Monetary Economics of Digital Currencies

L02: Money Theory Meets Cryptocurrency

Economics of Digital Finance

BSc Course

Lesson Overview

Today's Topics

1. Functions of money revisited
2. Quantity theory in digital age
3. Cryptocurrencies as money
4. Stablecoin economics
5. Currency substitution

Learning Objectives

- Apply monetary theory to digital currencies
- Assess crypto against money functions
- Analyze stablecoin stability mechanisms
- Understand Gresham's Law implications

Monetary economics provides rigorous framework for evaluating digital currencies

Functions of Money: Economic Analysis

Medium of Exchange
Economic rationale:

- Eliminates barter inefficiency
- Reduces search and matching costs
- Transaction cost $= c_b - c_m$ where $c_m \ll c_b$
  (Transaction cost with barter minus cost with money; money makes trading much cheaper)

Requirements:

- Acceptability (network effect)
- Divisibility
- Portability

Unit of Account
Economic rationale:

- Reduces cognitive costs
- With n goods: $\frac{n(n-1)}{2} \to n-1$ prices
  (With n goods, barter needs n(n-1)/2 exchange rates; money needs only n-1 prices)
- Enables economic calculation

Store of Value
Requirements:

- Stable purchasing power
- Low volatility: $\sigma_{\text{money}} < \sigma_{\text{goods}}$
  (Money's price volatility must be lower than goods for it to work as stable measuring stick)
- Inflation protection

These functions matter because digital currencies must satisfy all three to replace traditional money effectively

Quantity Theory of Money in Digital Age

Classical Equation of Exchange

$$MV = PY$$

(Money supply times velocity equals price level times real output—how money flows through economy)

- M = Money supply
- V = Velocity of circulation
- P = Price level
- Y = Real output

Implications

- If V stable: $\Delta M \rightarrow \Delta P$
  (If velocity is stable, increasing money supply leads to higher prices—more money chasing same goods)
- Seigniorage = $\frac{\dot{M}}{P}$
  (Rate of money creation divided by price level—profit from printing money)
- Inflation tax on money holders

Digital Currency Complications

Bitcoin example:

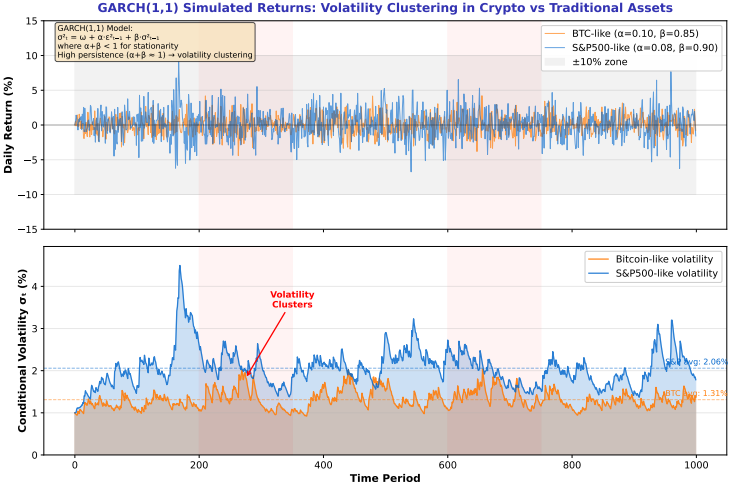
- M fixed at 21 million (deflationary)
- V highly volatile and hard to measure
- Which P? (Crypto priced in fiat)

Velocity Puzzle

- Traditional money: $V \approx 5 - 7$
- Bitcoin: V varies 2-20+
- Stablecoins: Very high turnover

Quantity theory matters because it explains how Bitcoin's fixed supply creates deflationary pressure, making it impractical as everyday money

Bitcoin as Money: The Volatility Problem



High volatility (50-85% annually) makes Bitcoin impractical as a unit of account—imagine if the dollar's value changed 50% per year

Cryptocurrencies as Money: Economic Assessment

Medium of Exchange: Grade C-

- Limited merchant acceptance
- High transaction costs (at times)
- 10-60 min confirmation times
- Scalability trilemma

Unit of Account: Grade F

- Extreme volatility
- "Menu cost" of repricing
- No contracts denominated in BTC

