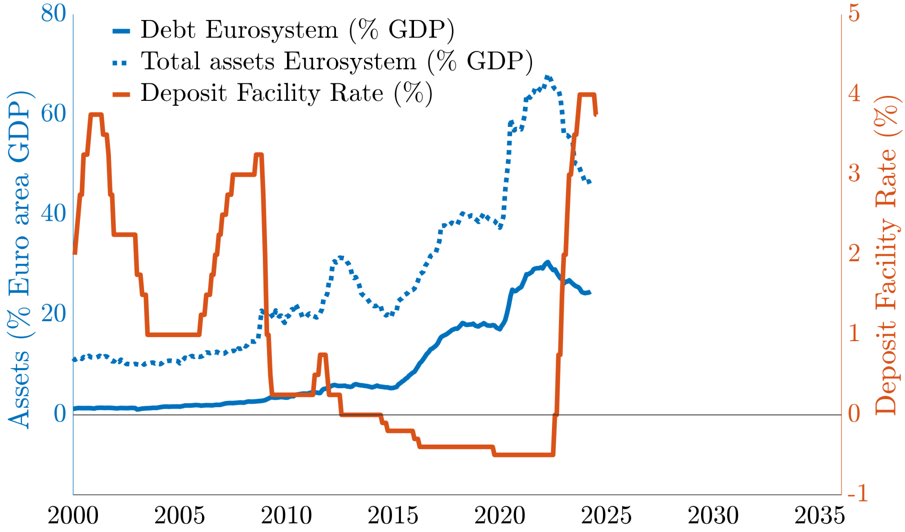
Balance sheet policies and Central Bank losses in a HANK model

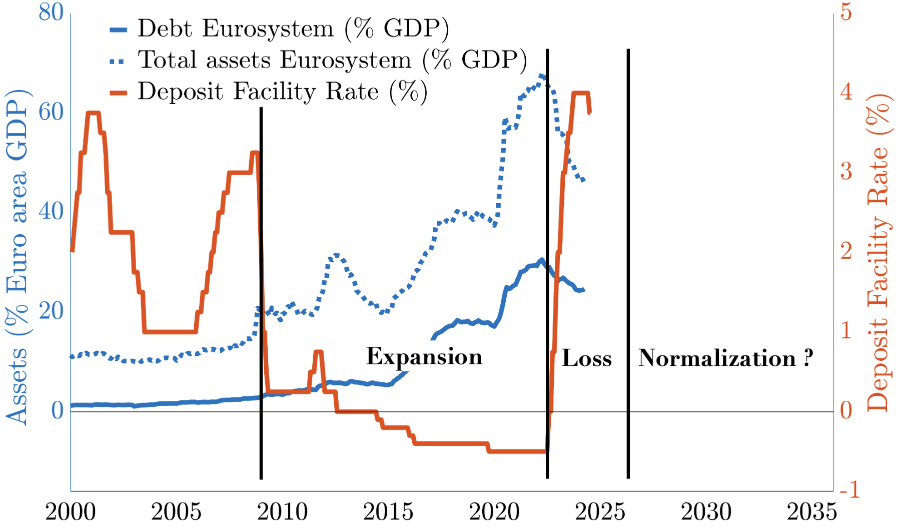
Charles Labrousse (PSE/Insee) & Yann Perdereau (PSE)

July 19, 2024

QE, CB losses and QT: a play in three acts



QE, CB losses and QT: a play in three acts



Motivation

- What are the effects of Central Bank balance sheet policies ?

Motivation

- What are the effects of Central Bank balance sheet policies ?
  1. Can QE stimulate an economy stuck at the ZLB ?
  2. How to cover Central Bank's losses ?
  3. What is the effect of Quantitative Tightening?

