CBDCs, Financial Inclusion, and Optimal Monetary Policy

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Introduction

- Central banks are actively studying the potential adoption of central bank digital currencies (CBDCs).
- Notable examples include Sweden's E-Krona and China's Digital Currency Electronic Payment.
- Emerging macroeconomic literature:
  - Macro effects: (George, Xie, and Alba 2020; Ikeda 2020; Kumhof et al. 2021; Cong and Mayer 2021; Benigno, Schilling, and Uhlig 2022; Ferrari Minesso, Mehl, and Stracca 2022).
  - Financial stability: (Chiu et al. 2019; Benigno 2019; Skeie 2019; Fernández-Villaverde et al. 2021; Agur, Ari, and Dell'Ariccia 2022).
- We focus on the **monetary policy transmission**, **financial inclusion** and **welfare** aspects of CBDCs.

Research Questions

- We address the following research questions:
  1. Do CBDCs attenuate or amplify monetary policy transmission channels?
  2. Do CBDCs increase welfare of the unbanked through financial inclusion?
  3. Should the interest rate on the CBDC be adjustable or fixed?

This Paper

- Using a TANK model, we find that the introduction of a CBDC amplifies monetary policy transmission.
- Optimal policy exercise: CBDC rate should track deposit rate.

This Presentation

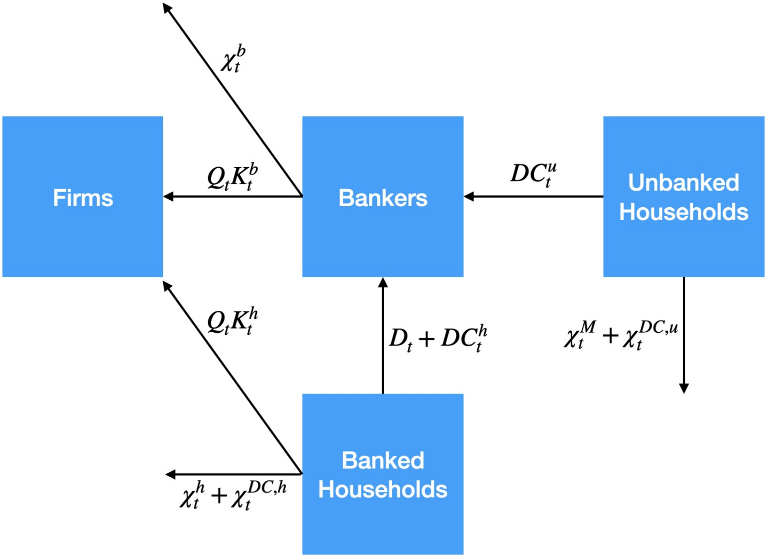
- TANK model
  - Monetary policy transmission
- Optimal policy and macroprudential policy
  - Ramsey planner problem and instruments

New Keynesian Model

Model Overview

- Households
  - Two types: banked and unbanked
  - Both types consume and supply labour
  - Heterogeneity wrt. access to savings technology
  - Banked have access to deposits, equity, and digital currency.
  - Unbanked use money and digital currency.
- Production
  - Cobb-Douglas production with labour and capital
  - Staggered price setting as in Rotemberg (1982)
- Banks
  - Standard as in Gertler and Kiyotaki (2010)
  - Take deposits and issue equity
- Policy authorities

Model Overview



BHH Problem

- Utility function,

$$\mathbb{V}_t^h = \max_{\{C_{t+s}^h, L_{t+s}^h, D_{t+s}, K_{t+s}^h, DC_{t+s}^h\}_{s=0}^{\infty}} E_t \sum_{s=0}^{\infty} \beta^s \ln\left(C_{t+s}^h - \zeta_0^h \frac{(L_{t+s}^h)^{1+\zeta}}{1+\zeta}\right),$$

s.t.,

$$\begin{aligned} C_t^h + D_t + Q_t K_t^h + \chi_t^h + DC_t^h + \chi_t^{DC,h} + T_t^h \\ = w_t L_t^h + \Pi_t + (z_t^k + (1-\delta)Q_t)K_{t-1}^h + \frac{R_{t-1}D_{t-1} + R_{t-1}^{DC} DC_{t-1}^h}{\pi_t}. \end{aligned}$$

- BHH pays cost of adjusting equity holdings:

$$\chi_t^h = \frac{\varkappa^h}{2}\left(\frac{K_t^h}{K_t}\right)^2 \Gamma_h K_t.$$

