Managing the transition to central bank digital currency

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Introduction

Motivation

✓ Many central banks are investigating options to introduce a retail CBDC.

✓ In this context,
   → limits on individual's CBDC holdings,
   → negative interest on CBDC exceeding a certain baseline amount,
   → limited access to CBDC for foreigners

   have been proposed as measures to deal with structural bank disintermediation through deposit substitution.

✓ To avoid an unintended tightening of the monetary policy stance, the central bank could also provide additional liquidity (Brunnermeier and Niepelt, 2019; Adalid et al., 2020).

What we do

✓ We study the transition from a steady state without CBDC to one with CBDC in an open-economy DSGE model, where the central bank can implement policies to mitigate welfare effects that arise during the transition (as occasionally binding constraints).

✓ We find that CBDC demand overshoots persistently during the transition to the new steady state, causing deposits, investments, GDP and welfare to fall.

✓ Mitigating policies can reduce the welfare loss during the transition.

  → Holding limits turn out to be most effective.

  → Interest policies and asset purchases also reduce welfare loss but are less effective.

The model

Model in one chart
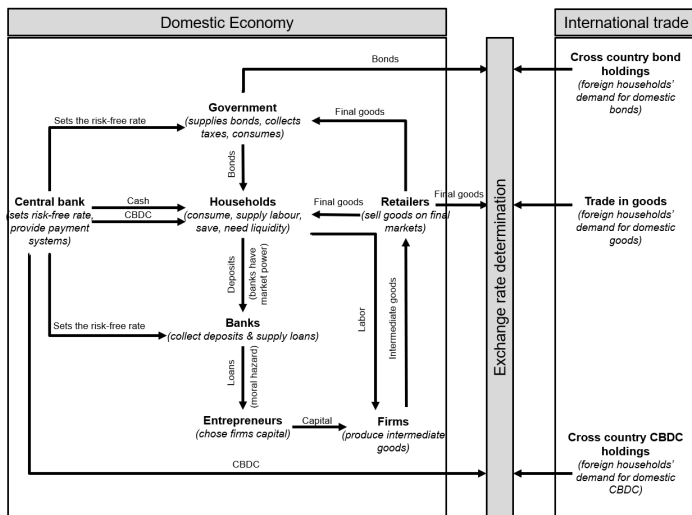
Key friction

HHs face a CIA constraint and demand payment services:

$$\mathcal{L}_t = \chi_L \left[\mu_M M^{1-\eta_L} + \mu_D D^{1-\eta_L} + \mu_{DC} DC^{1-\eta_L} \right]^{\frac{1}{1-\eta_L}}$$

Cash, deposits and CBDC have value as payment instruments.

Banks extract rent through the deposit contract (Andolfatto, 2021):

$$\underbrace{\gamma_t \mu_D \chi_L^{\frac{1}{\eta_L}} C_t^{\eta_L} D_t^{-\eta_L}}_{\text{Value for payments}} = \beta E_t \left(\frac{\lambda_{t+1}}{\pi_{t+1}} \right) (R_t - R_t^D)$$

The optimal deposit rate is a mark-down on the lending rate:

$$R_t^D = \frac{\theta_{t,D}}{\theta_{t,D} - 1} F_t \ \text{ with } \frac{\theta_{t,D}}{\theta_{t,D} - 1} < 1$$

The central bank

Cash is issued by the central bank and carries a holding cost.

$$\underbrace{\gamma_t \mu_M \chi_L C_t^{\eta_L} M_t^{-\eta_L}}_{\text{Value for payments}} = \lambda_t - \underbrace{\beta E_t \left(\lambda_{t+1} \frac{\xi}{\pi_{t+1}} \right)}_{\text{Holding cost}}$$

The domestic central bank issues a CBDC in a monetary policy neutral way (no expansion of the balance sheet).