Motivation

- What are the effects of Central Bank balance sheet policies ?
  1. Can QE stimulate an economy stuck at the ZLB ?
  2. How to cover Central Bank's losses ?
  3. What is the effect of Quantitative Tightening?
- Our focus: the fiscal-monetary interaction of balance sheet expansions

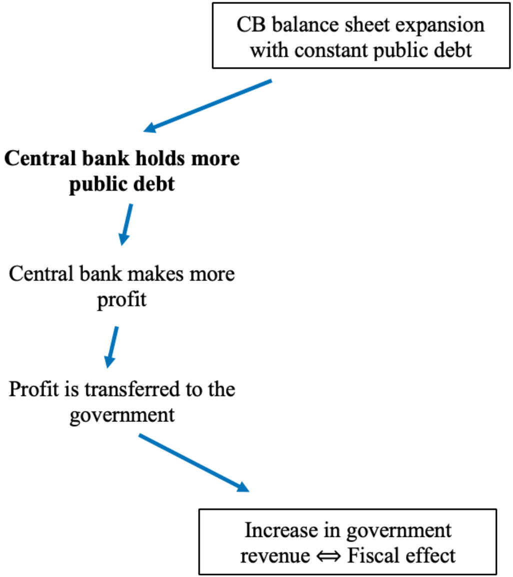
Findings

1. Balance sheet expansions **stimulate the economy**:
   - increase in consumption, output and inflation
   - decrease in interest rate

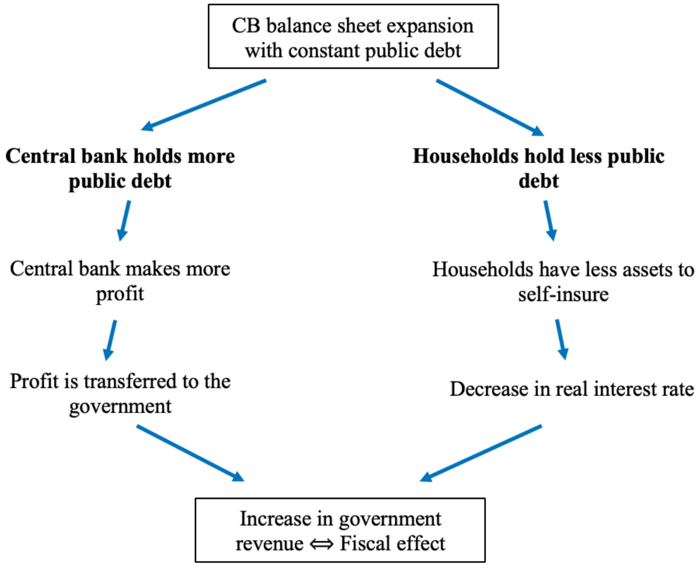
Findings

1. Balance sheet expansions stimulate the economy
2. This non-neutrality stems from **three distortions**:
   - distortive income tax (fiscal channel)
   - imperfect capital markets (liquidity channel)
   - inflation tax

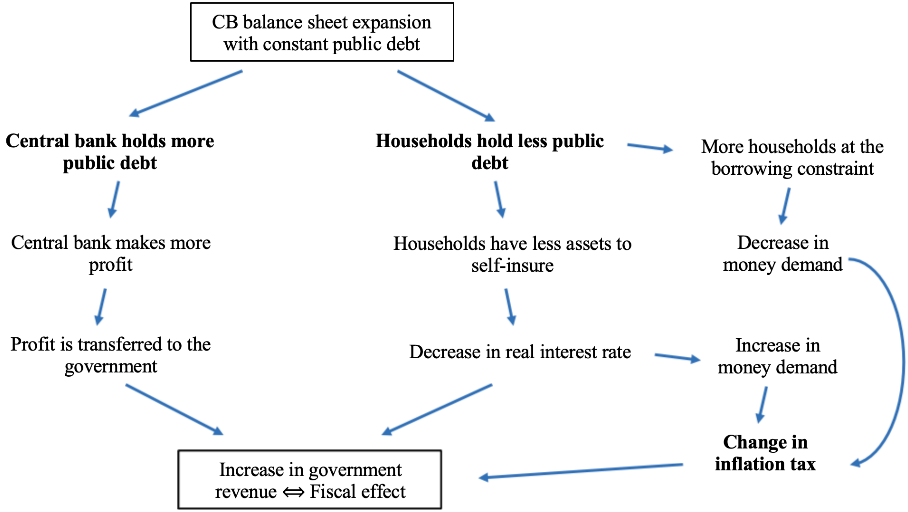
Fiscal-monetary interactions in heterogeneous-agent model



