

L38: Stablecoin Mechanisms

Module E: DeFi Ecosystem

Blockchain & Cryptocurrency

December 2025

- Understand different stablecoin mechanism types
- Analyze fiat-backed stablecoins (USDC, USDT)
- Explore crypto-backed stablecoins (DAI, MakerDAO CDPs)
- Evaluate algorithmic stablecoins and their failure modes
- Compare stablecoin trade-offs (decentralization, stability, capital efficiency)

What is a Stablecoin?

Definition: A cryptocurrency designed to maintain a stable value relative to a reference asset (usually \$1 USD).

Why Stablecoins?

- **Price stability:** Avoid crypto volatility
- **Medium of exchange:** Pay for goods/services
- **DeFi building block:** Lending, trading, yield farming
- **Store of value:** Park funds without exiting crypto
- **Remittances:** Fast, cheap cross-border payments

Total Stablecoin Market Cap: \$140B (Dec 2024)

Top Stablecoins:

- 1 USDT (Tether): \$90B
- 2 USDC (Circle): \$35B
- 3 DAI (MakerDAO): \$5B

Challenge: Hard to achieve all three simultaneously.

1 Stability

- Maintain peg to target (e.g., \$1)

2 Decentralization

- No central authority, censorship-resistant

3 Capital Efficiency

- Minimal collateral required

Trade-offs:

- **Fiat-backed (USDC):** Stable + efficient, but centralized
- **Crypto-backed (DAI):** Stable + decentralized, but capital inefficient
- **Algorithmic (failed UST):** Decentralized + efficient, but unstable

Type 1: Fiat-Backed Stablecoins

Mechanism: 1 stablecoin backed by \$1 in bank account.

How It Works:

- 1 User deposits \$100 fiat to issuer
- 2 Issuer mints 100 stablecoin tokens
- 3 User can redeem 100 tokens for \$100 fiat anytime
- 4 Issuer holds reserves (cash, T-bills, commercial paper)

Examples:

- **USDC (Circle):** Fully backed by cash and short-term US Treasuries, monthly attestations
- **USDT (Tether):** Mixed reserves, less transparent, largest stablecoin
- **BUSD (Binance):** Regulated by NYDFS (shut down 2023)

Advantages:

- Strong peg stability
- Capital efficient (1:1 backing)
- Easy to understand

Issuer: Circle (US fintech company)

Backing:

- 100% reserves in cash and short-term US Treasuries
- Held at regulated banks
- Monthly attestations by Grant Thornton (accounting firm)

Minting/Burning:

- Institutions can mint/redeem 1:1 with Circle
- Retail users buy on exchanges

Regulation:

- Subject to US money transmission laws
- Can freeze addresses (OFAC sanctions compliance)

Market Cap: \$35B (Dec 2024), deployed on Ethereum, Solana, Avalanche, Polygon, etc.

USDT: Tether Controversy

Largest stablecoin (\$90B) but controversial.

Issues:

- **Opacity:** Reserves not fully transparent until recent years
- **Commercial Paper:** Historically held risky commercial paper (reduced since 2022)
- **Legal Issues:** Fined by CFTC (\$41M, 2021) for misleading reserve claims
- **Banking:** No clear disclosure of reserve custodians

Current Reserves (2024):

- 80% US Treasuries
- 10% cash
- 5% corporate bonds
- 5% other (Bitcoin, gold, loans)

Why Still Dominant?

- First-mover advantage (launched 2014)
- Deepest liquidity on all exchanges
- Network effects

Advantages

- Strong peg (usually)
- Capital efficient (1:1)
- Redeemable for fiat
- Widely accepted
- Regulated (institutional trust)

Disadvantages

- Centralized (issuer control)
- Censorship risk (freeze funds)
- Counterparty risk (trust issuer)
- Opaque reserves (sometimes)
- KYC required for redemption

Black Swan Risk: Bank run if users lose confidence in reserves.

Historical Example: Silicon Valley Bank collapse (March 2023) briefly depegged USDC to \$0.87 (Circle had \$3.3B deposited there).

Type 2: Crypto-Backed Stablecoins

Mechanism: Backed by crypto collateral (overcollateralized).

