



Digital Money Workshop 2018

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“Blockchain Economics”

with Joseph Abadi

“On the Equivalence btw Private & Public Money”

with Dirk Niepelt

III 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 *with Dirk Niepelt*
 - 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 \Rightarrow MRS/SDF

1. Record-keeping device (information role)

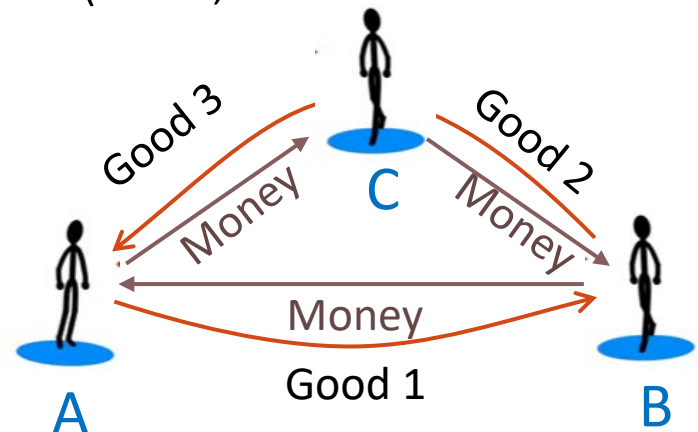
- Balance of tokens as a crude summary of history
- Centralized (CBDC) vs. decentralized (cash, DLT)

2. Medium of exchange

- double-coincidence of wants
- $\max U(x)$ subject to

- Budget constraint $B = 0$
- Liquidity constraint $\mathcal{L} \leq 0$

- 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 $v_t = E_t[\sum_{s=t+1}^T \beta^s \frac{\partial u / \partial c_s}{\partial u / \partial c_t} C F_s]$

2. Liquidity value $l_t = E_t[\sum_{s=t+1}^T \beta^s \alpha_{s-1} \frac{\partial u / \partial c_s}{\partial u / \partial c_t} C F_s]$
where $\frac{\alpha_t}{\alpha_{t+1}} := \frac{\lambda_t}{\partial u / \partial c_t} \mathcal{L}'$ (velocity)

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

3. Bubble value $b_t = \lim_{T \rightarrow \infty} E_t[\underbrace{\beta^T}_{<1} \underbrace{\prod_{s=t}^{T-1} (1 + \alpha_s)}_{>1} \frac{\partial u / \partial c_T}{\partial u / \partial c_t} b_T]$

- Completes market/OLG

Reflows 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

A	L
High v	High l, b
Low l, b	Low v

- Rents:
 - “free lunch”
 - Curse excessive supply, **ICOs** \Rightarrow 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

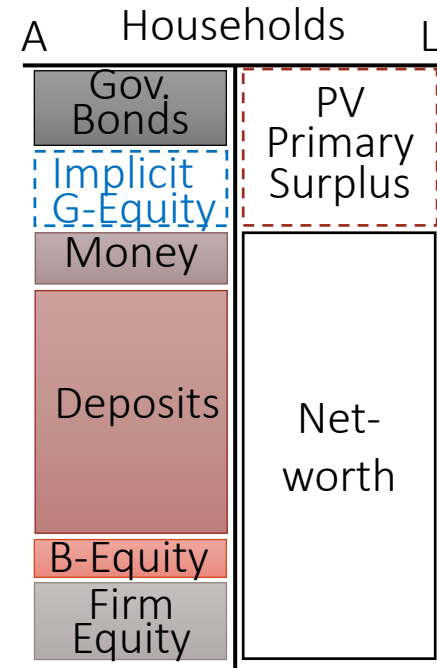
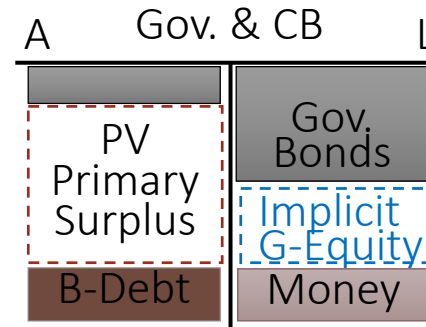
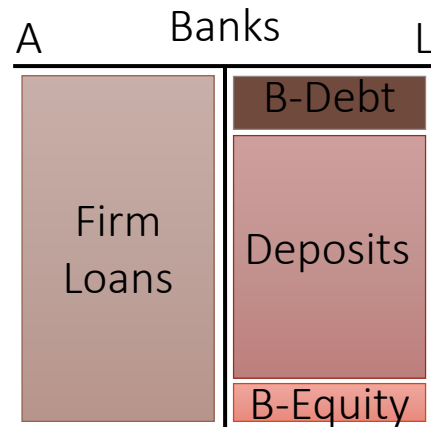
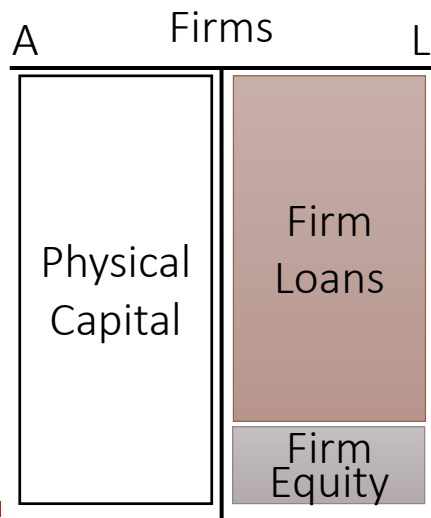
Money	Public	Private
Outside	Cash CBDC	Cryptocurrencies
Inside (debt obligation)		Bank deposits Credit cards, e-money (Alipay), ...

