Overview

- Macro Model
  - From Impulse Response Function to Risk Dynamics/Resilience

- Models of Money
  - In the digital age: Blockchain, Crypto, and Digital CB Money
  - Currency competition
    - “Fork competition” Abadi & Brunnermeier 2018
Traditional Macro: Impulse Response

- Study of deviation from steady state after shock
  - One shock-one-deterministic return to steady state

- Persistence

- Amplification (BGG, KM, ...)
  - Deterministic path back to steady state
Risk-focused Macro

- Nonlinearities
  - Skewness, fat tails, ...
- Endogenous Volatility Dynamics
  - Time-varying volatility

![Graph showing drift and volatility of η with stochastic steady state]
Risk-focused Macro

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- Endogenous Volatility Dynamics
  - Time-varying volatility
    - Volatility Paradox  "low measured volatility is most risky"
Risk-focused Macro

- **Nonlinearities**
  - Skewness, fat tails, ...

- **Endogenous Volatility Dynamics**
  - Time-varying volatility
    - Volatility Paradox
      - “low measured volatility is most risky”
    - Paradox of Prudence
      - “micro-prudent is macro imprudent”
Risk-focused Macro

- **Nonlinearities**
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- **Endogenous Volatility Dynamics**
  - Time-varying volatility
  - Volatility Paradox
  - Paradox of Prudence

- **Focus on time-varying risk-premia**
  - \( p_t = E_t \left[ \sum_{\tau=1}^{T-t} M_{t,t+\tau} y_{t+\tau} \right] + E_t \left[ M_{t,T} p_T \right] \)

Empirical Failure of
- Expectation hypothesis
- Uncovered interest rate parity

SDF news  Cash-flow news
Models of Money

- **Outside Money as a bubble**
  - OLG Model enables trading across generations
    - Samuelson 58
  - Money as *Store of Value* & Safe Asset partial insurance
    - Bewley only money idio. endowmt.-risk
    - I Theory of Money money & capital coexist capital w/ idio. risk
  - Money as *Medium of Exchange*
    - Money has lower transaction costs

- **Inside Money**
  - Created by intermediary sector
    - Banks as risk diversifies BrunSan
  - Is better medium of exchange (liquidity) than outside money
    - Brunnermeier & Niepelt (2018)
Yap stone ⇒ 2-tier system w/ inside money

- Island Yap

- Fixed supply
  - Hard to create/forge

- Unit of account

- Medium of exchanges
  - Difficult to transport

- Derive “claims”/tokens (inside money)
Gold $\Rightarrow$ 2-tier system w/ inside money

- **Bad store of value** (historically)
  - high volatility due to new gold discoveries

- **Bad medium of exchange**
  - “The big problem of small change”
    
    Tom Sargent & Francois Velde
Outside vs. Inside Money

- **2-tier financial system (fractional reserve banking)**
  
  Anchor: e.g. Gold/Yap Stone  
  Unit of account
  
  Currency - no claim
  
  Deposits - private debt
  
  Credit
  
  Medium of Exchange
  (easy to swap, carry,...)
  
  Store of Value

- **Back ing with**
  
  - Commodity (e.g. gold)
  
  - Less liquid risky claims/credit
  
  - Data
2 Tier Financial System

- Technologies $b$

- Technologies $a$

"The I Theory of Money" with Yuliy Sannikov
Shock impairs assets: 1st of 4 steps

- Technologies $b$

- Technologies $a$

See Video 2 on YouTube channel Markus.Economicus
Shrink balance sheet: 2\textsuperscript{nd} of 4 steps

- Technologies \textit{b}

- Technologies \textit{a}

“Paradox of Prudence”

Like Keynes’ Paradox of Thrift but not in savings levels but in risk space (see Euro book p. 179)
Liquidity spiral: asset price drop: 3\textsuperscript{rd} of 4

- Technologies \( b \)

- Technologies \( a \)
Disinflationary spiral: 4th of 4 steps

- Technologies \( b \)

- Technologies \( a \)

- Inside money supply
- Money demand (since more idio risk)

Same holds for tokens
Outside vs. Inside Money

- 2-tier financial system (fractional reserve banking)

- Anchor: e.g. Gold/Yap Stone
- Currency - no claim
- Deposits - private debt
- Credit

- Unit of account
- Medium of Exchange (easy to swap, carry, ...)
- Store of Value
Digital Economy – Rethinking Money

- Role of cash and reserves (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? CBDC?
  - Cryptocurrencies?
  - Blockchain technology?
- Competition among currencies
  (and other stores of value, means of payments) in a world with declining transaction costs
- Tokenization

“Blockchain Economics” with Joseph Abadi
When Intermediary? When Blockchain?

