A New Tool for Economic Policy: Central Bank Digital Currencies

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Definitions as a starting point:

➢ **CBDC** is a **digital liability of a central bank** that is widely available to the general public. It is analogous to a digital form of paper money *(Fed, 2022).*

➢ **A CBDC** is a digital payment instrument, denominated in the national unit of account, that is a **direct liability of the central bank** *(BIS, 2020).*

Current situation:

❑ From the **BIS (2020) survey** emerged:
- 80% of Central Banks interviewed → Are investigating a CBDC project.
- 40% of Central Banks interviewed → From theory to experiment/pilot project.

❑ **ECB (2021)** and **Fed (2022)** declared they have started working towards issuing a "**Digital Euro**" and a "**U.S. Digital Dollar**".

❑ **PBoC (2021):**
- In 2014 the e-Yuan project started.
- Beijing winter Olympics 2022, 2 million e-Yuan traded per day (more than 300'000 $)

Flexibility of design:

o Central bank as the issuer or a "synthetic CBDC" (Adrian and Mancini-Griffoli, 2019; BIS, 2020).

o Retail CBDC or wholesale CBDC (Bech and Garrat, 2017).

o «Cash-like» (zero coupon) or «Deposit-like» (interest-bearing, positive or negative) (Bordo and Levin, 2017; ECB 2020; IMF, 2022).

o Infrastructure design is required (ECB, 2020; BIS, 2021).

o Users' privacy (ECB, 2020; Fed 2022)

o Grant or Loan (we consider here an open-ended loan)

Possible benefits of CBDCs	Possible risks of CBDCs
Contrast and or substitute the decline in the use of cash (ECB, 2020; Cesaratto and Febrero 2022).	Effect on the commercial banks' sector (ECB, 2020; Panetta, 2021; Fed, 2022)
Effectiveness of Monetary Policy (Buetzer, 2022)	Efficacy of Monetary Policy Implementation (ECB, 2020; Fed, 2022)
Financial inclusion (BIS, 2020; ECB, 2020; Cecchetti and Schoenholts, 2021)	Financial Stability (ECB, 2020; Panetta, 2021; Fed, 2022)
Improvements to Cross-Border Payments (BIS 2021; Fed; 2022)	Adoption of a foreign CBDC (Brunnermeier et al., 2021; BIS, 2020)
Extend public access to safe central bank money (Meaning et al. 2018; BIS, 2021; Andolfatto, 2021; Fed, 2022).	

Method:

We use **Sawyer and Passarella's (2021) model** to compare different fiscal and monetary policies within a **Stock-Flow Consistent Framework (SFC)**.

➢ SFC models allow a macroeconomic view of the economy as a whole.

➢ SFCs allow observing how different economic variables interact with each other.

➢ SFCs guarantee the consistency between flow and stock variables.

➢ SFCs are designed to meet 4 accounting principles *(Nikiforos and Zezza, 2017; Caverzasi and Godin, 2015):*

   ❖ Flows consistency

   ❖ Stock consistency

   ❖ Stock-flow consistency

   ❖ Quadruple entry

Nominal balance sheet matrix:

	Lower-class households	Upper-class Households	Production firms	Commercial banks	Central bank	Government	Foreign sector	Σ
Cash	$+h_w$	$+h_r$			$-h_s$			0
Account deposits	$+m1_w$	$+m1_r$		$-m1_s$				0
Savings deposits		$+m2_h$		$-m2_s$				0
Loans	$-l_h$		$-l_f$	$+l_s$				0
CBDC	$+CBDC_w$	$+CBDC_r$	$+CBDC_f$		$-CBDC_s$			0
CBDC loans	$-l_{CBDCw}$	$-l_{CBDCr}$	$-l_{CBDCf}$		$+l_{CBDCs}$			0
Required reserves				$+hb_d$	$-hb_s$			0
Discretionary reserves				$+hb_d^*$	$-hb_s^*$			0
Central bank advances				$-a_d$	$+a_s$			0
Capital stock			$+k$					$+k$
Shares issued		$+e_h$	$-e_s$					0
Government securities		$+b_h$		$+b_b$	$+b_{cb}$	$-b_s$		0
Official reserves (net)					$+h_f$		$-h_f$	0
Balance (net worth)	$-v_{wn}$	$-v_r$	$-v_f$	$-v_b$	$-v_{cb}$	v_g	v_{fs}	$-k$
Σ	0	0	0	0	0	0	0	0

Transactions-flows matrix:

|	Lower-class households	Upper-class households	Production firms		Commercial banks	Central bank	Government	Foreign sector	Σ
			Current	Capital					
Consumption	$-c_w$	$-c_r$	$+c$						0
Investment			$+id$	$-id$					0
Government spending			$+gov$				$-gov$		0
Export			$+x$					$-x$	0
Import			$-im$					$+im$	0
Memo: national income			$[y]$						
Taxes on income and wealth	$-tax_w$	$-tax_r$					$+tax$		0
Fiscal transfers	$+tr$						$-tr$		0
Wage bill	$+(1-\Omega_r)\cdot wb$	$+\Omega_r \cdot wb$	$-wb_f$				$-wb_g$		0
Interest on loans	$-rl_{-1}\cdot lh_{-1}$		$-rl_{-1}\cdot lf_{-1}$		$+rl_{-1}\cdot ls_{-1}$				0
Repayments on loans	$-rep\cdot lh_{-1}$				$+rep\cdot lhs_{-1}$				0
Interests on savings deposits		$+rm_{-1}\cdot m2h_{-1}$			$-rm_{-1}\cdot m2s_{-1}$				0
Return on government securities		$+rb_{-1}\cdot bh_{-1}$			$+rb_{-1}\cdot bb_{-1}$	$+rb_{-1}\cdot bcb_{-1}$	$-rb_{-1}\cdot bs_{-1}$		0
Seigniorage income						$-f_{cb}$	$+f_{cb}$		0
Entrepreneurial profit		$+fd_f$	$-f_f$	$+fu_f$					0
Amortisation funds			$-a_f$	$+a_f$					0
Bank profit		$+f_b$			$-f_b$				0
Change in cash	$-\Delta h_w$	$-\Delta h_r$				$+\Delta h_s$			0
Change in CBDC	$-\Delta CBDC_w$	$-\Delta CBDC_r$		$-\Delta CBDC_f$	$+\Delta CBDC_f$	$+\Delta CBDC$			0
Change in CBDC loans	$+\Delta l_{CBDCw}$	$+\Delta l_{CBDCr}$		$+\Delta l_{CBDCf}$		$-\Delta l_{CBDC}$			0
Change in loans	$+\Delta l_h$			$+\Delta l_f$	$-\Delta l_s$				0
Change in account deposits	$-\Delta m1_w$	$-\Delta m1_r$			$+\Delta m1_s$				0
Change in saving deposits		$-\Delta m2h$			$+\Delta m2_s$				0
Change in shares		$-\Delta eh\cdot pe$		$+\Delta esr\cdot pe$					0
Change in government securities		$-\Delta bh$			$-\Delta bb$	$-\Delta bcb$	$+\Delta bs$		0
Change in Required reserves					$-\Delta hbd$	$+\Delta hbd$			0
Change in Discretionary reserves					$-\Delta hbd^*$	$+\Delta hbd^*$			0
Change in Central bank advances					$+\Delta ad$	$-\Delta ad$			0
Change in official reserves (net)						$-\Delta hf$		$+\Delta hf$	0
Σ	0	0	0	0	0	0	0	0	0

