

Central Bank Digital Currency with Adjustable Interest Rate in Small Open Economies

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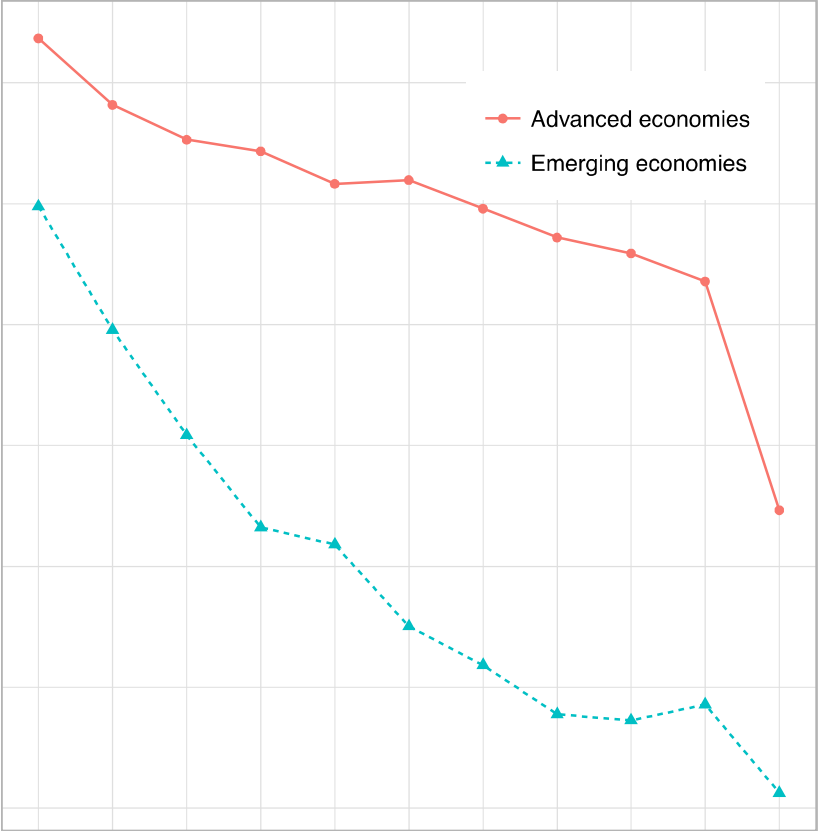
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Circulation of notes and coins smaller than \$50 (2007-2017)



in 2017 (%)

(b) Change from 2007 to 2017

Source: Bank for International Settlements – CPMI Red Book



Traditional Money Could Be 'Surpassed' By E-Money, Stablecoins: IMF Paper

Jul 16, 2019 at 12:31 | Daniel Palmer

A new IMF paper suggests that cash and bank deposits could be left behind as digital money and fiat-pegged cryptos see greater adoption.



Bank of Japan: Adopting Central Bank Crypto Would Mean Dropping Cash

Jul 5, 2019 at 09:00 | Daniel Palmer

A Bank of Japan official has ruled out the launch of a central bank digital currency because to do so may require the country to abandon cash.



Russia's Central Bank Is Considering Launching a Digital Currency

Jun 17, 2019 at 13:30 | Daniel Palmer

The head of Russia's central bank has said the institution is investigating the possible future launch of a digital currency.



14 Banks, 5 Tokens: Inside Finality's Expansive Vision for Interbank Blockchains

Jun 13, 2019 at 08:00 | Ian Allison

Fresh off a \$63 million fundraise, execs at bank blockchain consortium Finality shed some light on the often-secretive project's plan to tokenize fiat...



Bundesbank Chief Warns on Risks of Central Bank Digital Currencies

Jun 3, 2019 at 13:04 | Benedict Alibasa

The head of Germany's central bank has said central bank digital currencies could destabilize financial systems and worsen bank runs.



ECB Official Says Wholesale Central Bank Digital Currency a 'Viable Option'

May 28, 2019 at 09:00 | Yogita Khatri

A European Central Bank council member has come out generally in favor of wholesale central bank digital currencies.

Introduction

- ▶ What this paper is about
 - ▶ Retail CBDC for domestic general use, and not (yet) accessible to foreign entities
 - ▶ Digital money that replaces, instead of competing with, cash
 - ▶ CBDC as a secondary policy instrument, not just to eliminate the ZLB

- ▶ What is CBDC? We use the definition from Barrdear and Kumhof (2016)
 - ▶ “... a **universally accessible** and *interest-bearing* **central bank liability**, implemented via *distributed ledgers*, that competes with bank deposits as **medium of exchange**...”
 - ▶ Being “interest-bearing” is a key innovation in CBDC
- ▶ Kumhof and Noone (2018) finds an adjustable interest rate to be one of the CBDC design principles
 - ▶ Interest-bearing vs adjustable

