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 $b$

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

$t = 2$
1. Interbank borrowing and lending occurs
2. Fraction $\lambda$ of households withdraw cash

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

Spending generates Liquidity Demand

Households' Bank $\neq$ Entrepreneurs' Bank

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 $\lambda$ 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 $i$:

  $\alpha_i$ 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:

$$(1 - \alpha_i) b_i + \alpha_{-i} b_{-i}$$

\begin{align*}
\lambda & \quad \text{Withdraw Cash} \\
1 - \lambda & \quad \text{Wait until the end}
\end{align*}
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 $\tau$ per unit.
Interpretation of $\tau$ the transfer cost.

- The time between dates 2 and 3 in the model is large (think commercial loans).
- We interpret $\tau$ as the long term costs of liquidity risk management.
- $\tau$ 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.

$\tau$ 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 \( b_\ell^* \), net borrowing by each bank, \( z_h^* \) and \( z_\ell^* \), and an interest rate in the interbank market, \( r^* \), such that:

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

(ii) For each bank \( i \), \( b_i^* \) and \( z_i^* \) maximize its payoff \( \pi_i \), 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 $\tau$, 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 $\tau$.
  - The bank in the low-outsourcing zone $\ell$ 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 $\ell$.

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

• With no settlement cost, in equilibrium production is distorted away from second-best outcome.

• Bank $\ell$ has to hold liquidity at date 2 against claims issued by bank $h$. This reduces lending by bank $\ell$.

• This liquidity externality surfaces in good times.

• If the outsourcing propensities are sufficiently different, a positive $\tau$ 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 $\tau$.

- Reduction in settlement cost $\tau$ implies that liquidity externality has more bite.

- Relative to earlier equilibrium, bank $h$ increases its lending and bank $\ell$ reduces its lending.
  
  - If $\alpha_h$ is sufficiently higher than $\alpha_\ell$, 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 $\tau$ falls.

Proposition

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

(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.