Implications of CBDC for the operational framework of monetary policy

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We should understand better the implications of a CBDC

- Increasing attention from authorities and academics
- Implications remain to be fully understood: financial stability, currency competition, financial inclusion, payments & innovation...
- This paper: implications of CBDC for the operational framework of monetary policy

What is the operational framework?

- Monetary policy is implemented through several instruments:
  - **(i)** overnight lending and deposit facilities;
  - **(ii)** asset purchases;
  - **(iii)** direct lending to banks (typically subsidized below lending facility, as in TLTRO).

- Currently CBs in advanced economies operate a floor system, satiating commercial banks with reserves, so that interbank rates are close to the deposit facility rate

How does CBDC affect the operational framework?

- Introducing CBDC could reduce excess reserves (by reducing the amount of bank deposits), thus changing the conditions in the interbank market

- Questions:

  (i) What are the general equilibrium implications of CBDC adoption in a floor system?

  (ii) What are the implications of using different instruments to compensate for the fall in reserves?

  (iii) What are the consequences of different CBDC designs for MP transmission?

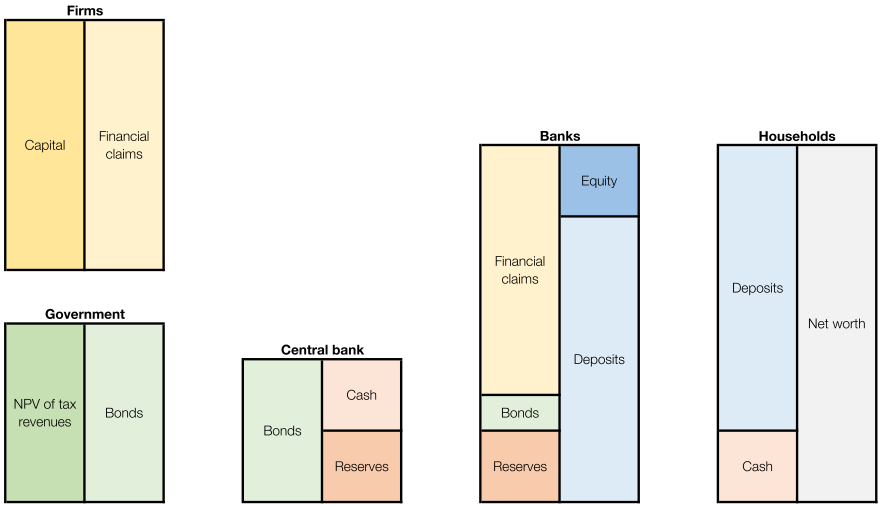
What we do

- We introduce CBDC in a realistic model of MP transmission, which includes:
  - **(i)** heterogeneous banks that:
    - borrow from households and lend to firms,
    - lend/borrow in an OTC interbank market,
    - can access CB facilities;
  - **(ii)** a CB with all the tools discussed above;
  - **(iii)** households with preferences for liquid asset holdings (cash, CBDC and deposits);
  - **(iv)** a standard NK block.
- We calibrate the model to replicate the Eurosystem balance sheet in the medium-term
- We explore alternative scenarios about CBDC take-up and different policy options by CB

What we find

- In the long run:
  - CBDC decreases bank intermediation and increases equilibrium rates
  - Absent other measures, a large takeup leads to a corridor or even a "ceiling" system with a structural lack of reserves
  - This can be avoided if the CB engages in further asset purchases or provides lending at IB rates, without any macro consequence
  - If CB subsidizes lending even below IB rates, it can compensate for the increase in bank funding costs and stimulate credit and output
- Along the transition path:
  - TBC

Model overview



Households

- Instantaneous utility function:

$$U(C_t, L_t, H_t) = \log(C_t) + \vartheta \log(L_t) - g(H_t),$$

where

$$L_t \equiv \left[(D_t)^{\frac{\varepsilon-1}{\varepsilon}} + \eta_M (M_t)^{\frac{\varepsilon-1}{\varepsilon}} + \eta_{DC} \left(D_t^{DC} \right)^{\frac{\varepsilon-1}{\varepsilon}} \right]^{\frac{\varepsilon}{\varepsilon-1}},$$

with $\varepsilon > 1$.

