

Bank Market Power and Central Bank Digital Currency: Theory and Quantitative Assessment¹

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¹Previously circulated as "Central Bank Digital Currency and Banking." The views expressed in this paper are those of the authors and not necessarily the views of the Bank of Canada.

- A central bank digital currency (CBDC) is a digital form of central bank money that can be used for general payment.
- Central banks are considering issuance of a CBDC (BIS)
 - Out of 65 major central banks, 86% engage in CBDC work
 - 60% started experiments or proof-of-concept
 - 14% doing development and pilot arrangements
- One concern: a CBDC may cause bank disintermediation
 - A CBDC is a substitute to bank deposits as payment instruments
 - Raise bank funding cost and reduce lending

- Build a model where
 - Banks create deposits and make loans
 - Deposits are inside money used for transactions
 - Banks have market power in deposit market
- Introduce a deposit-like interest-bearing CBDC
 - Increases deposits *and* loans under a moderate CBDC rate
 - Disintermediation under a high CBDC rate
- Theoretic findings robust to modelling choices
 - Price vs quantity competition in the deposit market, loan market structure, endogenous bank entry, risk taking considerations, heterogenous banks etc.

- Calibrate to US and quantify the effects of a deposit-like CBDC
 - Promotes intermediation if its rate between 0.3% and 1.49%
 - Lending increases up to 1.96%
 - Output can increase up to 0.21%
 - A zero-interest CBDC effective if 3.40% local stores reject cash
- Check the robustness of results under alternative calibrations

- Central Bank Digital Currency
 - **Andolfatto (2018), Keister and Sanches (2018)**, Brunnermeier and Niepelt (2018), Barrdear and Kumhof (2016), Davoodalhosseini (2018), Zhu and Hendry (2018) ...
- New Monetarist Models
 - Berentsen, Camera and Waller (2007), Lagos and Wright (2005), Lagos and Zhang (2018), Rocheteau and Wright (2005) ...
- Imperfect Bank Competition
 - Dreschler, Savov and Schnabl (2017,2018), Kurlat (2018)...
- Special Features of Digital Currencies
 - Chiu and Wong (2016), Chiu and Koepl (2019), Choi and Rocheteau (2020) ...

- 1 Introduction
- 2 Model without a CBDC
- 3 Effects of a CBDC
- 4 Quatitative Analysis

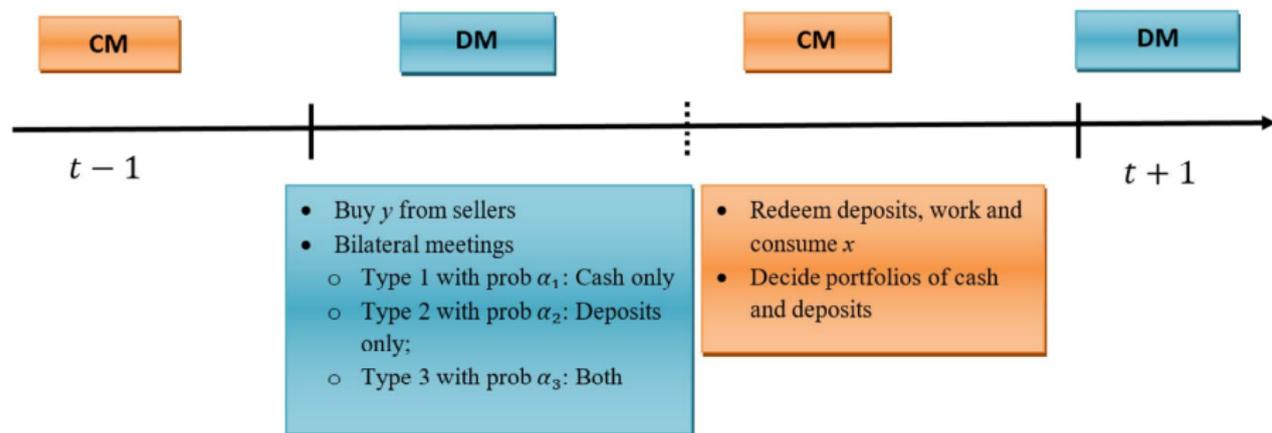
Outline

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- Time is discrete and continues forever
- Two markets open sequentially each period
 - Decentralized Market (DM) with search and info. frictions
 - Centralized Market (CM)
- Four types of private agents
 - A continuum of households divided into buyers and sellers
 - A continuum of short-lived entrepreneurs
 - N bankers each owns a commercial bank
- Consolidated central bank and government