- ▶ Objective
 - ▶ To assess the welfare and stability outcomes of an adjustable interest rate on money in small open economies
- ▶ Reference model:
 - ▶ Closed-economy DSGE framework proposed in Barrdear and Kumhof (2016)
- ▶ Main takeaways:
 - ▶ Welfare and economic stabilisation improve under the price-based regime
 - ▶ There are distributional effects
 - ▶ Exchange rate and foreign debt tend to be more stable

Existing practices and literature

- ▶ Existing practices among central banks
 - ▶ Monetary Authority of Singapore, European Central Bank, Bank of Japan, Bank of Canada, Bank of England, Bank of Thailand, and more...
 - ▶ Mainly on building the DLT infrastructure, not as an asset
- ▶ Existing research
 - ▶ Barrdear and Kumhof (2016), Levin and Bordo (2017), Kumhof and Noone (2018), Meaning et al (2018) ...
 - ▶ Emphasise on the benefits of adjustable-interest design
- ▶ We fill the gap – Examine CBDC with adjustable and non-adjustable interest returns in the same framework

An adjustable return to monetary assets

- ▶ Log-linearised money demand function as in Woodford (2003)

$$\hat{m}_t = \eta_y \hat{Y}_t - \eta_i \left(\hat{i}_t - \hat{i}_t^m \right) + \epsilon_t \quad (1)$$

quantity of money is negatively associated with the opportunity cost

- ▶ $\hat{i}_t - \hat{i}_t^m$: opportunity cost of holding money
- ▶ Non-adjustable interest: $\hat{i}_t^m = 0$
 - ▶ Analogous to cash
 - ▶ Quantity of money (cash) adjusts passively, following changes in returns of alternative assets (e.g bonds and deposits)
- ▶ Adjustable interest: \hat{i}_t^m varies with economic conditions
 - ▶ Central bank specifies \hat{m}_t or \hat{i}_t^m , in addition to \hat{i}_t .
 - ▶ Effects of \hat{i}_t and \hat{i}_t^m on money demand are opposite