Issuance of a CBDC affects the economy in two ways:

1. It relaxes the cash-in-advance constraint of households.
2. It reduces the market power of banks, producing an endogenous increase in deposit rates.
   ▶ If deposits fall, banks are disintermediated and reduce credit supply.
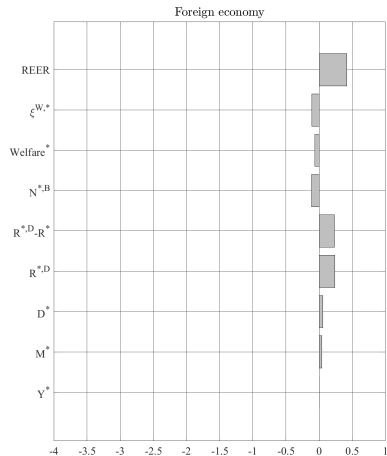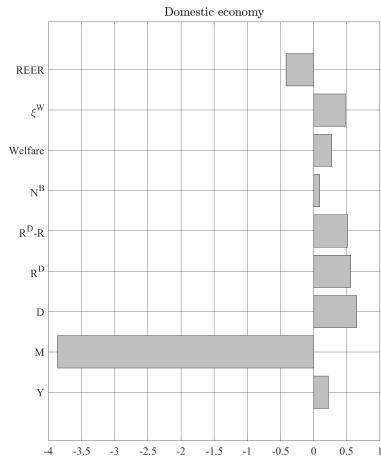   ▶ With a sufficiently large increase in deposit rates, a CBDC may lead to a crowding-in of deposits.

CBDC demand

Demand for CBDC in home (H) and foreign (F) economies:

H:
$$\underbrace{\gamma_t \mu_{DC} \chi_L^{\frac{1}{\eta_L}} C_t^{\eta_L} DC_t^{-\eta_L}}_{\text{Value for payments}} = \lambda_t - \underbrace{\beta E_t \left(\lambda_{t+1} \frac{R_t^{DC}}{\pi_{t+1}} \right)}_{\text{Remuneration}}$$
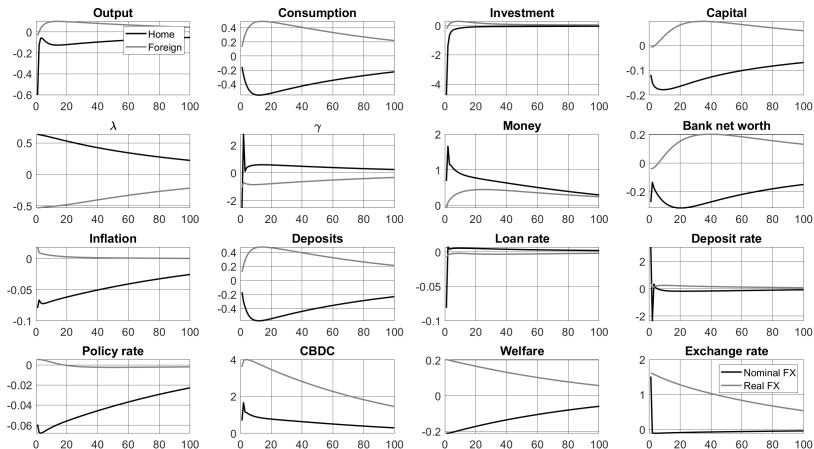
F:
$$\underbrace{\gamma_t^* \mu_{DC}^* \chi_L^{* \frac{1}{\eta_L^*}} C_t^{* \eta_L^*} \frac{DC_t^{*}}{NER_t}^{-\eta_L^*}}_{\text{Value for payments}} = \lambda_t^* - \underbrace{\beta^* E_t \left(\lambda_{t+1}^* \frac{R_t^{DC}}{\pi_{t+1}^*} \frac{NER_t}{NER_{t+1}} \right)}_{\text{Remuneration}}$$

$$- \underbrace{\lambda_t^* \phi^{*,DC} \frac{DC_t^{*}}{NER_t}}_{\substack{\text{Cross-border} \\ \text{cost}}}$$

Steady-state impact

Transition dynamics

Transition from steady state without to one with CBDC

Shown as percent relative to new steady state.