Fiscal-monetary interactions in heterogeneous-agent model



Fiscal-monetary interactions in heterogeneous-agent model

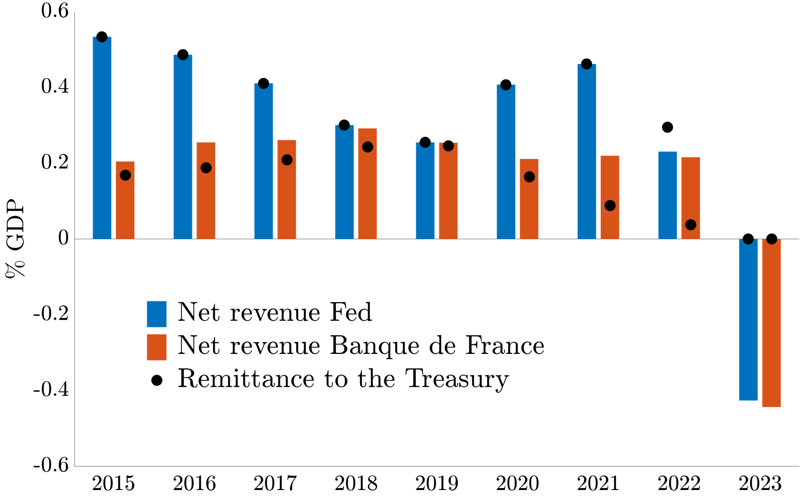


Findings

1. Balance sheet expansions stimulate the economy
2. This non-neutrality stems from three distortions
3. The **magnitude of the stimulus** depends on
   - the size of the expected future balance sheet
   - the fiscal transmission of Central Bank losses

What are Central Bank losses?

Figure: **Fed and Banque de France's losses**



Central Bank Losses in 2023 over the world

	Operating losses in 2023	GDP share
Bank of Italy	7.1 €Bn	0.3%
Banque de France	12.4 €Bn	0.5%
Bundesbank	21.6 €Bn	0.5%
Federal Reserve	114 $Bn	0.5%
Bank of England	40 £Bn	1.3%
Bank of Japan	71 $Bn	1.4%

Findings

1. Balance sheet expansions stimulate the economy
2. This non-neutrality stems from three distortions
3. The magnitude of the stimulus depends on expectations
4. Welfare gains are **unevenly distributed**

Model

Households: Aiyagari with money in utility

The program of households i is the following:

$$\max_{\{C_{i,t},N_{i,t},A_{i,t},M_{i,t}\}_{t=0}^{\infty}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t Z_t \left(\frac{C_{i,t}^{1-\sigma}-1}{1-\sigma} - \nu \frac{N_{i,t}^{1+\psi}}{1+\psi} + \chi \frac{\min\left\{\bar{m}, \frac{M_{i,t}}{P_t}\right\}^{1-\mu}}{1-\mu} \right)$$

Households: Aiyagari with money in utility

The program of households i is the following:

$$\max_{\{C_{i,t},N_{i,t},A_{i,t},M_{i,t}\}_{t=0}^{\infty}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t Z_t \left(\frac{C_{i,t}^{1-\sigma}-1}{1-\sigma} - \nu \frac{N_{i,t}^{1+\psi}}{1+\psi} + \chi \frac{\min\left\{\bar{m}, \frac{M_{i,t}}{P_t}\right\}^{1-\mu}}{1-\mu} \right)$$

such that

$$P_t C_{i,t} + A_{i,t} + M_{i,t} = (1+i_{t-1})A_{i,t-1} + M_{i,t-1} + (1-\tau_t)W_t z_{i,t} N_{i,t} + \Pi_t(z_{i,t})$$

$$A_{i,t} \geq 0$$

$$z_{i,t} = e^{x_{i,t}} \;,\; x_{i,t} = \rho_z x_{i,t-1} + \epsilon_{i,t} \;,\; \epsilon_{i,t} \sim \mathcal{N}(0, \sigma_z^2)$$

Calibration

Households: money demand

$$\frac{M_t}{P_t} = \min\left\{\bar{m}, C_t^{\frac{\sigma}{\mu}}\left(\chi\frac{1+i_t}{i_t+\eta_t}\right)^{\frac{1}{\mu}}\right\}$$