- Two means of payments in DM:
 - Cash issued by central bank
 - Deposits issued by commercial banks
- Cash and deposits differ in terms of acceptability, e.g.
 - Deposits are digital and cash is physical
 - Deposits can serve online transactions while cash cannot

Buyers



Inverse Demand for Deposits

- Demand for cash z and deposit d determined by

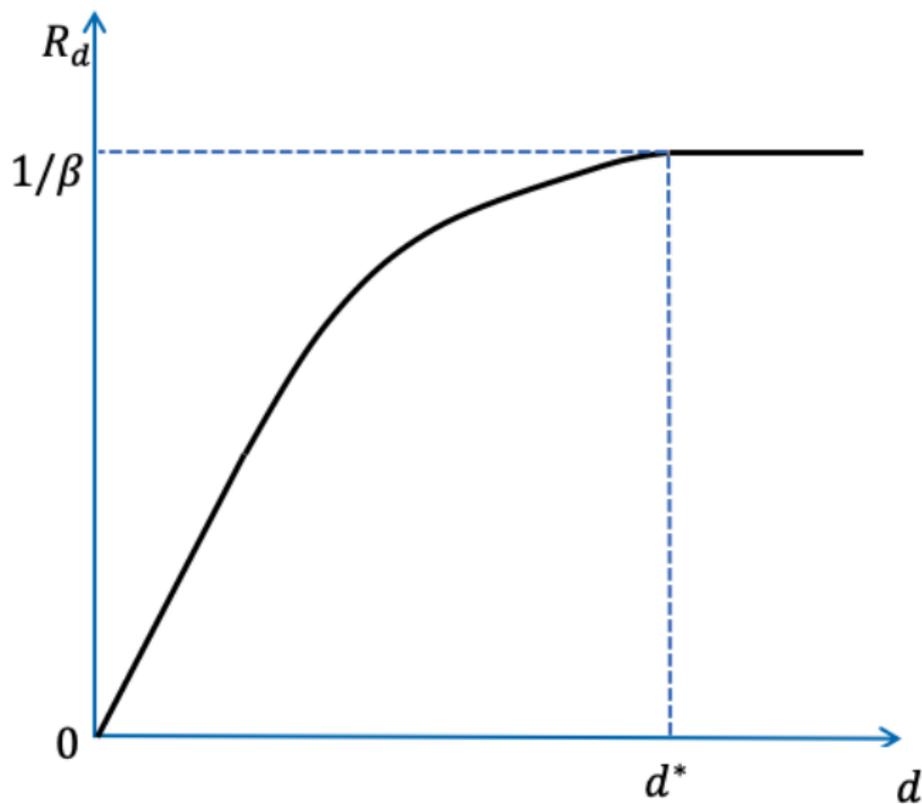
$$\frac{1}{\beta R_z} - 1 = \alpha_1 \lambda (z \cdot R_z) + \alpha_3 \lambda (z \cdot R_z + d \cdot R_d)$$

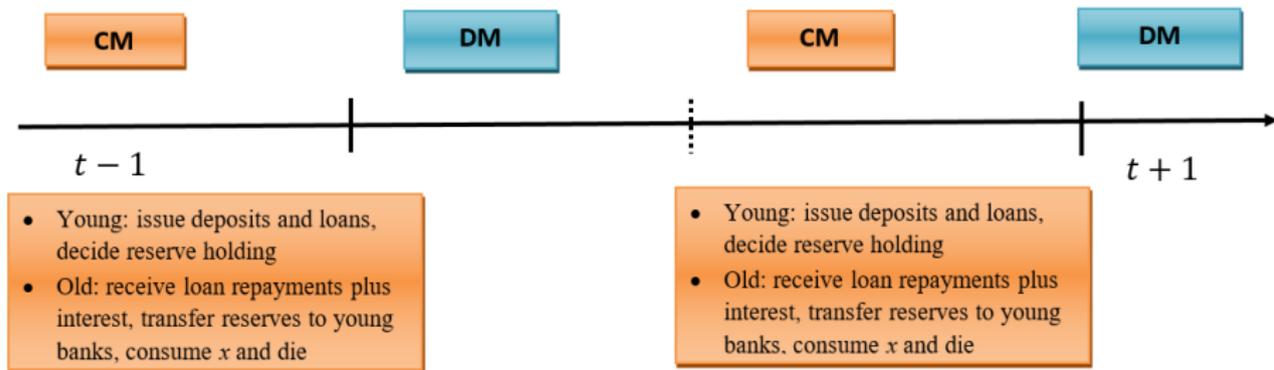
$$\frac{1}{\beta R_d} - 1 = \alpha_2 \lambda (d \cdot R_d) + \alpha_3 \lambda (z \cdot R_z + d \cdot R_d)$$

where $\lambda =$ liquidity premium.