# Policies during the transition

Holding limits

$$DC_t = \begin{cases} DC \text{ demand} & \text{if } DC_t < \overline{DC} \\ \overline{DC} & \text{if } DC_t \geq \overline{DC} \end{cases}$$
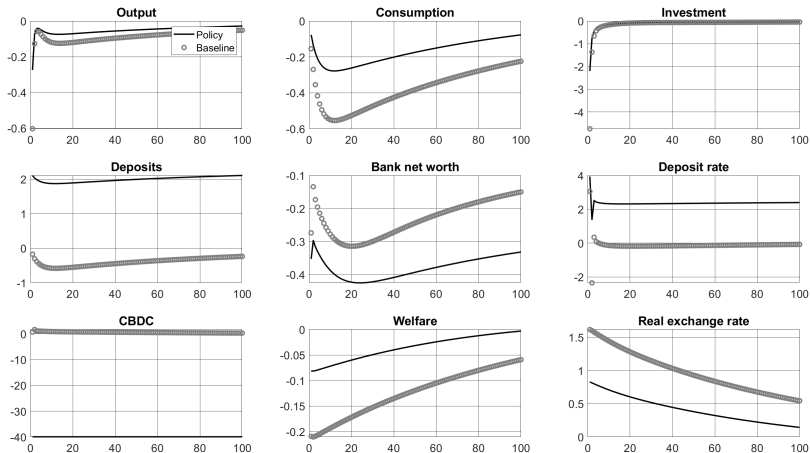
$$DC_t^* = \begin{cases} DC^* \text{ demand} & \text{if } DC_t^* < \overline{DC}^* \\ \overline{DC}^* & \text{if } DC_t^* \geq \overline{DC}^* \end{cases}$$

✓ $\overline{DC}$ and $\overline{DC}^*$ are domestic and foreign quantity limits.
✓ Quantity limits can be set differently for domestic and foreign households.
✓ We investigate a holding limit at steady-state CBDC demand and at 50 % of steady-state demand.

Holding limit at new steady-state demand
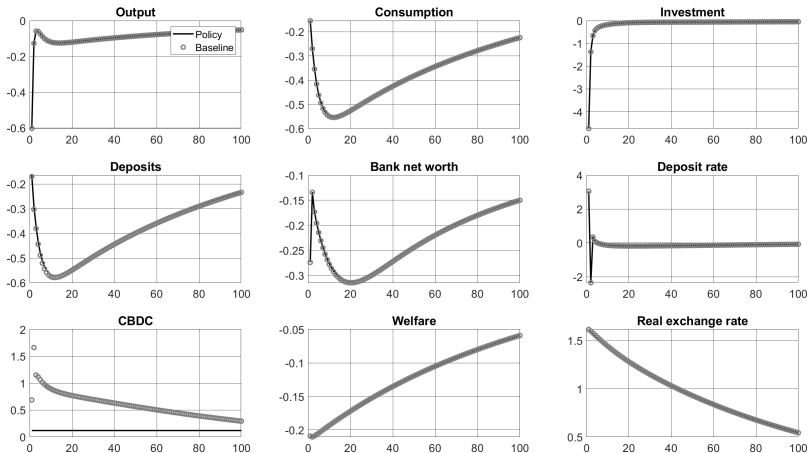
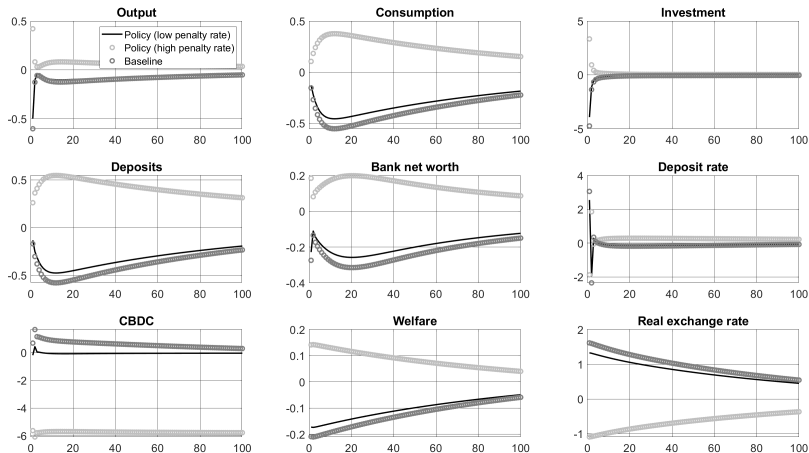# Holding limit of 50% of steady-state demand

The holding limit is kept at 50% until the economy is close to the new steady state (period 100) and then gradually relaxed.

Two-tiered remuneration

$$R_t^{DC} = \begin{cases} 1 \text{ (no remuneration)} & \text{if } DC_t < \overline{DC} \\ 1\frac{\overline{DC}}{DC_t} + R_-^{DC}\frac{DC_t-\overline{DC}}{DC_t} & \text{if } DC_t \geq \overline{DC} \end{cases}$$

✓ The thresholds $(\overline{DC}, \overline{DC}^*)$ are set to 50% of steady-state CBDC demand in each country.

