

The UST Death Spiral: Anatomy of an Algorithmic Stablecoin Collapse

A Technical Deep Dive into the \$40 Billion Failure

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Spring 2026

After this lecture you will be able to:

1. **Explain** the mint/burn arbitrage mechanism that underpinned the UST/LUNA peg and why it was structurally unstable [*Understand*]
2. **Reconstruct** the day-by-day timeline of the May 2022 collapse, identifying the key trigger events and feedback loops [*Analyze*]
3. **Evaluate** the systemic lessons for stablecoin design, DeFi protocol risk, and regulatory responses that followed [*Evaluate*]

Scope

Case: Terra/LUNA ecosystem

Date: May 7–12, 2022

Loss: ≈\$40B in 96 hours

Contagion: >\$70B in follow-on failures

Regulatory trigger: MiCA Art. 16 reserves requirement; SEC \$4.47B settlement

This lecture covers verified on-chain data, LFG treasury disclosures, and post-mortem analyses from Chainalysis, Jump Trading, and academic reconstructions.

What Is an Algorithmic Stablecoin?

Three stablecoin designs:

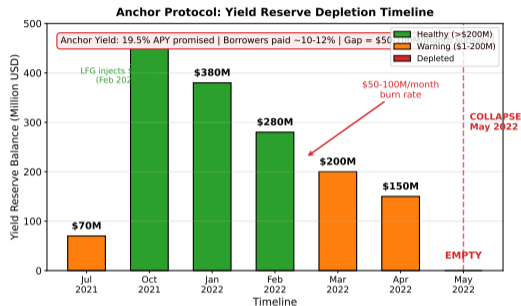
Fiat-backed	Crypto-backed	Algorithmic
USDC, USDT 1:1 dollars in bank Centralised Auditable	DAI 150%+ collateral Over-collateralised Liquidatable	UST, FRAX <i>No collateral</i> Mint/burn arb Faith-dependent

Algorithmic stablecoins rely solely on:

- A second “governance/seigniorage” token (LUNA)
- An arbitrage incentive to restore peg via minting/burning
- Market confidence that the mechanism will hold

No collateral floor. If confidence collapses, the mechanism has nothing to fall back on.

Bass & Weissberger (2022): “Algorithmic stablecoins are, in essence, a confidence game dressed as a monetary system.” All three major algo-stables (Basis, Iron Finance, UST) collapsed within months of reaching scale.



The UST/LUNA Mint/Burn Mechanism

The invariant: $1 \text{ UST} \equiv \$1$ worth of LUNA

UST < \$1: Burn 1 UST \rightarrow receive \$1 of LUNA (profit).
Reduces UST supply.

UST > \$1: Burn \$1 of LUNA \rightarrow mint 1 UST. Sell at premium. Increases UST supply.



Arbitrage: if $\text{UST} < \$1$, burn UST for \$1 of LUNA.
If $\text{UST} > \$1$, burn LUNA for 1 UST.

Why arbitrageurs participate:

1. On-chain profit when peg deviates
2. Protocol enforces swap at \$1 face value
3. No counterparty risk (trustless)

Hidden assumption:

The mechanism only works if arbitrageurs *trust LUNA will hold value*. If LUNA crashes faster than they can profit, the incentive inverts.

The Circularity Problem

UST is backed by LUNA. But LUNA derives value from UST demand. Each token's price depends on the other's stability.

The mechanism was mathematically sound in normal conditions. The failure was not a bug – it was the correct operation of the mechanism under conditions of collapsing confidence in LUNA.

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- Borrowing rates $\approx 12\text{--}15\%$ APY – gap subsidised by LFG
- LFG injected \$450M (Feb 2022) and \$450M more (May 2022)
- Yield declining was the distress signal the market feared

Anchor Protocol: The 19.5% Yield Trap

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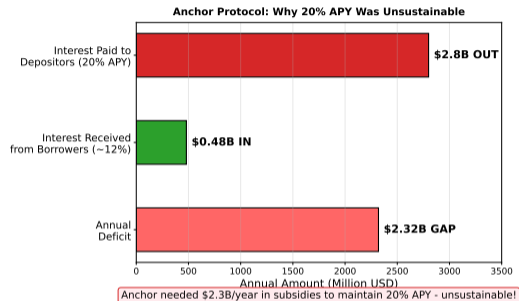
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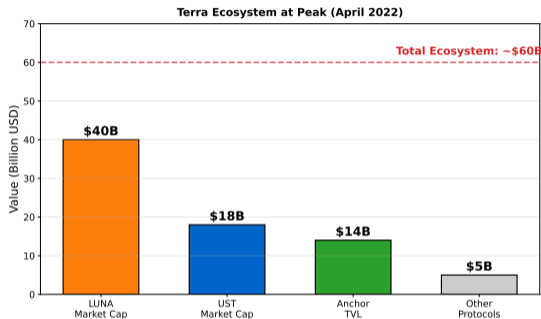
Scale at peak:

- \$14B in Anchor = 75% of all UST outstanding
- Anchor was a *demand subsidy*, not a lending market

A 19.5% risk-free yield on a dollar-denominated asset is impossible in traditional finance. The rate was sustainable only while LFG reserves lasted and UST demand grew faster than subsidy costs. Neither condition held.



