# Anatomy of a Run: The Terra Luna Crash

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# Overview

- Key findings:

  - Fragile system due to subsidized deposit and lending rates.
  - Blockchain transparency led to cascade effects in investor behavior.
  - Larger investors ran more decisively, incurring smaller losses. Larger players like Alameda Research had significant market impact.

- Main comments:
  1. Risk spillovers from within and outside of crypto markets
  2. Capital design for stablecoins
  3. Stable value token designs

# Impressive data collection and descriptions

Put together, our data cover 7.5 million blocks that contain 228 million transactions from October 3, 2020, to May 15, 2022. One transaction can result in multiple logs on the blockchain. We collect 657 million transaction logs. These logs cover 367 million voting records of oracle prices, 109 million records of LUNA and UST transfers, and 162 million records of smart contract execution results (including 40 million records of CW20 token transfers). Among these transactions, there are 5.4 million Anchor transactions, 1.8 million native swap records, and 97 thousand bridge transfers from Terra to Ethereum.

Our data cover 3.7 million addresses. Among them are 25 centralized exchanges (CEXs), 864 trading pairs on 4 decentralized exchanges (DEXs), 10 inter-chain bridges, 58 DeFi protocols, 319 blockchain validators, 69 other entities including hedge funds and venture capitals, 4,498 CW20 tokens, and 58,941 unnamed smart contracts.

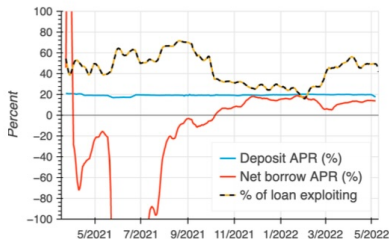# Key takeaway 1: Fragile system due to subsidized deposit and lending rates



**Figure 2: Anchor net rates and exploiting loans.** This figures shows the daily APR of lending (blue line) and borrowing (red line) on Anchor after considering the opportunity cost of the collateral and the ANC subsidy. We assume borrowers use the minimum permitted amount of collateral by the LTV limit and sell ANC subsidies after receiving them. The dashed line shows the proportion of loans from Anchor that are posted back to Anchor as deposits. The series are smoothed with 7-day rolling averages.

# Key takeaway 2: Blockchain transparency adds to the run risks of stable value claims

Transparency with different degrees of salience (in ascending order):

1. Individual large wallet transactions and withdrawals
2. Imbalance in on-chain liquidity pools, e.g. Curve, Uniswap
3. Secondary market price from exchanges
4. Twitter/X posts on 1-3

Transparency increases the likelihood of forming run equilibrium a la Morris and Shin (1998)

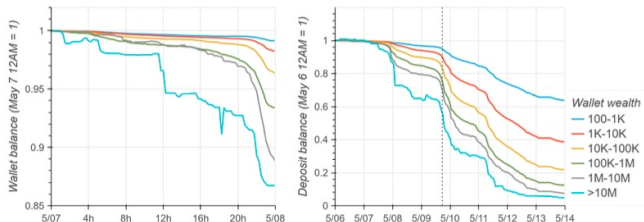# Key takeaway 3: Larger investors (possible insiders?) ran faster



**Figure 16: Anchor outflows by size.** The left panel shows withdrawals from Anchor over the day of May 7, 2022, broken out by the size of the deposit balance of addresses as of May 6, before the run. The sample excludes any addresses held by intermediaries or large institutions and focuses on individual addresses. We also remove addresses with less than 100 UST in Anchor. The right panel shows the same analysis over the period from May 6 to May 14, 2022.
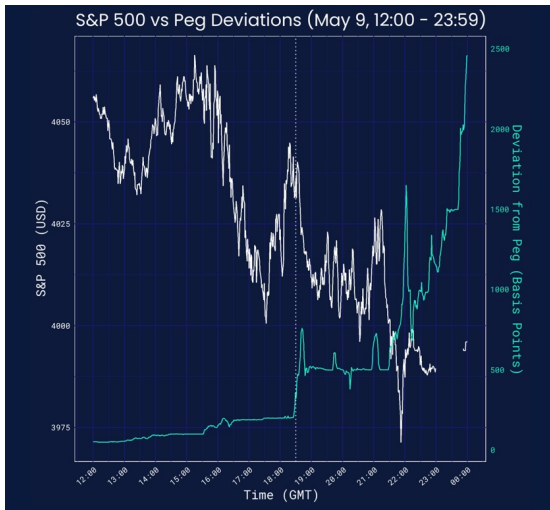
Better disclosures of insider wallets might be helpful

