Money Creation in Decentralized Finance: A Dynamic Model of Stablecoins and Crypto Shadow Banking

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Stablecoins and Decentralized Finance (DeFi)

- Demand for blockchain-based safe assets with stable value
  - DeFi: blockchain-based alternatives to banking, brokerage, and exchanges
  - A financial system needs safe assets as means of payment and store of value
  - Portfolio rebalancing between volatile crypto and stablecoin
  - Pledge crypto holdings to borrow stablecoins for payments
- Stablecoins: stable prices against reference currencies, backed by reserves
  - Specialized stablecoin service providers: MakerDAO, Tether, TrueUSD ...
  - Established multi-national networks: JPM Coin, Fnality (a consortium of banks and exchanges), Diem (a consortium led by Facebook)

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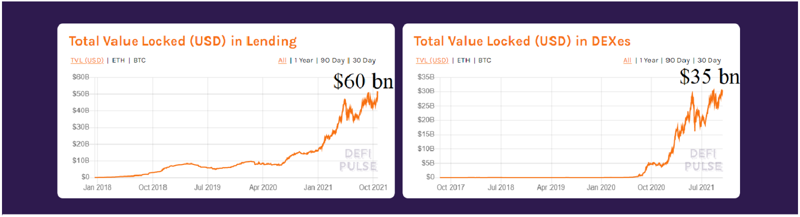

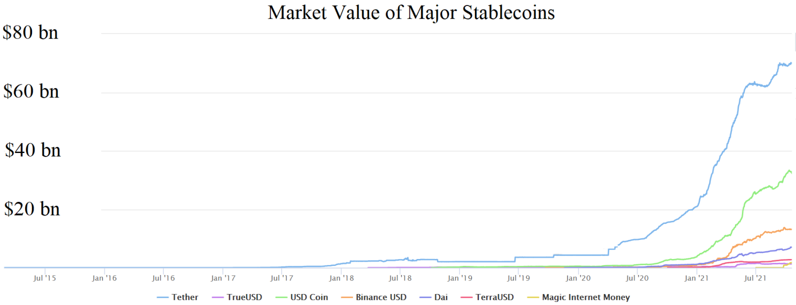

Research Questions

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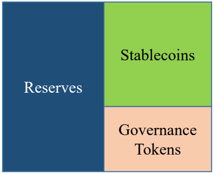
- Focus on over-collateralized stablecoins backed by risky reserves

Crypto Shadow Banking

Panel A: Stablecoin Backed by Reserves



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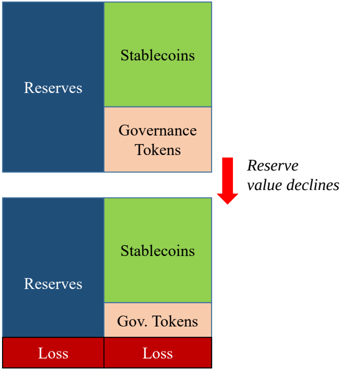

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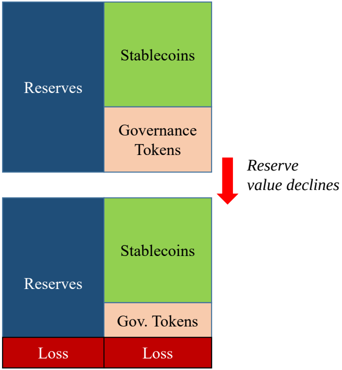
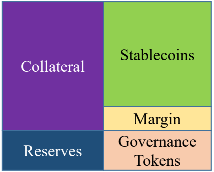


Panel B: User Collateral and Platform Reserves



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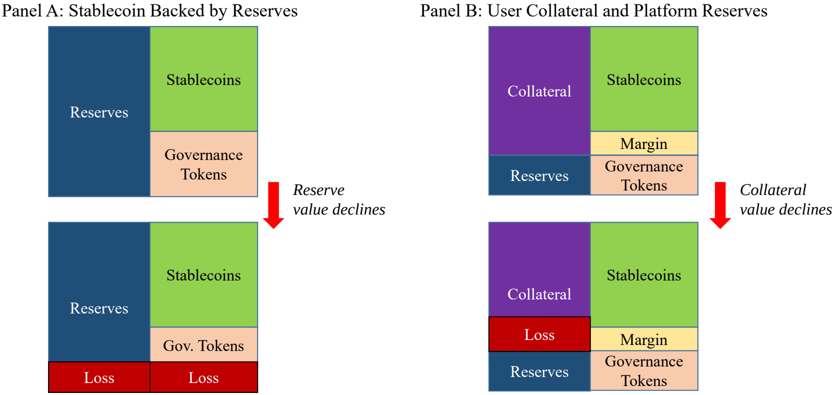