- Gov.-Regulating money supply
Limit private money creation or compete with it
 - CDBC vs. Chicago Plan/Vollgeld

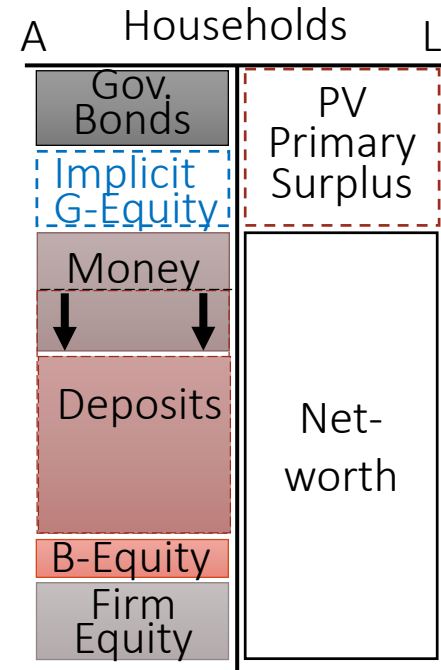
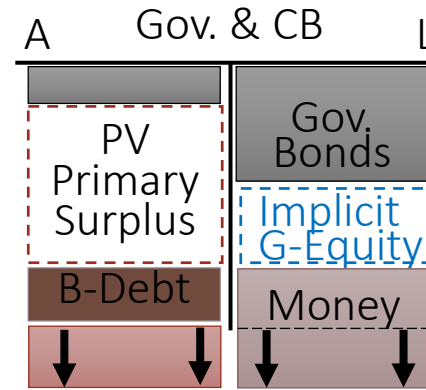
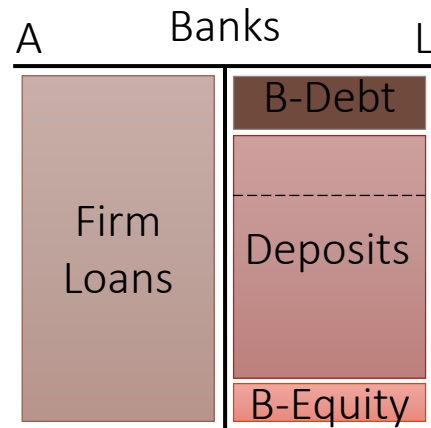
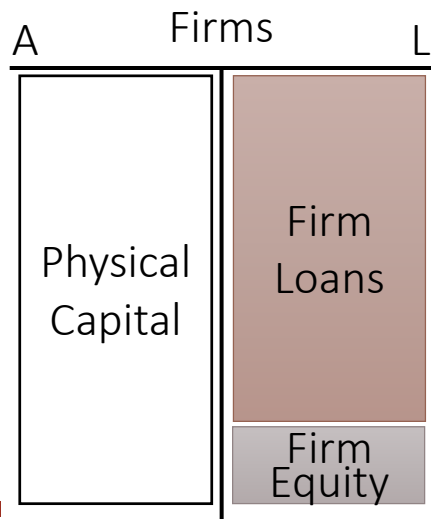
Equivalence btw Public and Private Money

- Brunnermeier & Niepelt (2018)
“Modigliani-Miller/Ricardian Equivalence type theorem”
- Example: Crowd out public money (CBDC) crowds out private money (deposits) insured 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