- increasing function of the consumption
- decreasing function of the interest rate
- decreasing function of the borrowing constraint multiplier: even at the ZLB, we will not have all agents at the satiation
- satiation point, necessary for the ZLB analysis

Firm: New Keynesian block

The program of the firm j is the following:

$$\max_{\{y_{j,t},n_{j,t},p_{j,t}\}_{t=0}^{\infty}} \mathbb{E}_0 \sum_{t=0}^{\infty} Q_{0,t}\left[p_{j,t}y_{j,t} - W_t n_{j,t} - P_t\Theta_t\right]$$

$$\text{such that} \quad \begin{cases} y_{j,t} = n_{j,t} & \text{(Production function)} \\ \Theta_t = \frac{\theta}{2}\left(\frac{p_{j,t}}{p_{j,t-1}} - 1\right)^2 Y_t & \text{(Rotemberg cost)} \\ y_{j,t} = \left(\frac{p_t}{P_t}\right)^{-\epsilon} Y_t & \text{(Demand)} \end{cases}$$

This yields the Phillips curve:

$$\frac{\epsilon}{\theta}\left(w_t - \frac{\epsilon - 1}{\epsilon}\right) + \frac{1}{r_{t+1}}\frac{Y_{t+1}}{Y_t}\pi_{t+1}(\pi_{t+1} - 1) = \pi_t(\pi_t - 1)$$

Calibration

Government with remittances from Central Bank

Government budget constraint:

$$(1 + r_t)d_{t-1} + \bar{G} = d_t + s_t^{CB} + \tau_t w_t \int_i z_{i,t} n_{i,t} \mathrm{d}i$$

Tax rule for τ_t:

$$\tau_t - \bar{\tau} = \rho_\tau(\tau_{t-1} - \bar{\tau}) + (1 - \rho_\tau)\gamma_d(d_{t-1} - \bar{d})$$

Calibration

Central Bank

	Outside the ZLB	**At the ZLB**
Nominal interest rate	$\mathrm{i}_t = \max\left\{0, \bar{i} + \varphi(\pi_t - \bar{\pi})\right\}$	

Central Bank

	Outside the ZLB	**At the ZLB**
Nominal interest rate	$\mathrm{i}_t = \max\left\{0, \bar{i} + \varphi(\pi_t - \bar{\pi})\right\}$	
Public debt held by CB	$d_t^{CB} = d_{t-1}^{CB} - \Delta QT_t$	$d_t^{CB} = d_{t-1}^{CB} + \Delta QE_t$

Central Bank

	Outside the ZLB	At the ZLB
Nominal interest rate	$\mathrm{i}_t = \max\left\{0, \bar{i} + \varphi(\pi_t - \bar{\pi})\right\}$	
Public debt held by CB	$d_t^{CB} = d_{t-1}^{CB} - \Delta QT_t$	$d_t^{CB} = d_{t-1}^{CB} + \Delta QE_t$
Money supply	Identified by households money demand	$m_t = m_{t-1} + \Delta QE_t$

Calibration

Fiscal-monetary interaction

The CB makes profit or loss through money creation and debt holding:

$$\Psi_t^{CB} = \Delta M_t + (1 + i_{t-1}) D_{t-1}^{CB} - D_t^{CB}$$

Fiscal-monetary interaction

The CB makes profit or loss through money creation and debt holding:

$$\Psi_t^{CB} = \Delta M_t + (1 + i_{t-1})D_{t-1}^{CB} - D_t^{CB}$$

Case 1: "CB securities"

$$\begin{cases} S_t^{CB} = \max\left\{0, \Psi_t^{CB} - (1 + i_{t-1})X_{t-1}^{CB}\right\} \\ X_t^{CB} = (1 + i_{t-1})X_{t-1}^{CB} + S_t^{CB} - \Psi_t^{CB} \end{cases}$$

Fiscal-monetary interaction

The CB makes profit or loss through money creation and debt holding:

$$\Psi_t^{CB} = \Delta M_t + (1 + i_{t-1})D_{t-1}^{CB} - D_t^{CB}$$

Case 1: "CB securities"