Baseline scenario (1 of 2):
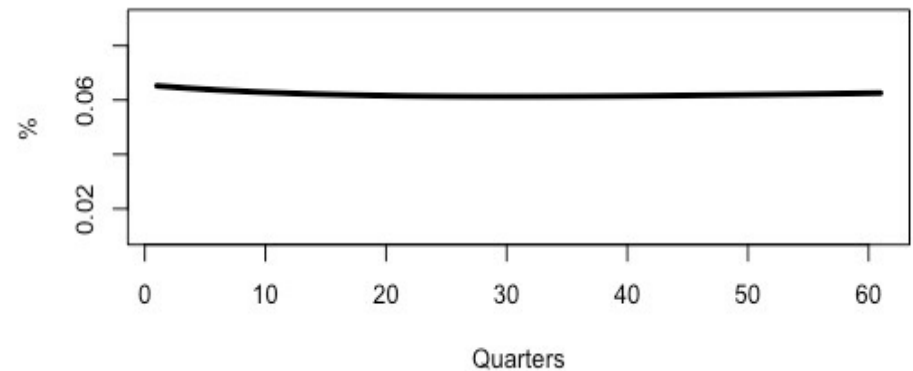
Normalised nominal GDP
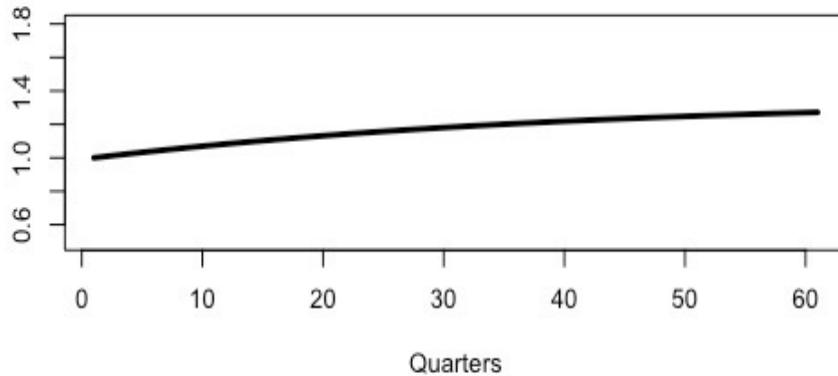
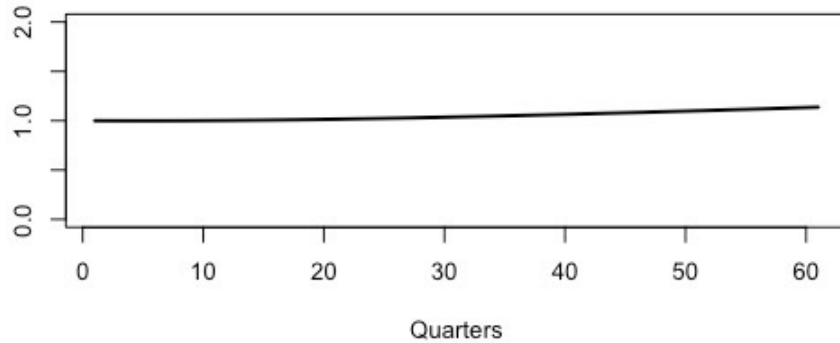## Normalised disposable income
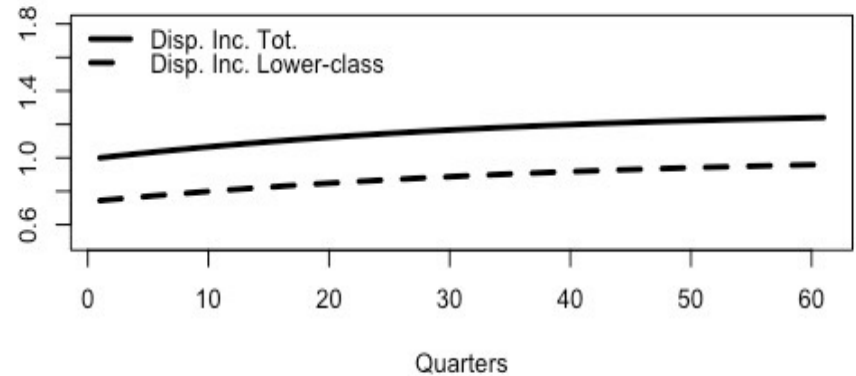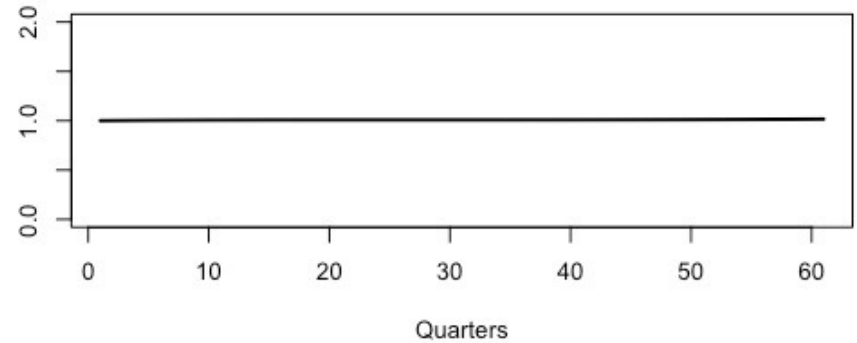