- Imply an inverse demand for deposits $\mathbf{R}_d(d)$ by buyers

Inverse Demand for Deposits: $R_d(d)$





- Cournot competition on deposits
- Perfect competition on loans (this talk)

Cournot Competition in Deposit Market

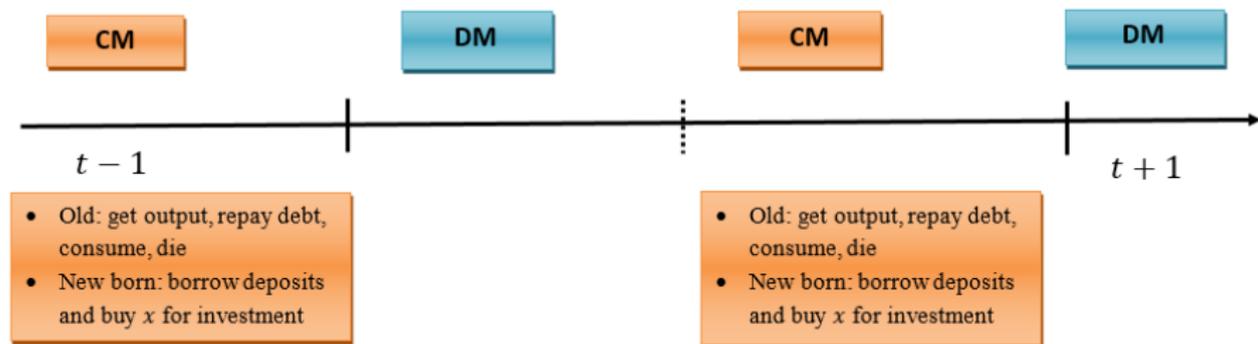
- Banker j best responds to competitors' quantity $d_{-j} = \sum_{i \neq j} d_i$,

$$\max_{r_j, \ell_j, d_j} \left\{ R_\ell \ell_j + R_r r_j - \mathbf{R}_d (d_{-j} + d_j) d_j \right\}$$

s.t. $\ell_j + r_j = d_j, \quad r_j \geq \chi d_j.$

- r_j is reserve balances and R_r is its real gross rate
- χ is the reserve requirement.
- Symmetric Cournot equilibrium \Rightarrow aggregate deposit supply $D(R_\ell)$ and loan supply $L^S(R_\ell)$

Entrepreneurs



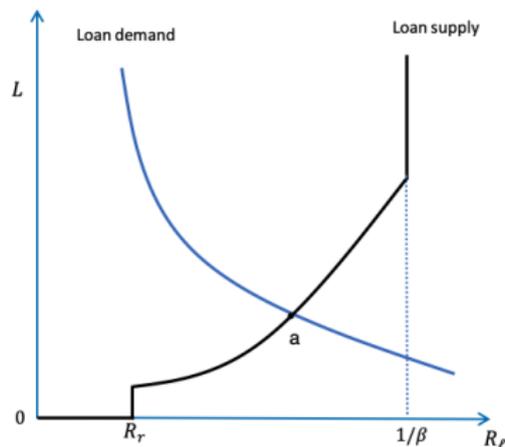
- Entrepreneurs invest ℓ today and get $f(\ell)$ tomorrow
- Given real loan rate R_ℓ an entrepreneur solves

$$\max_{\ell} [f(\ell) - R_\ell \ell]$$

- Imply a loan demand function by entrepreneurs

$$L^d(R_\ell) = f'^{-1}(R_\ell)$$

Existence and Uniqueness of Equilibrium



Proposition

Under certain technical conditions, there exists a unique symmetric steady state equilibrium.

Remark: Equilibrium loan and deposit quantities are low relative to perfect competition.

