Digital Money Workshop 2018
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“Blockchain Economics” with Joseph Abadi
“On the Equivalence btw Private & Public Money” with Dirk Niepelt

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Digital Economy – Rethinking Money

- Role of cash and other forms of outside money
  - Cash as protector of privacy in an open society
- What new forms of money might emerge?
- Should central banks endorse/fight
  - digital money?
  - cryptocurrencies?
  - Blockchain technology?
- Competition among currencies
  (and other means of payments, store of value, carrier of info)
  in a world with declining transaction costs
- Tokenization
Overview

- 3 roles of money & 3 components of asset’s value
- Money creation creates rents & resource cost free
- Private vs. public money
  - Who is allowed to issue “money”?
  - Should government compete with private money or disallow it?
    - CDBC vs. Vollgeld/sovereign money
  - Equivalence Theorem
- What’s special about digital money?
- What’s special about crypto money? with Joseph Abadi
  - Blockchain trilemma
  - Fork competition vs. Hayekian currency competition
  - Enforcement: Ownership vs. Possession
  - Crypto currencies are special blockchains
Roles of Money

- When is money “essential” a la Hahn?
  - Changes in allocation ⇒ MRS/SDF

1. Record-keeping device (information role)
   - Balance of tokens as a crude summary of history
   - Centralized (CBDC) vs. decentralized (cash, DLT)

2. Medium of exchange
   - double-coincidence of wants
   - \( \max U(x) \) subject to
     - Budget constraint \( B = 0 \)
     - Liquidity constraint \( L \leq 0 \)
     - Cash in advance, MIU, shopping time, New monetarism

3. Store of value
   - bubble – money changes the asset span
   - e.g. Samuelson OLG, Bewley, “I Theory of Money”
3 Components of an Asset’s Value

\[ p_t = v_t + l_t + b_t \]

1. Fundamental value

\[ v_t = E_t \left[ \sum_{s=t+1}^{T} \beta^s \frac{\partial u}{\partial c_s} CF_s \right] \]

2. Liquidity value

\[ l_t = E_t \left[ \sum_{s=t+1}^{T} \beta^s \alpha_{s-1} \frac{\partial u}{\partial c_s} CF_s \right] \]

where \( \frac{\alpha_t}{\alpha_{t+1}} = \frac{\lambda_t}{\partial u/\partial c_t} L' \) (velocity)

- Improves medium of exchange, (relaxes \( L \)-constraint)

3. Bubble value

\[ b_t = \lim_{T \to \infty} E_t \left[ \beta^T \prod_{s=t}^{T-1} \frac{1 + \alpha_s}{\partial u/\partial c_T} b_T \right] \]

- Completes market/OLG
Rents from Money Creation

- Extreme form: issue bubbly liquid asset
  - No (social) resource costs Friedman ‘69

- More general: hold illiquid asset with high $v$ (cash flow)
  issue liquid asset with low $v$

  \[
  \begin{array}{c|c}
  A & L \\
  \hline
  \text{High } v & \text{High } l, b \\
  \text{Low } l, b & \text{Low } v
  \end{array}
  \]

- Rents:
  - “free lunch”
  - Curse excessive supply, ICOs ⇒ inflation
  - Who has the right to “collect” these rents? Competitiveness
Public/Private Money Competition

- Restrict private money  Chicago plan, Vollgeld
- Compete with private money  CBDC

- Competition among private monies
  - Centralized ledgers  Alipay with WeChatPay
  - Decentralized ledger  Blockchain Trilemma, Fork
## Classifying Money

<table>
<thead>
<tr>
<th>Money</th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside</td>
<td>Cash, CBDC</td>
<td>Cryptocurrencies</td>
</tr>
<tr>
<td>Inside (debt obligation)</td>
<td></td>
<td>Bank deposits, Credit cards, e-money (Alipay), ...</td>
</tr>
</tbody>
</table>

- Gov.-Regulating money supply
  - Limit private money creation or compete with it
    - CDBC vs. Chicago Plan/Vollgeld
Equivalence btw Public and Private Money


- Example: Crowd out public money (CBDC) crowds out private money (deposits) s.t. $\mathcal{L}, \mathcal{L}'$ stay constant
  - Resource problem: No, since no social costs (Friedman ’69)
  - Wealth problem: Redistributes rents

- Wealth redistribution issue does not arise when
  1. Banks very competitive, so that they had to pass on all rents to borrowers/savers
  2. Banks’ ownership structure = tax paying structure (Barro ’74)
    - Swap banks claims for reduction of implicit tax liability claims
    - Any representative agent economy
Equivalence: CBDC vs. Deposits

Physical Capital

Firms

Firm Loans

Firm Equity

L

A

Banks

Firm Loans

Deposits

B-Equity

A

Gov. & CB

PV Primary Surplus

Gov. Bonds

Implicit G-Equity

Money

L

Gov. Bonds

Implicit G-Equity

Money

Deposits

B-Equity

Firm Equity

Households

PV Primary Surplus

Net-worth
Equivalence: CBDC vs. Deposits
Equivalence: CBDC vs. Deposits

- **Key insight:** Central bank “passes through” funding
- If banks are non-competitive, CB’s supply function has to be such that banks set the same deposit rates
More Examples

- **CBDC vs. deposits with bank runs**
  - Transfers needed

- **Chicago Plan** – the end of fractional reserve banking (Fisher, 1935, 1936)
  - Equivalence:
    Central bank buys up all deposits at (possibly distorted) market price

- **“Vollgeld”/ “sovereign money” (prohibition)**
  - “Vollgeld” redistributes rents from banks to central bank
  - Equivalence only if HH exposures to bank profits = taxes (Ricardian equivalence)
What’s Special about “Digital Money”?