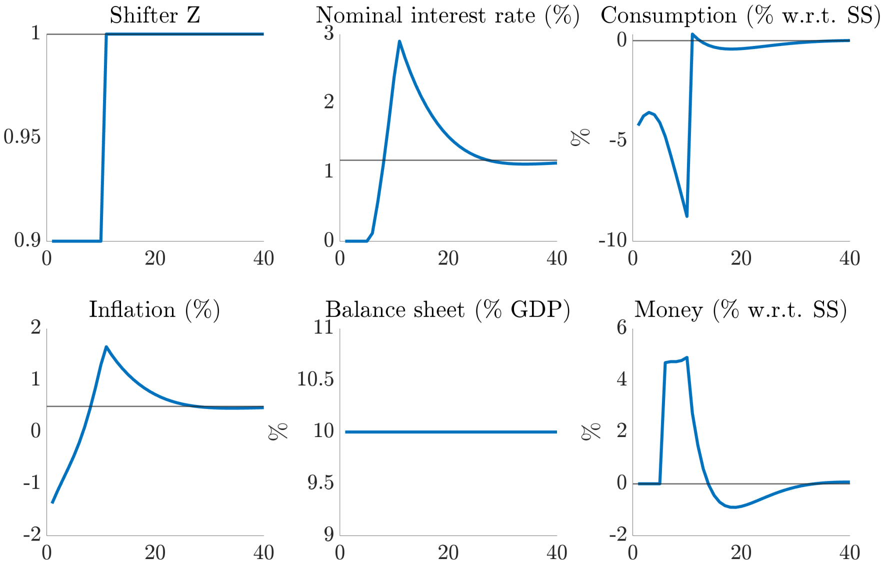
$$\begin{cases} S_t^{CB} = \max\left\{0, \Psi_t^{CB} - (1 + i_{t-1})X_{t-1}^{CB}\right\} \\ X_t^{CB} = (1 + i_{t-1})X_{t-1}^{CB} + S_t^{CB} - \Psi_t^{CB} \end{cases}$$

Case 2: "Treasury support"

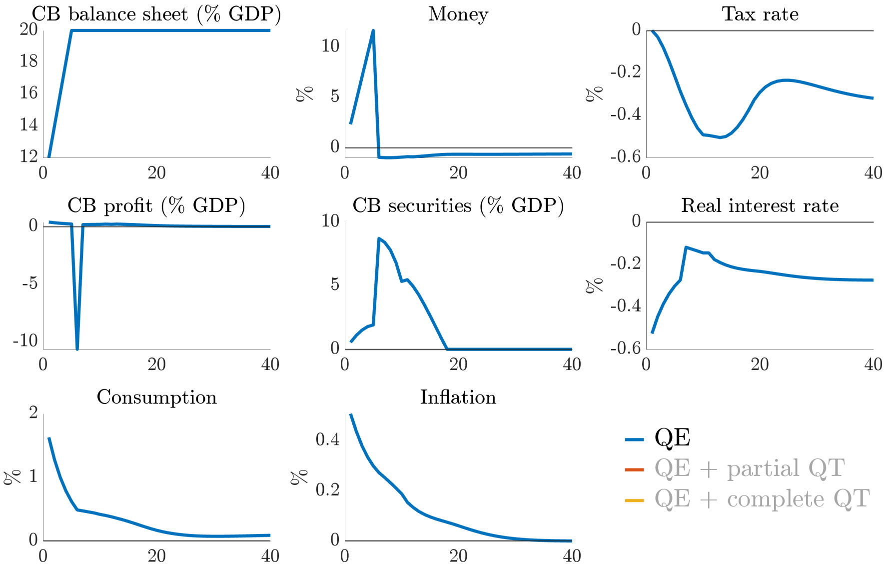
$$\begin{cases} S_t^{CB} = \Psi_t^{CB} & \text{(Remittance to the Treasury)} \\ X_t^{CB} = 0 & \text{(CB securities)} \end{cases}$$