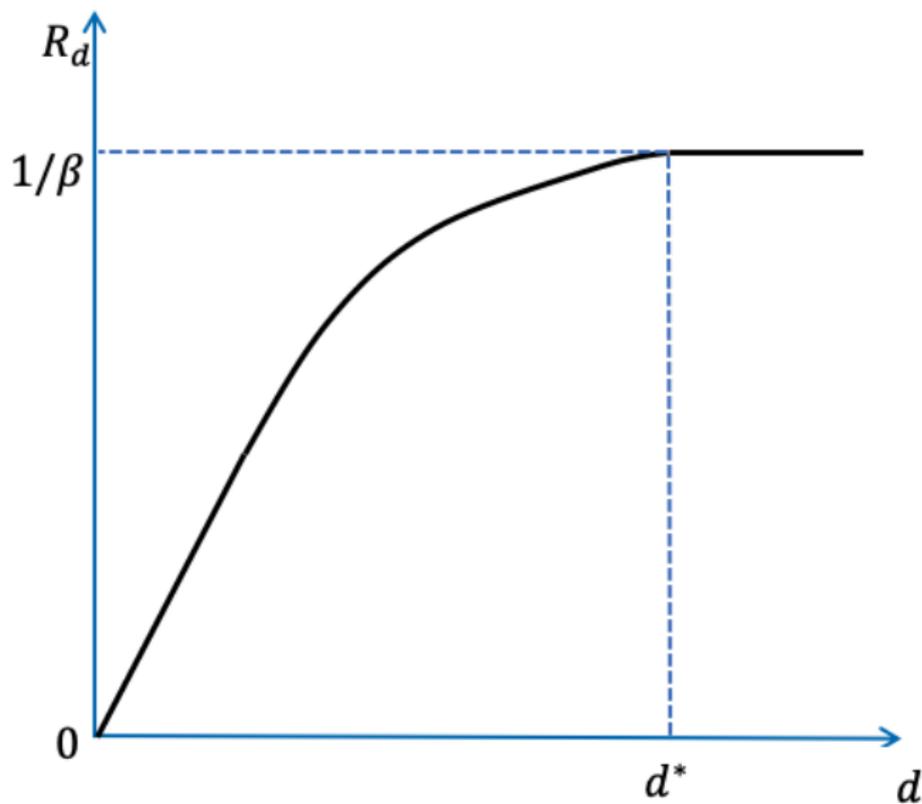
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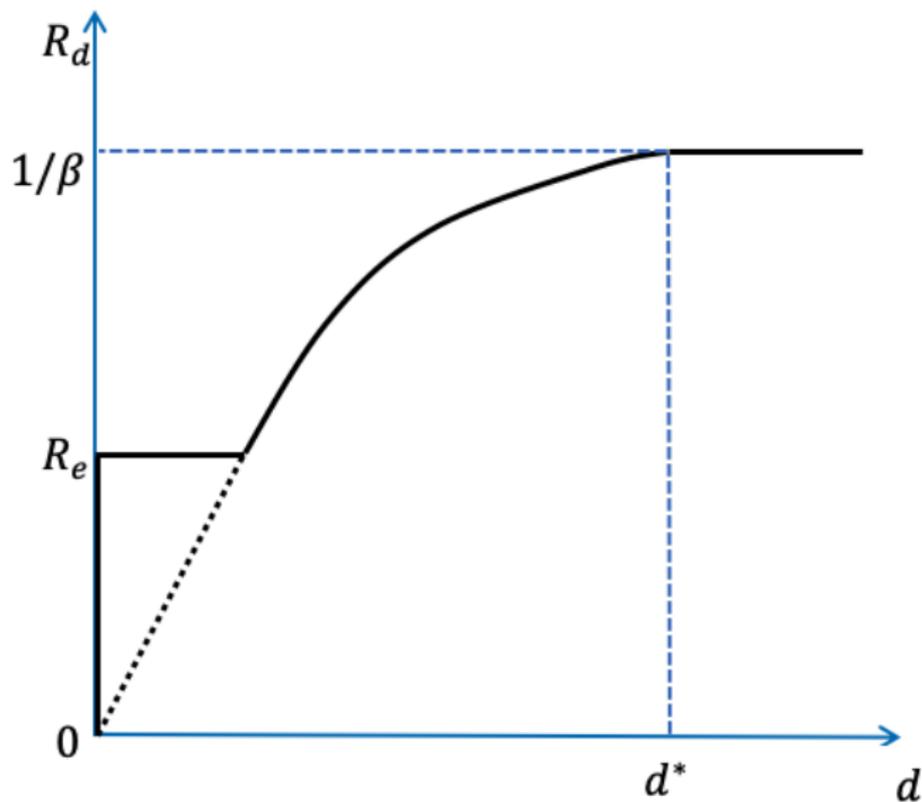
Interest Bearing Deposit-Like CBDC