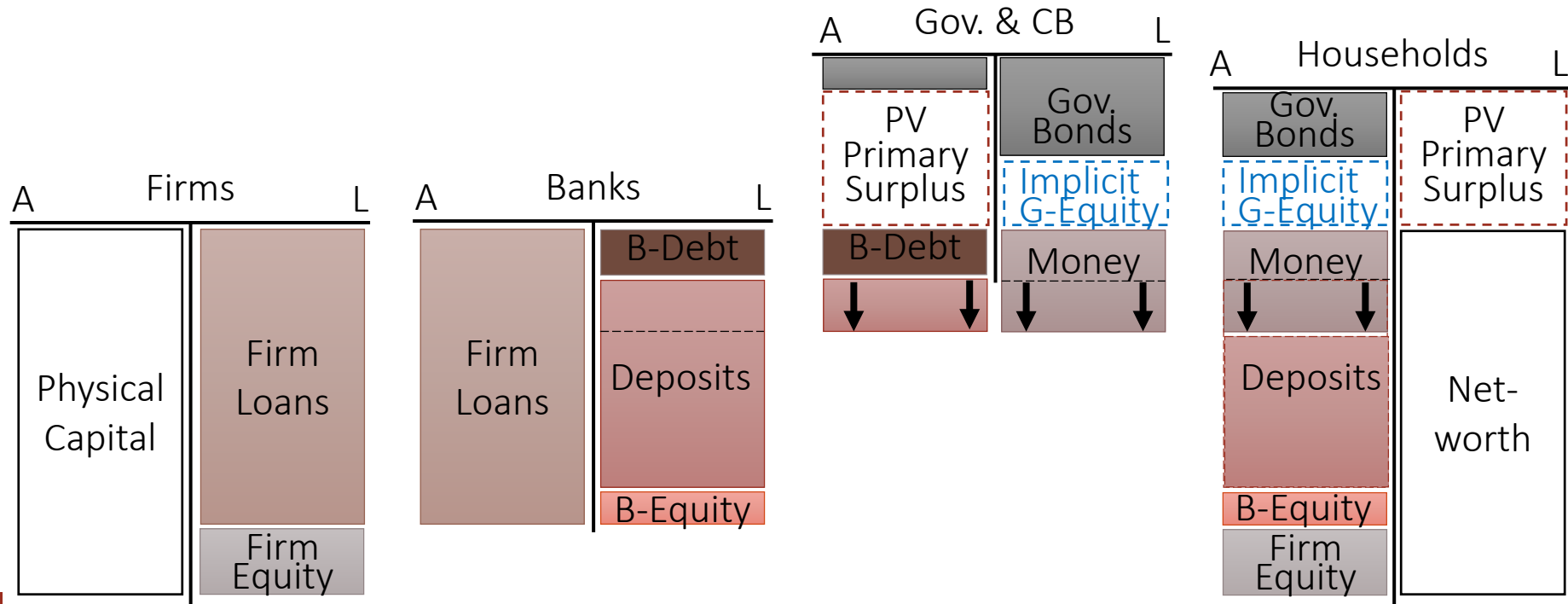
Equivalence: CBDC vs. Deposits



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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
 - ⇒ record keeper(s) receives **info rents**
 - Example: Ant Financial's credit scoring
 - Convenience to use ⇒ higher velocity
 - Equivalence can be maintained.
 - Easy to exchange
 - ⇒ network externalities decline
 - ⇒ separates store of value from medium exchange
 - ⇒ Lower rents for issues

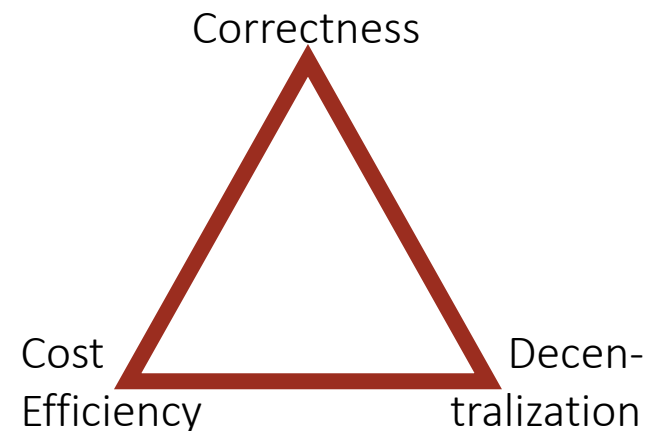
What's Special about Crypto Currencies?

- Abadi & Brunnermeier (2018) “Blockchain Economics”
- 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

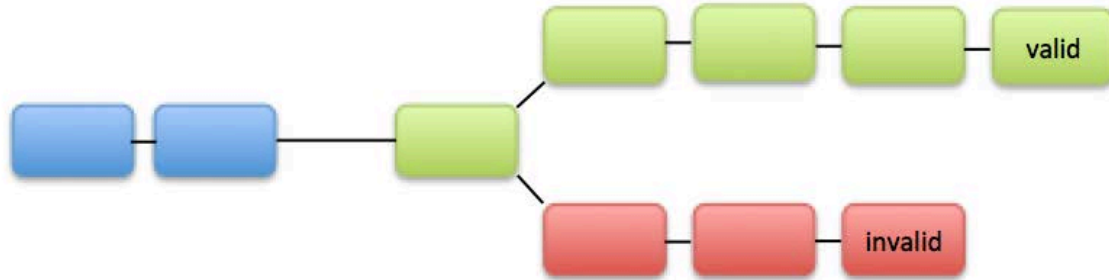
Blockchain Trilemma



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
 - ⇒ 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 ⇒ no future rents/franchise value
static incentive scheme
 - Rollback record keepers will compete to write on old chain
 - ⇒ Punishment is not costly
 - No franchise value needed!

2 Forms of Competition

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

		Ability to <u>FORK</u>	
		yes	no
Ability to <u>ENTER</u>	free entry	Blockchain	
	restricted	Permissioned Blockchain	Monopolistic intermediary

- “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 \neq 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