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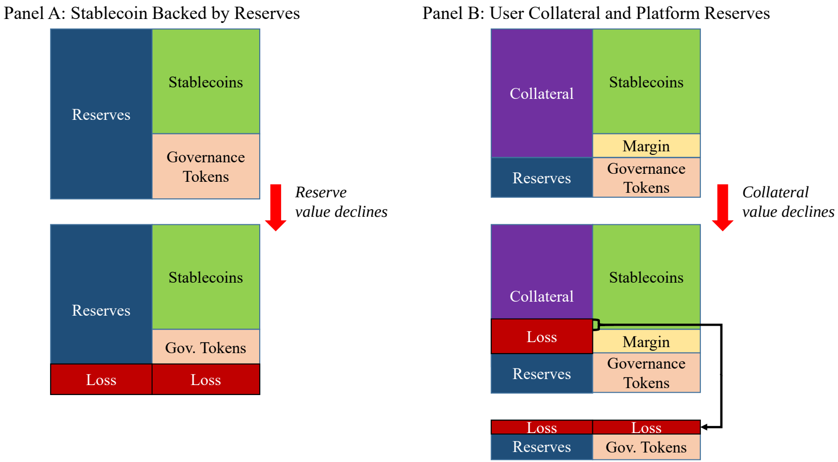

A Dynamic Model of Stablecoin Economics

A Model of Stablecoins: The Model Setup

- Reserves M_t: $dM_t = rM_t dt + (P_t + dP_t)dS_t + N_t f_t dt + N_t \sigma dZ_t - dDiv_t$
  - Dollar value of users' demand: $\int_{i \in [0,1]} u_{i,t} dt = N_t = P_t S_t$ (price $\times$ quantity)
  - Proportional transaction fees, f_t, under constant velocity
  - The "dividend" payout, $dDiv_t$, goes to the governance token holders
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- P_t, endogenous token (dollar) price, evolves as $\frac{dP_t}{P_t} = \mu_t^P dt + \sigma_t^P dZ_t$
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- A risk-neutral representative user i's ($i \in [0, 1]$) net payoff over dt:

$$\max_{u_{i,t}} \underbrace{\frac{1}{\beta} N_t^{\alpha} u_{i,t}^{\beta} A^{(1-\alpha-\beta)} dt - u_{i,t} f_t dt - u_{i,t}\eta|\sigma_t^P| dt}_{\text{Transaction utility}} + u_{i,t}\left(\frac{dP_t}{P_t} - rdt\right)$$

  - Safety preference η (Gorton, Pennacchi, 1990; DeMarzo, Duffie, 1999; Dang, Gorton, Holmström, Ordoñez, 2014; Moreira and Savov, 2017)

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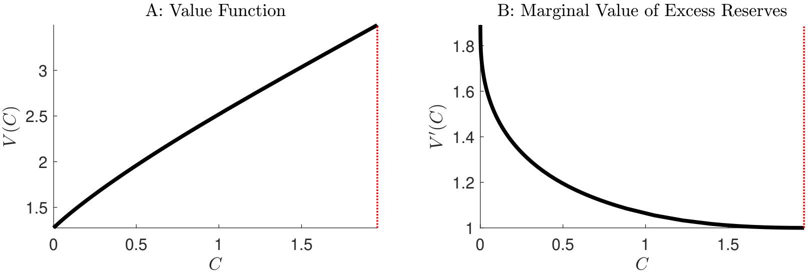
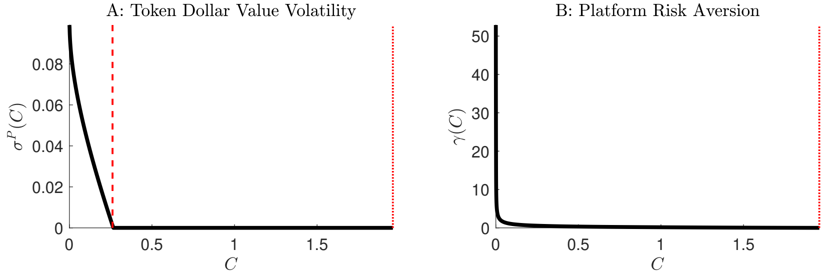
- The issuer's value function: $V(C_t) = \max_{\{f_t, S_t, Div_t\}} \mathbb{E}\left[\int_{s=t}^{\infty} e^{-\rho(s-t)} dDiv_s\right]$
  - $V(C_t)$ is the market valuation of governance tokens (secondary units)
  - Effective risk aversion: $\gamma(C) \equiv -\frac{V''(C)}{V'(C)}$

