

Credit lines, bank deposits or CBDC?  
Competition & efficiency in modern payment systems

Monika Piazzesi  
Stanford & NBER

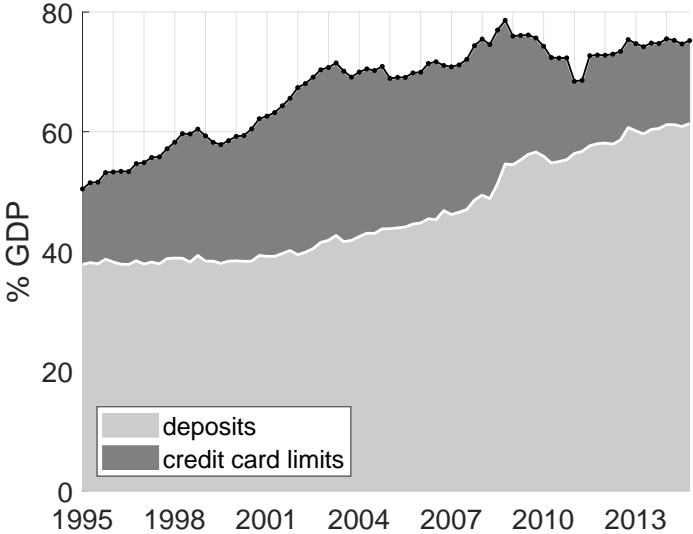
Martin Schneider  
Stanford & NBER

CB & DC virtual seminar series, April 2021

# Message

- Central bank digital currency (CBDC)
  - ▶ rapidly growing literature with many proposals
  - ▶ this talk: interest-bearing reserve accounts for everyone
- Market for liquidity
  - ▶ bank deposits
  - ▶ credit lines
- Commercial banks

# Deposits and credit card limits at US commercial banks



# Message

- Central bank digital currency (CBDC)
  - ▶ rapidly growing literature with many proposals
  - ▶ this talk: interest-bearing reserve accounts for everyone
- Market for liquidity: bank deposits & credit lines
- Commercial banks
  - ▶ add value by providing liquidity
  - ▶ complementarity between bank deposits & credit lines

⇒ CBDC not complementary to credit lines,  
beneficial only if much cheaper to produce than deposits

- Mechanism relies on externality among liquidity providers
  - ▶ applies also to stablecoins, money market mutual funds

# Literature

- Theoretical studies of CBDC
  - ▶ irrelevance theorems: Faure-Gersbach 2018, Brunnermeier-Niepelt 2019
  - ▶ constrains bank lending: Keister-Sanches 2019
  - ▶ undercuts market power in deposits: Andolfatto 2018, Chiu-Davoodalhosseini-Jiang Zhu 2020
  - ▶ affects bank liquidity management: Niepelt 2021
  - ▶ affects financial stability: Fernandez-Villaverde-Sanches-Schilling-Uhlig 2020, Keister-Monnet 2020, Williamson 2020
- Credit lines
  - ▶ part of optimal liquidity provision: Holmström-Tirole 1998,...
  - ▶ important payment instrument: Sufi 2007, Strahan 2010, Berger-Sedunov 2017
- Complementarity of deposits & loans at individual bank level
  - ▶ Kashyap-Rajan-Stein 2002, Gatev-Schuermann-Strahan 2009

## Model

- Continuum of households, work & consume goods
  - ▶ every period, fraction  $v_c$  of households consume, all work
  - ▶ iid preference shock  $\xi_t \in \{0,1\}$  selects consumers
  - ▶ discount factor  $\beta$ , utility from consumption goods and labor

$$\xi_t \log c_t - \theta \frac{N_t^{1+1/\varepsilon}}{1+1/\varepsilon}$$

- ▶ aggregate consumption  $C_t = E[c_t(\xi_t)]$
- Continuum of competitive firms
  - (i) consumption good producers use capital & labor:  $Y_t = K_t^\alpha N_t^{1-\alpha}$
  - (ii) capital good producers use consumption goods 1-1
    - fraction  $v_i$  selected by iid productivity shocks  $\chi_t \in 0,1$
    - aggregate investment  $I_t = E[i_t(\chi_t)]$
- Parameters  $v_c, v_i$  describe *predictability of liquidity needs* in economy