Experiment and results

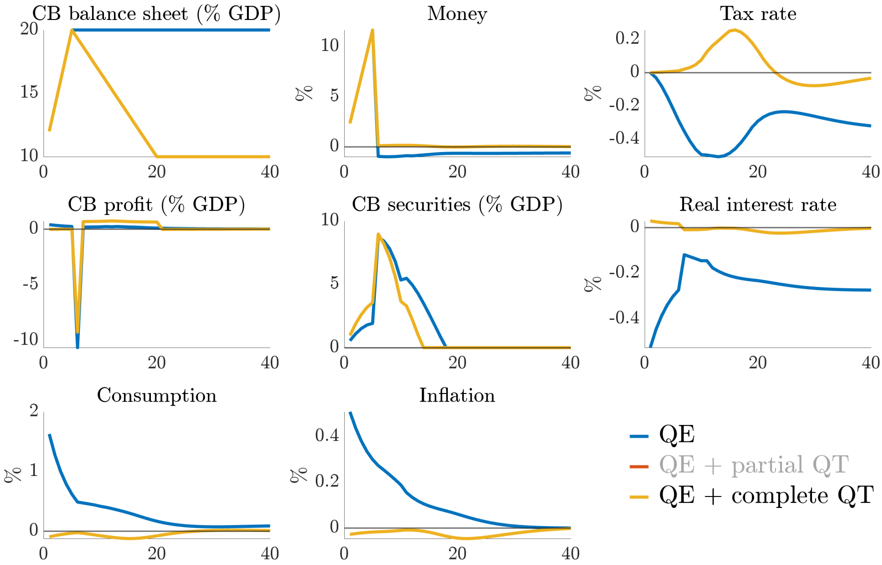
Counterfactual: negative demand shock and ZLB



Permanent QE



Permanent QE vs QE with complete QT



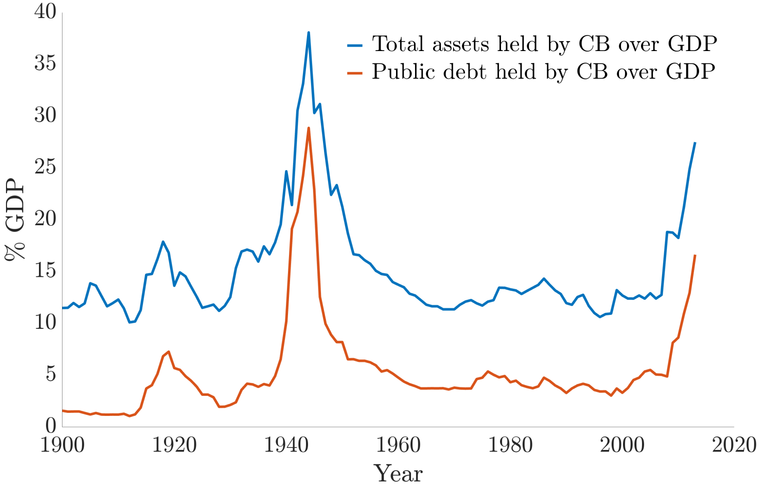
What will be the future ECB balance sheet size?

What will be the future ECB balance sheet size?

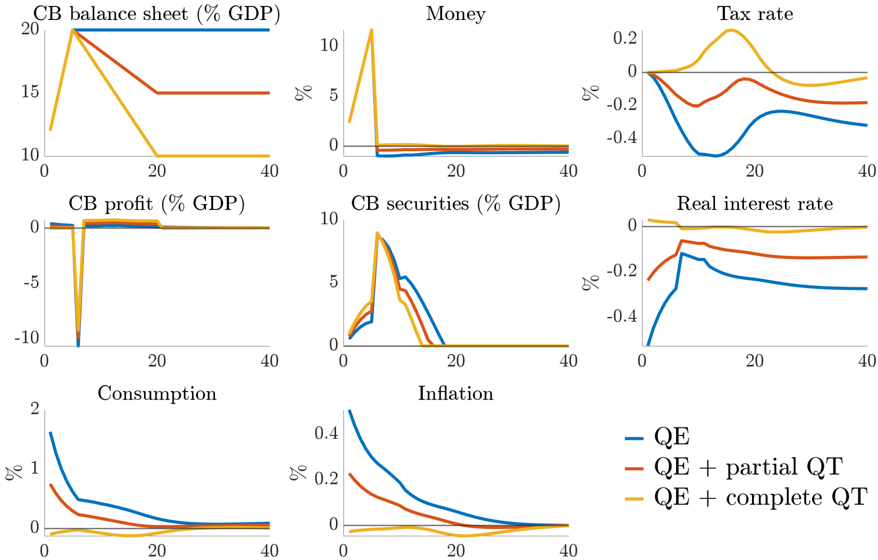
- Isabel Schnabel (27 March 2023): "However, **the size of our balance sheet will not return to the levels seen before the global financial crisis**."

