Making Algorithmic Stablecoins More Stable

The Terra-Luna Case Study

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Stablecoins (i)

- Peg its price to another asset (e.g. USD)

Use cases:

- **Bridges** between fiat currencies and crypto ecosystem
- **Cross-border payments**
- Lending and borrowing

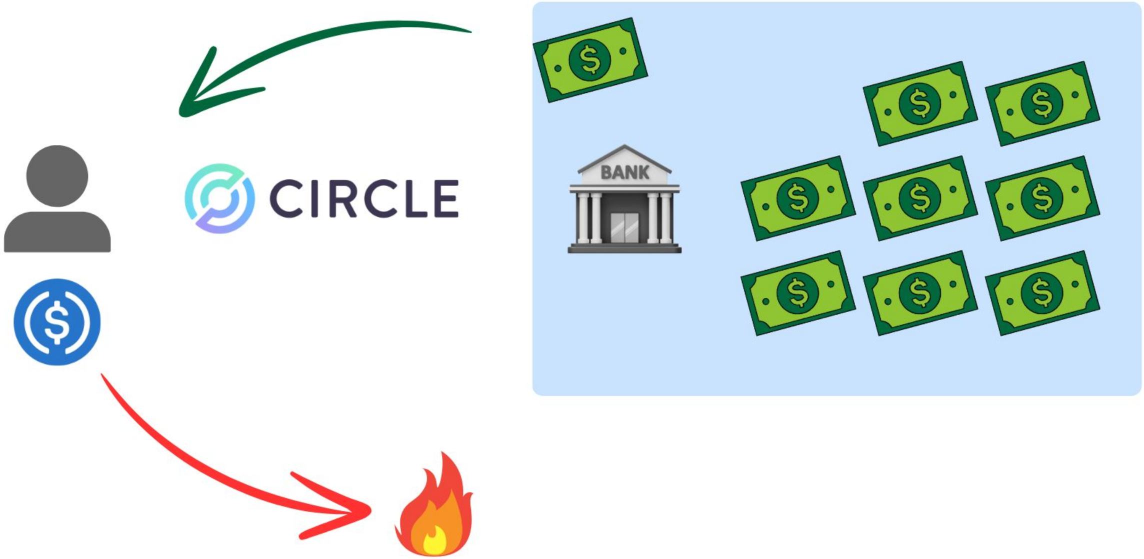
Stablecoins (ii)

Three types:

- Fiat-Collateralized
- Crypto-Collateralized
- Algorithmic

Fiat-Collateralized Stablecoins – USDC (i)

Fiat-Collateralized Stablecoins – USDC (ii)



Algorithmic Stablecoins (i)

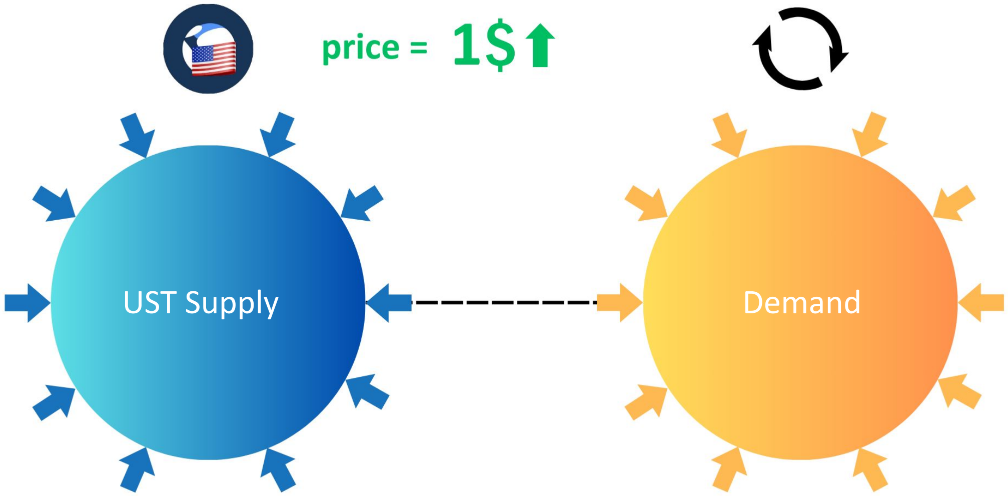
- Peg its price to another asset (e.g. USD)
- Doesn’t have a collateral
- Algorithmic mechanism to expand or contract the supply