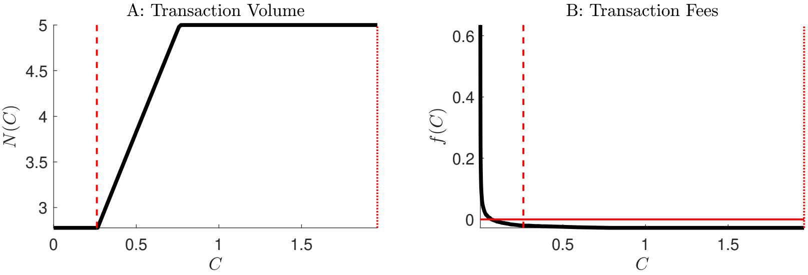
The Issuer's Value Function (Governance Token Valuation)



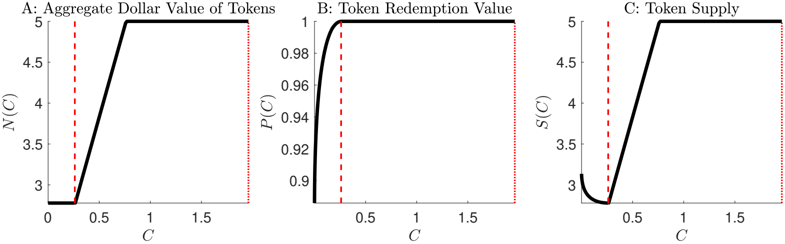
Endogenous Exchange-Rate Regimes



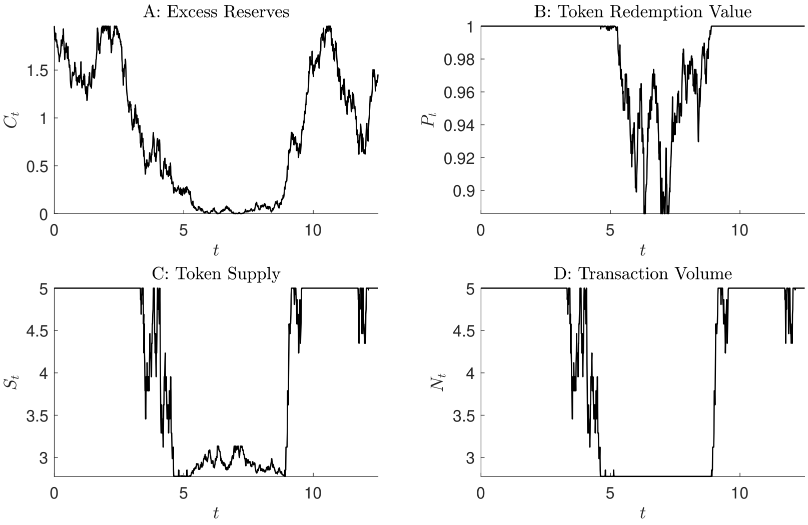
Transaction Volume and Fees



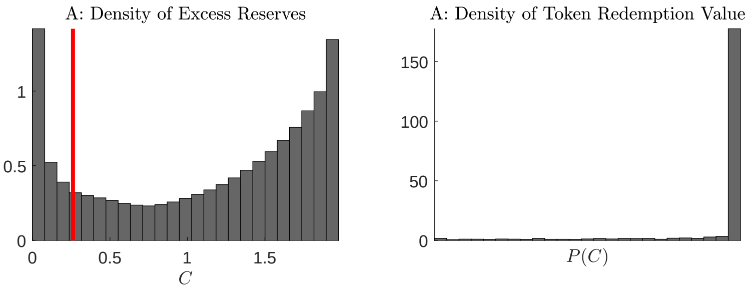
Token Price and Supply Dynamics



Simulation


A: Excess Reserves
B: Token Redemption Value
C: Token Supply
D: Transaction Volume
C_t
P_t
S_t
N_t
t
0
0.5
1
1.5
5
10
0.9
0.92
0.94
0.96
0.98
3
3.5
4
4.5

Distribution



- Low-reserve states: debasement → depressed token demand → low transaction value and fee revenues → slow rebuild of reserves → persistent debasement
- Low-reserve states: token price stability → strong token demand → high transaction value and fee revenues → reserves accumulate → token price stability