UHH Problem

- Analogously, the UHH's problem is:

$$\mathbb{V}_t^u = \max_{\{C_{t+s}^u, L_{t+s}^u, M_{t+s}, DC_{t+s}^u\}_{s=0}^{\infty}} E_t \sum_{s=0}^{\infty} \beta^s \ln\left(C_t^u - \zeta_0^u \frac{(L_t^u)^{1+\zeta}}{1+\zeta} \right),$$

subject to its budget constraint,

$$C_t^u + M_t + \chi_t^M + DC_t^u + \chi_t^{DC,u} + T_t^u = w_t L_t^u + \frac{M_{t-1} + R_{t-1}^{DC} DC_{t-1}^u}{\pi_t},$$

and the CIA constraint

$$C_t^u \leq \frac{M_{t-1}}{\Pi_t}$$

Bankers

- Bankers ($j = b$) share a perfect insurance scheme with the BHH (Gertler and Kiyotaki 2010).
- Intermediate financing between households and firms (through deposits, DC, and equity).
- Bankers seek to maximise franchise value, $\mathbb{V}_t^b$:

$$\mathbb{V}_t^b = E_t \left[\sum_{s=1}^{\infty} \Lambda_{t,t+s}^h \sigma_b^{s-1} (1 - \sigma_b) n_{t+s} \right].$$

- A financial friction (moral hazard) is used to limit the banker's ability to raise funds.
- Banker can abscond with fraction θ^b of assets.
- Thus, the bankers face the following incentive compatibility constraint:

$$\mathbb{V}_t^b \geq \theta^b Q_t k_t^b,$$

Bank Balance Sheet and Flow of Funds

- Bank balance sheet contains digital currency deposits and net worth:

Assets	Liabilities + Equity
Loans $Q_t k_t^b$	Deposits d_t
Management costs χ_t^b	Digital currency deposits dc_t
	Net worth n_t

- Flow of funds of an individual banker:

$$n_t = [z_t^k + (1-\delta)Q_t]k_{t-1}^b - \frac{R_{t-1}}{\pi_t}d_{t-1} - \frac{R_{t-1}^{DC}}{\pi_t}dc_{t-1},$$

- Management costs of the banker governed by $\varkappa^b > 0$ and $x_t = \frac{dc_t}{Q_t k_t^b}$, a banker's digital currency deposit leverage ratio:

$$\chi_t^b = \frac{\varkappa^b}{2} x_t^2 Q_t k_t^b,$$

Firms

- Firms and production in the model are standard.
- Final goods are produced by perfectly competitive firms using intermediate goods as inputs into production.
- Each differentiated intermediate good is produced by a constant returns to scale technology given as follows:

$$Y_t(i) = A_t K_{t-1}(i)^{\alpha} L_t(i)^{1-\alpha},$$

- Intermediate firms are subject to nominal rigidities à la Rotemberg.

Fiscal and Monetary Policy

- Central bank is assumed to operate an inertial Taylor Rule for the nominal interest rate:

$$\frac{R_t}{\bar{R}} = \left(\frac{R_{t-1}}{\bar{R}}\right)^{\rho_R} \left(\pi_t^{\phi_\pi} X_t^{\phi_Y}\right)^{1-\rho_R} \exp(\varepsilon_t^R)$$

- The central bank sets the nominal return on digital currency one-for-one in-line with the nominal interest rate on deposits:

$$R_t^{DC} = R_t.$$

Market Clearing

- Aggregate consumption, labor supply, and digital currency holdings by the BHH and UHH are given as:

$$C_t = \Gamma_h C_t^h + \Gamma_u C_t^u,$$
$$L_t = \Gamma_h L_t^h + \Gamma_u L_t^u,$$
$$DC_t = \Gamma_h DC_t^h + \Gamma_u DC_t^u.$$

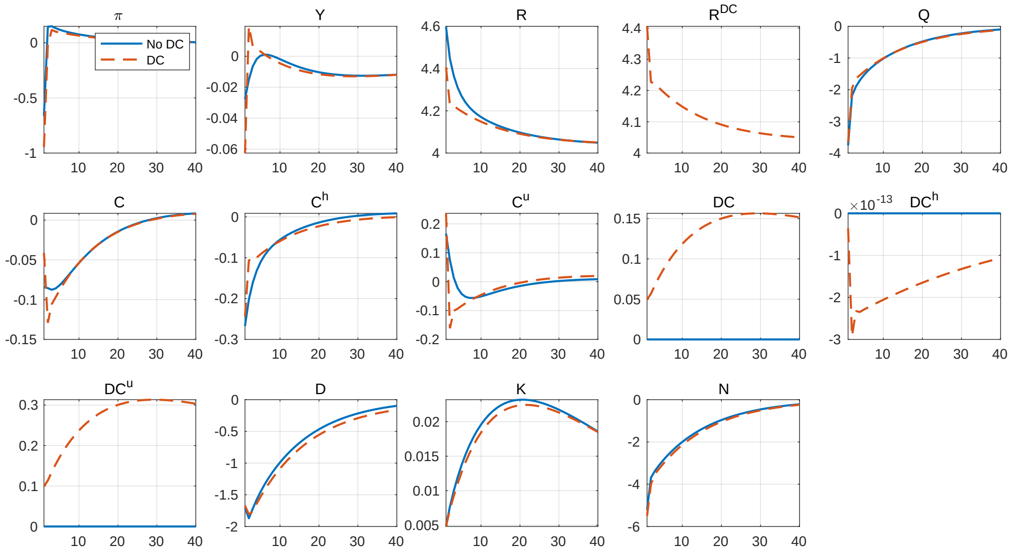
- The aggregate resource constraint of the economy is:

$$Y_t = C_t + \left[1 + \Phi\left(\frac{I_t}{\bar{I}}\right)\right] I_t + \frac{\kappa}{2}(\pi_t - 1)^2 Y_t + \Gamma_h(\chi_t^h + \chi_t^b + \chi_t^{DC,h}) + \Gamma_u(\chi_t^{DC,u}),$$

- Aggregate capital:

$$K_t = \Gamma_h(K_t^h + K_t^b).$$

IRFs to a 1% Annualised Monetary Policy Shock



Optimal Policy

Optimal Monetary Policy

- Ramsey planner has two instruments: R and R^{DC}:

$$\max_{\{R_{t+s}, R^{DC}_{t+s}\}_{s=0}^{\infty}} \mathbb{V}_t = \Gamma_h \mathbb{V}_t^h + \Gamma_u \mathbb{V}_t^u,$$

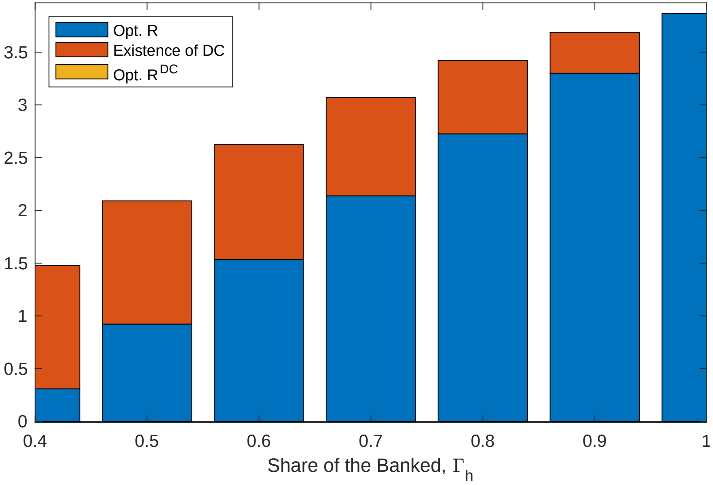
- As CBDC and deposits are imperfect substitutes: no colinearity
- Using this framework, we can evaluate whether CBDC rates need to track the policy rate: i.e. should they be adjustable or fixed?

Optimal Policy w/ Commitment

- Economy is subject to TFP and cost-push shocks.
- Baseline economy: TANK w/o CBDC.
- The welfare improvements associated with optimal policy come from
  1. Introduction of CBDC (with $R_t = R_t^{DC}$)
  2. Optimal monetary policy (one instrument)
  3. Optimal R_t^{DC} policy (two instruments)
- We decompose welfare improvements into these three components

Optimal Policy w/Commitment, TFP Shock

Figure Welfare decomposition, TFP shock, DC near-perfect substitute ($\varkappa^{DC}$ low)



Optimal Policy w/Commitment, Cost-Push Shock

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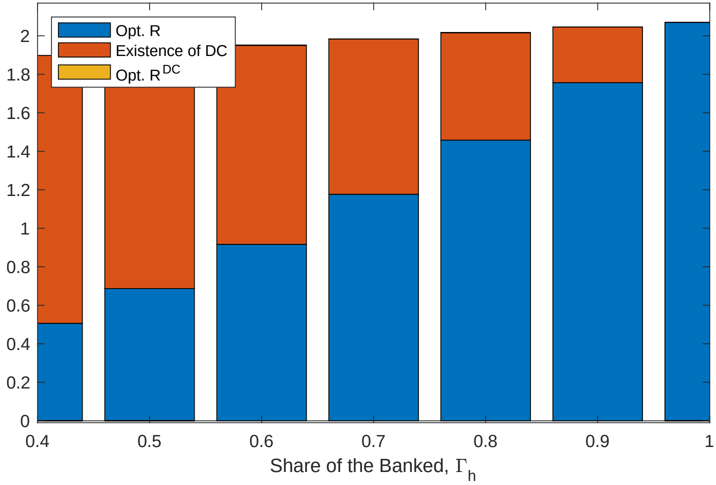