Annual inflation
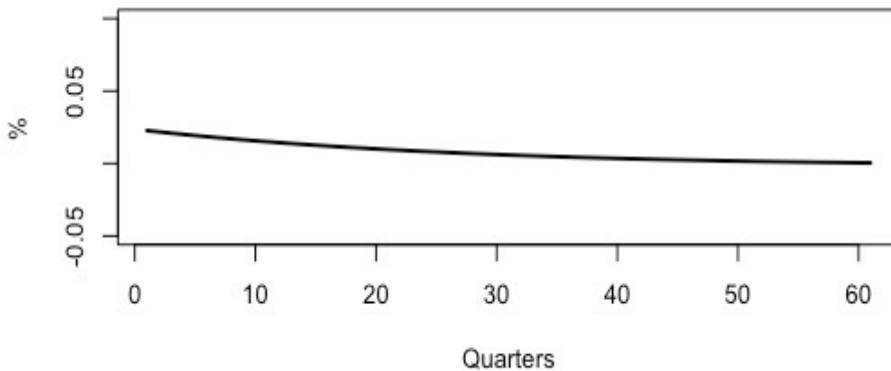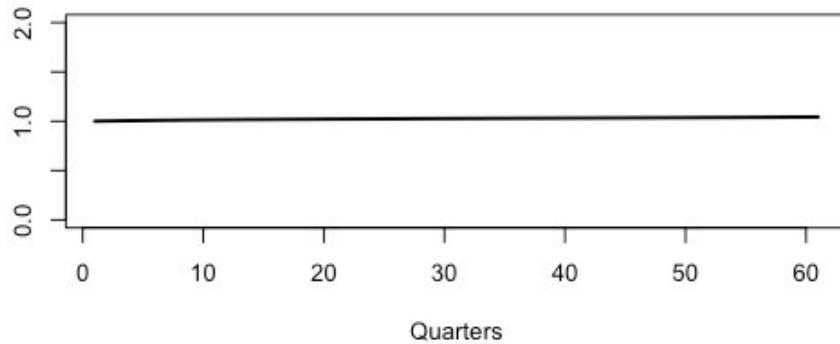

Unemployment rate

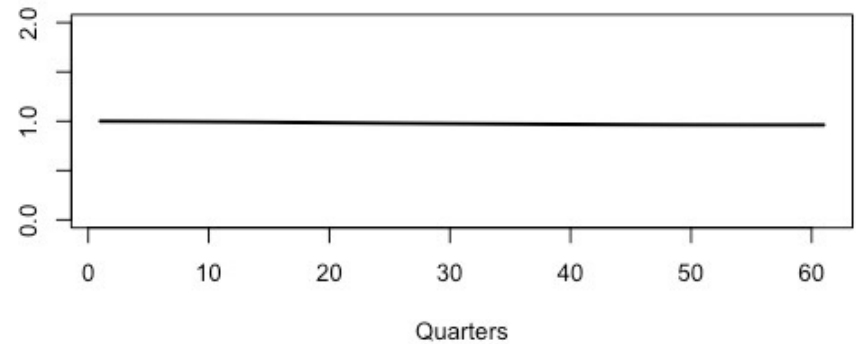# Baseline scenario (2 of 2):

Capital / output ratio

Public debt on GDP

Households wealth on GDP

Broad money on GDP

Description of scenarios (1 of 2):

Treatment	Target sector	Policy
1- Fiscal transfer to households	All households	The government increases social transfers to households by 5% of the previous period's GDP value
Transmission channel: Propensity to consume out of income		
↑ Transfers → ↑ Y_w & ↑ Yr → ↑ C_w & ↑ C_r→ ↑ Y		

Treatment	Target sector	Policy
2- Quantitative Easing	Upper-class households	The Central Bank purchases government bonds held by households for a value equal to the 5% of the previous period's GDP
Transmission channel: Capital Gains and Propensity to consume out of wealth		
↑ $Bills_{BC}$ → ↑ $D_{equities}$ & ↑ D_{bills} → ↑ $P_{equities}$ & ↑ P_{bills} → ↑ $NetWorth_r$ → ↑ C_r → ↑Y		

Description of scenarios (2 of 2):

Treatment	Target sector	Policy
3- CBDC to households	All households	Issuance of CBDC credited to households equal to 5% of the previous period's GDP value
Transmission channel: Propensity to consume out of wealth		
$\uparrow$ CBDC $\rightarrow$ $\uparrow$ NetWorth$_w$ & $\uparrow$ NetWorth$_r \rightarrow \uparrow$ C$_w$ & $\uparrow$C$_r \rightarrow \uparrow$ Y		