- Liquidity services in the utility function with imperfect substitution across assets as in Drechsler et al. (2017), Di Tella and Kurlat (2017) and Wang (2022), among others.

Banks

- Based on Arce, Nuño, Thaler and Thomas (2020)
- Continuum of banks operating in different islands indexed by $j \in [0, 1]$
  - **(i)** Start with some after-dividend equity N_t^j and issue deposits D_t^j at rate R_t^D
  - **(ii)** Learn idiosyncratic productivity $\omega_t^j \overset{iid}{\sim} F(\omega)$
  - **(iii)** Make portfolio choice:
    - Finance firms' physical capital A_t^j with return $\omega_t^j R_t^K$
    - Purchase govt. bonds $b_t^{G,j}$ with return R_{t+1}^G
    - Gross borrowing B_t^+ and lending B_t^- in IB mkt at effective rates R_t^B, R_t^L
    - Subject to leverage constraint: $Q_t^K A_t^j \leq \phi N_t^j$
  - **(iv)** Banks that found no partner in the IB mkt access standing facilities of the CB
- Balance sheet:

$$\underbrace{Q_t^K A_t^j}_{\substack{\text{Claims} \\ \text{on firms}}} + \underbrace{B_t^{-,j}}_{\substack{\text{IB} \\ \text{lending}}} + \underbrace{b_t^{G,j}}_{\substack{\text{Govt.} \\ \text{bonds}}} = \underbrace{B_t^{+,j}}_{\substack{\text{IB} \\ \text{borrowing}}} + \underbrace{D_t^j}_{\text{Deposits}} + \underbrace{N_t^j}_{\text{Equity}}$$

Interbank market

- Decentralized, OTC market: search frictions → market does not automatically clear (similar to Afonso and Lagos, 2012, and Bianchi and Bigio, 2021)
- Interbank rate: $R_t^{IB} = \varphi(\theta_t) R_t^{DF} + [1 - \varphi(\theta_t)] R_t^{LF}$

→ Position of IB rate inside interest rate corridor (R_t^{DF}, R_t^{LF}) depends on IB market tightness θ_t (ratio of borrowing over lending orders), with $\varphi'(\cdot) < 0$

Central bank

- The central bank sets the two policy rates (R_t^{DF}, R_t^{LF}) such that:

  (i) corridor width is constant

  $$R_t^{LF} = R_t^{DF} + \chi$$

  (ii) IB market rate (the "operational target") follows a Taylor rule with inertia

  $$R_t^{IB} = \rho R_{t-1}^{IB} + (1-\rho)[\overline{R} + \nu \pi_t]$$

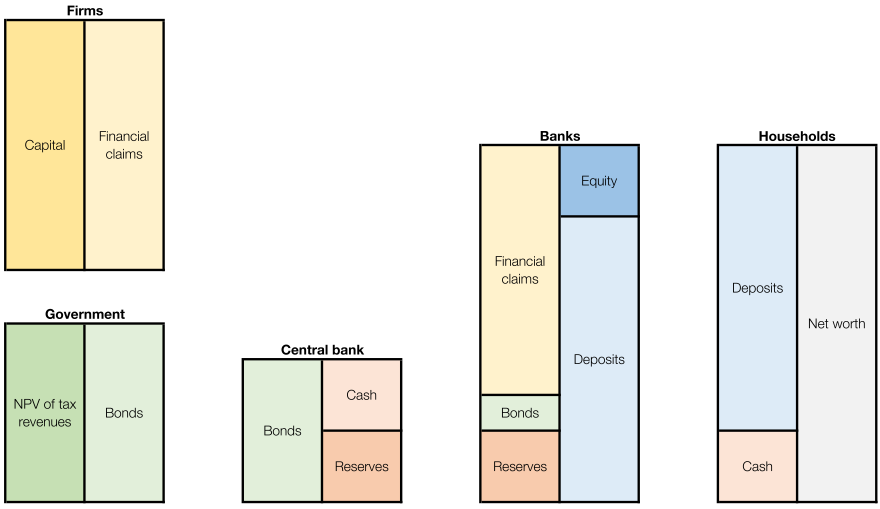
- Balance sheet:

$$\underbrace{b_t^{G,CB}}_{\text{Bond holdings}} + \underbrace{\Phi^B(1-\Gamma_t^B)}_{\text{CB loans}} = \underbrace{\Phi^L(1-\Gamma_t^L)}_{\text{CB reserves}} + \underbrace{M_t + D_t^{DC}}_{\text{Cash + CBDC}}$$