- CBDC designed to be a perfect substitute for bank deposits
 - Can be used in type 2 and 3 meetings
- Pay nominal interest i_e (positive or negative): gross real rate R_e
- The CBDC not as reserves \implies banks do not hold the CBDC

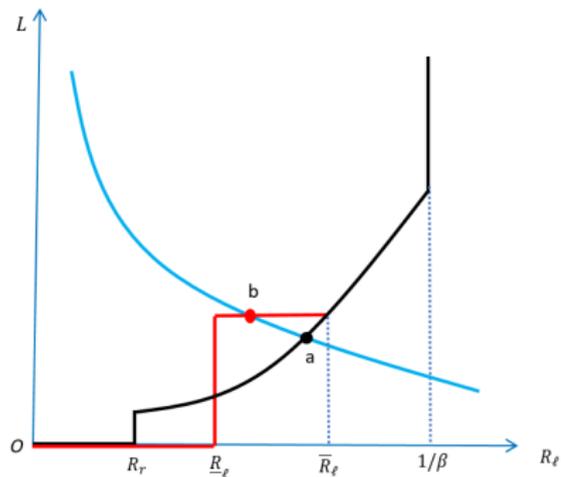
Inverse Demand for Deposits: $R_d(d)$



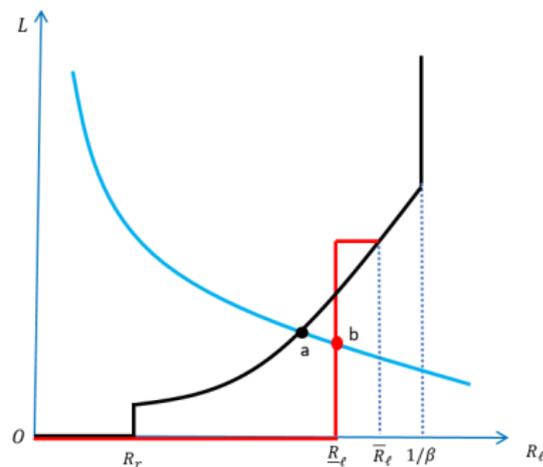
The Effect of a CBDC on Deposit Demand



Effects of CBDC on Equilibrium



(a) Medium i_e



(b) High i_e

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- 1 What is the range of i_e that improves bank intermediation?
- 2 How large is the positive effect of the CBDC?
- 3 How does a zero-interest CBDC affect the economy, in particular, when the use of cash declines?

