Platforms, Tokens, and Interoperability

Markus K. Brunnermeier

Jonathan Payne

Princeton University

Virtual Seminar Series on CBDC

18. November 2021

Tech Trends

- Digital platforms
- Digital tokens
- CBDC

Interaction

matching technology

payment technology

- Policy Questions
  - How to regulation competition between
    - **Public Market** ⟷ **Platform** (incumbent) ⟷ **Platform** (entrant)
    - $ (CBDC) ⟷ Private Token (stable coin) ₮ ⟷ Private Token ₮′
    - Should CBDC be legal tender?
- Key: **Interoperability**

Forms of Interoperability

1. Token **Exchangeability** (without fee)
   - Token platform cannot charge exchange (exit) fee

2. Token **Acceptability** (for contracting and payment)
   - All tokens are accepted on all platforms
   - CBDC as legal tender

3. Ledger **Portability**
   - Entrant platform can take over incumbent ledger

Forms of Interoperability

1. Token **Exchangeability** (without fee) ➡ avoids lock-in effect lower markup on retail platform
   - Token platform cannot charge exchange (exit) fee

2. Token **Acceptability** (for contracting and payment) ➡ destroys commitment via smart contracts ➡ less credit
   - All tokens are accepted on all platforms
   - CBDC as legal tender

3. Ledger **Portability** ➡ new platform can't credibly inflict defaults on old platform
   - Entrant platform can take over incumbent ledger

Model ingredients – big picture

- Usual: Matching model with matching intensity λ
  No tokens
  Agents have no platform choice

- Here: "Strategic platform" competes with public market + entrant platform
  Platforms issue tokens
  - Choice:
    - On retail space: mark-up ψ
    - On payment space: interoperability of token, credit interest rate (κ)

- Agents (buyers/sellers) - risk-neutral with time preference rate ρ
  - Discrete Choice:
    - Which market/platforms

Model setup

- Platforms: public | private (incumbent) | private (entrant)
  - Payment technology: $ | ₮ | ₮’ (λ^{e} arrival rate)
  - Matching technology
    - Selling arrival rate: $\lambda^{s\$i} = \lambda^{s\$}\xi^{s\$i}$ | $\lambda^{s₮i} = \lambda^{s₮}\xi^{s₮i}$ | $\lambda^{s₮'i} = (1+\Lambda)\lambda^{s₮i}$
    - Buying arrival rate: $\lambda^{b\$i}$

$\lambda^{s\$}$: Platform specific common

$\xi^{s\$i}$: idiosyncratic, Fréchet distribution

Λ: Matching edge

When entrant enters, public market place matching rate also improves by factor Λ

- Timing of agents (in cts. time)
  - Agent observes trading rates on platforms
  - Agents decides which platform to “search”
  - Trading opportunities arise
  - All “active agents trade competitively at platform specific price for seller p_t^P for buyer $\hat{p}_t^P = (1+\psi_t^P)p_t^P$

ψ_t^P: Mark-up

Roadmap

- Motivation and Preview

- **Model 1: without credit**
  - Sellers hold tokens until the opportunity to become buyer

- **Model 2: with credit** via smart contracts
  - Buyers borrow from platform until opportunity to become seller

Model 1 (without Credit)

- **Platform** sets
  - mark-up ψ for goods price
  - exchange (exit) fee $\varepsilon^{₮\$}$, $\varepsilon^{₮₮'}$

- **Agents**
  - *Decision between ₮ and $*

    seller → **buyer**

    Others: sellers → buyers → buyers

    ₮, $

    $\eta > 1 - \eta$

    - For $\varepsilon^{₮\$} > 0$ good to have ₮ good to have $ ➡ **Anticipated Lock-in Effect** (agents stay away from lock-in)

  - *Occasional decision between ₮ and ₮'* (when λ^e)

    seller → **buyer**

    Others: sellers → buyers → buyers ➡ **Lock-in Effect**

    Past sellers had no opportunity to hold ₮'

    ₮, no ₮'

Model 1 (without Credit)

- **Platform** sets
  - mark-up ψ for goods price
  - exchange (exit) fee $\varepsilon^{₮\$}$, $\varepsilon^{₮₮'}$
- **Agents**
  - *Occasional decision between ₮ and ₮'* (when λ^e)

	seller	→	buyer	
Others: sellers →	buyers ₮, no ₮'	→	buyers	➡ **Lock-in Effect** Past sellers had no opportunity to hold ₮'

- **Token lock-in effect limits competition across (retail) platforms**
  - For $\varepsilon^{₮\$} = 0$ and $\Lambda > 0$, platform sets

⇨ $\varepsilon^{₮₮'} = 1$ maximum exchange rate fee

⇨ $\psi^{\$} = \left(\frac{1}{1+\Lambda}\right)^{\frac{\xi^s+\xi^b}{1+\xi^b}} \left(\frac{1}{1-\eta}\right)^{\frac{1}{1+\xi^b}} - 1$ decreases in entrant's edge Λ

Interaction
token & retail

Model 1 (without Credit)

- **Platform** sets
  - \- mark-up ψ for goods price
  - \- exchange (exit) fee $\varepsilon^{₮\$}$, $\varepsilon^{₮₮'}$
- **Agents**
  - *Occasional decision between ₮ and ₮'* (when λ^e)

seller → buyer

Others: sellers → buyers (₮, no ₮') → buyers ➡ **Lock-in Effect**

Past sellers had no opportunity to hold ₮'