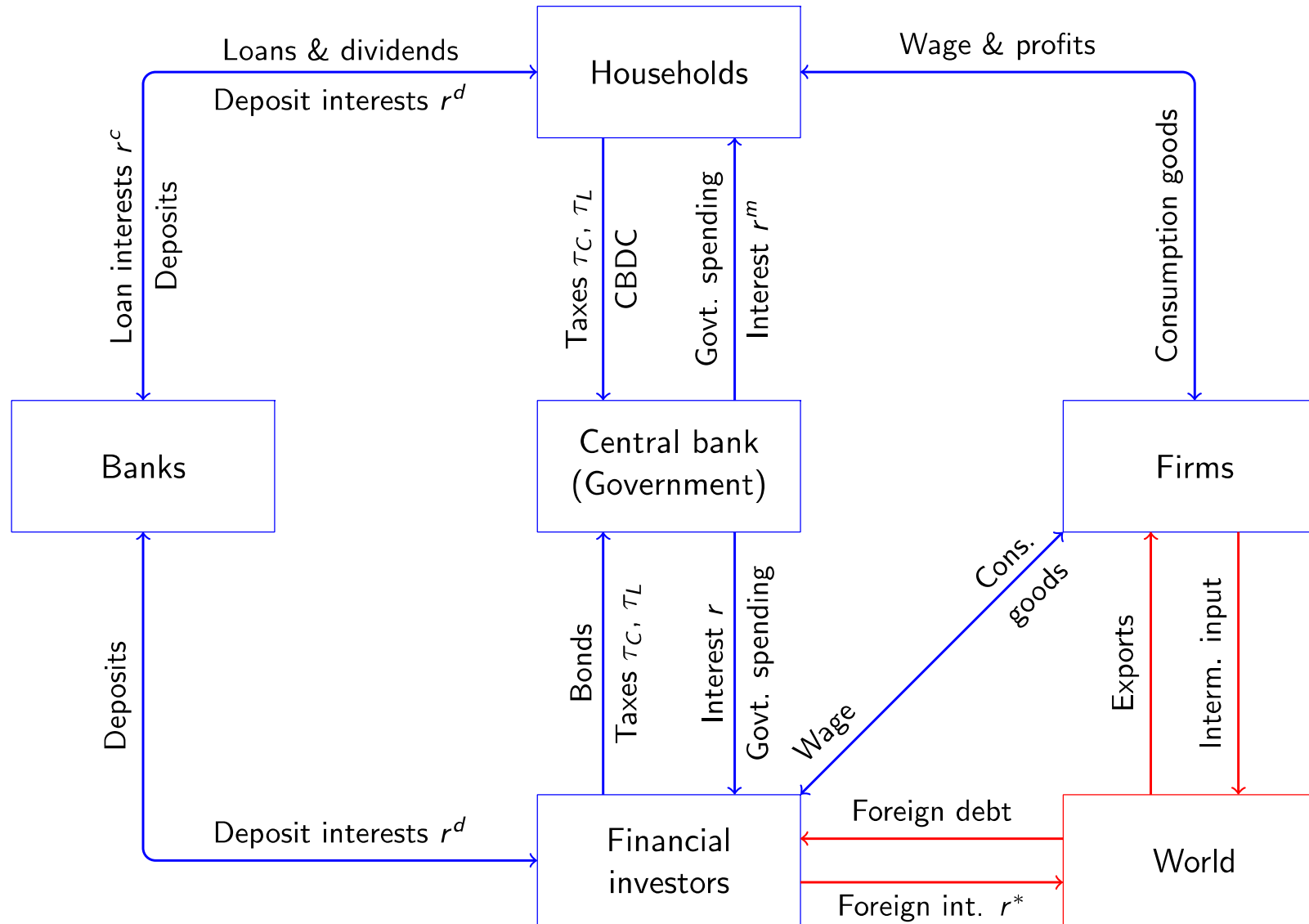
Why \hat{i}_t^m should be adjustable

- ▶ Consider a situation when there is an oversupply of currency
- ▶ Two scenarios if $\hat{i}_t^m = 0$
 1. currency depreciates against alternative assets, e.g. bonds
 2. general price level rises
- ▶ If \hat{i}_t^m is adjustable
 - ▶ \hat{i}_t^m is lowered to reduce demand for money

Methodology

- ▶ Barrdear and Kumhof (2016) — BoE working paper
 - ▶ Simplified version for clarity
 - ▶ New Keynesian model with price rigidity
 - ▶ Extended to incorporate an exogenous foreign sector
- ▶ Dynamics are driven by three exogenous shocks
 - ▶ Domestic productivity shock
 - ▶ Foreign interest rate shock
 - ▶ Foreign demand shock
- ▶ CBDC with the following regimes
 - ▶ Non-adjustable interest
 - ▶ Adjustable interest – price rule
 - ▶ Adjustable interest – quantity rule
- ▶ Solved at second order in Dynare

Model outline



CBDC issuance

- ▶ Deposits and CBDC are not perfect substitutes in providing liquidity services
 - ▶ Transaction cost is lower with CBDC
 - ▶ Interest rate on CBDC does not follow deposit interest, $r_t^m \neq r_t^d$
- ▶ CBDC is part of government budget

$$b_t + m_t = r_{t-1}b_{t-1} + r_{t-1}^m m_{t-1} + g_t - Tax \quad (2)$$

- ▶ No guaranteed on-demand exchange with bank deposits
- ▶ Model parameters follow Barrdear and Kumhof (2016)

Monetary and fiscal policies

- ▶ **Baseline regime:** Taylor rule + fiscal rule

- ▶ Policy interest rate, i_t , responds +vely to output and inflation

$$i_t = \rho_i i_{t-1} + (1 - \rho_i) (\phi_{i,gdp} gdp_t + \phi_{i,\pi} \pi_t) \quad (3)$$

where $\rho_i \in [0, 1)$, $\phi_{i,y}, \phi_{i,\pi} > 0$.

- ▶ Government budget responds -vely to output

$$gdx_t^{rat} = \overline{gdx^{rat}} - \phi_{b,gdp} \ln \left(\frac{gdp_t}{\overline{gdp}} \right) \quad (4)$$

where gdx_t^{rat} is the adjusted budget deficit to GDP ratio

- ▶ Grid search for optimal coefficients ρ_i , $\phi_{i,gdp}$, $\phi_{i,\pi}$, and $\phi_{b,gdp}$.

Alternative monetary policies

- ▶ CBDC regimes

- ▶ Non-adjustable CBDC interest: $i_{m,t}$ is constant

$$i_{m,t} = \bar{i}_m \quad (5)$$

- ▶ Price rule: $i_{m,t}$ follows i_t , but also responds to inflation

$$i_{m,t} = \rho_{i_m} i_{m,t-1} + (1 - \rho_{i_m}) (i_t - \phi_{i_m,\pi} \pi_t) \quad (6)$$

When inflation is high, $i_{m,t}$ is lowered, increasing the opportunity cost of liquidity

- ▶ Quantity rule: quantity of money responds to inflation

$$\frac{m_t}{gdp_t} = \rho_m \frac{m_{t-1}}{gdp_{t-1}} + (1 - \rho_m) (-\phi_{m,\pi} \pi_t) \quad (7)$$

where $\rho_{i_m}, \rho_m \in [0, 1)$, $\phi_{i_m,\pi}, \phi_{m,\pi} > 0$.

