Payment System Externalities

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Motivation

- Banks have (at least) two vital roles in the economy.
  - Accept deposits and make loans.
  - Provide payment services to households.

- We pose the following questions:

i. How does a bank's role in the payment system affect its lending function?

ii. How will recent and planned innovations in payment systems affect banks?
   - Focus on Wholesale Central Bank Digital Currency (CBDC).

What we do

- Construct a stylized model of banks that make loans and participate in the payment system.
    - Segmented banking markets + cash-in-advance type constraint.
    - No uncertainty / asymmetric information / insolvency / bank runs.
    - This is a model of a bank in stable or normal times.

- Determine the planning outcome and the equilibrium volume of lending across banks.

- Examine the effects of CBDC on equilibrium.
    - Wholesale-only CBDC reduces settlement cost in the payment system.

Overview of Results

i. In normal times, a liquidity externality exists across banks.
   - The externality is created by a bank's need to hold liquidity against claims issued by different banks.

ii. A settlement cost on bank claims reduces the externality, but creates its own friction.

iii. Wholesale CBDC exacerbates inequality in lending across banks, but raises overall efficiency.

Model

$t = 0$

1. Households deposit cash D in banks
2. Central bank creates reserves C
3. Banks lend to entrepreneurs using bank claims b

Loans exceed Deposits

$t = 1$

1. Entrepreneurs buy supplies from households
2. Households deposit claims into own bank

Households' Bank $\neq$ Entrepreneurs' Bank

$t = 2$

1. Interbank borrowing and lending occurs
2. Fraction λ of households withdraw cash

Spending generates Liquidity Demand

$t = 3$

1. Output produced
2. Interbank settlement
3. Fraction $(1 - \lambda)$ of households get cash
4. Depositors repaid
5. Bank profits paid out to households

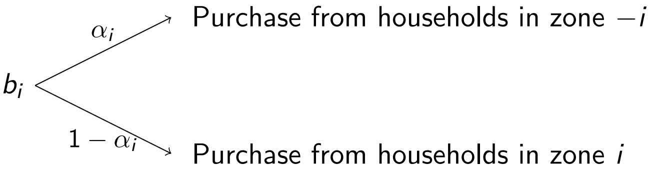
Interbank Settlement is Costly

Model Details

- Two *banks*. Each bank operates as a monopolist in its own zone.
- Each zone has one representative bank, a continuum of entrepreneurs, and a continuum of households.
- *Households*:
  - Deposit D per household into the bank, Provide supplies to entrepreneurs.
  - Fraction λ of households are impatient, need to consume before output is realized.
- *Entrepreneurs:*
  - Obtain loan from bank in home zone to purchase inputs and produce using a concave technology $f(k)$
  - Entrepreneurs need to cross zones to purchase inputs.

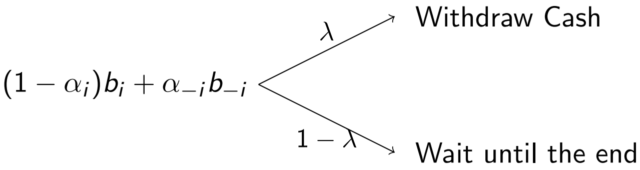
Payment System

- Entrepreneurs in zone i:



- α_i is the outsourcing propensity.
- Zones differ in outsourcing propensity,
- Outsourcing propensity is either high or low.
- Ex ante, this is the only difference across zones.

- Households in zone i have interim cash demand that each bank has to satisfy:



Interbank Transfers

- There are two types of interbank transfers:
  1. Interim: To meet interim liquidity needs, banks can trade reserves in the interbank market at an interest rate r.
     - Here, we assume there are N pairs of zones, N large.
     - So banks act as price-takers in this market.
     - Interest rate r set by market clearing, and establishes the opportunity cost of lending in your own zone.
  2. Ex post: Banks transfer reserves to settle net claims owed.
     - One bank may be a net payer, the other may be a net receiver.
- A net payer at date 3 incurs a deadweight settlement cost τ per unit.

Interpretation of τ the transfer cost.