Effects of An Interest-Bearing CBDC

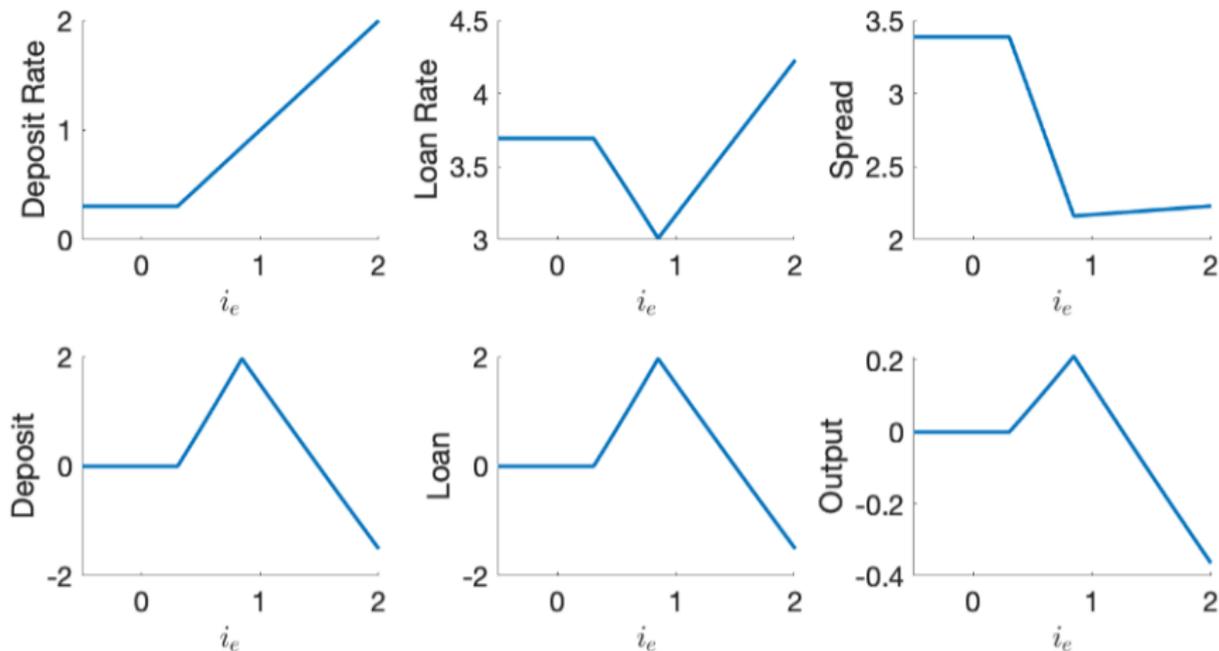


Figure 6: Effects of CBDC Rate

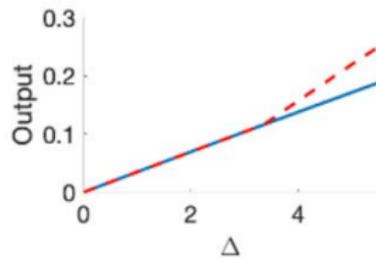
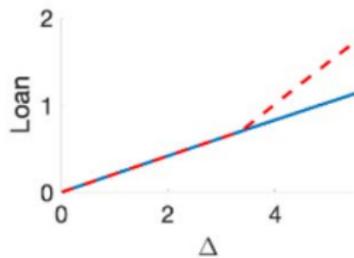
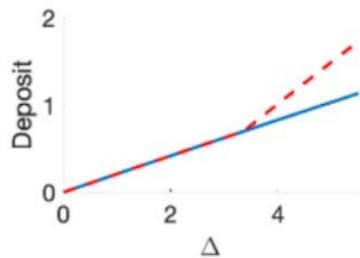
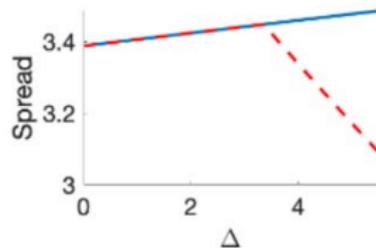
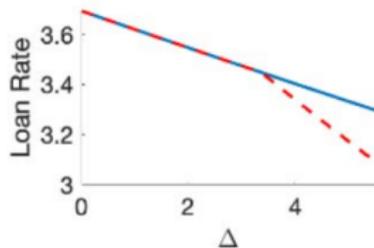
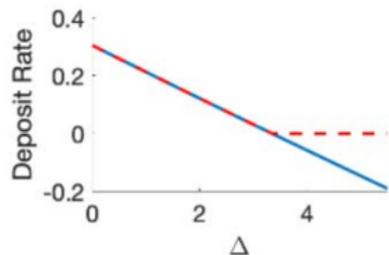
Effects of An Interest-Bearing CBDC

- Promotes bank intermediation when $0.3\% < i_e < 1.49\%$
- Increases output when $0.3\% < i_e < 1.26\%$
- Maximum increase 1.96% in lending, 0.21% in output

Non-Interest Bearing Deposit-Like CBDC

- CBDC designed to be perfect substitute for bank deposits
 - Can be used in type 2 and 3 meetings
- Pay nominal interest $i_e = 0$
- Use of cash declines: $\alpha_3 \rightarrow \alpha_3 - \Delta\% \times \alpha_3$, $\alpha_2 \rightarrow \alpha_2 + \Delta\% \times \alpha_3$

Use of Cash Declines



— No CBDC - - With CBDC

Conclusion

- CBDC promotes bank intermediation
 - for a range of $i_e > 0$ or if cash use declines
 - Effects quantitatively sizeable
- CBDC has a positive effect even if it is not used
 - Usage not a measure of success
 - Lending and deposit rates are better measures
 - May not have a big impact on central bank balance sheet
- Results are robust to a couple of modelling choices