- ▶ When inflation is high, liquidity is withdrawn from the economy

Optimal monetary policy

- ▶ Life-time welfare as a function of consumption, labour, and holdings of deposits and CBDC

$$\mathbb{W}_t = U(c_t, n_t, d_t, m_t) + \beta E_t \mathbb{W}_{t+1} \quad (8)$$

- ▶ Policies are optimal when the welfare is maximised

Table: Optimal coefficients

	ρ_i	ϕ_π	$\phi_{b,gdp}$	$\phi_{i_m,\pi}$	ρ_{i_m}	$\phi_{m,\pi}$	Welfare		
							Society	Household	Financial Investor
Baseline	0.9	1	2	-	-	-	-2.1227	-2.2495	0.2865
Price rule	0.9	1	2	0.2	0.9	-	-2.1224	-2.2490	0.2832
Quantity rule	0.9	1	2	-	-	8	-2.1228	-2.2495	0.2851

- ▶ Price rule is welfare-improving, but not Pareto-optimal
- ▶ Quantity rule does not improve welfare

Welfare changes under individual shocks

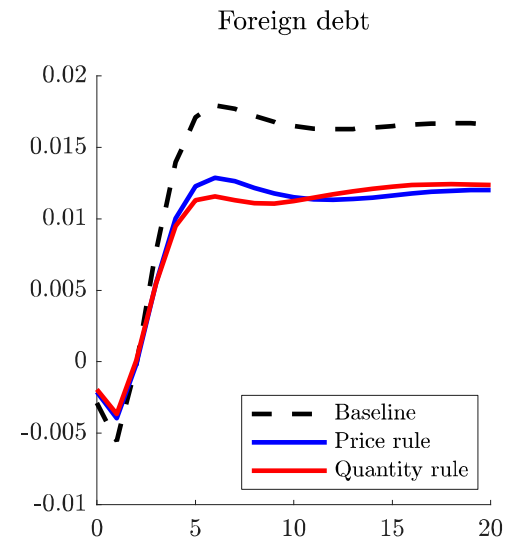
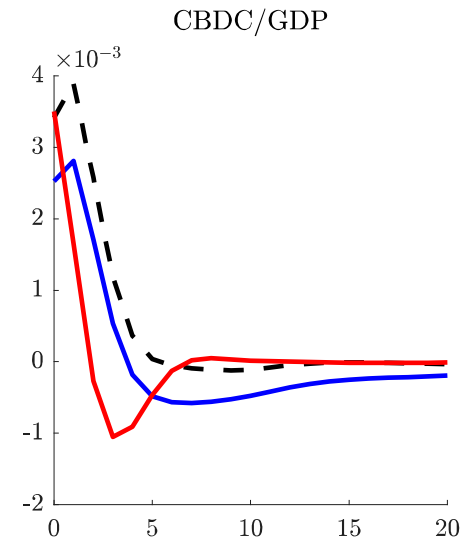
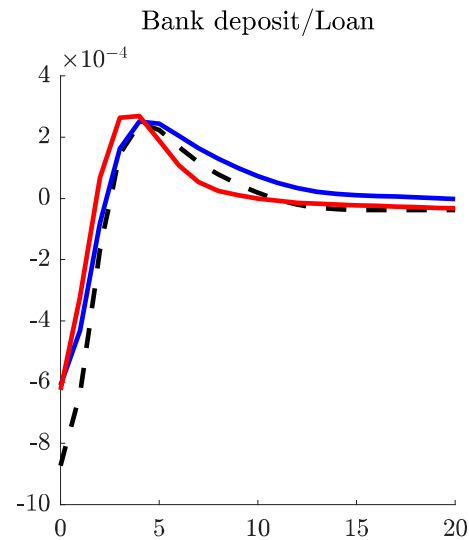
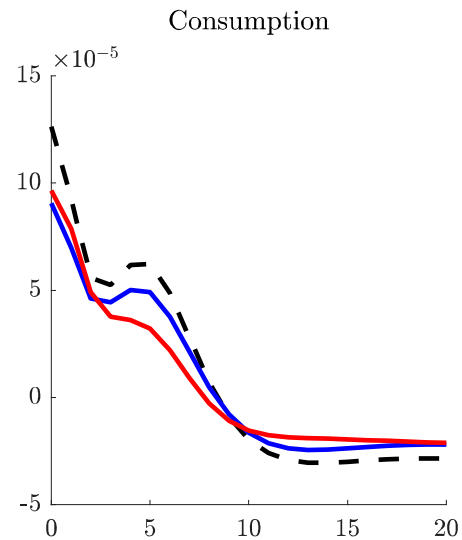
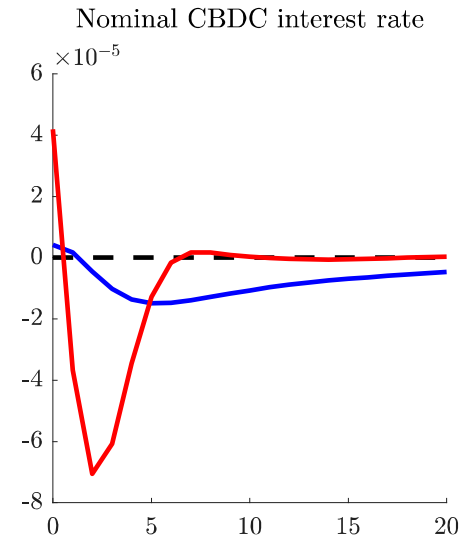
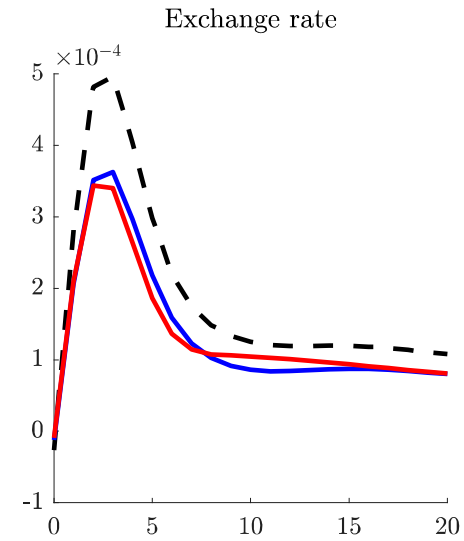
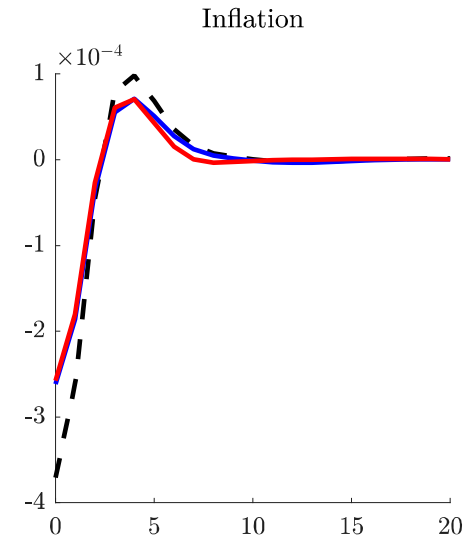
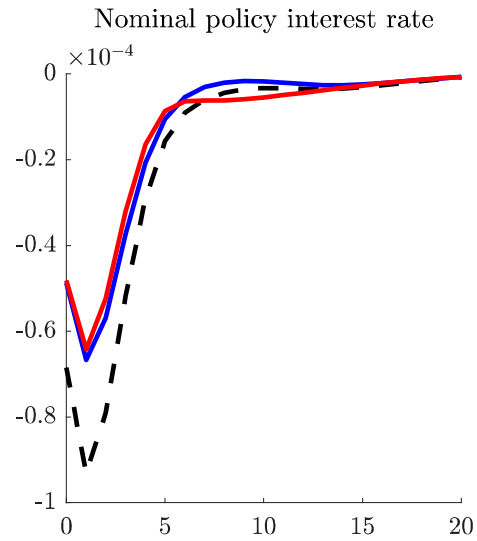
- ▶ Welfare effects may vary when some shocks are absent
- ▶ We simulate the model again with individual shocks

