into the CBDC ecosystem, and how can these be addressed?

Benefits:

    a) Efficiency: Integration can enhance transaction efficiency and reduce costs, as Curve's AMM offers low fees, low slippage, and high liquidity for stablecoin trading.
    b) Innovation: Integration can foster innovation and new use cases, as Curve's AMM enables cross-chain swaps, synthetic asset creation, and yield farming for CBDCs.

c) Inclusion: Integration can promote financial inclusion and accessibility, as Curve's AMM operates on blockchain technology, allowing for 24/7 availability and decentralization of cross-border CBDC transactions.

Conclusion

The exploration into Curve Finance's dynamic ecosystem has revealed insightful patterns and transformative shifts. The nuanced analysis of trading volume patterns highlighted specific peak days, weeks, and months, offering a comprehensive understanding of market behavior. The negative correlation between liquidity and trading volume emphasized the delicate balance in strategic liquidity management.

Tracing Curve Finance's historical evolution showcased its resilience, adaptability, and continuous commitment to innovation since its inception in 2020. Examining unusual market activities during events like the SVB collapse and UST depegging provided valuable insights into the protocol's responses to external shocks.

The introduction of veCRV marked a pivotal moment, enhancing governance participation, boosting yields for liquidity providers, and fostering increased demand and value for CRV. The remarkable growth in Total Value Locked and the number of veCRV holders underscore the positive reception of this mechanism.

Looking forward, monitoring trading volume and liquidity dynamics remains crucial for adapting to market shifts. Enhancing educational initiatives for users and addressing challenges in integrating DeFi platforms with central bank digital currencies (CBDCs) could streamline adoption. Continued collaboration between traditional financial institutions, represented by the Bank for International

Settlements (BIS), and DeFi platforms like Curve is essential for fostering innovation and bridging gaps in the financial ecosystem.

In summary, this comprehensive analysis positions Curve Finance as a key player in the evolving landscape of decentralized finance, with a resilient history, user-centric innovations, and collaborative endeavors with traditional financial institutions.

References

Understanding CurveURL

Understanding CryptoPools URL

AMM Logic White Paper URL

DeFi Platform Curve Finance Takes First Steps Toward crvUSD - CoinDesk URL

How Yield Farming on Curve Is Quietly Conquering DeFi - CoinDesk URL

Reentrancy Vulnerability - Coindesk, Tradedog

Front-End Attack - Coindesk, Crypto Briefing