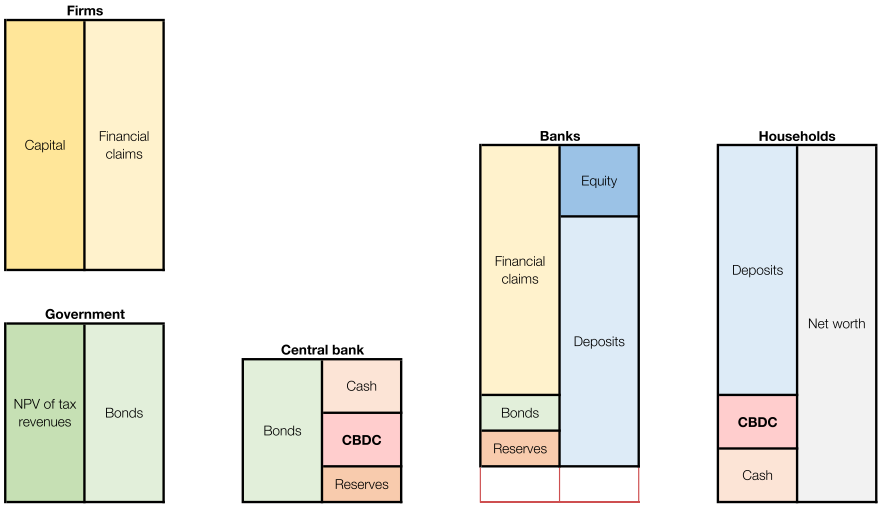
Calibration

- We replicate the Eurosystem and EA banking sector balance sheets
- We use the ECB SMA forecasts of policy rates and balance sheet size in the medium run
  - $R^{DF} = 1\%$, $R^{LF} = 1.75\%$
  - APP + PEPP = 15% of EA GDP
- The elasticity of substitution between the different types of liquid assets held by the household is taken from Wang (2022) [based on the estimated deposit rate pass-through of policy rate shocks in 2000-2008]
- Focus first on an unremunerated CBDC