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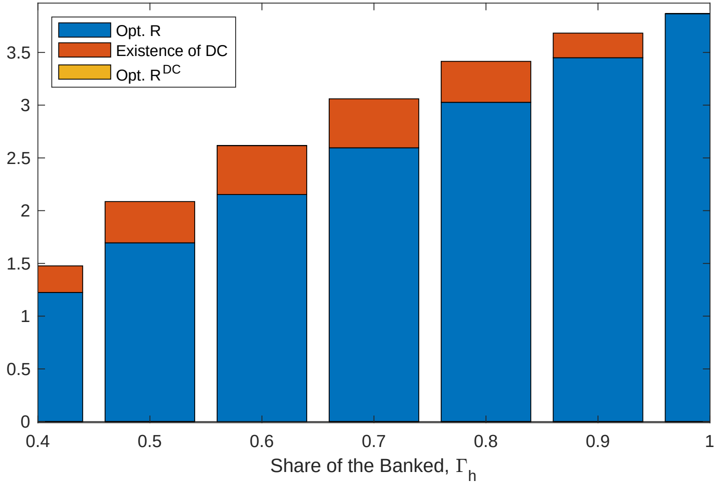

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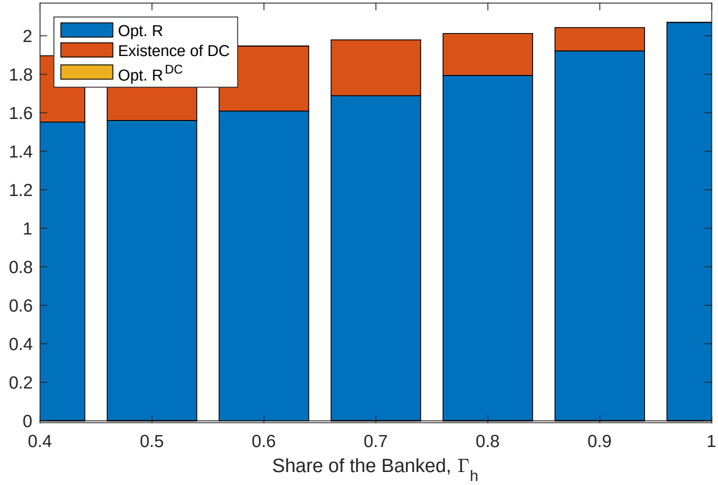


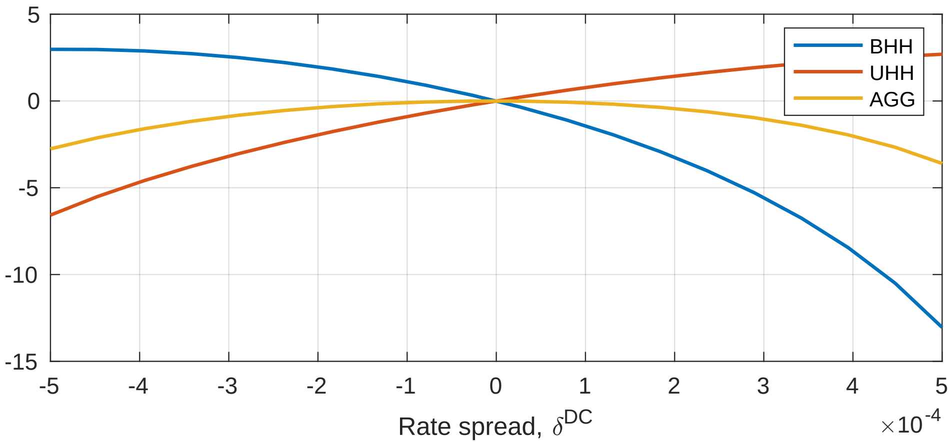
Welfare of Different Interest Rate Rules

- Assume policymaker sets a CBDC rate at a spread δ^{DC} over the policy rate,

$$R_t^{DC} = R_t + \delta^{DC}.$$

- We compare welfare outcomes to the case when the spread between CBDC rates and deposit rates are zero in response to a 1% TFP shock.
- Aggregate welfare is maximized when $R_t^{DC} = R_t$, with distributional effects when spreads are non-zero.

Welfare of Different Interest Rate Rules



Concluding Remarks

- In this paper we focus on the financial inclusion effects of introducing a CBDC.
- Our results suggest that the introduction of a CBDC increases welfare for the unbanked, and amplifies monetary policy transmission.
- Optimal policy requires the CBDC rate to track the policy rate, yielding higher welfare than rules that require a constant rate of remuneration on the CBDC.

Thank You!

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