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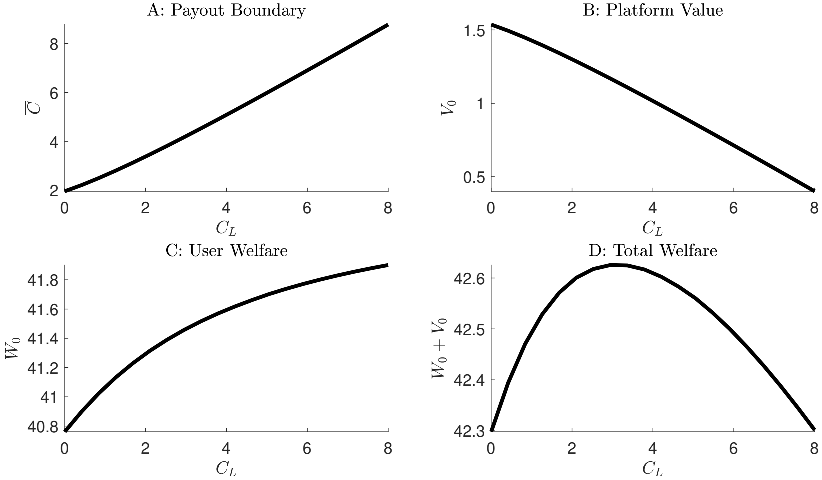
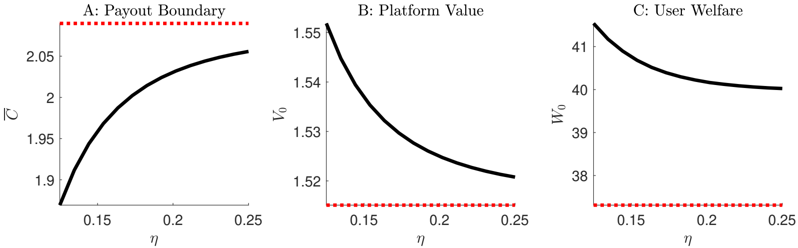
- At issuance, the jump $\uparrow$ in C implies a jump $\uparrow$ in token demand
  - $\rightarrow$ To rule out predictable price movement (arbitrage), the platform must simultaneously expand stablecoin supply (i.e., selling stablecoins for dollar)

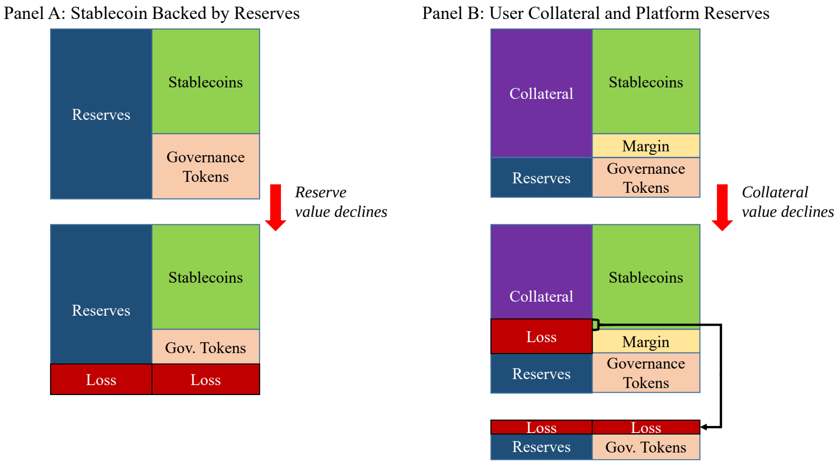
Capital Regulation $C \geq C_L$ Stabilizes P_t and Can Be Optimized



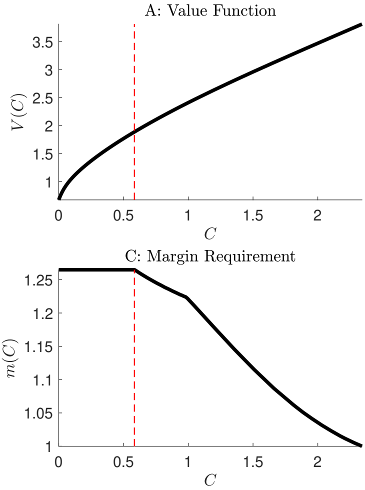
Perfect Stability $\sigma_t^P = 0$ Destroys Welfare