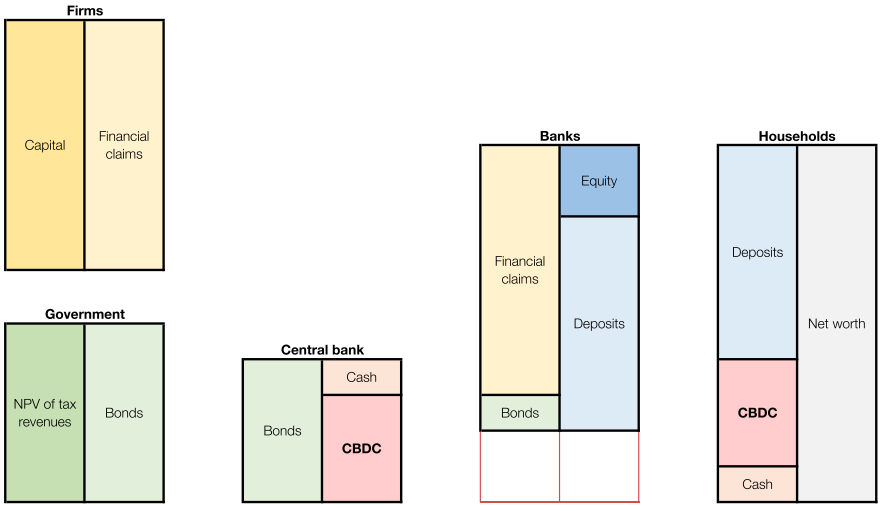
Introduction of a CBDC – floor system



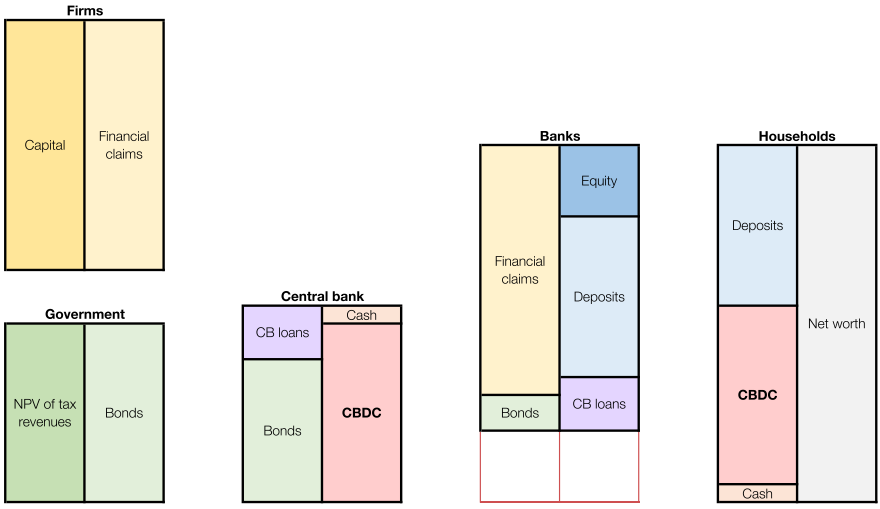
Introduction of a CBDC – floor system



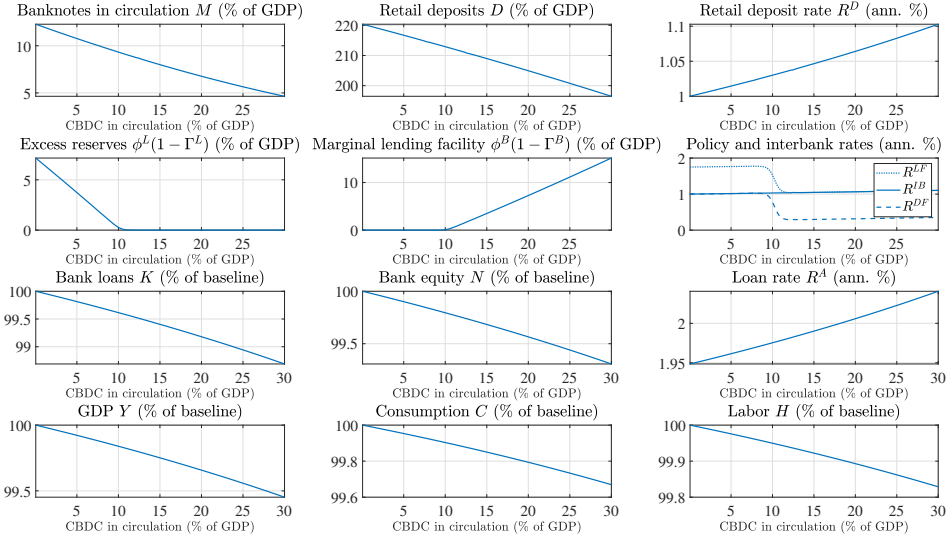
Introduction of a CBDC – corridor system