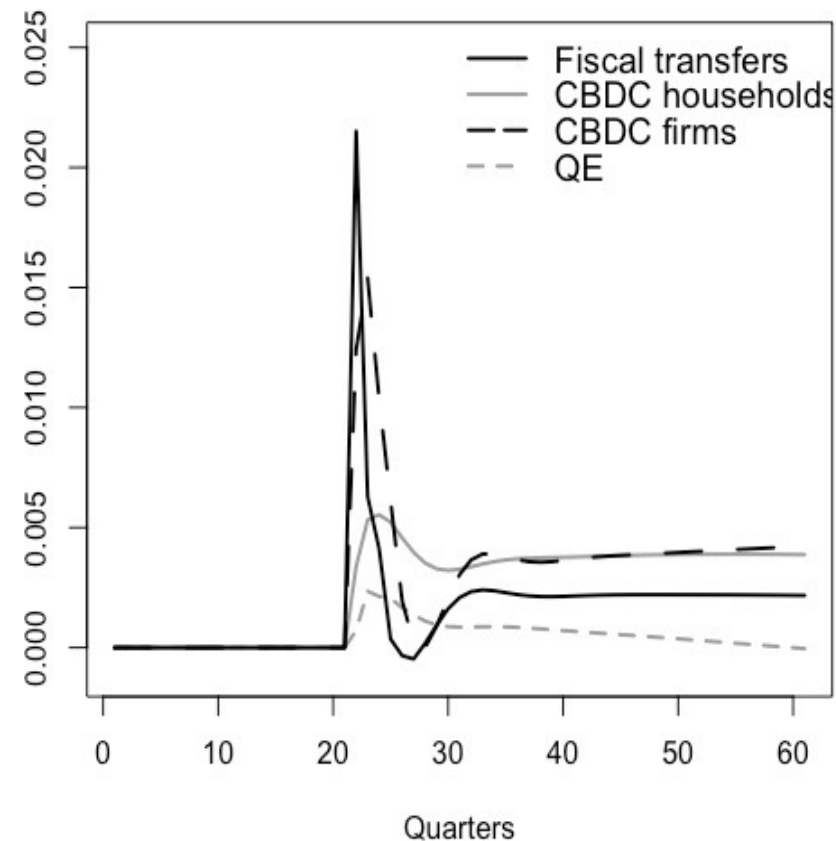| Treatment	Target sector	Policy
4- CBDC to firms	Firms	Issuance of CBDC credited to firms equal to 5% of the previous period's GDP
Transmission channel: Sensitivity of investments and the interest rate to firms' leverage		
$\uparrow$ CBDC$_f \rightarrow \downarrow$ L$_f \rightarrow \downarrow$ LEV $\rightarrow \uparrow$ ID $\rightarrow \uparrow$ Y		

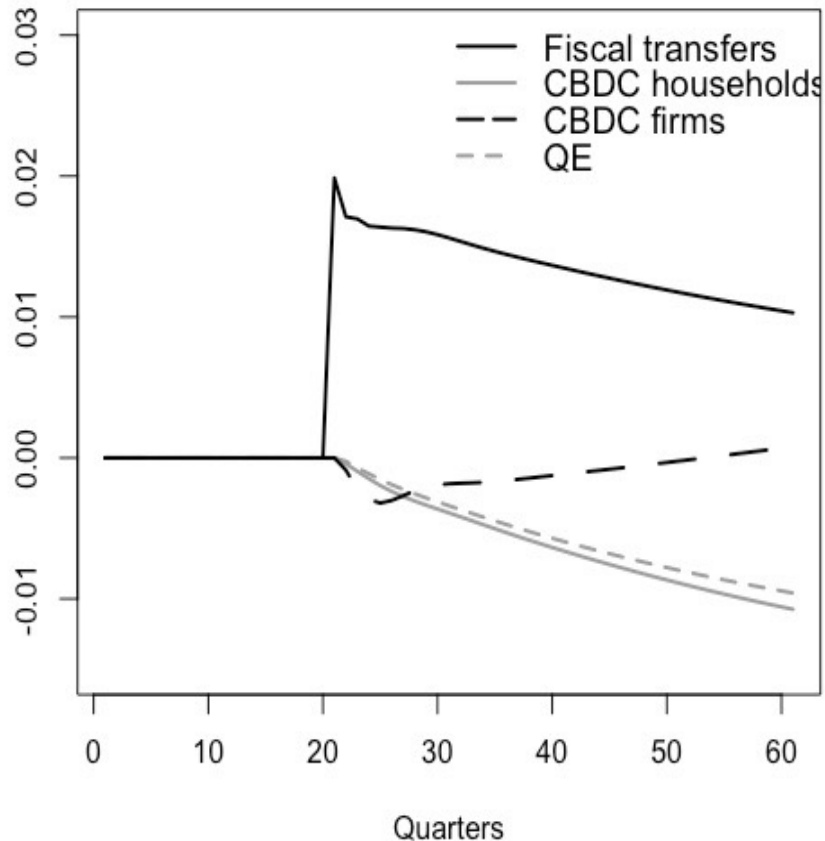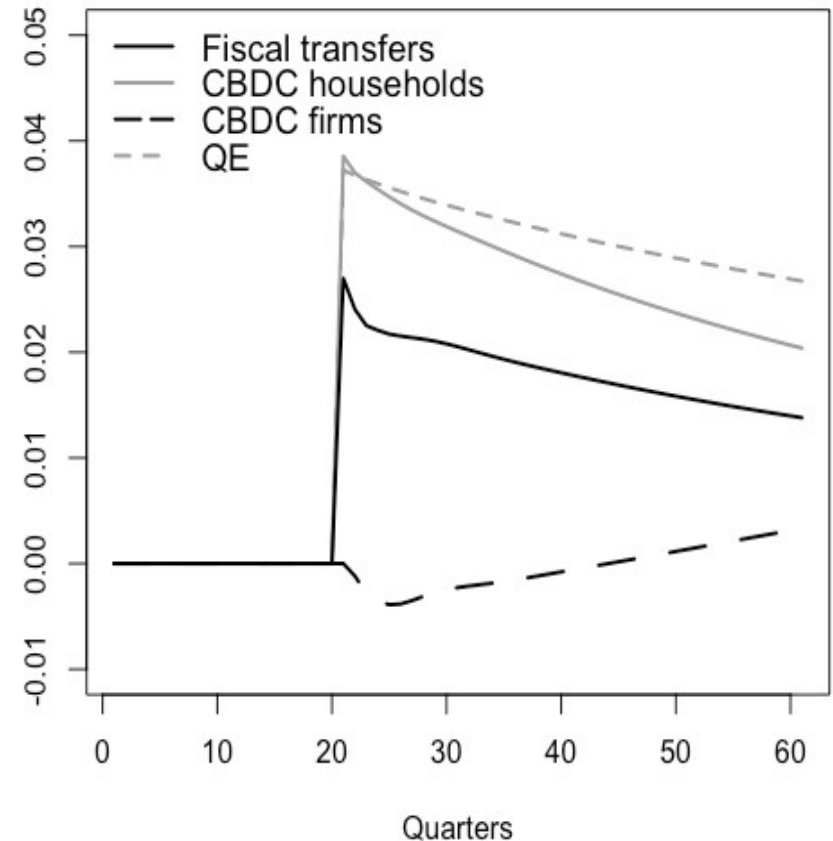# Results → GDP dynamics (1 of 3):