Table: Welfare and sources of shocks.

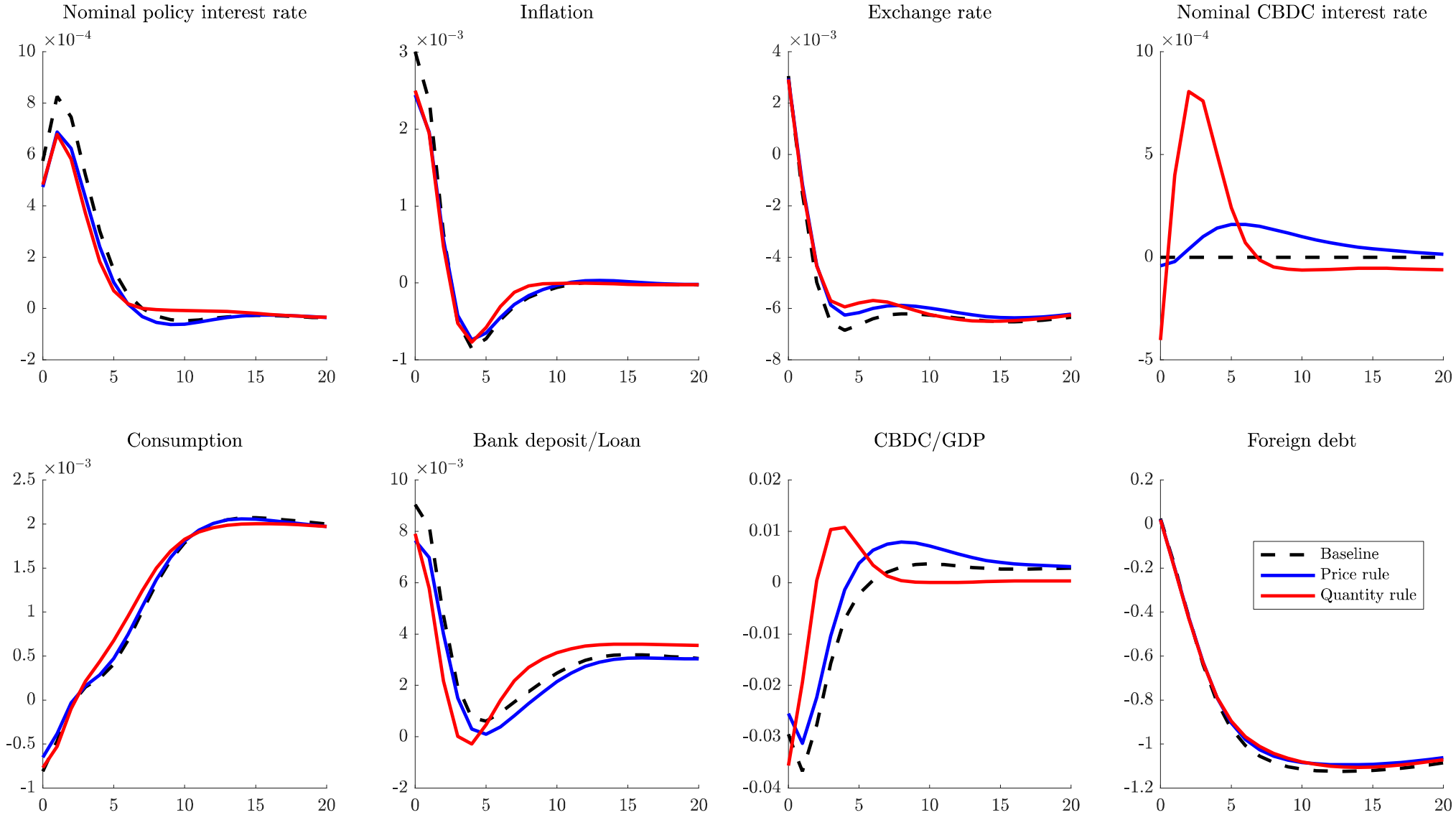
	Productivity shock			Foreign interest rate shock			Foreign demand shock		
	Society	Household	Fin. inv.	Society	Household	Fin. inv.	Society	Household	Fin. inv.
Baseline	-2.1269	-2.2543	0.2945	-2.1232	-2.2500	0.2866	-2.1264	-2.2538	0.2944
Price rule	-2.1269	-2.2543	0.2945	-2.1227	-2.2493	0.2832	-2.1265	-2.2540	0.2945
Quantity rule	-2.1269	-2.2543	0.2945	-2.1232	-2.2500	0.2854	-2.1265	-2.2539	0.2943

- ▶ Households are better off under a foreign interest rate shock
- ▶ Financial investors are better off only under a foreign demand shock