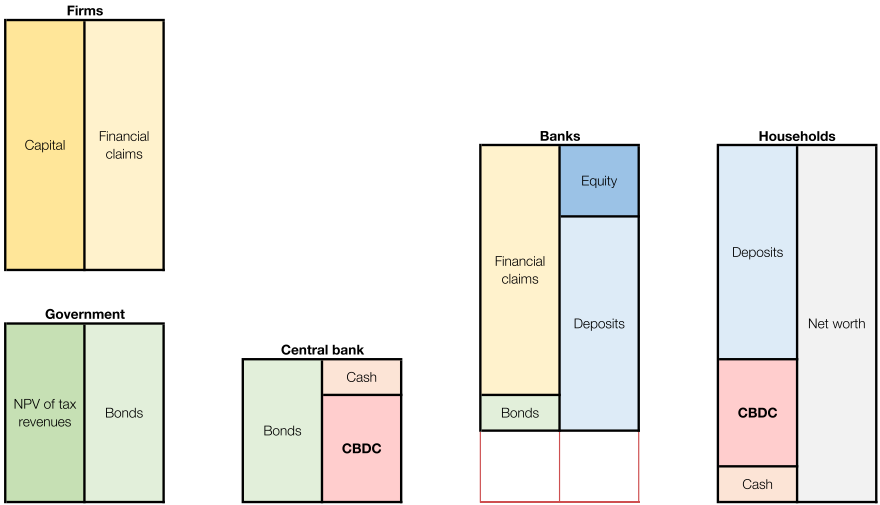
Introduction of a CBDC – ceiling system



Introduction of a CBDC – quantitative results



Maintaining the floor system with asset purchases



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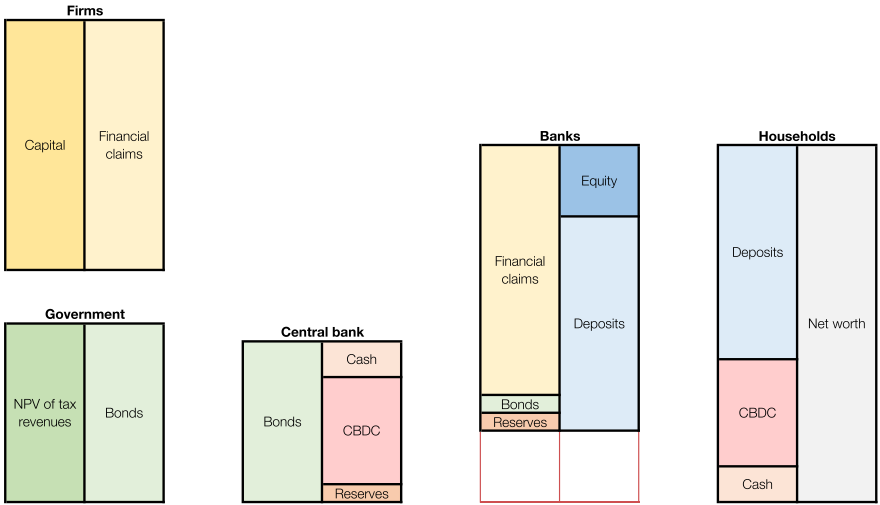
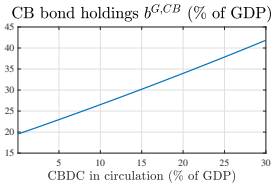
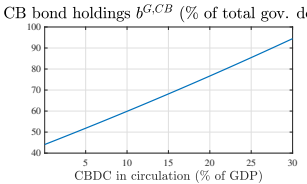
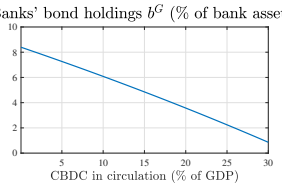


Maintaining the floor system with asset purchases

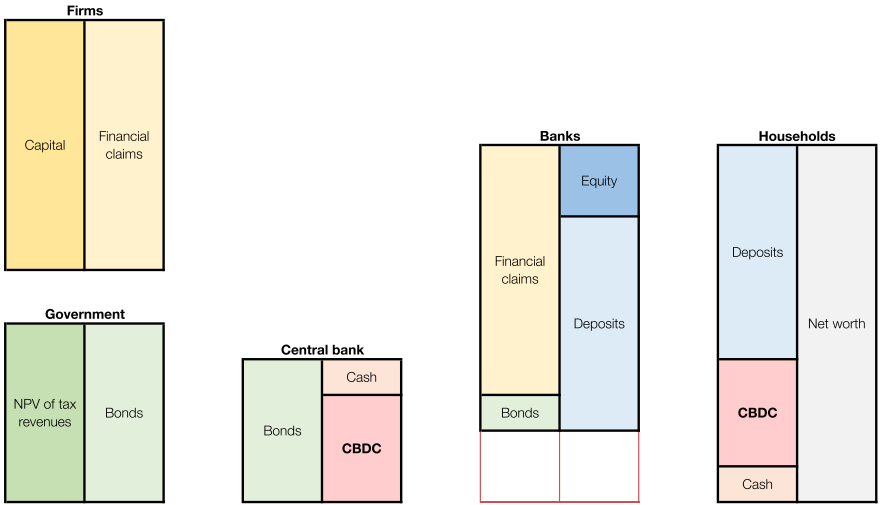
- Increase in CB bond holdings necessary to keep reserves at their pre-CBDC level?