Terra implemented a Seigniorage-based approach

Algorithmic Stablecoins (ii)

Algorithmic Stablecoins (iii)

Algorithmic Stablecoins (iv)



Terra Protocol

UST

Stablecoin

LUNA

Governance Token

Terra Protocol – Stability Mechanism (i)

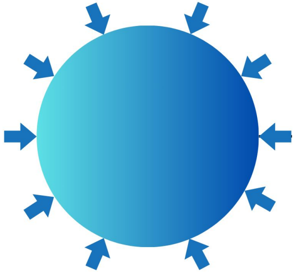
1 UST = $0.95

1 UST

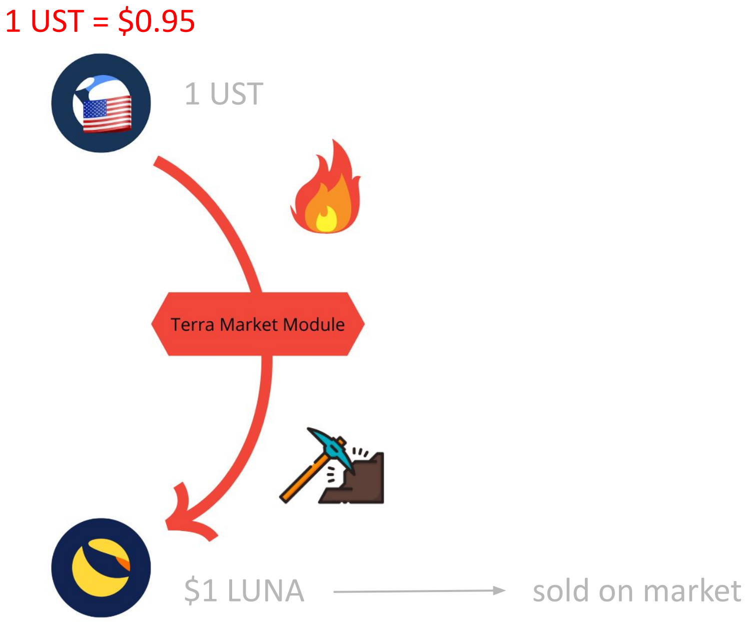
Terra Protocol – Stability Mechanism (ii)