✓ The penalty rate R_-^{DC} is set to 0.97 (300 basis points below parity), and to 0.95 (500 basis points below parity).

Two-tiered remuneration

Penalty rates are 3% and 5%, respectively, for holdings above 50% of steady-state demand.
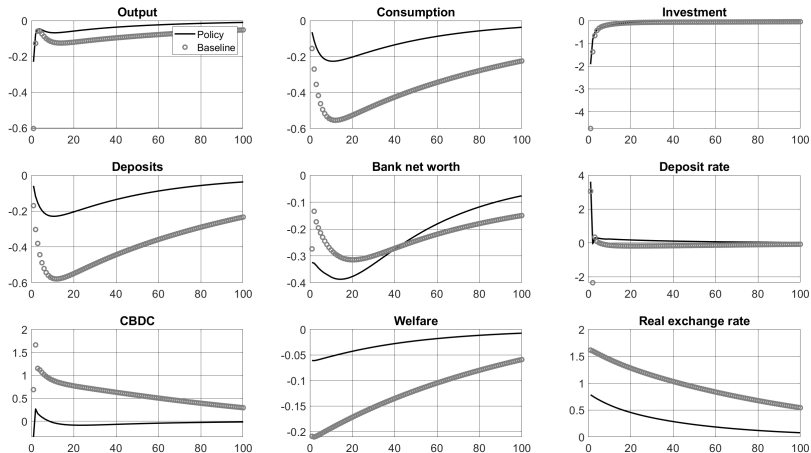
Central bank balance sheet expansion

The central bank purchases assets (AP) proportional to excess CBDC demand with $\chi_{AP} \in (0, 1]$:

$$AP_t = \begin{cases} 0 & \text{if } DC_t < DC_{ss} \\ DC_t - \chi_{AP}DC_{ss} & \text{if } DC_t \geq DC_{ss} \end{cases}$$

Revenues are transferred to the government.

Central bank balance sheet expansion

The central bank buys assets for CBDC demand in excess of new steady state.
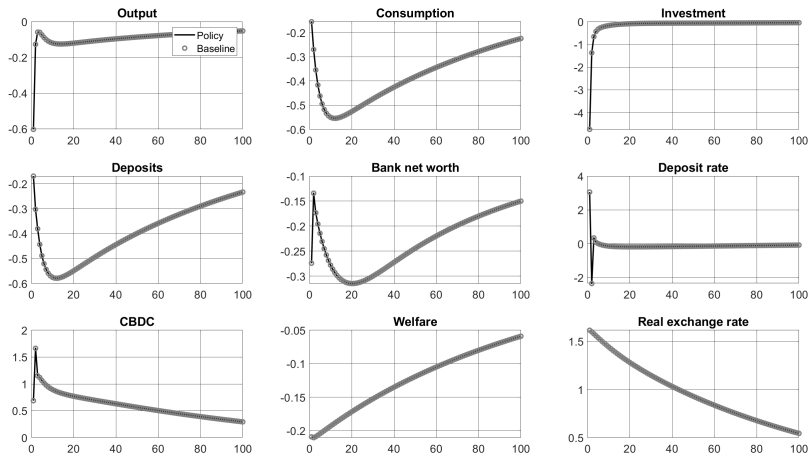
Limited access of foreigners to CBDC

Foreigners can either not access the CBDC at all:

$$DC_t^* = 0 \ \ \forall \ t$$

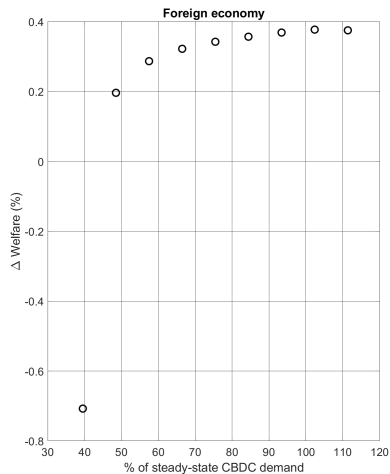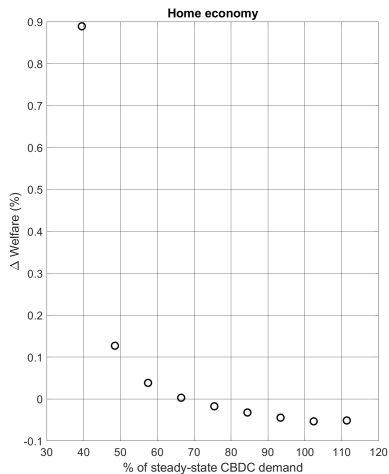or there are higher costs for CBDC cross-border transactions:

$$\phi^{*,DC} = 0.1$$

Domestic CBDC – no access of foreigners

[◂ High holding costs]