Store of Value: Grade C

- Long-term appreciation (but volatile)
- Digital gold narrative
- Correlation with risk assets

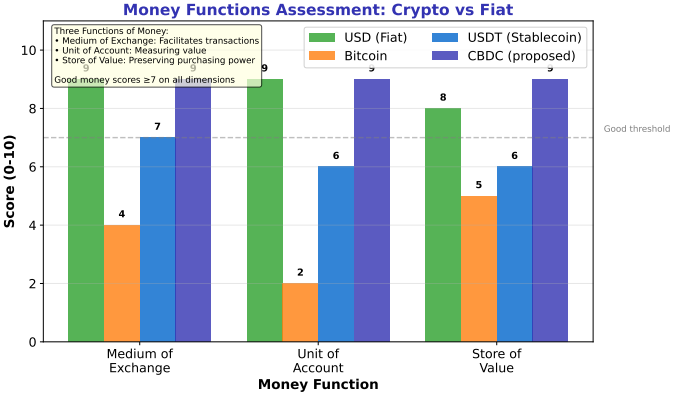
Yermack (2015) Conclusion

"Bitcoin behaves more like a speculative investment than a currency"

- Low correlation with major currencies
- High correlation with tech stocks
- Driven by speculation, not trade

These poor grades matter because they explain why Bitcoin hasn't replaced traditional money despite 15+ years of existence

Money Functions: Comparative Assessment



CBDCs designed to achieve high scores across all functions; stablecoins compromise

Stablecoin Economics: Design and Mechanisms

Types by Collateral

1. Fiat-backed (USDT, USDC)

- 1:1 reserve in bank accounts
- Trust in issuer and audits
- Redemption guarantee

2. Crypto-backed (DAI)

- Over-collateralized (150%+)
- Smart contract enforcement
- Liquidation mechanisms

3. Algorithmic (failed: UST)

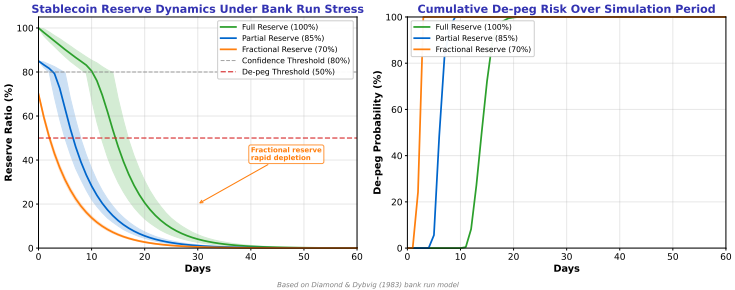
- No collateral backing
- Arbitrage-based stability
- Prone to death spirals

Economic Trade-offs

- Capital efficiency vs. safety
- Centralization vs. transparency
- Scalability vs. collateral needs

Terra/UST collapse (2022) showed algorithmic designs are inherently fragile

Stablecoin Market Evolution



Market concentrated in USDT; Terra collapse caused $40B+ losses in May 2022

Gresham's Law and Currency Substitution

Gresham's Law

"Bad money drives out good"

- When two currencies circulate at fixed rate
- Undervalued currency hoarded
- Overvalued currency spent

Digital Application

- Bitcoin hoarded ("HODL")
- Stablecoins used for transactions
- Self-fulfilling: reduces velocity

Currency Substitution

Dollarization analogy:

- Weak local currency replaced
- "Crypto-ization" in high-inflation countries
- Argentina, Venezuela, Turkey cases

Economic Consequences

- Loss of monetary policy autonomy
- Seigniorage transfer abroad
- Financial stability risks

Currency competition creates both opportunities and risks for monetary systems

Money Demand for Digital Currencies

Traditional Money Demand

$$M^d/P = L(Y, i)$$

(Real money demand depends on income Y (positive) and interest rate i (negative))

- $L_Y > 0$: Transaction motive
- $L_i < 0$: Opportunity cost
  (Higher income means more money needed for transactions; higher interest means higher cost of holding money)
- Baumol-Tobin inventory model

Portfolio Approach

$$M^d = f(W, r_m, r_b, \pi^e, \sigma)$$

- Wealth effect
- Relative returns
- Inflation expectations

Crypto Money Demand
Additional factors:

- Speculative motive dominates
- Network effects matter
- Regulatory risk premium

Empirical Challenges

- What is "crypto money supply"?
- How to measure crypto velocity?
- Multiple exchanges, prices

Traditional money demand models require significant adaptation for crypto analysis

Seigniorage in Digital Currency Systems

Traditional Seigniorage

$$S = \frac{\dot{M}}{P} = \frac{\Delta M}{M} \cdot \frac{M}{P}$$

(Seigniorage = growth rate of money times real money balances—how much value the money issuer extracts)

- Revenue from money creation
- Accrues to central bank/government
- Inflation tax on money holders

Bitcoin "Seigniorage"

- Block rewards to miners
- Declining over time (halvings)
- Dissipated in mining costs

Stablecoin Seigniorage

- Interest on reserves kept by issuer
- Tether earns billions annually
- Users bear opportunity cost

Policy Implications

- Who captures monetary rents?
- Private vs. public money trade-offs
- CBDC: Returns seigniorage to public

Stablecoin issuers capture seigniorage that would otherwise accrue to governments

Monetary Policy Implications

Transmission Mechanism Risks

- Crypto reduces money multiplier
- Interest rate channel weakened
- Bank reserves less relevant

Financial Stability

- Pro-cyclical crypto prices
- Contagion from crypto crashes
- Interconnection with TradFi

Central Bank Responses

- CBDC development (defensive)
- Stablecoin regulation
- Reserve requirements for crypto banks

Long-term Questions

- Can crypto coexist with fiat?
- Optimal regulatory perimeter?
- International coordination needs?

Central banks view crypto growth as potential challenge to monetary sovereignty

Key Takeaways

Main Conclusions

1. Bitcoin fails core money functions due to volatility
2. Stablecoins are "money-like" but carry risks
3. Quantity theory applies but needs adaptation
4. Seigniorage distribution is policy issue

Economic Framework

- Money functions: MoE, UoA, SoV
- Quantity theory: $MV = PY$
- Gresham's Law and hoarding
- Currency substitution dynamics

Core Insight

Monetary economics reveals why cryptocurrencies struggle as money: they optimize for speculation, not monetary functions. Stablecoins address some issues but create new ones.

Next lesson: Central Bank Digital Currencies (CBDCs)

Key Terms

Velocity of Money Rate at which money circulates in economy.

Gresham's Law "Bad money drives out good"; overvalued currency circulates, undervalued hoarded.

Stablecoin Cryptocurrency maintaining stable value, typically pegged to fiat.

Fiat-Backed Stablecoin Stablecoin backed 1:1 by fiat reserves.

Algorithmic Stablecoin Stablecoin using supply adjustments without full collateral.

Quantity Theory of Money $MV = PY$ relationship linking money, velocity, prices, output.

Seigniorage Profit from issuing money; face value minus production cost.

Barter Direct goods exchange without money; requires double coincidence of wants.

Collateral Assets pledged as security for loan or stablecoin.

Over-collateralization Pledging more collateral than loan value for safety.

Liquidation Forced sale of collateral when value drops below threshold.

Arbitrage Profiting from price differences; maintains stablecoin pegs.

Death Spiral Self-reinforcing collapse where falling prices trigger more selling.

HODL Hold despite price drops; crypto slang resisting sales.

Dollarization Country adopting foreign currency instead of own.

Opportunity Cost Value of next best alternative foregone when choosing.

Inflation Tax Hidden tax reducing purchasing power when government prints money.

Deflationary Prices falling over time; fixed-supply currencies trend deflationary.

Money Multiplier Bank lending amplifies deposits into larger money supply.

TradFi Traditional Finance; conventional banks versus DeFi.

Further Reading

Academic Papers

- Yermack (2015): "Is Bitcoin a Real Currency?"
- Gorton & Zhang (2023): "Taming Wildcat Stablecoins"
- Brunnermeier et al. (2019): "The Digitalization of Money"

Policy Analysis

- BIS (2022): "The Future Monetary System"
- IMF (2023): "Elements of Effective Crypto Policies"
- ECB (2022): "Stablecoin Assessment"

All readings available on course platform