- **Token lock-in effect limits competition across (retail) platforms**
  - For $\varepsilon^{₮\$} = 0$ and $\Lambda > 0$, platform sets
    - ⇨ $\varepsilon^{₮₮'} = 1$ maximum exchange rate fee
    - ⇨ $\psi^{\$} = \left(\frac{1}{1+\Lambda}\right)^{\frac{\xi^s+\xi^b}{1+\xi^b}} \left(\frac{1}{1-\eta}\right)^{\frac{1}{1+\xi^b}} - 1$ decreases in entrant's edge Λ

    Interaction token & retail
  - For $\Lambda = 0$ and $\varepsilon^{₮₮'} = 0$ (**exchange interoperability**) $\psi^{\$} = 0$
    - Implementation of $\varepsilon^{₮₮'} = 0$ via "CBDC as digital ledger"

Roadmap

- Motivation and Preview

- **Model 1: without credit**
  - Sellers hold tokens until the opportunity to become buyer

- **Model 2: with credit** via smart contracts
  - Buyers borrow from platform until opportunity to become seller

Model 2 (with Credit and Production)

- Matching **platform** (not intermediary) (eBay, not Amazon)
  - $\psi = 0$ no mark-ups (by assumption)
  - κ amount of credit via smart contract
- **Agents** (with Production)

	buyer	**seller**
buyers	of 1 input good	of $z > 1$ output goods

- ₮ *vs.* $
  - Enforceability

	Rate	agent's payoff	platform payoff	Default
Output sold on ₮ platform	$@\lambda^{₮i}$	$(1-\kappa)zp^{₮}$	$\kappa p^{₮}$	
Output sold on \$ platform	$@\lambda^{\$i}$	$\gamma_{(\kappa)} zp^{\$}$ 0		if sold on \$ platform

⇨

Model 2 (with Credit and Production)

- Matching **platform** (not intermediary) (eBay, not Amazon)
  - $\psi = 0$ no mark-ups (by assumption)
  - κ amount of credit via smart contract
- **Agents** (with Production)

	buyer	**seller**
buyers	of 1 input good	of $z > 1$ output goods

- ₮ *vs.* $

Enforceability	Rate	agent's payoff	platform payoff	Default
Output sold on ₮ platform	$@\lambda^{₮i}$	$(1-\kappa)zp^{₮}$	$\kappa p^{₮}$	
Output sold on $ platform	$@\lambda^{\$i}$	$\gamma_{(\kappa)}zp^{\$}$ 0		if sold on $ platform

  - Without acceptability: Default and sell for $ if $\lambda^{₮i} - \lambda^{\$i}$ is small
  - **With acceptability** (e.g. via CBDC as legal tender) ➡ kills of commitment via smart contracts

➡ Credit only from intermediated trades (not matching platforms)

Model 2 (with Credit and Production)

- Matching **platform** (not intermediary) (eBay not Amazon)
  - $\psi = 0$ no mark-ups (by assumption)
  - κ amount of credit via smart contract
- **Agents** (with Production)
  - ₮ *vs.* ₮′ entrant token platform (with arrival occurrence λ^e)
    - Entrant platform invites agents/creditors, who can default on incumbent platform ➡ **Anti-Lock-in Effect**
      - Incumbents platform's loss increases with size of its loan book
    - Lemma: For $\Lambda = 0$ (no competitive edge)
entrance = paying off entrant (via killer acquisition)
    - As if incumbent faces occasionally reoccurring killer acquisition costs
      - Higher λ^e ➡ lower κ (smaller loan book)
    - **Portability Interoperability**
      - Entrant can not credibly commit not to take over incumbent's loan book

➡ Lower killer acquisition costs ➡ higher κ (loan book)

Conclusion

- Platforms and token issuers - interaction
  - *Extra:* Should retail platforms and payment platforms be allowed to merge?
- How to regulate vs. compete with platforms with CBDC?
  - Interoperability implementation as CBDC
    - Exchange
    - Acceptability CBDC as legal tender
    - Portability (ledger)
- CBDC as legal tender
  - restores competition between private platforms (lower mark-ups)
  - hurts credit provision via smart contracts
- Portability of ledger
  - Reduces killer acquisitions and avoids excessive entry of platforms

Extra Slides

1. Inversion of "Information Advantage"

- Information advantage
  for customer
  - Borrower
  - Insurance client, …

soon, for seller/platform
- Lender (platform) "will know more about me
- Insurance company than I know about myself"
- Asset managers, … Privacy regulation

- Customer has multiple attributes and knows most of them,
  but only platform can better connect/statistically infer them
  - STATISTICAL INFORMATION
    - Correlation between attributes
  - Traditional example:
    - I like a red car
    - Insurance companies knows (from big data) that
      drivers of red cars are more accident prone

Informed principal problem

1. From Adverse Selection to Inverse Selection

- First generation — Rothschild Stiglitz
  - Asymmetric information matters for markets
  - Markets can unravel, so role for market design
  - Coverage is increasing in riskiness (*Counterfactual!*)

- Second generation – advantageous selection — Finkelstein, Einav, Fang
  - Asymmetric information is multidimensional
  - Low-risk types buy lots of insurance due to their high risk aversion
  - Heterogeneity in risk aversion

- Third generation (?)
  - Big data changes the notion of asymmetric information
  - “who knows what” needs to be updated
  - Once insurer/platform knows some basic information about you, statistical inference allows it to know more about risks