Maintaining the floor system with CB loans



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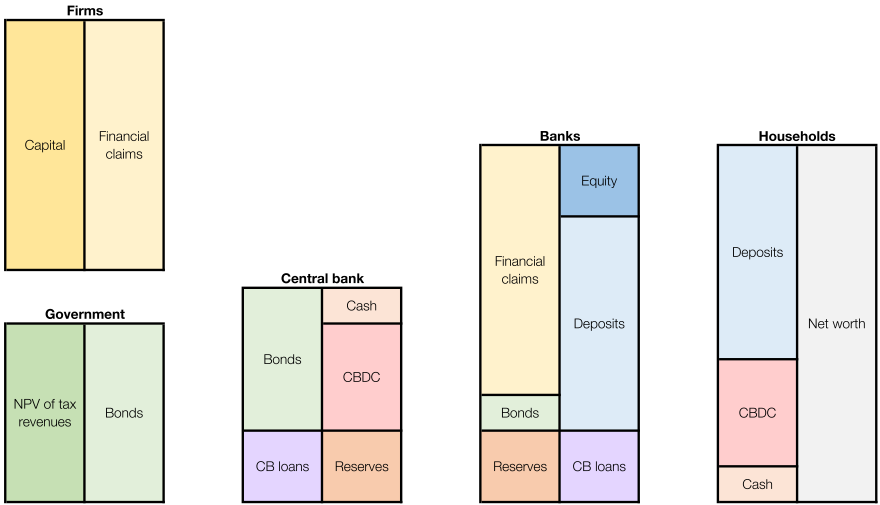
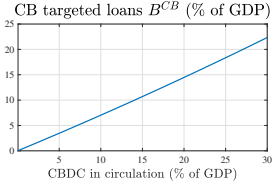
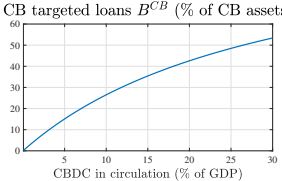
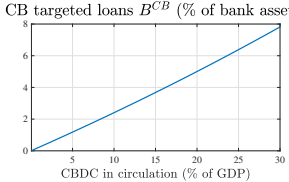


Maintaining the floor system with CB loans

- Banks are offered funds B_t^{CB} at the DFR ($R_t^{CB} = R_t^{DF}$)
- Can borrow up to an allowance proportional to their loan portfolio: $B_t^{CB,j} \leq \psi Q_t^K A_t^j$
- Max allowance necessary to keep reserves at their pre-CBDC level?