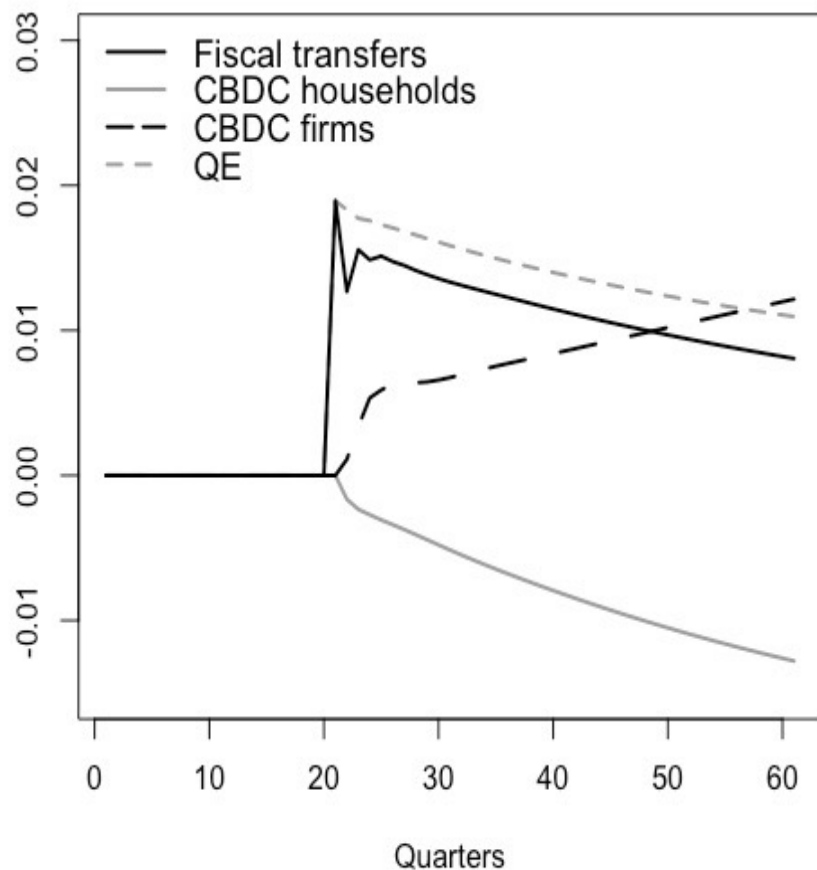**Nominal GDP**
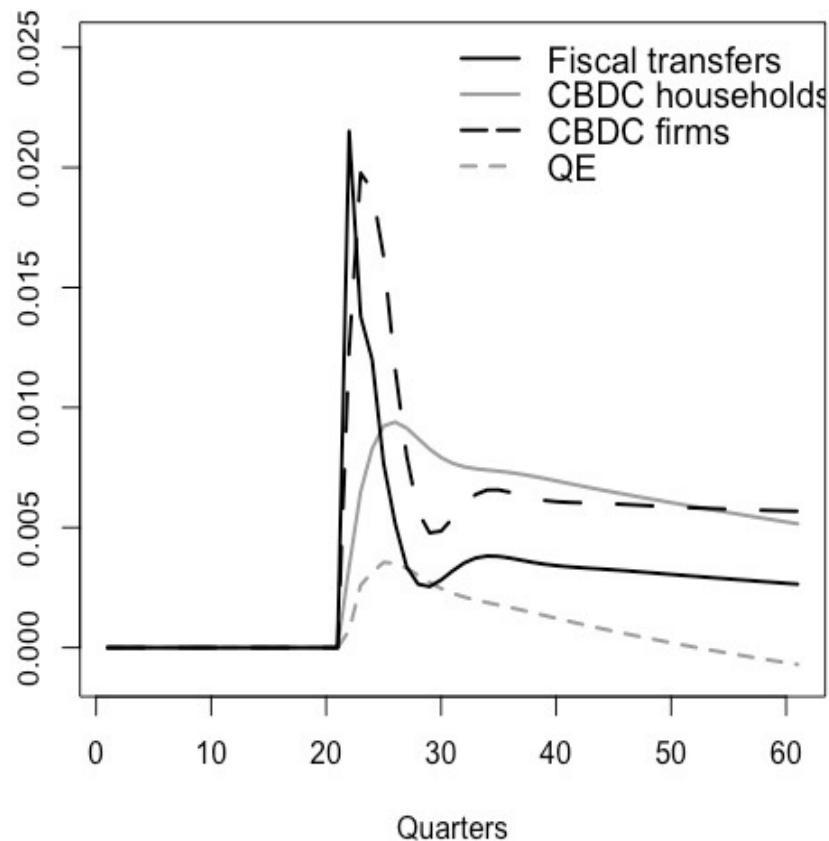
Real GDP

Results → Public sector finances (2 of 3):

Results → Effects on the banking sector (3 of 3):

Deposits with commercial banks

Bank profits
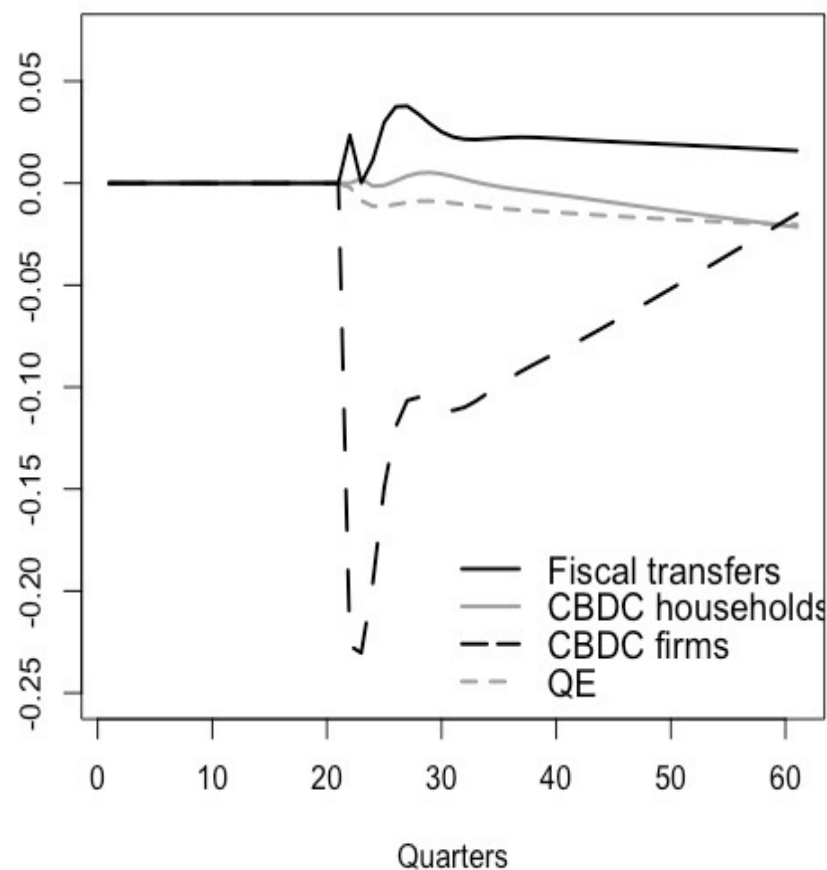
Conclusions:

Our analysis shows that:

1. Issuing a CBDC has the potential of activating a new transmission channel.

2. Fiscal transfers have the highest immediate impact, but in the long run issuing a CBDC is more effective.
   - The positive impact of QE on GDP and on banks' profits is entirely due to asset inflation.

3. CBDCs are very effective monetary policy tool:
   - In the long run, the provision of CBDC to households appears to be the most effective in boosting nominal and real GDP. But at the cost of an expansion of the Central Bank's balance sheet.
   - The scenario of CBDC to firms, in the long run, has a positive impact on GDP. But it has a negative impact on the profits of the banking sector, which could create financial stability issues.

Thank you for your attention!

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Balance sheets in QE scenario:

A. Pre-shock

Upper-class households	
Assets	**Liabilities**
h_r	v_r
$m1_r$	
$m2_h$	
e_h	
b_h	

B. Post-shock

Upper-class households	
Assets	**Liabilities**
h_r	v_r
$m1_u^0 + \dfrac{(1-\lambda_m)}{2} \cdot QE$	
$m2_h^0 + \dfrac{(1-\lambda_m)}{2} \cdot QE$	
$e_h^0 + \lambda_m \cdot QE$	
$b_h^0 - QE$	

C. Pre-shock

Central Bank	
Assets	**Liabilities**
a_s	h_s
b_{cb}	hb_s
h_f	hb_s^*

D. Post-shock

Central Bank	
Assets	**Liabilities**
a_s	h_s
$b_{cb}^0 + QE$	hb_s
h_f	hb_s^*

Balance sheets in CBDC to households scenario:

A. Pre-shock

Upper-class households	
Assets	**Liabilities**
h_u	v_u
$m1_u$	
$m2_h$	
e_h	
b_h	

B. Post-shock

Upper-class households	
Assets	**Liabilities**
h_u	l_{CBDCu}
$m1_u$	v_u
$m2_h$	
e_h	
b_h	
$CBDC_u$	

C. Pre-shock

Lower-class households	
Assets	**Liabilities**
h_l	l_h
$m1_l$	v_{lv}

D. Post-shock

Lower-class households	
Assets	**Liabilities**
h_l	l_h
$m1_l$	l_{CBDCl}
$CBDC_l$	v_{lv}

E. Pre-shock

Central Bank	
Assets	**Liabilities**
a_s	h_s
b_{cb}	hb_s
h_f	hb_s^*

F. Post-shock

Central Bank	
Assets	**Liabilities**
a_s	h_s
b_{cb}	hb_s
h_f	hb_s^*
l_{CBDCs}	$CBDC_s$

Balance sheets in CBDC to firms scenario:

A. Pre-shock

Firms	
Assets	Liabilities
k	l_f
	e_h
	v_f

B. Policy shock

Firms	
Assets	Liabilities
k	l_f
$CBDC_f$	e_h
	l_{CBDCf}
	v_f

C. Behavioural response

Firms	
Assets	Liabilities
k	l_f
	e_h
	l_{CBDCf}
	v_f

D. Pre-shock

Commercial banks	
Assets	Liabilities
l_s	$m1_s$
hb_d	$m2_s$
hb_d^*	a_d
b_b	

E. Policy shock

Commercial banks	
Assets	Liabilities
l_s	$m1_s$
hb_d	$m2_s$
hb_d^*	a_d
b_b	

F. Behavioural response

Commercial banks	
Assets	Liabilities
l_s	$m1_s$
hb_d	$m2_s$
hb_d^*	a_d
b_b	
$CBDC_f$	

G. Pre-shock

Central Bank	
Assets	Liabilities
a_s	h_s
b_{cb}	hb_s
h_f	hb_s^*

H. Policy shock

Central Bank	
Assets	Liabilities
a_s	h_s
b_{cb}	hb_s
h_f	hb_s^*
l_{CBDCf}	$CBDC_f$

I. Behavioural response

Central Bank	
Assets	Liabilities
a_s	h_s
b_{cb}	hb_s
h_f	hb_s^*
l_{CBDCf}	$CBDC_f$

Different assumptions on the model's parametrization (1 of 4):