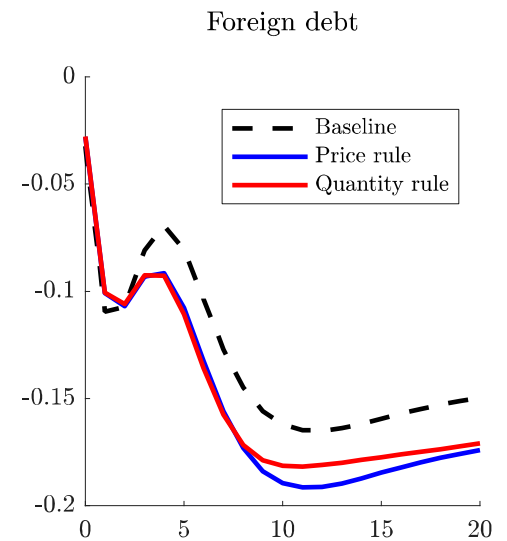
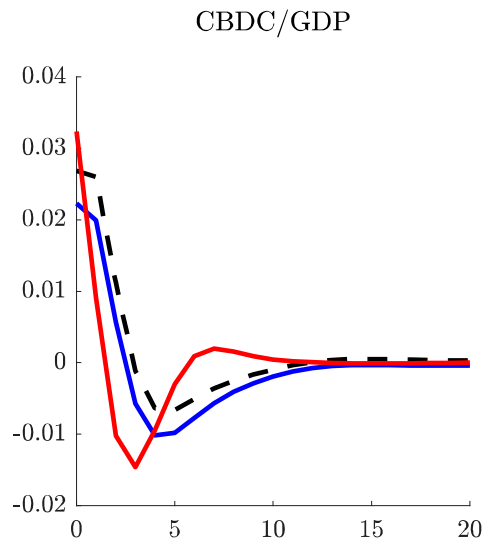
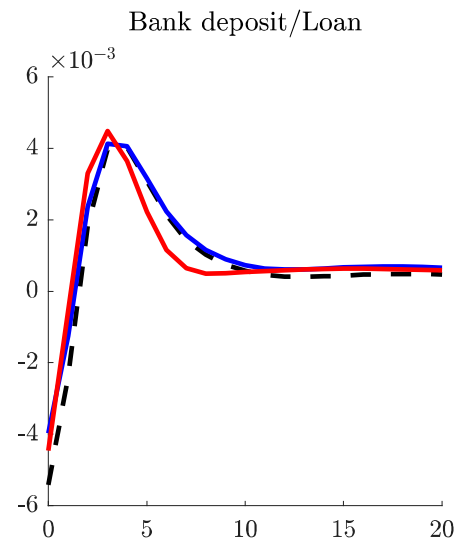
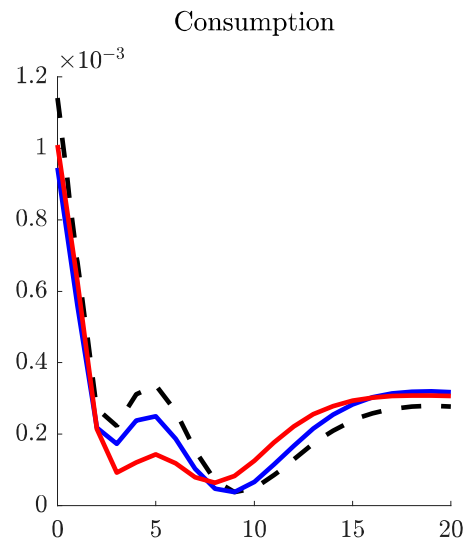
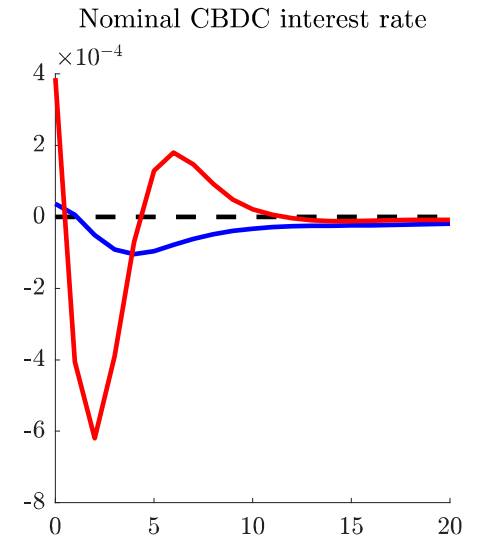
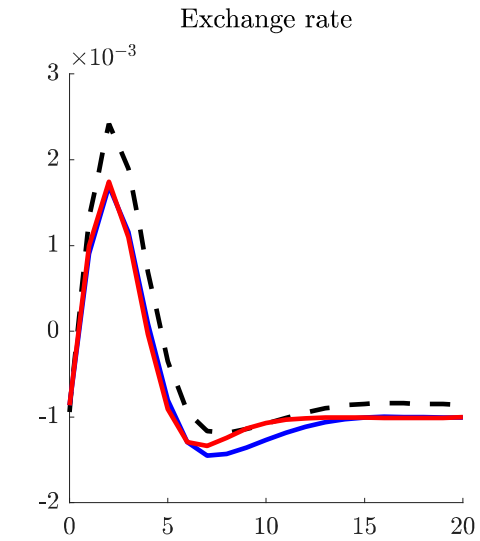
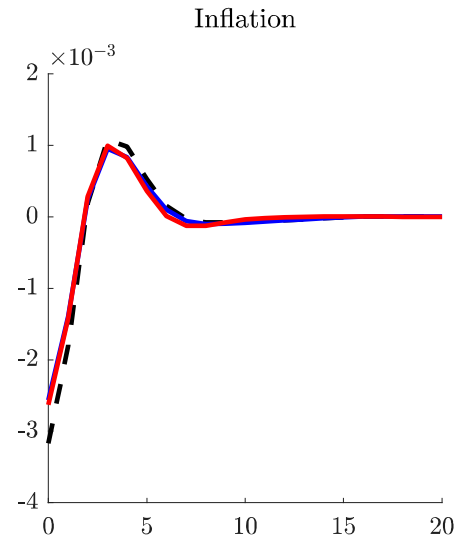
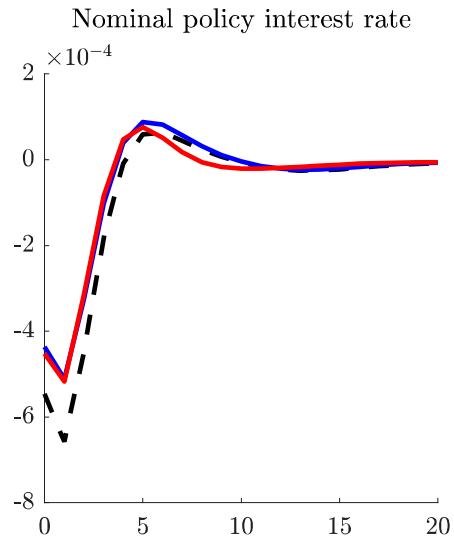
Responses of the economy: Productivity shock