1. Money as record keeping device (token)
What’s Special about “Digital Money”? 

1. Money as record keeping device (token)

- Information role of money
  $\Rightarrow$ record keeper(s) receives info rents
  - Example: Ant Financial’s credit scoring

- Convenience to use $\Rightarrow$ higher velocity
  - Equivalence can be maintained.

- Easy to exchange
  $\Rightarrow$ network externalities decline
  $\Rightarrow$ separates store of value from medium exchange
  $\Rightarrow$ Lower rents for issues
What’s Special about Crypto Currencies?


- Decentralized record keeping
  - PoW blockchain vs. permissioned blockchain

- Fork competition
  - Info portability + record-keeper competition
  - Instability (split in subgroups)

- Correctness
  - Monopolist’s incentives are dynamic
  - PoW-Blockchain incentives are static
  - Rollback

- Enforcement: Ownership vs. Possession
Economically Relevant Differences
btw. Centralized Ledger and Blockchain

1. **Free entry** (for record-keepers)
   • But requires identity management. Hence, PoW
2. **Ability to roll back** blockchain
3. **Portability** of Information (for proposers)
Rollback

- With centralized ledger
  - Future rents/franchise value incentives centralized record keeper to correctly report transactions
dynamic incentive scheme
  - No rollback
    $\Rightarrow$ Punishment is costly
    - High franchise value needed in order for punishment to be credible
      - For TBTF institution (like Wells-Fargo) must be even higher

- With blockchain
  - Free entry $\Rightarrow$ no future rents/franchise value
static incentive scheme
  - Rollback record keepers will compete to write on old chain
    $\Rightarrow$ Punishment is not costly
    - No franchise value needed!
2 Forms of Competition

- Competition via entry and forking (“platform competition”)

<table>
<thead>
<tr>
<th>Ability to ENTER</th>
<th>ability to FORK</th>
<th>Ability to ENTER</th>
<th>Ability to FORK</th>
</tr>
</thead>
<tbody>
<tr>
<td>free entry</td>
<td>yes</td>
<td>Blockchain</td>
<td>no</td>
</tr>
<tr>
<td>restricted</td>
<td>Permissioned Blockchain</td>
<td>Monopolistic intermediary</td>
<td></td>
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</tbody>
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- “Fork competition”: 2 necessary ingredients
  - Competition among record-keepers
  - Replication of info
Fork competition

- With centralized ledger, information is not portable
  ⇒ Competition is reduced
    - Example: Alibaba’s credit scoring, Amazon’s seller rating, Facebook friends

- With Blockchain, information is portable
  ⇒ Competition is fierce (contestable market for platforms)
    - Example: Software developers have incentive to develop new technologies to fork off existing chains
      Bitcoin Cash, Bitcoin Gold, ….
Fork ≠ Hayekian Currency Competition

- Two types of currency competition:
  - Hayekian: sell old and buy new (price adjusts)
    - require active decision to participate
      (ignore new currency and save on info collection cost)
  - Fork: duplicate history
    + “helicopter drop” of new currency based on current stakes
    - endowment effect if it is given to you
      (even if one only sells new currency, pay info collection cost)

- Fork currency competition is fiercer than Hayekian
Enforcement: Cryptocurrency is Special

- So far ignored enforcement distinction btw ownership & possession
  - Ownership is traded in the secondary market
  - Possession is conferred by the previous possessor and enforced by some entity
    - Example: Land registry requires enforcer who “kicks out the squatters”

- Enforcement of land registry, stock registry ... necessary ...
  - central authority needs to be incentivized
    - When to bundle enforcer & record keeper?

- Currency/platform info is special:
  “Money is a bubble” - no fundamental value/no dividend
... to sum up

- Money creation creates rents & resource cost free
- Private vs. public money with Dirk Niepelt
  - Who is allowed to issued “money”?
  - Should government compete with private money or disallow it?
    - CDBC vs. Vollgeld
  - Equivalence
    - Liquidity creation is resource cost free
    - Rent distribution
      - Perfect competitive – passed on to borrowers/savers
      - Ownership structure
- What’s special about digital money? with Joseph Abadi
- What’s special about crypto money?
  - Blockchain trilemma
  - Fork competition
    - Fork currency competition vs. Hayekian competition
  - Ownership vs. Possession: crypto currencies are special blockchains
Extra slides
Models of Money

- **Store of value**
  - OLG: Samuelson
  - Friction: Bewley
  - X Brunnermeier-Sannikov: “I Theory of Money”

- **Medium of exchange – double-coincidence of wants**
  - Cash-in-Advance Models Clower
  - Money in Utility Function Sidrauski
  - Shopping time models
  - New Monetarism Lagos-Wright

- **Unit of account**
  - New Keynesian Models
Back to Money and its History

- Island Yap
- Provides status
  b/c society agrees
  - Coordination of
    (higher order) beliefs
- Ledger
- Fixed supply
  - Hard to create/forge
- Unit of account
- Means of payment
  - Difficult to transport
  - Token