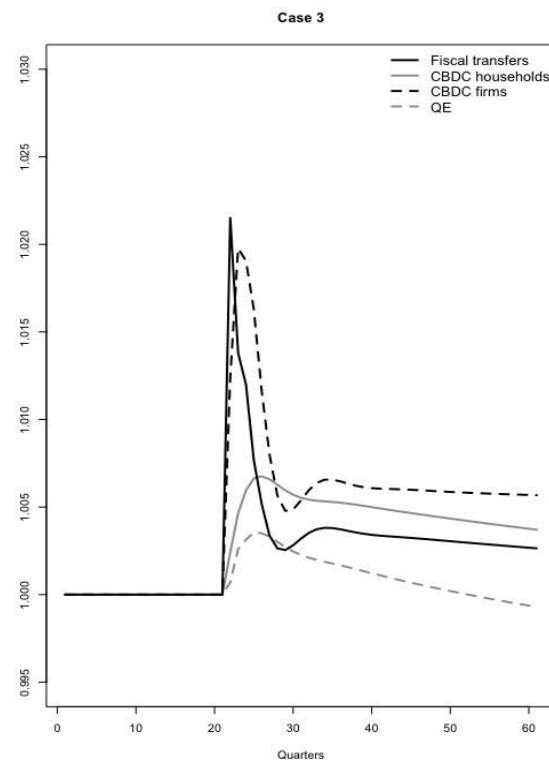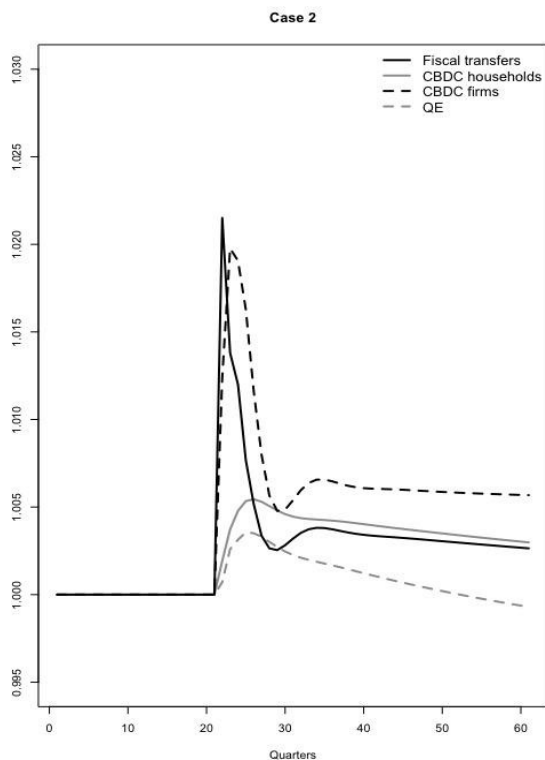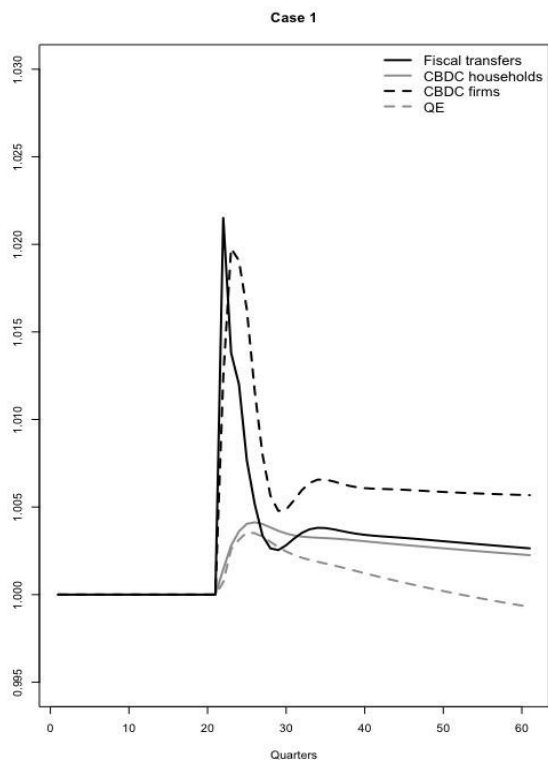**Investment induced by CBDC, as a percentage (η) of the CBDC loan to firms.**

Parametrization	Case 1	Case 2	Case 3
$\eta = 0\%$	$\eta = 1\%$	$\eta = 2\%$	$\eta = 3\%$
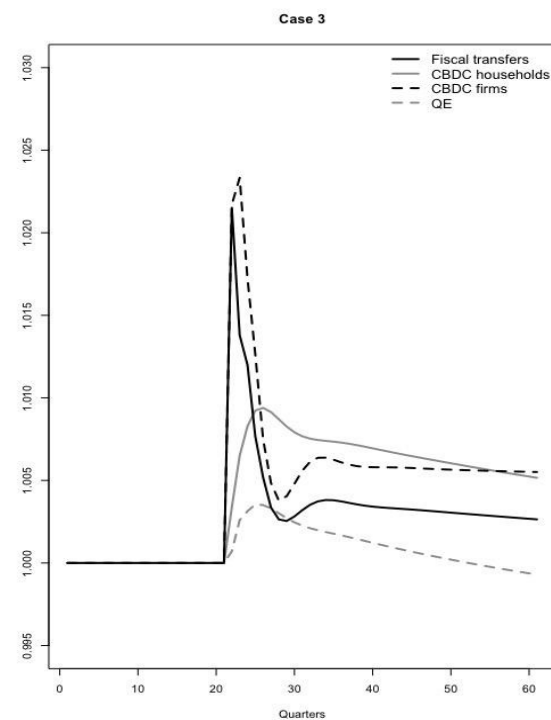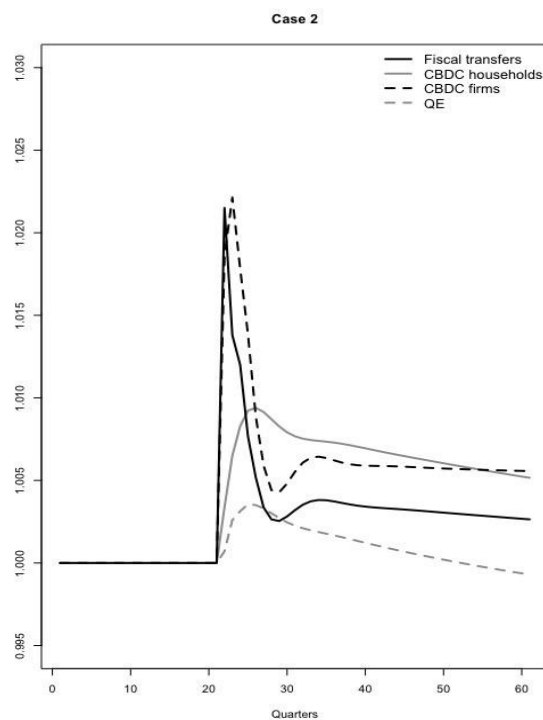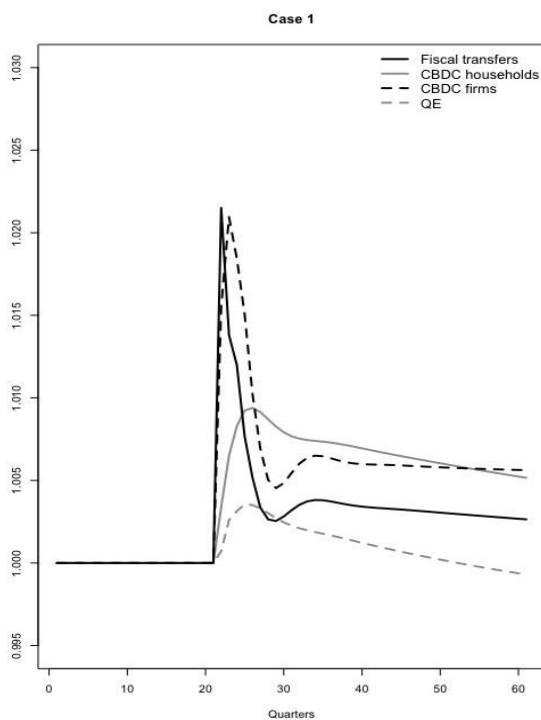
Different assumptions on the model's parametrization (2 of 4):