1 UST = $0.95 → UST supply must be reduced

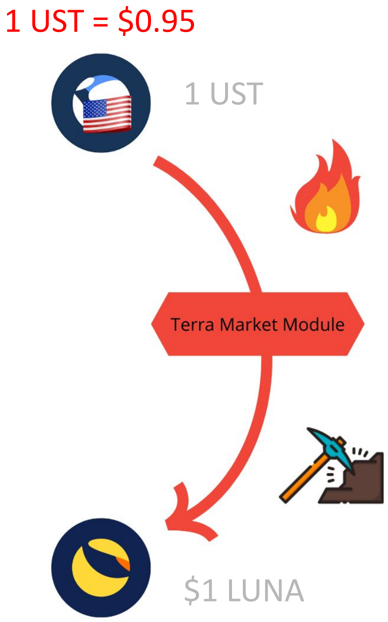
1 UST

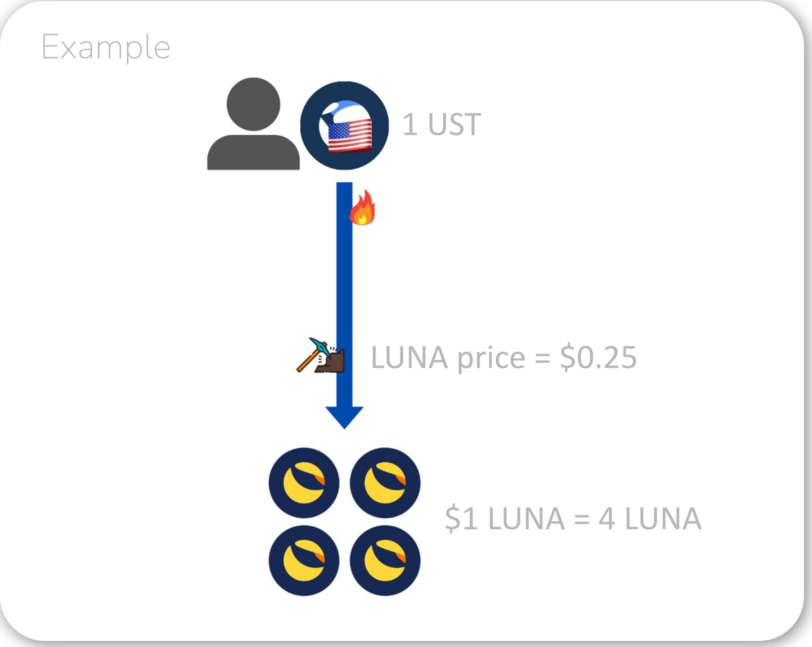


Terra Protocol – Stability Mechanism (iii)

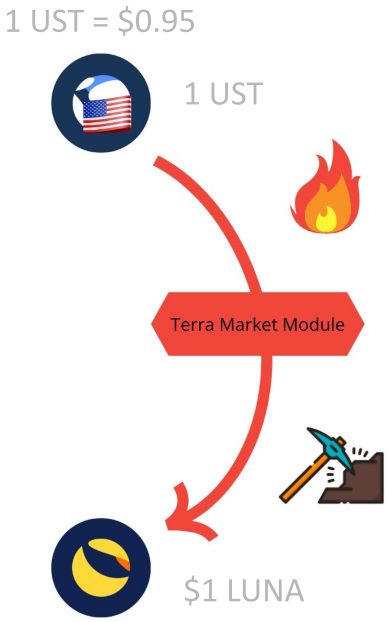


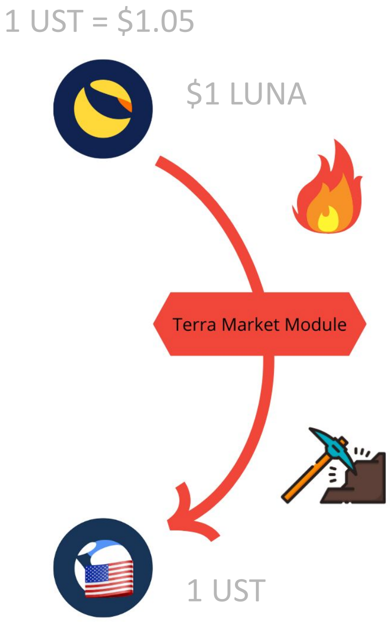
Terra Protocol – Stability Mechanism (iv)





Terra Protocol – Stability Mechanism (v)





The Terra-Luna Collapse

In May 2022 the Terra-Luna protocol collapsed

Loss of over $60B in just few days

Causes of the collapse:

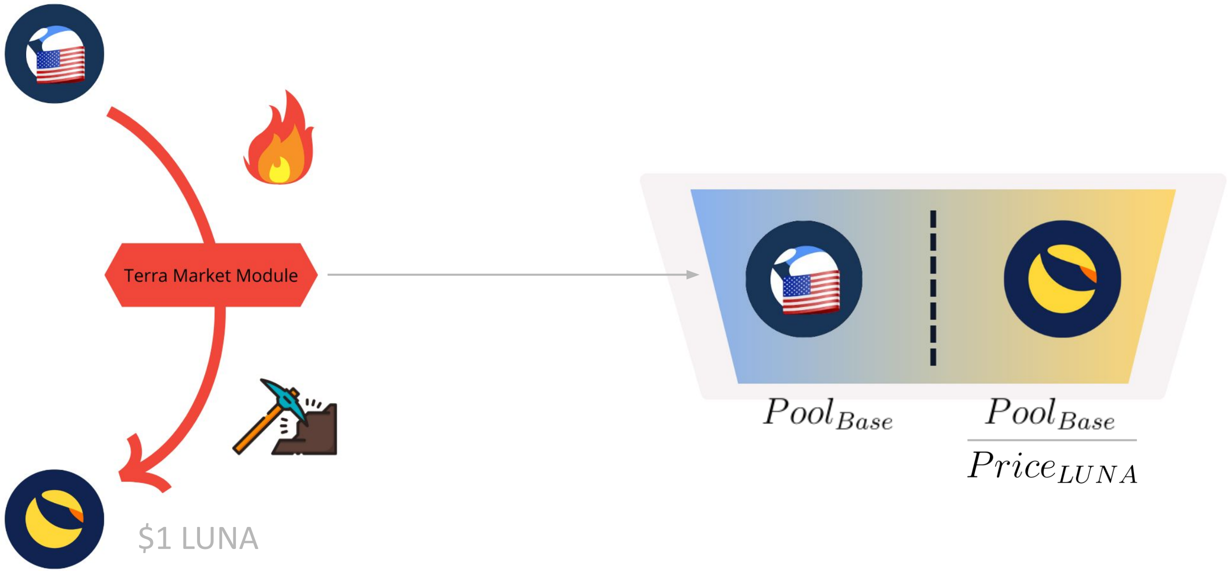
- LUNA hyperinflation
- Stabilization Mechanism failure

Research Objectives

- Analyze the dynamics of the Terra-Luna collapse
  - Simulation-based approach

- Enhancement proposals
  - Using our simulations to evaluate these improvements

Virtual Liquidity Pool – VLP (i)



Virtual Liquidity Pool – VLP (ii)

Market-making algorithm implementing a constant-product formula (CPF)

$$CP = Pool^2_{Base} \cdot \frac{1}{Price_{LUNA}}$$

- $Pool_{Base}$ represents the baseline quantity of UST
- $Price_{LUNA}$ expresses the price of LUNA in USD as observed in external markets

Virtual Liquidity Pool – VLP (iii)

δ represents the deviation of UST amount in the VLP compared to $Pool_{Base}$

$$Pool_{UST} = Pool_{Base} + \delta, \quad Pool_{LUNA} = \frac{CP}{Pool_{UST}}$$

When swaps occur in VLP, δ is updated

Virtual Liquidity Pool – VLP (iv)

“Virtual” because it had the capacity of replenish itself, bringing δ back to zero

At the end of each block produced in the Terra blockchain, the new value of delta is computed:

$$\delta := \delta \cdot \left(1 - \frac{1}{PoolRecoveryPeriod}\right)$$

Redemption Capacity: the amount of UST the protocol can mint or burn per time unit

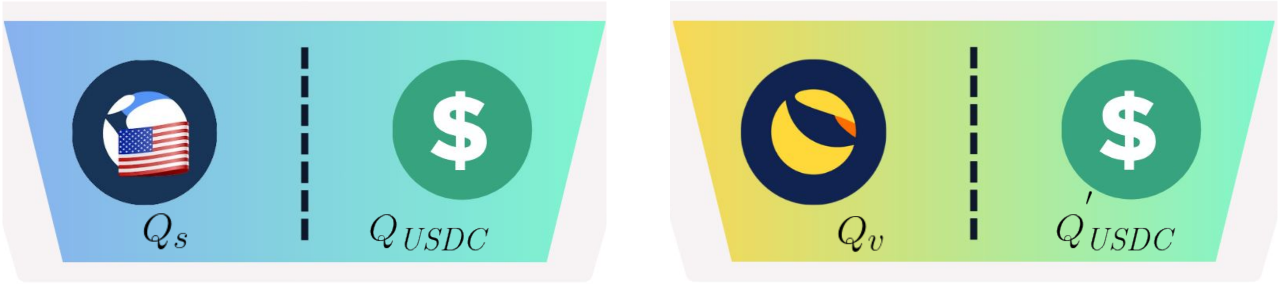
Our Approach

Two simulations:

- Stabilization mechanism
- LUNA hyperinflation

Market Dynamics

Two AMMs implementing a CPF to replicate the market dynamics affecting UST and LUNA



$$k_s = Q_s \cdot Q_{USDC}$$

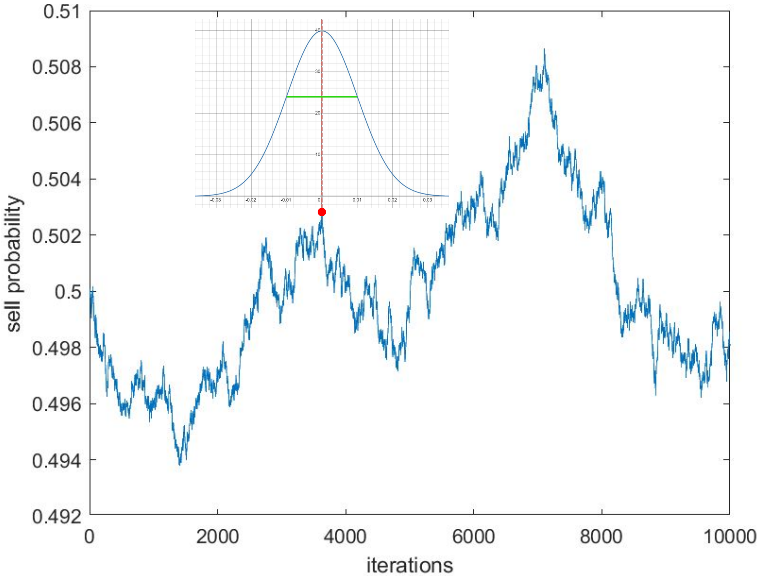
$$k_v = Q_v \cdot Q'_{USDC}$$

Random Walk

Token swaps are modeled as stochastic processes

- A random walk determines the selling/buying probability

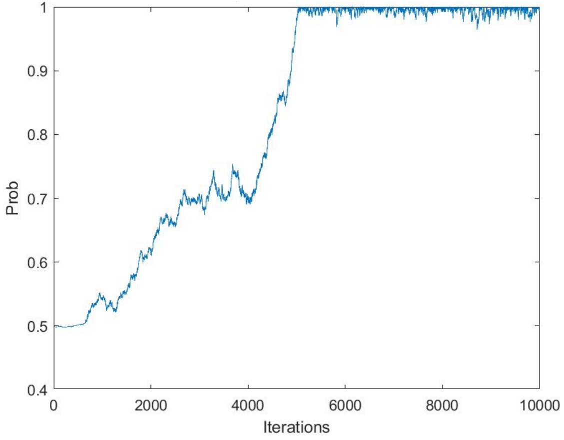
Token Sell Probability



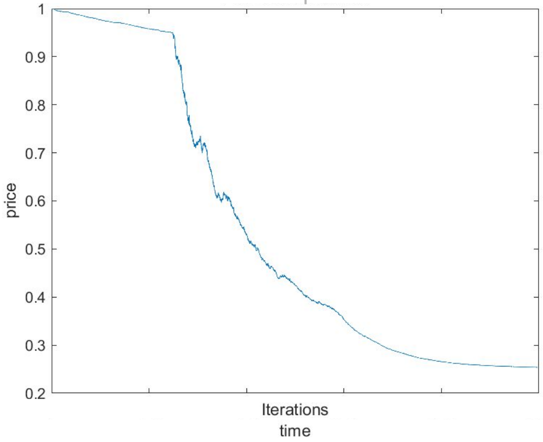
Stress Conditions (i)