## Liquidity constraints

- Time moves in half steps  $t - .5, t, t + .5, \dots$ 
  - ▶ non-integer periods: households & firms trade goods ( $C + I$ );  
production occurs; only banks trade assets
  - ▶ integer periods: households & firms trade assets; factors paid
  - ▶ to transfer funds in/out of non-integer periods, households & firms must use payment instruments
- **buyers of goods** = households & capital producers
  - need payment instruments *before* buying
  - unpredictable liquidity needs: only share  $v$  gets chance to buy
- **sellers** = producers of goods
  - need payment instruments *after* selling
  - predictable liquidity needs: store funds, pay wages & rents later
- banks = providers of payment instruments
  - need payment instruments to meet customer outflows

## Payment instruments & financial frictions

- Competitive banks offer 2 payment instruments
  - ▶ deposits: hold **before** trade, spend if needed, keep otherwise
  - ▶ credit lines: draw down to receive loan if needed, don't use otherwise
  - ▶ prices per unit of liquidity provided
  - ▶ *arranging credit line avoids holding deposits that may not be needed*
- Equity issuance is costless for banks & firms
- Financial frictions in banks & firms
  1. bank collateral constraint:  $\text{debt} \leq \phi$  value of assets
    - payment instruments must be safe
  2. asset management services  $\kappa$  per unit of assets at price  $p$ 
    - delegated asset management is costly
    - production of services requires capital & labor
    - *firms favor credit lines over deposits to avoid cost*



# Equilibrium

- Assets available to households in integer periods
  - ▶ payment instruments, capital, bank equity
  - ▶ contingent claims on all preference & productivity shocks
  - household sector: large family insures members, owns banks & firms
- Symmetric competitive equilibrium
  - ▶ prices, allocation + asset positions (many identical firms & banks)
  - ▶ maximize utility & shareholder values + market clearing
- *Liquidity-centric* view of banking
  - ▶ independence of savings & liquidity provision
    - banks are good at credit lines, bad at holding capital
    - restrict preference & technology parameters s.t. capital held by banks to back payment instruments  $<$  total capital
  - size of banking sector reflects demand for liquidity, not savings
  - ▶ MM & Ricardian equivalence hold except for payment instruments
    - banks can hold firm & government debt, not just capital

## Comparing payment systems

- Characterizing equilibrium
  - ▶ allocation = solution to planner problem w/ resource constraint

$$C_t(1 + \Omega_t^c) + I_t(1 + \Omega_t^i) = Y_t(1 - \Omega_t^y)$$

- ▶ liquidity costs  $\Omega$ s depend on details of payment system
- Real effects of payment system
  - ▶ more costly payment system = less efficient production technology
    - ★ allocation responds as in neoclassical growth model
  - ▶ effects may differ by sector
    - ★ for example,  $\Omega^i > \Omega^c \rightarrow$  payment system discourages investment
- Now steady-state welfare for different payment systems
  - ▶ summarize predictability of liquidity needs by  $v_c = v_i := v$
  - ▶ equilibrium balance sheets before & after trade + liquidity costs  $\Omega$

# Banks offer only deposits

Before trade

Buyer	
A	L
	$D$

Seller	
A	L

Bank	
A	L
$K$	$D$ $E$

Central Bank	
A	L

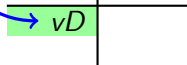
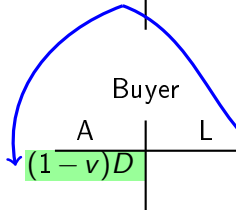
After trade