How It Works:

- 1 User deposits \$150 of ETH as collateral
- 2 Protocol mints \$100 DAI stablecoin
- 3 Collateralization ratio: 150% (over-backed for safety)
- 4 If ETH price drops, position liquidated to protect peg

Example: DAI (MakerDAO)

- Largest decentralized stablecoin (\$5B)
- Backed by ETH, WBTC, USDC, and other assets
- Governed by MKR token holders

Advantages:

- Decentralized (no central issuer)
- Transparent (all on-chain)
- Censorship-resistant

Core Components:

1. Collateralized Debt Positions (CDPs) / Vaults

- User deposits collateral (e.g., ETH)
- Mints DAI up to collateralization ratio limit
- Pays stability fee (interest) to protocol

2. Collateralization Ratio

- Minimum: 150% for ETH (can borrow \$100 DAI with \$150 ETH)
- Varies by collateral type (WBTC, stETH, etc.)

3. Liquidation

- If collateral value drops below threshold, vault liquidated
- Auction mechanism sells collateral to repay DAI debt

4. Governance (MKR Token)

- Set collateral types, ratios, stability fees
- Manage risk parameters

DAI Minting Example

User Actions:

Step 1: Open Vault

- Deposit 10 ETH (worth \$20,000 at \$2,000/ETH)

Step 2: Mint DAI

- Collateralization ratio: 150%
- Max DAI: $\frac{20,000}{1.5} = 13,333$ DAI
- User mints 10,000 DAI (safe margin)

Step 3: Use DAI

- Spend DAI for expenses, DeFi, trading

Step 4: Repay and Close

- Repay 10,000 DAI + stability fee (e.g., 2% annually)
- Withdraw 10 ETH collateral

Risk: If ETH drops to \$1,333, vault liquidated (collateral ratio falls below 150%).

How DAI maintains \$1 peg:

1. Arbitrage

- If DAI $<$ \$1: Mint DAI (cheap), sell for \$1+ (profit)
- If DAI $>$ \$1: Buy DAI (cheap), repay vault (profit)

2. Stability Fee (Borrow Rate)

- High fee: Reduces DAI supply (repayments exceed new minting)
- Low fee: Increases DAI supply (more minting)

3. DAI Savings Rate (DSR)

- Users lock DAI to earn yield
- Reduces circulating supply, supports peg

4. Peg Stability Module (PSM)

- Swap USDC for DAI 1:1 (no slippage)
- Backstop for large depeg events

Original Vision: Pure crypto-backed, decentralized stablecoin.

Current Reality (2024):

- 40% backed by USDC (centralized stablecoin)
- 30% backed by ETH/crypto
- 20% backed by Real-World Assets (RWAs: T-bills, bonds)
- 10% other

Trade-off:

- **USDC backing:** Improves peg stability, capital efficiency
- **Cost:** Reduces decentralization (Circle can freeze USDC)

Community Debate:

- Should DAI maximize decentralization or stability?
- “Endgame” proposal aims to reduce USDC exposure

Type 3: Algorithmic Stablecoins

Mechanism: Maintain peg through algorithmic supply adjustments (no collateral or minimal collateral).

How It Works (Theoretically):

- If price \downarrow \$1: Increase supply (mint new tokens, sell for profit)
- If price \uparrow \$1: Decrease supply (buy and burn tokens, or incentivize burns)

Examples:

- **Terra UST:** Failed spectacularly (May 2022, next lecture)
- **AMPL (Ampleforth):** Rebase token (adjusts balances daily)
- **FRAX:** Hybrid (partially collateralized, partially algorithmic)

Theoretical Advantage:

- Capital efficient (no or minimal collateral)
- Decentralized (no issuer)
- Scalable

Reality: Most pure algorithmic stablecoins have failed (death spirals).

Death Spiral Scenario:

- 1 Stablecoin depegs below \$1 (e.g., \$0.95)
- 2 Protocol mints sister token to incentivize buying stablecoin
- 3 Sister token price crashes (dilution from minting)
- 4 Loss of confidence accelerates stablecoin selling
- 5 Stablecoin drops further (\$0.80, \$0.50, \$0.10...)
- 6 **Result:** Spiral to zero, total collapse

Root Cause: No intrinsic backing or demand floor.

Lesson: Algorithmic stability relies entirely on market confidence. Once lost, irrecoverable.

Analogy: Like a central bank with infinite money printer but no reserves.

Innovation: Partially collateralized, partially algorithmic.