A critical aspect of our simulation methodology is the ability to introduce stress conditions that can lead to market collapses

Token sell probability



Token price



Stress Conditions (ii)

Two methods for implement the **crisis scenario**:

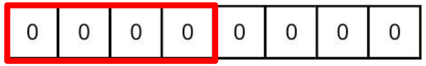
- Variable Mean Approach Based on Price
- Variable Probability Approach

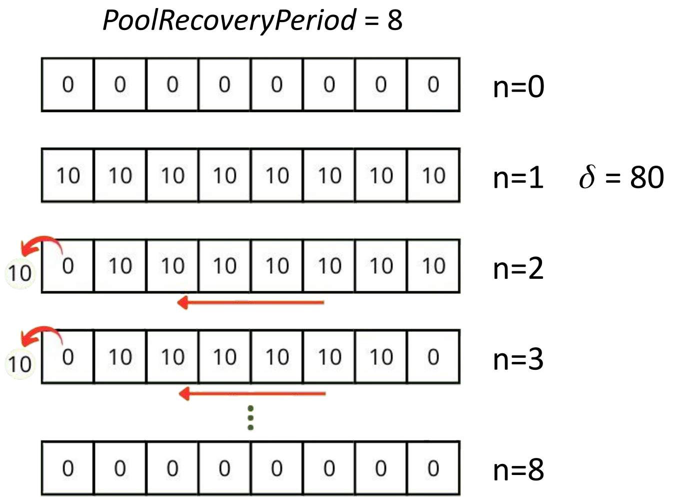
Variable Mean Approach Based on Price → crisis scenario triggered when the UST price falls below $0.95

Variable Probability Approach → crisis scenario triggered when UST sell probability goes above 70%

1) Modifying the TerraPoolδ Mechanism

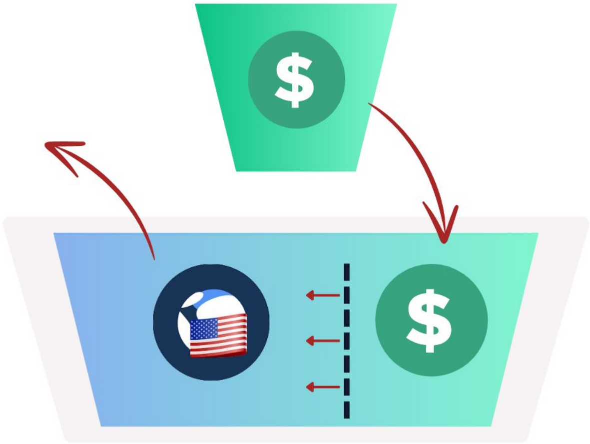
- Our approach brings δ back to zero within a finite number of blocks.
- Vector of length *PoolRecoveryPeriod*
- During a crisis scenario, the length of the vector is halved $\Rightarrow$ the **redemption capacity doubles**





2) Implementing a USDC Reserve Pool

- Reserve pool of USDC that acts as a collateral
- In a crisis scenario, automatically purchase UST
- 20% of the total UST supply



3) Implementing a BTC Reserve Pool against LUNA Hyperinflation

- The Luna Foundation Guard (LFG) was created to support the price of UST

LFG
Luna Foundation Guard

- It built a reserve made up of more than 80.000 BTC

- During collapse, LFG tried to support UST's price by making strategic purchases using its reserve.