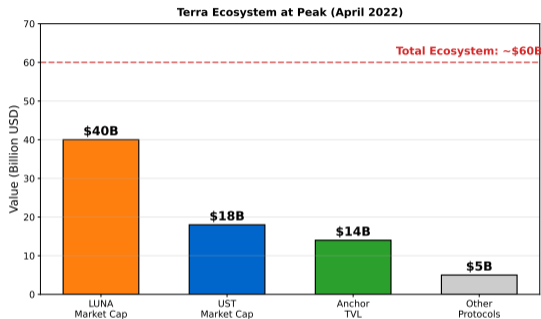
Terra at Its Peak: A \$60 Billion Ecosystem



Terra ecosystem at peak (April 2022):

<u>Component</u>	<u>Value</u>
LUNA market cap	\$41.0B
UST market cap	\$18.7B
Anchor TVL (UST deposits)	\$14.0B
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Terra DeFi TVL (total)	\$29.7B

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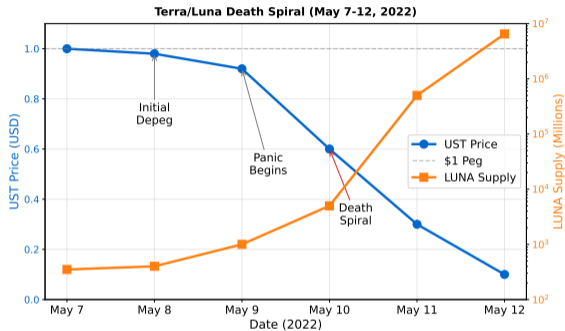
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Three structural vulnerabilities visible in hindsight:

1. 75% of UST supply concentrated in one protocol (Anchor)
2. LFG BTC reserve = only \$3.5B against \$18.7B UST – a 19% backing ratio
3. LUNA market cap needed to *exceed* UST market cap at all times for the mint/burn to hold; at \$18.7B UST, a 55% LUNA crash would invert the ratio

Do Kwon, Terraform Labs CEO, publicly announced a \$10B Bitcoin reserve accumulation plan (Feb 2022). The plan was meant to provide a final collateral backstop – but \$3.5B was insufficient to absorb a coordinated sell-off.

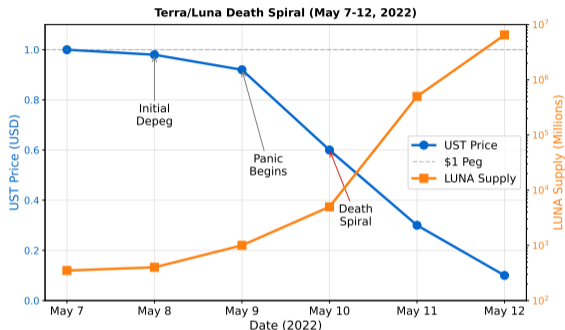
Day by Day: The Death Spiral (May 7–12, 2022)



Timeline of collapse:

- **May 7:** \$285M UST withdrawn from Anchor and dumped via Curve pool; UST briefly depegs to \$0.98. LFG begins selling BTC reserves to defend peg.