Buyer	
A	L
$(1-v)D$	

Seller	
A	L
	$vD$

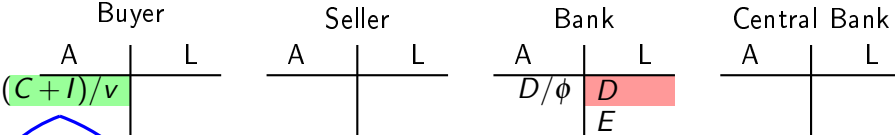
Bank	
A	L
$K$	$D$ $E$

Central Bank	
A	L

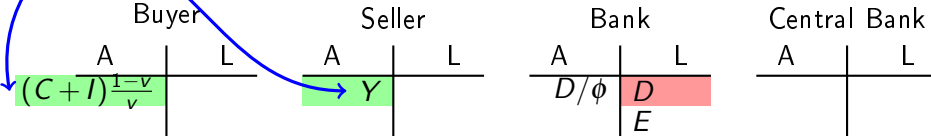


# Banks offer only deposits

Before trade



After trade



## Banks offer only deposits

- Resource constraint for equivalent planner problem

$$C_t \left( 1 + p \frac{\kappa^{2-v}}{\phi} \right) + I_t \left( 1 + p \frac{2-v}{v} \left( \frac{\kappa}{\phi} + \kappa^i \right) \right) = Y_t \left( 1 - p \frac{\kappa}{\phi} \right)$$

- Properties of banking with deposits
  - ▶ liquidity costs are high if liquidity needs are unpredictable  
( $v$  small, large precautionary deposit holdings)
  - ▶ investment extra costly because firms are not natural savers  
(balance sheet costs  $\kappa^i$ )
  - ▶ all interbank flows wash out; bank liquidity constraints do not bind  
(payments, reserves & funds market: Piazzesi & Schneider 2019)

## Banks offer deposits & credit lines

- credit lines: contingent liabilities are off balance sheet

Before trade

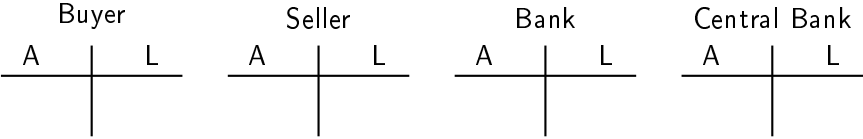
Buyer	Seller	Bank	Central Bank
A   L	A   L	A   L	A   L

After trade

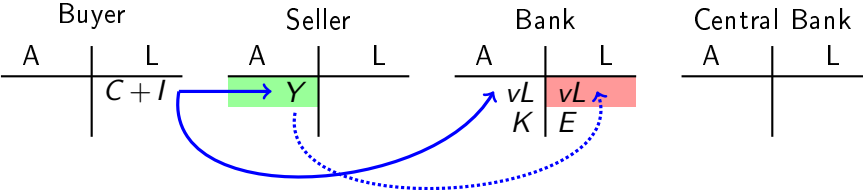
Buyer	Seller	Bank	Central Bank
A   L	A   L	A   L	A   L
		$vL$   $vL$	
		$K$   $E$	

# Banks offer deposits & credit lines

Before trade



After trade



## Banks offer deposits & credit lines

- Resource constraints with & without credit lines

$$C_t + I_t = Y_t \left( 1 - p \frac{\kappa}{\phi} \right)$$
$$C_t \left( 1 + p \frac{\kappa}{\phi} \frac{2 - \nu}{\nu} \right) + I_t \left( 1 + p \frac{2 - \nu}{\nu} \left( \frac{\kappa}{\phi} + \kappa^i \right) \right) = Y_t \left( 1 - p \frac{\kappa}{\phi} \right)$$

- Welfare gains from credit lines
  - avoid precautionary holdings of deposits = higher TFP
  - avoid firms' balance sheet costs = investment-specific tech progress
  - complementarity of products at banks = higher TFP  
due to **collateral savings**, not liquidity constraint



## Entry of deposits-only intermediary

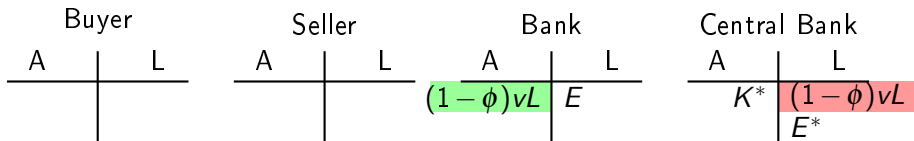
- New intermediary
  - ▶ maximal leverage  $\phi^*$ , asset management costs  $\kappa^*$
  - ▶ e.g. CBDC with central bank deposits offered at marginal cost
- CBDC good only if new technology better
  - ▶ welfare gains require  $\kappa^*/\phi^* < \kappa/\phi$
  - ▶ either cheaper asset management or better ability to commit
- CBDC good if technology better & banks offer only deposits
  - ▶ all depositors migrate to central bank
  - ▶ commercial banks disappear; no value beyond liquidity provision
  - ▶ investment *increases* because liquidity is cheaper
- CBDC good if banks also offer credit lines?