- The time between dates 2 and 3 in the model is large (think commercial loans).
- We interpret τ as the long term costs of liquidity risk management.
- τ is motivated by a few underlying frictions.
  - Opportunity cost of collateral on outflows in Fedwire, or prefunding obligations in CHIPS.
    - Fedwire imposes fee of 50 bp on uncollateralized daylight overdrafts.

  1. Liquidity coverage ratio under Basel III, based on future net outflows.
  2. Explicit fees for using system, charged to net payers. E.g., Fedwire has fees of up to 82 bp on transfers.
- τ represents costs in the payment system

Market Equilibrium

- Nash equilibrium in lending + inter-bank market clears.

Definition

A market equilibrium in the model consists of claims issued by high- and low-outsourcing banks, b_h^* and b_ℓ^*, net borrowing by each bank, z_h^* and z_ℓ^*, and an interest rate in the interbank market, r^*, such that:

(i) The interim liquidity constraint of each bank i, equation, is satisfed.

(ii) For each bank i, b_i^* and z_i^* maximize its payoff π_i, given the interbank interest rate, r^*, and the claims issued by its matched bank, b_{-i}^*.

(iii) The interbank loan market clears; that is, $z_h^* + z_\ell^* = 0$.

Planner's Problem

- First-best problem: Planner not subject to settlement cost τ, and can freely transfer reserves across banks.
  - In the planner's solution to the first-best problem, the liquidity constraints bind, and all banks lend the maximal amount.
- Second-Best Problem: Planner also subject to settlement cost τ.
  - The bank in the *low-outsourcing* zone ℓ lends more than high zone h.
  - This reduces settlement cost.

Liquidity Externality

Suppose that $\tau = 0$, so that there is no settlement cost at date 3, and $\alpha_h > \alpha_\ell$. Then,

(i) In the second-best planning outcome, bank h issues the same number of claims as bank ℓ.

(ii) In the unique market equilibrium, bank h issues more claims than bank ℓ.

- With no settlement cost, in equilibrium production is distorted away from second-best outcome.
- Bank ℓ has to hold liquidity at date 2 against claims issued by bank h. This reduces lending by bank ℓ.
- This liquidity externality surfaces in good times.
- If the outsourcing propensities are sufficiently different, a positive τ dampens the liquidity externality.

Wholesale CBDC

- E.g., Project Jasper (Bank of Canada), Project Ubin (Monetary Authority of Singapore), Stella Project (Bank of Japan and ECB).
- Broadly, all try to move payments to a distributed ledger to reduce settlement costs across banks.
- In our model, corresponds to a reduction in τ.
- Reduction in settlement cost τ implies that liquidity externality has more bite.
- Relative to earlier equilibrium, bank h increases its lending and bank ℓ reduces its lending.
    - If α_h is sufficiently higher than α_ℓ, this moves equilibrium lending amounts even further away from each other.
- In the second-best outcome, amounts lent come closer to each other.

Real Implications of Wholesale CBDC

- Consider the productivity gap (i.e., difference in marginal productivities) across zones.
- Reducing settlement cost increases inequality in lending across zones.
- However, the second-best outcome moves in the opposite direction.
- Important caveat: Overall efficiency improves as τ falls.

Proposition

Suppose that $\tau < \bar{\tau}$ and $\alpha > \bar{\alpha}$. Then, with a small decrease in the settlement cost τ:

(i) *The equilibrium inter-zonal productivity gap increases if $b_h^* \geq b_\ell^*$ and decreases if $b_h^* < b_\ell^*$.*

(ii) *The inter-zonal productivity gap in the second best outcome decreases.*

Conclusion

- We explore how the payment role of banks affects their lending behavior.
  - Stylized model of banks in normal/good times: No distress or insolvency.
- A liquidity externality arises in good times as well.
  - Inter-connectedness requires a bank to hold liquidity against claims issued by other banks.
- Settlement cost of net claims dampens this externality.
- Innovations that reduce the settlement cost (wholesale CBDC) exacerbate inequalities in lending, but improve overall efficiency.