LFG | Luna Foundation Guard
@LFG_org

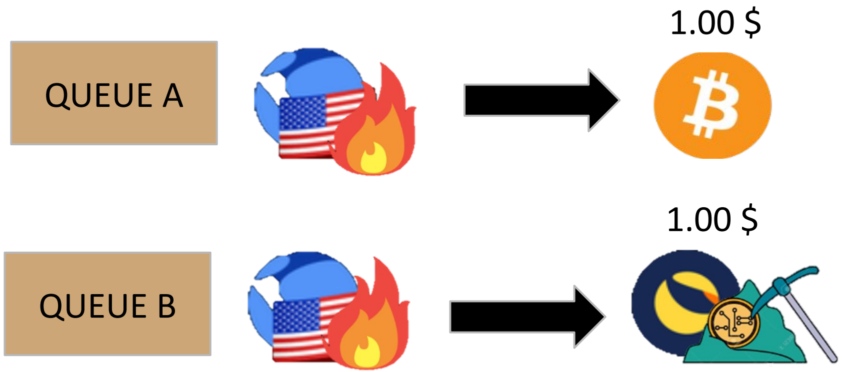
1/ As of Saturday, May 7, 2022, the Luna Foundation Guard held a reserve consisting of the following assets:
· 80,394 $BTC
· 39,914 $BNB
· 26,281,671 $USDT
· 23,555,590 $USDC
· 1,973,554 $AVAX
· 697,344 $UST
· 1,691,261 $LUNA

2:05 AM · May 16, 2022 · Twitter Web App

3) Implementing a BTC Reserve Pool against LUNA Hyperinflation

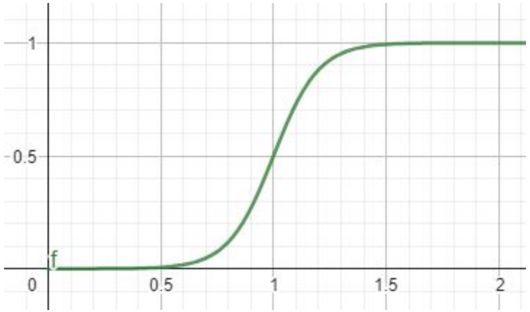
Introducing a queue system:

- Queue A: users who want to swap 1 UST for 1$ worth of BTC
- Queue B: users who want to swap 1 UST for 1$ worth of LUNA



3) Implementing a BTC Reserve Pool against LUNA Hyperinflation

- Use a logistic function to decide which queue to activate



- The probability of activating Queue A depends on two factors:
  1. How far the price has moved from the target
  2. The percentage of filling of the BTC reserve

Results (i)

30 simulations of 100.000 iterations:

- goal: inducing the system to collapse...

  ⇒ volatility is gradually increased during the simulations

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30 simulations of 100.000 iterations:

- goal: inducing the system to collapse…

    ⇒ volatility is gradually increased during the simulations

Original implementation of Terra is unable to face such scenarios

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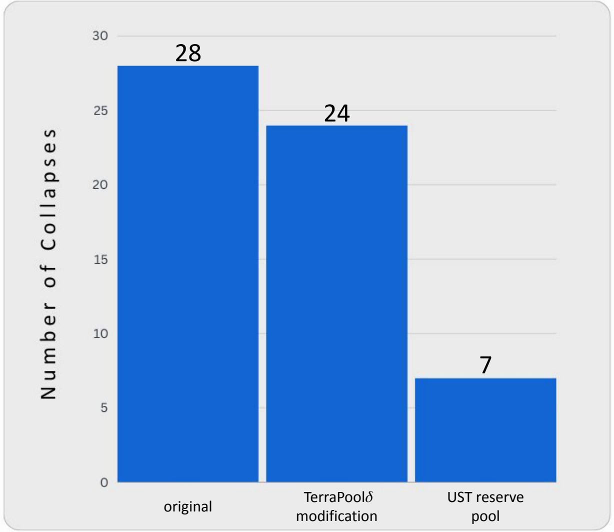
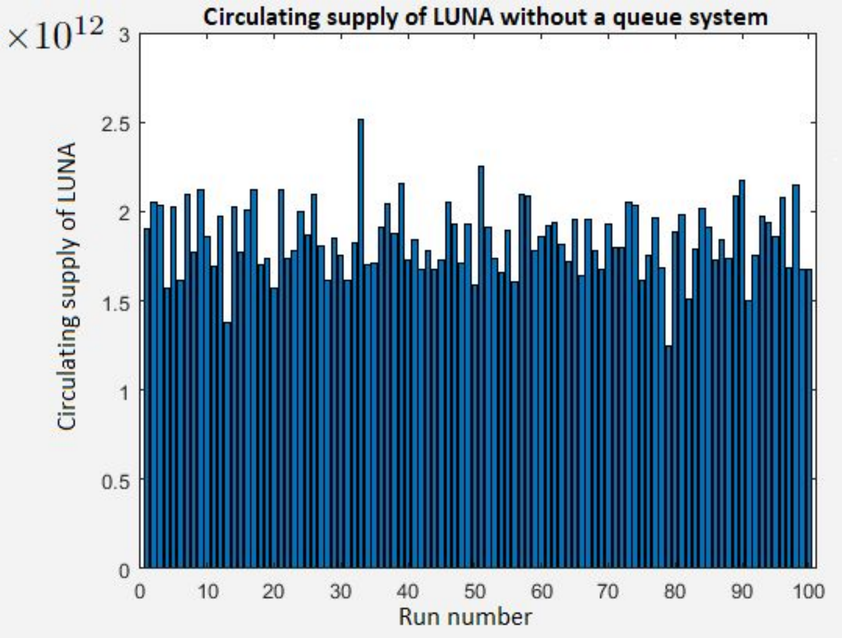
30 simulations of 100.000 iterations:

- goal: inducing the system to collapse…

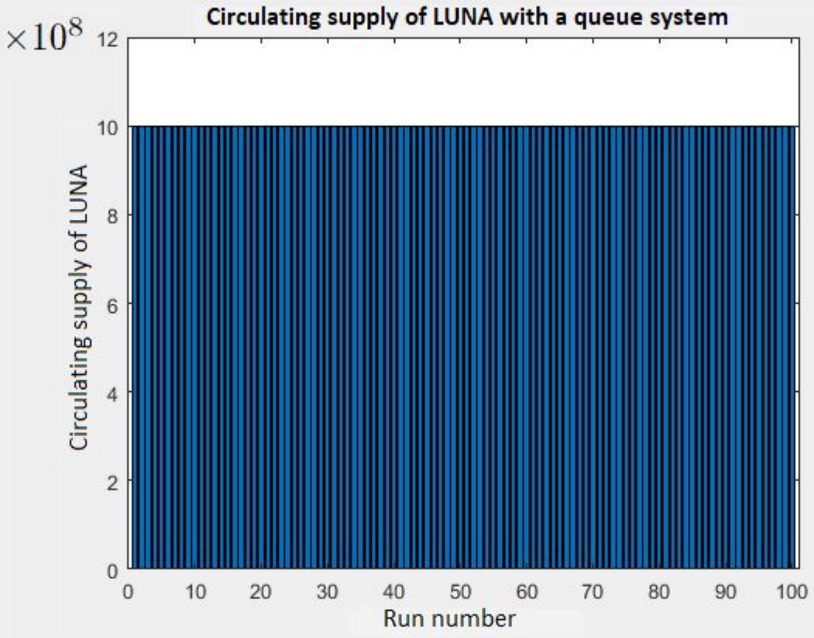
  ⇒ volatility is gradually increased during the simulations



Results (ii)



Circulating supply of LUNA without a queue system
$\times 10^{12}$
3
2.5
2
1.5
1
0.5
0
Circulating supply of LUNA
0 10 20 30 40 50 60 70 80 90 100
Run number



Circulating supply of LUNA with a queue system
$\times 10^{8}$
12
10
8
6
4
2
0
Circulating supply of LUNA
0 10 20 30 40 50 60 70 80 90 100
Run number

Conclusions

- Importance of reserve pools
- Refining replenishment mechanism
- The critical point of the USDC or BTC Reserve Pool methods is that we are moving away from the concept of a pure algorithmic stablecoin

Thank you!