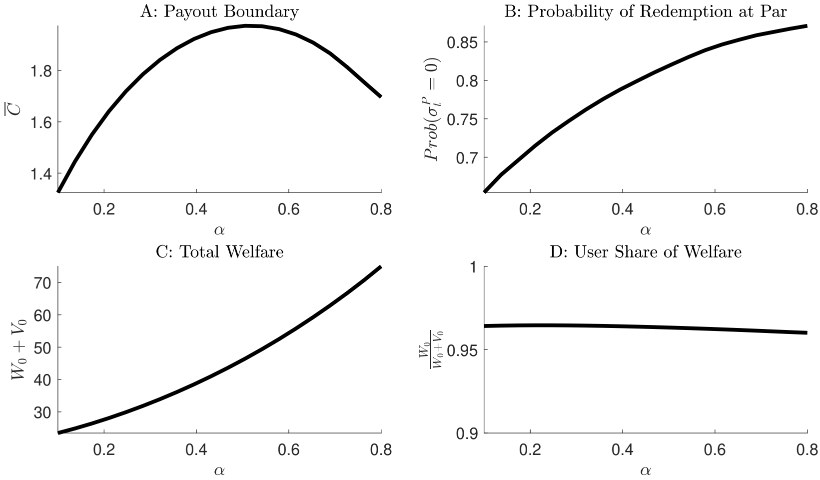
Crypto Shadow Banking: Structure



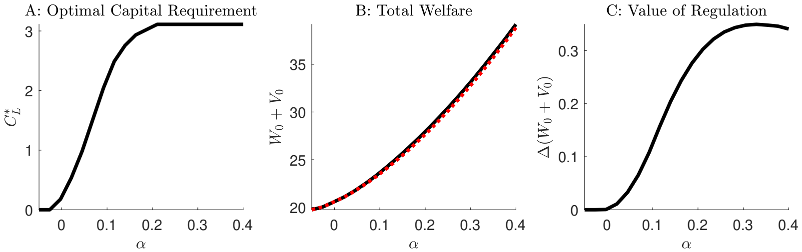
Crypto Shadow Banking: Optimal Margin Requirement



Should Platforms Issue Stablecoins? Network Effect α



Should Platforms Issue Stablecoins? Capital Regulation & Network Effects



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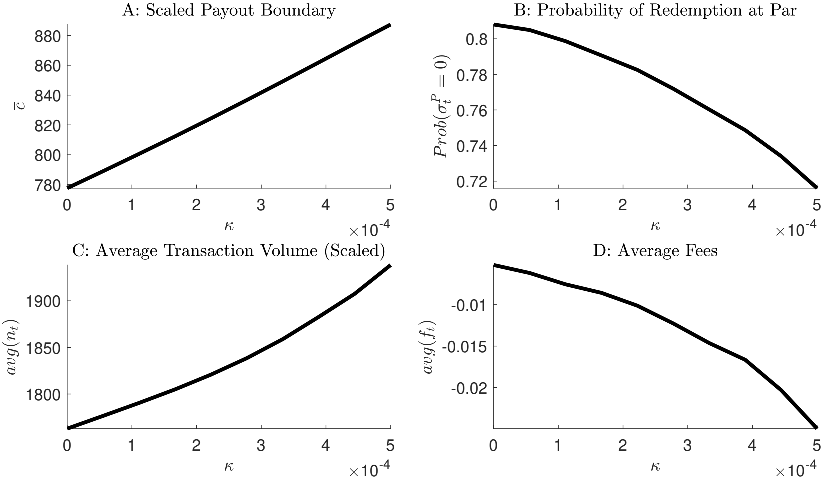
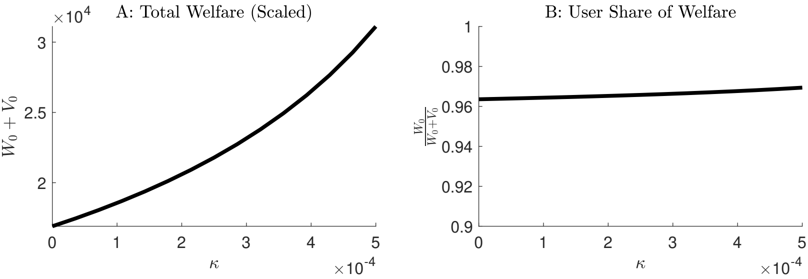
  - Statistically speaking, data and excess reserves should be cointegrated – both data and excess reserves grow exponentially over time

Should Platforms Issue Stablecoins? The Data/Stablecoin Paradox



Should Platforms Issue Stablecoins? The Welfare Split.



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