Mechanism:

- Collateral Ratio (CR) adjusts dynamically (e.g., 85% collateral, 15% algorithmic)
- To mint 1 FRAX: Deposit \$0.85 USDC + burn \$0.15 FXS (governance token)
- To redeem 1 FRAX: Receive \$0.85 USDC + \$0.15 FXS

CR Adjustment:

- If FRAX \downarrow \$1: Lower CR (reduce collateral requirement)
- If FRAX \uparrow \$1: Raise CR (increase collateral backing)

Advantage:

- More capital efficient than 100% collateralized (DAI)
- More stable than pure algorithmic (UST)

Market Cap: \$600M (Dec 2024), survived Terra collapse.

Type	Example	Backing	Decentralized	Efficient
Fiat-backed	USDC	USD (1:1)	No	Yes
Fiat-backed	USDT	Mixed	No	Yes
Crypto-backed	DAI	ETH+USDC	Partial	No
Algorithmic	UST	None (failed)	Yes	Yes
Hybrid	FRAX	USDC+FXS	Partial	Partial

Observations:

- No stablecoin achieves all three (trilemma)
- Fiat-backed dominates by market cap (90%)
- Crypto-backed (DAI) is most decentralized with stable track record
- Pure algorithmic has failed repeatedly

1. Trading Pair

- Most crypto traded against USDT/USDC (not USD)

2. DeFi Lending

- Earn 3-10% APY on stablecoin deposits

3. Payments

- Remittances, merchant payments (fast, low-cost)

4. Liquidity Provision

- Low impermanent loss for stablecoin pairs (USDC/DAI)

5. Hedging

- Exit volatility without converting to fiat

6. Yield Farming

- Stable base for leveraged strategies

US Regulation (Evolving):

- **USDC, USDT:** May be classified as securities or payment systems
- **Stablecoin Bill (proposed):** Require reserves, FDIC insurance, regular audits
- **SEC View:** Some stablecoins may be securities if yield-bearing

EU MiCA Framework (2024):

- Stablecoins classified as E-Money Tokens
- Reserve requirements (1:1 backing)
- Issuer licensing
- Consumer protections

Impact:

- Fiat-backed stablecoins: More regulation, higher barriers
- Decentralized stablecoins (DAI): Regulatory gray area
- Algorithmic stablecoins: Likely banned or heavily restricted

Historical Depegs:

1. USDC (March 2023)

- Silicon Valley Bank collapse (\$3.3B USDC reserves)
- USDC briefly dropped to \$0.87
- Recovered within days (FDIC backstop, Circle transparency)

2. DAI (Black Thursday, March 2020)

- ETH crashed 50% in hours
- Liquidations overwhelmed system
- DAI briefly spiked to \$1.10 (high demand)

3. USDT (Multiple Times)

- Briefly depegged to \$0.95-\$0.98 during FUD
- Always recovered (deep liquidity)

Lesson: Even well-backed stablecoins can temporarily depeg during extreme stress.

Audit Levels (Best to Worst):

1 Full Audit

- Independent auditor verifies reserves
- Rare (expensive, time-consuming)

2 Attestation

- Accountant confirms reserve snapshot
- More common (USDC, USDT)

3 Self-Reporting

- Issuer publishes own data
- Least trustworthy

4 On-Chain (Crypto-Backed)

- Reserves visible on blockchain (DAI)
- Most transparent

Best Practice: Monthly attestations minimum, real-time on-chain tracking preferred.

Key Takeaways:

- Stablecoins face trilemma: stability, decentralization, capital efficiency
- Fiat-backed (USDC, USDT) dominate market cap (90%) but are centralized
- Crypto-backed (DAI) is decentralized but capital inefficient (150% collateralization)
- Algorithmic stablecoins (UST) have repeatedly failed via death spirals
- Hybrid models (FRAX) balance collateral and algorithm
- Depegs can occur even with strong backing (SVB crisis affected USDC)
- Regulatory focus intensifying (reserve requirements, licensing)

Next Lecture: Case Study - Terra/Luna Collapse (largest algorithmic stablecoin failure).

- ❶ Why did MakerDAO add USDC backing despite reducing decentralization?
- ❷ What would happen to USDC if Circle's bank failed without FDIC coverage?
- ❸ How does DAI's Peg Stability Module (PSM) prevent large depegs?
- ❹ Why do pure algorithmic stablecoins tend to enter death spirals?
- ❺ Should regulators treat stablecoins as money, securities, or commodities?