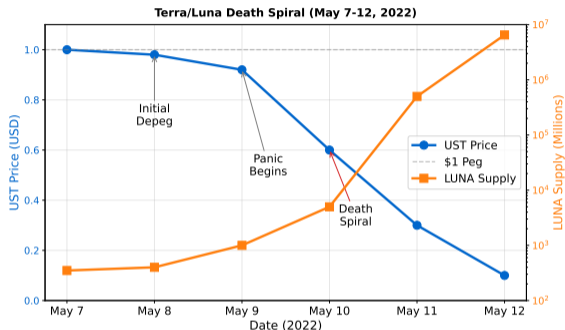
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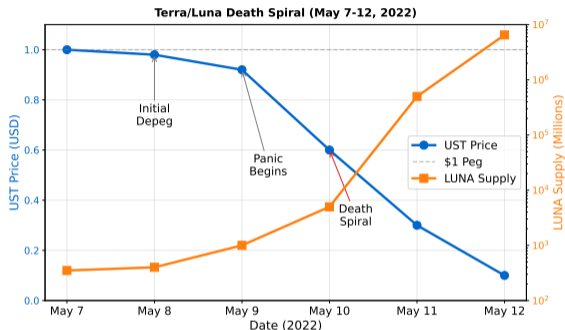
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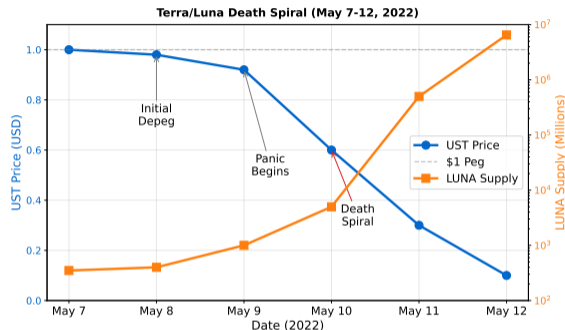
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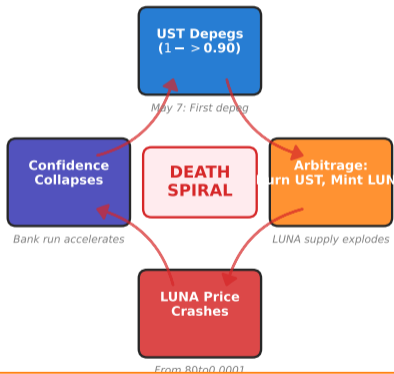


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- **May 11–12:** UST reaches \$0.10. LUNA effectively worthless at \$0.0001. Combined \$40B in value destroyed in 96 hours.

The May 7 initiating transaction is confirmed on-chain: a wallet drained \$285M of UST from Curve in a single transaction. Whether this was a coordinated attack or opportunistic profit-taking remains disputed. The structural weakness, not the trigger, was the cause.

Terra/Luna Death Spiral Mechanics



May 7-12, 2022: UST \$1.00 -> \$0.01 | LUNA 350M -> 6.5T tokens | \$40B+ lost

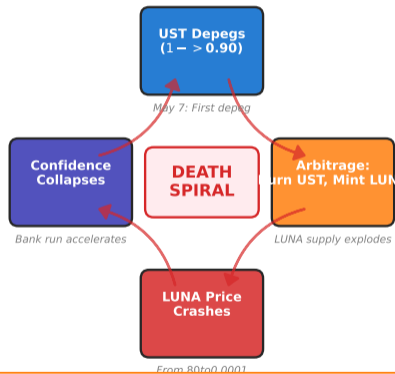
Soros reflexivity applied to Terra:

George Soros: “Market prices influence the fundamentals they are supposed to reflect.”

The positive feedback loop:

1. UST sells off → price drops below \$1
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3. LUNA supply hyperinflates → LUNA price crashes
4. Each new UST requires *more* LUNA to be minted (same \$1 value, lower LUNA price)
5. More LUNA supply → faster LUNA collapse
6. LUNA collapse → less confidence in UST backstop
7. → More UST selling → back to Step 1

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This dynamic is sometimes called a “bank run on an empty bank.” Traditional bank runs can be stopped with a lender of last resort. The UST mechanism had no equivalent – LFG’s BTC was finite and dwarfed by the panic volume.

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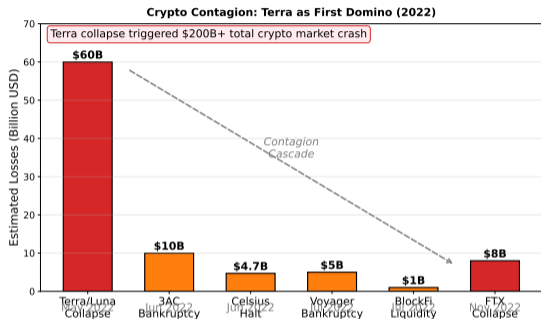
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Why this is a “death spiral” not just a “crash”:

Each step makes the next step worse. The peg mechanism amplifies the very panic it is designed to prevent. There is no equilibrium below the confidence threshold.