Responses of the economy: Foreign interest rate shock



Responses of the economy: Foreign demand shock



Stabilisation effects

- ▶ We compare the second moments of key macroeconomic variables under alternative policy regimes

Table: Volatility of key variables

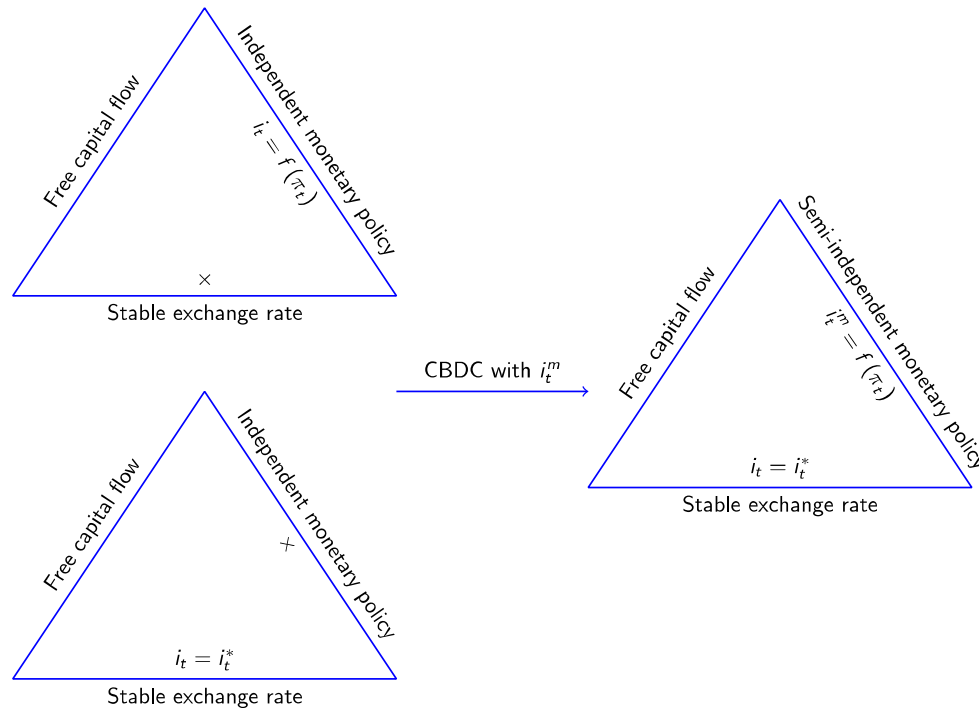
	Baseline	Price Rule	Quantity Rule
GDP	0.0089	0.0074	0.0074
Consumption	0.0271	0.0268	0.0269
Inflation	0.0057	0.0047	0.0047
Exchange rate	0.0496	0.0486	0.0489

Note: This table reports the standard deviations of key variables obtained from a stochastic simulation of the models using second-order perturbations around the stochastic steady state in Dynare 4.5.3. Variables are expressed in percentage deviations from the steady states.

- ▶ Price rule delivers the best stabilisation effect for these variables

Our limitation and extension

- ▶ We do not discuss cross-border flows of CBDC in this paper
 - ▶ Central banks are experimenting cross-border payment based on DLT
 - ▶ It may entails more complicated dynamics via the exchange rate channel
- ▶ With the present framework, central banks in emerging markets may find it possible to relax the macroeconomic trilemma



Concluding remarks

- ▶ We introduce CBDC with adjustable interest rate to a small open economy model
 - ▶ CBDC is not transferred internationally
 - ▶ Alternative regimes are simulated
- ▶ Price rule provides improvements in welfare, with distributional effects
 - ▶ Households possessing CBDC are better off
 - ▶ Financial investors with no CBDC are worse off
- ▶ Better stabilisation effects
- ▶ Ongoing and future work
 - ▶ Macroeconomic trilemma and CBDC
 - ▶ Access by nationality

Thank you.