# Commet 1: Risk spillovers within crypto market
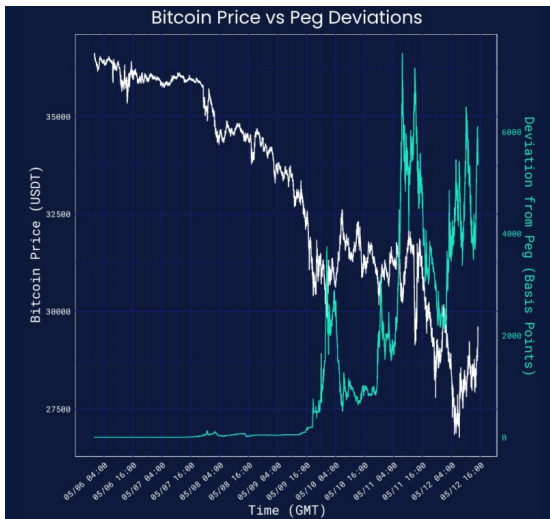


Shah and Latif (2022)
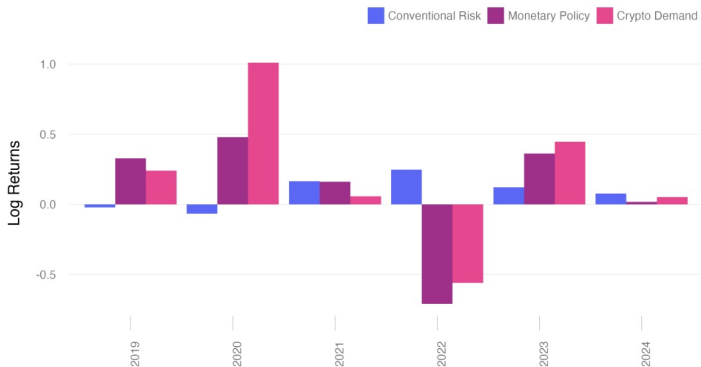
# Comment 1: Risk spillovers across markets



S&P 500 vs Peg Deviations (May 9, 12:00 - 23:59)

Shah and Latif (2022)

# Comment 1: Risk spillovers across market



Panel B: Bitcoin (log) returns decomposition by year

Adams, Ibert, Liao (2024)

# Comment 2: Capital framework for stablecoins

Table 1: Fiat-backed Stablecoin (Consolidated) Balance Sheet Structure

| Assets | Liabilities + Equity |
| --- | --- |
| Token reserve assets | Tokenized Liabilities |
| Corporate assets | Corporate Liabilities |
| | Equity capital |

# Comment 2: Capital framework for stablecoins

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Table 2: Terra algo stablecoin balance sheet on May 7, 2022 [1]

| Assets | Liabilities + Equity |
|---|---|
| Luna held as reserve asset: $26.6 | UST $18.8 B |
| | Equity held in Luna: $7.8B |

# Comment 2: Capital framework for stablecoins

Risk-based capital= Market risk + credit risk + operational risks
Market risk: 75% sell off in May 2021 in 5 days, assume 100% liquidation cost; capital needed is at least 175%
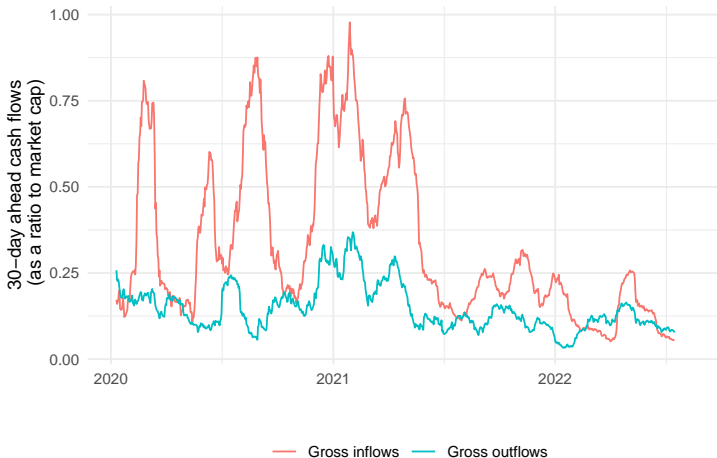


Ratio of Luna to UST market cap

Liao, Fishman, Fox-Geen (2024)

# Comment 3: Implications for digital token money design

Demand shifts in stablecoins can be large



Liao (2022)

# Comment 3: Implications for digital token money design

Typical bank LCR requirements are insufficient to accommodate large demand shifts for tokenised liabilities

Table 4: Liquidity ratios

| Assumption | Run rate | Liquidity ratio |
|---|---|---|
| Non-operational deposit run rate under Basel LCR | -40.0% | 196% |
| Observed 30-day worst run rate with inflows capped at 75% of outflows | -9.2% | 850% |
| Observed 30-day worst run rate with 0% inflow | -36.9% | 212% |
| U.S. GSIBs' LCR average 2022Q2 | | 118% |

*Notes:* This table presents the liquid ratio of USDC calculated under different assumptions of run rates as of August 5, 2022. The calculation is based on the reserve as of August 5, 2022 and is broadly reflective of the general reserve mix of 80% T-bill and 20% cash deposits. The total circulation of USDC was $54.29 billion and the amount of HQLA consisting of Treasurys with less than 90 days of remaining maturity was $42.47 billion. The denominator is calculated as the run rate multiplied by the amount of USDC in circulation. Liquidity ratio is calculated as a ratio of HQLA to outflow according to Equation 1. The last row provides the LCR of the eight U.S. GSIBs based on their 2022Q2 public disclosures as a comparison.

Liao (2022)

# Comment 3: Implications for digital token money design

Macroprudential considerations

- ▶ Optimal asset backing for digital token money needs to be
  - ▶ Liquid
  - ▶ With elastic supply curve
  - ▶ With little consequences to the real economy as demand shifts along supply curve

- ▶ Potential candidates for stablecoin backing:
  - ▶ ~~Loans (Tokenised bank deposits)~~: Inelastic supply, illiquid
  - ▶ T-bills: Deep liquidity, possibly need supply adjustments from the Treasury
  - ▶ Reverse repo: Deep liquidity, collateralized, supply curve locally elastic
  - ▶ Central bank reserves: Ultimate safe asset with elastic supply curve

# New entrants in algo stables

Ethena: Crypto-collateralized, future hedged stable value token, 30%+ yield,
($3.6B market cap as of today)

# Summary

- Great paper detailing an important episode in the development of digital currencies
- Learnings can be applied to designs of deposit tokens and different variants of stablecoins
- Implications for future research:
    - Transparency can worsen run-risks
    - Programmable money = programmable runs (?)
    - Tokenized finance necessitates narrow forms of banking with different regulatory frameworks