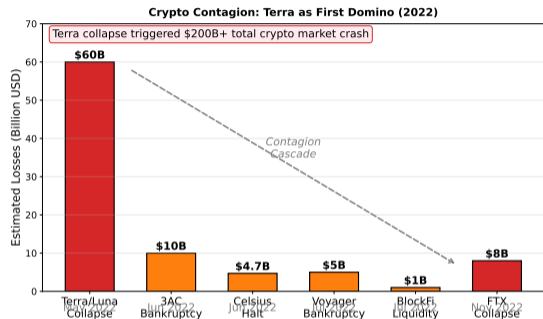
Contagion: The \$70 Billion Domino Chain



Interconnected exposures:

- **Celsius Network** (\$12B AUM): Had deposited UST and LUNA in Anchor for yield; frozen withdrawals June 2022; bankruptcy July 2022
- **Three Arrows Capital** (\$10B AUM): \$560M direct Terra exposure; liquidated by counterparties; collapsed June 2022
- **Voyager Digital** (\$5.8B): \$661M unsecured loan to 3AC; bankruptcy July 2022
- **BlockFi** (\$5B): \$80M 3AC exposure; emergency FTX rescue June 2022; then FTX collapsed November 2022
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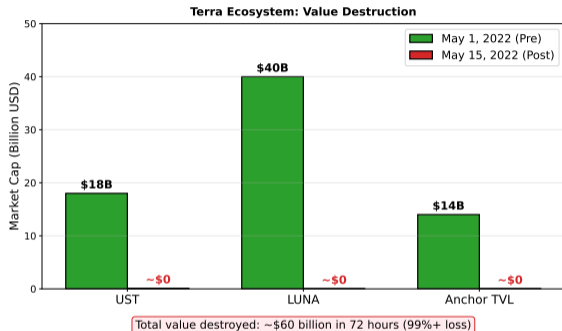
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Common thread: All were offering yields that required perpetual capital inflows. Terra exposed the entire “yield chain” as structurally fragile.

Total crypto market cap fell from \$1.8T (Jan 2022) to \$830B (Jun 2022) – a 54% decline. Terra was not the sole cause, but it was the triggering event that revealed systemic leverage across CeFi and DeFi simultaneously.

Why Algorithmic Stablecoins Are Structurally Fragile



Three structural weaknesses – confirmed by UST:

1. No Collateral Floor

Without real-world backing, minimum value is zero. Any confidence shock can drive price to zero – no economic anchor exists below which the asset cannot fall.

2. Reflexive Death Spiral

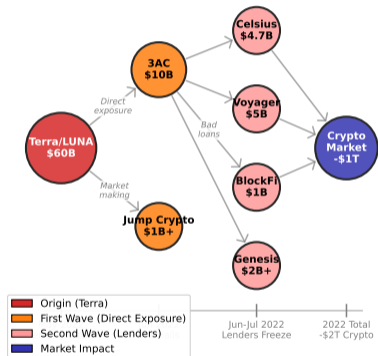
The peg mechanism requires LUNA to hold value. But LUNA holds value only because UST holds its peg. The circularity means both collapse simultaneously – and the mechanism accelerates the collapse.

3. Bank Run Dynamics

Rational behaviour for each individual (exit early) is collectively destructive. Once withdrawals exceed a threshold, all rational actors should exit – self-fulfilling collapse. No mechanism stops a unanimous bank run without external capital.

Eichengreen (2022) categorised algo-stables as “fundamentally fragile by design.” The same year, the BIS published a working paper showing that all non-collateralised stablecoins studied had failed within 18 months of reaching \$1B in market cap.

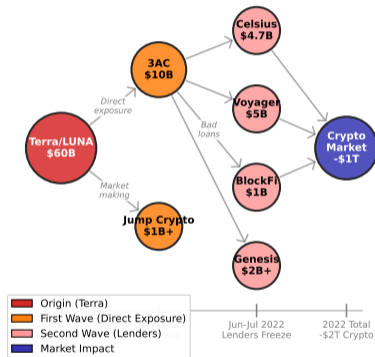
Terra/Luna Contagion Map: From \$60B Collapse to Crypto Winter



Legal outcomes (verified):

- Do Kwon arrested Montenegro Mar 2023; extradited to US Jan 2025
- SEC settlement: \$4.47B (Jun 2024, largest-ever crypto penalty)
- Do Kwon personal: \$204M disgorgement

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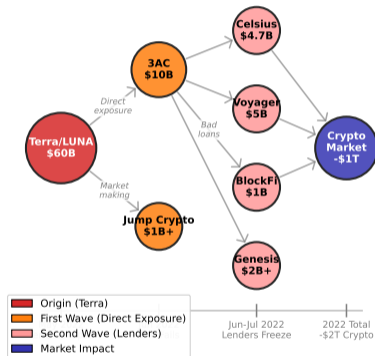
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Sound stablecoin design principles:

1. Collateral must *exceed* outstanding supply
2. Liquidation faster than price movements
3. No single protocol holds $>50\%$ of supply
4. Reserve assets uncorrelated with stablecoin

The Terra collapse became the “Lehman moment” of crypto – not because it was the largest failure, but because it demonstrated systemic interconnection, triggered regulatory action across three continents, and ended the era of uncollateralised algorithmic stablecoins.