"Optimal" holding limit

Conclusions

Conclusions

- ✓ In steady-state a CBDC reduces the market power of banks.
- ✓ Endogenously deposits and the deposit rate increase, credit supply expands slightly, welfare improves (by about 0.5% of consumption)
- ✓ During the transition, HHs demand excess CBDC:
  - → Deposits decrease below steady-state,
  - → Investment and return on capital fall, remuneration on deposits stagnants,
  - → GDP contracts in the home country (by about 1%), foreign economy largely unaffected.
- ✓ Policies are effective in governing the transition:
  - → A hard holding limit prevents the crowding out of deposits and reduce GDP losses by more than 50%.
  - → A two-tiered remuneration is less effective.
  - → Balance sheet expansion policies are effective in closing the output gap, but do not fully prevent the crowding-out of deposits.
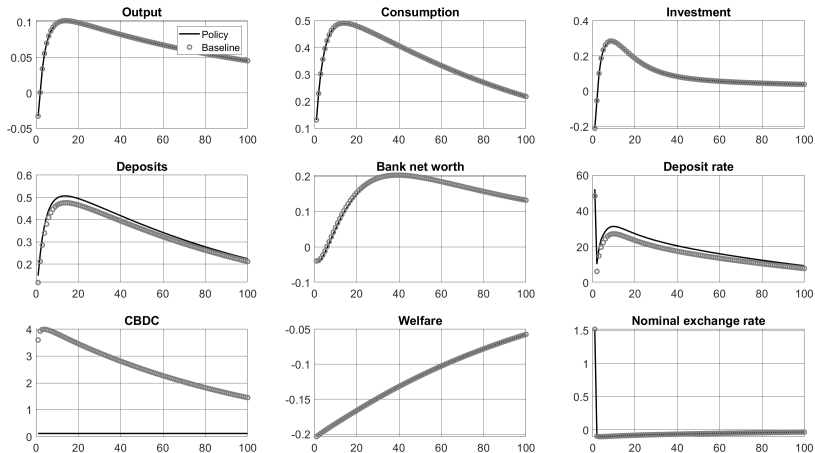
Appendix

Key friction – foreign economy

The problem is similar for the foreign economy. HH need liquidity:

$$C_t^* = \chi_L^* \left[\mu_M^*(M^*)^{1-\eta_L^*} + \mu_D^*(D^*)^{1-\eta_L^*} + \mu_{DC}^* \left(\frac{DC^*}{\mathbf{RER}_t} \right)^{1-\eta_L^*} \right]^{\frac{1}{1-\eta_L^*}}$$

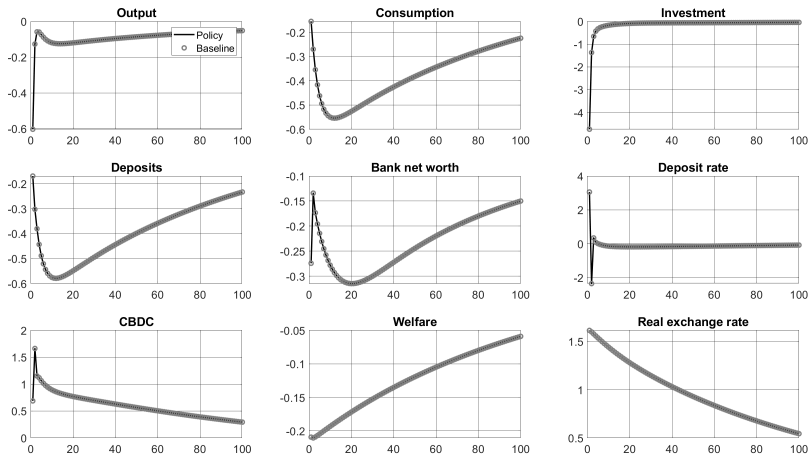cross-country CBDC holdings are subject to a quadratic cost proportional to ϕ^{DC}:

$$Cost_t = \phi^{DC} \left(\frac{DC_t^*}{RER_t} \right)^2$$

Soft holding limit – foreign economy

High holding costs for foreigners

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