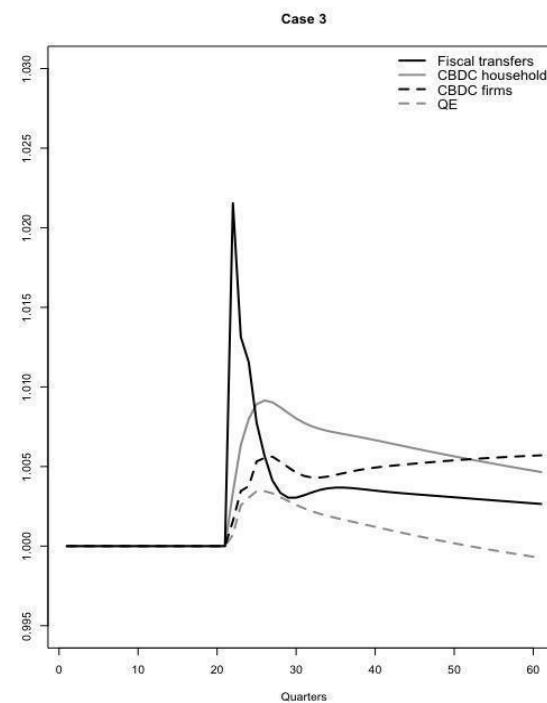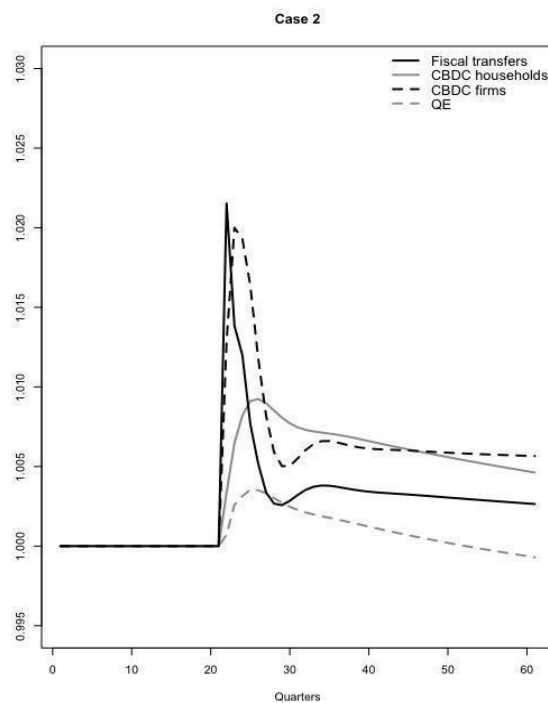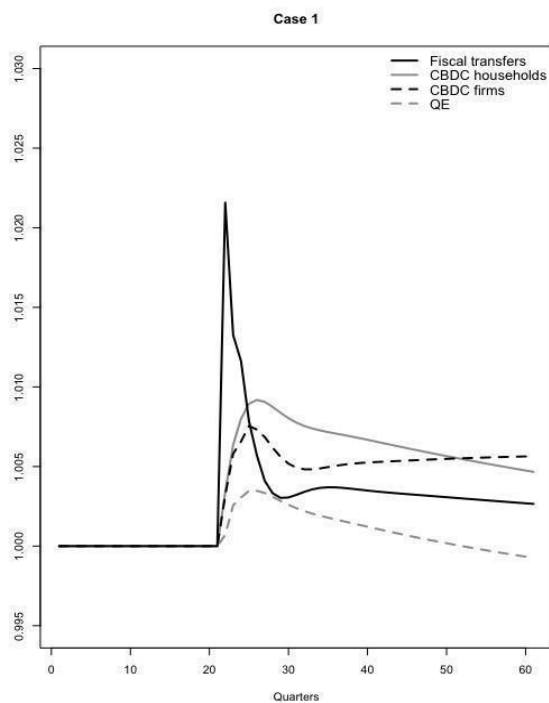**MPC CBDC of the lower-class (α_{CBDCl}) and the upper-class (α_{CBDCu})**

Parametrization	Case 1	Case 2	Case 3
$\alpha_{CBDCl} = 5\%$ $\alpha_{CBDCu} = 5\%$	$\alpha_{CBDCl} = 1\%$ $\alpha_{CBDCu} = 1\%$	$\alpha_{CBDCl} = 2\%$ $\alpha_{CBDCu} = 2\%$	$\alpha_{CBDCl} = 3\%$ $\alpha_{CBDCu} = 3\%$

Different assumptions on the model's parametrization (3 of 4):

Elasticity of investment (κ_2) and loan interest rate (μ_{l1}) to leverage

Parametrization	Case 1	Case 2	Case 3
$\kappa_2 = -0,4\%$ $\mu_{l1} = 0,1\%$	$\kappa_2 = -0,2\%$ $\mu_{l1} = 0,05\%$	$\kappa_2 = -0,4\%$ $\mu_{l1} = 0,05\%$	$\kappa_2 = -0,2\%$ $\mu_{l1} = 0,1\%$

Different assumptions on the model's parametrization (4 of 4):

MPCY of the lower-class households (α_1) and the upper-class households (α_7).

Parametrization	Case 1	Case 2	Case 3
$\alpha_1 = 49{,}7\%$ $\alpha_7 = 15\%$	$\alpha_1 = 49{,}7\%$ $\alpha_7 = 15\%$	$\alpha_1 = 49{,}7\%$ $\alpha_7 = 35\%$	$\alpha_1 = 49{,}7\%$ $\alpha_7 = 49{,}7\%$