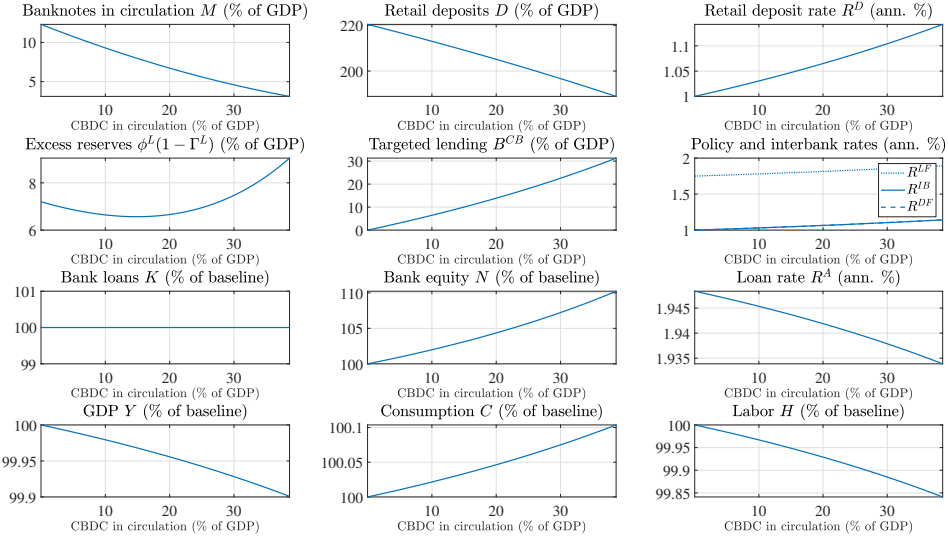




Targeted (subsidized) lending

- Maintaining the floor system via additional asset purchases or CB lending at the IB rate is neutral for allocations and prices
- However, subsidized lending (at rates below R^{IB}) is effective at stimulating credit supply
- We introduce targeted subsidized lending remunerated at $R_t^{CB} = R_t^{DF} - \chi^{CB}$
- We calibrate the necessary allowance ψ conditional on CBDC take up that keeps lending constant at its baseline level (with remuneration 1pp below the DFR)

Introduction of a CBDC – targeted lending



CBDC remuneration and equivalence result

- So far, focused on unremunerated CBDC
  - Without additional policies, lower overall returns on savings decrease households' wealth
- We show the existence of a "wealth neutral" remuneration rate of CBDC ($\bar{R}^{DC}$) as in Brunnermeier and Niepelt (2019)
  - It solves:

$$R^D D + M = R^D D' + M' + \bar{R}^{DC} D^{DC},$$

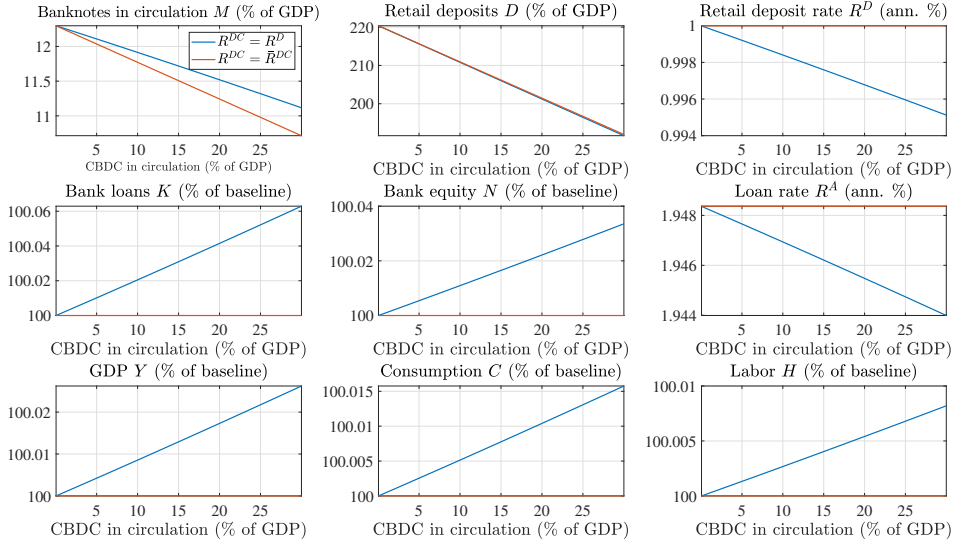
where X and X' are the steady-state before and after CBDC is introduced, so that

$$\bar{R}^{DC} = \frac{R^D \Delta D + \Delta M}{\Delta D + \Delta M}$$

where $\Delta X = X' - X$ (and since $D^{DC} = \Delta D + \Delta M$)

- Given CES preferences for liquidity, $\bar{R}^{DC}$ remains constant when η_{DC} changes

CBDC remuneration and equivalence result



Additional results

- Different design options:
  - (Tiered) remuneration
  - Holding limits
  - ...
- Alternative calibrations
  - Pre-crisis corridor system
  - Post-crisis negative rates and ZLB
  - ...
- Transitional dynamics

Concluding remarks

- Introduction of a CBDC in a realistic model of MP transmission
- CBDC decreases bank intermediation and aggregate excess reserves
- We analyze different policies aimed at maintaining the floor system
- Results crucially depend on design features (especially CBDC remuneration)

Thank you!