# Equilibrium with CBDC, bank deposits & credit lines

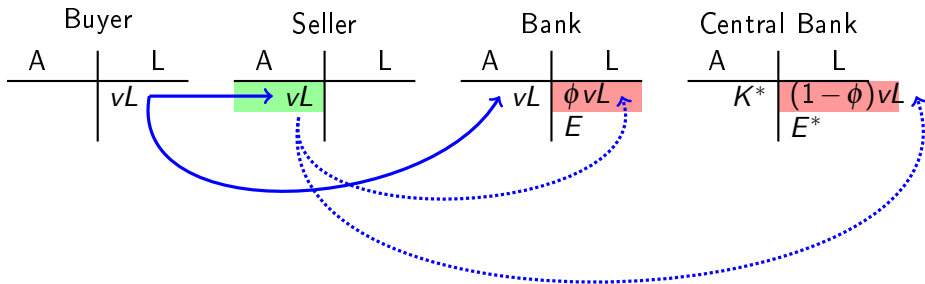
- Buyers' and sellers' choice of payment instruments
  - ▶ bank deposits & CBDC priced the same → bank customers indifferent
  - ▶ here: all buyers still use credit lines ( $v$  small,  $\kappa^*/\phi^*$  not too small)
  - ▶ paper: also case when households stop using credit lines
- Response by commercial banks
  - ▶ still issue deposits, match higher interest rate earned on CBDC
  - ▶ increase price of credit lines to break even
  - ▶ high funding costs, no longer profitable to invest in capital
- Now consider asset positions...

# Equilibrium with CBDC, bank deposits & credit lines

Before trade



After trade



# Equilibrium with CBDC, bank deposits & credit lines

- Comparing resource constraints

CBDC improves welfare if & only if  $\frac{\kappa^*}{\phi^*} < \frac{1 - \phi}{2} \frac{\kappa}{\phi}$

- if CBDC sufficiently cheap to offset cost of credit line = higher TFP
- if  $\kappa^*/\phi^*$  only marginally below  $\kappa/\phi$ , CBDC reduces welfare

- Interpretation

- ▶ competition for deposits distorts price of credit line
  - bank liquidity constraint not essential: the case  $\phi = 1$
- ▶ applies beyond CBDC to free entry of deposit-only intermediaries
- ▶ externality among liquidity providers who *jointly* support transactions
- hybrid payment systems, like deposits-only systems, incur extra costs

## Central bank credit line

- Can CB help keep asset side of banks unchanged?
  - ▶ Yes: offer credit line *to banks*, priced at  $\kappa/\phi$
- Choice of payment instruments
  - ▶ buyers still use credit line
  - ▶ all deposits migrate to CB
- Commercial bank response
  - ▶ before trade: no need for holding liquid funds
  - ▶ after trade: deposits replaced by loan from central bank
- Comparing resource constraints
  - ▶  $\Omega^c = \Omega^i = 0$ , same as before CBDC
  - ▶ but  $\Omega^y = p(\kappa/\phi + \kappa^*/\phi^*)$  is larger
  - ▶ sum of balance sheets now longer  $\rightarrow$  higher cost

# Message

- Central bank digital currency (CBDC)
  - ▶ rapidly growing literature with many proposals
  - ▶ this talk: interest-bearing reserve accounts for everyone
- Market for liquidity: bank deposits & credit lines
- Commercial banks
  - ▶ add value by providing liquidity
  - ▶ complementarity between bank deposits & credit lines

⇒ CBDC not complementary to credit lines,  
beneficial only if much cheaper to produce than deposits

- Mechanism relies on externality among liquidity providers
  - ▶ applies also to stablecoins, money market mutual funds