Centralized record-keeping

Decentralized record-keeping
Dynamic vs. Static Incentivization

- Franchise value:
  - Preserve future rents
  - Collusion among writers via dynamic punishment strategies (e.g. Tit-for-Tat)

- Free entry:
  - No continuation value ($V = 0$)
  - No collusion via dynamic punishment strategies
  - Requires identify management (Proof-of-Work)
Dynamic vs. Static Incentivization

Diagram showing the relationship between Dynamic Incentivization and Static Incentivization with entry costs for newcomers.
Dynamic vs. Static Incentivization

- **Dynamic Incentivization**
  - Private database/blockchain
  - Permissioned blockchain

- **Static Incentivization**
  - Public blockchain
  - Entry costs for newcomers

Number of writers vs. Dynamic Incentivization
What is a Blockchain? What is a fork?

- Hard fork: splits community into two (both continue)
- (Soft fork: backwards compatible with old rules software update)
2 Forms of Competition

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

<table>
<thead>
<tr>
<th>Ability to ENTER</th>
<th>Ability to FORK</th>
</tr>
</thead>
<tbody>
<tr>
<td>free entry</td>
<td>Blockchain</td>
</tr>
<tr>
<td>restricted</td>
<td>Permissioned Blockchain</td>
</tr>
</tbody>
</table>

- “Fork competition”: 2 necessary ingredients
  - Replication of info
  - Competition among writers

- Information advantage – limits competition
  - W.r.t. other potential proposer (who don’t know states/bitcoins)
  - W.r.t. readers (who can only detect distortions with probability)
Currency Competition

- Currency/cash competition à la Hayek (competition gives incentive for low inflation)
  - Cash as “imaginary ledger” (many wallets in your pockets)
    - Nobody knows distribution
    - *Flash back*: tribal reward system (see David Andolfatto)

- Proposal: New (private) currency with new (inflation) rule
  - Coordination with other users/“readers”
  - Have to “sell” old for new currency (loss in value)
Currency Competition

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- **Crypto currency competition**  
  - “Fork competition”
  - Proposer *forks* blockchain
    - Tries to attract writers (to ensure undistorted ledger)
    - Tries to attract readers/users
  - **Key insight/difference:** *All information is transferred to new branch*
    - Enhances competition among currencies/platforms!
    - Analogy to “Free Banking Era” in US (19th century)
  - Community can split – “doubles” money supply
Analog: Greek Currency Reform in 1922

Converted in a new banknote (half value) Converted in a bond
Cryptocurrency

- Store of value too volatile
  - Low correlation with other assets

- Medium of exchange too slow
  - Bitcoin: very low speed: 70 transactions/minute vs. 200,000 for Visa
  - Ether: 1500 transactions/minute
  - Ripple: permissioned Blockchain

- Historical comparison with Gold
  - High volatility due to new discoveries
  - Small change problem
“Tokenization” as Inside Money

- Tencent, Alibaba, Amazon, Apple, ... will offer tokens
  - “Private money”

- Are tokens money?

- What’s the difference between cryptocurrency and token?

**Cryptocurrency**
- By fiat: no claim
- Initial coin offering

**Token**
- Claim that can be exchanged for ...
Token as Inside Money

- 2-tier financial system (fractional reserve banking)

- Cryptos: outside money interbank market (permissioned blockchain)
- Tokens: inside money (easier to transact with)

- Anchor: e.g. Gold/Yap Stone
- Currency - no claim
- Deposits - private debt
- Unit of account
- Medium of Exchange (easy to swap, carry, ...)
- Credit
- Store of Value
Outside vs. Inside Money

- 2-tier financial system (fractional reserve banking)

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  - Tokens: inside money (easier to transact with)
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      - high PoW (Bitcoin) transactions costs are not a problem
      - Anchor: e.g. Gold/Map Stone
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          - Unit of account
            - Unit of account
              - Medium of Exchange
                - Medium of Exchange
                  - (easy to swap, carry,...)

- Tokens: inside money (easier to transact with)
Possession vs. Ownership: Enforcement

- So far: ignored distinction btw **ownership and possession**.
  - Ownership is traded in the secondary market
  - Possession requires enforcer

- Blockchain is good for determining ownership but not possession
  - Centralized intermediary = enforcer (of contracts)
  - Blockchains: Who is the enforcer?

- Currency is the outlier: no enforcer needed
Conclusion

- **Macro Model**
  - Endogenous volatility dynamics “Paradox of Prudence”
  - Not only impulse response function – back to steady state

- **Money Models**
  - Financial frictions + idiosyncratic risk $\Rightarrow$ endogenous demand for money
  - The I Theory of Money

- **Money in the Digital Age**
  - Traditional: centralized monopolistic leger (franchise value)
  - Blockchain: decentralized ledger (free entry competition)

- “Fork competition”
  - Competition between currencies (more fierce than Hayek’s)

- **Tokenization by social media/payment firms**
  - Tencent, Alipay, Amazon, Apple, ...
    - Analogy with Free Banking Era
  - Inside Money = Token
  - Outside money = Cryptocurrency

- **Interbank Market via permission Blockchain**

- **Macro models with digital agents/machines transferring money**