What will be the future ECB balance sheet size?

- Isabel Schnabel (27 March 2023): "However, **the size of our balance sheet will not return to the levels seen before the global financial crisis**."
- Ferguson et al. (2015): "Nominal reductions of balance sheets are rare"



Intermediary scenario: QE and partial QT



Benchmark: decomposition of consumption change

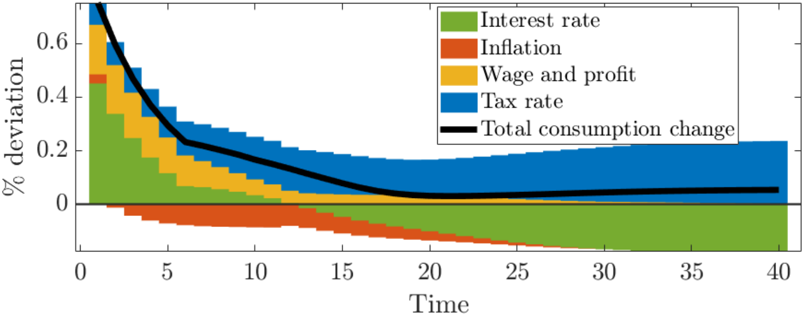
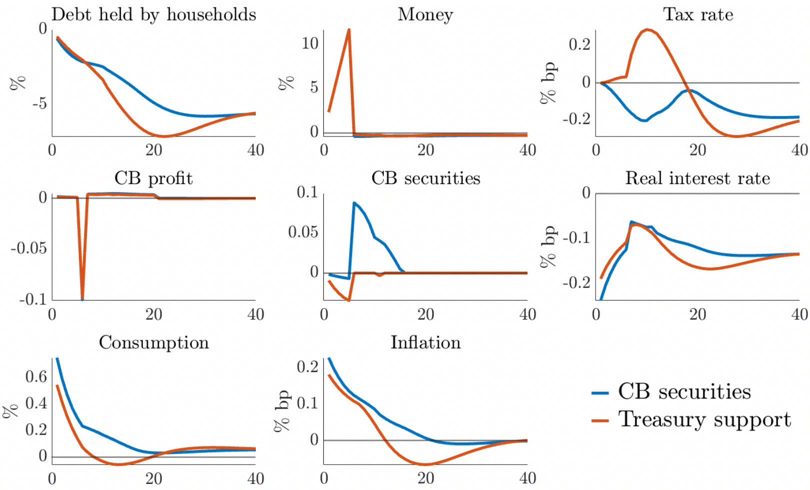
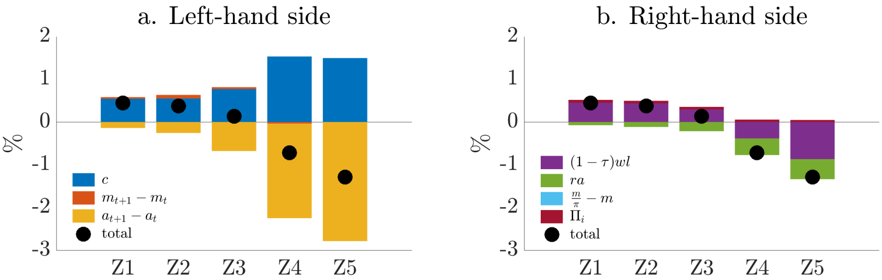


Figure: Emitting CB securities dominates Treasury support



Benchmark: Welfare and distributive effects

Figure: Budget constraint decomposition, change by productivity level



- Balance-sheet policy induces a change from capital to labor income
- Therefore, policy mix is progressive – welfare

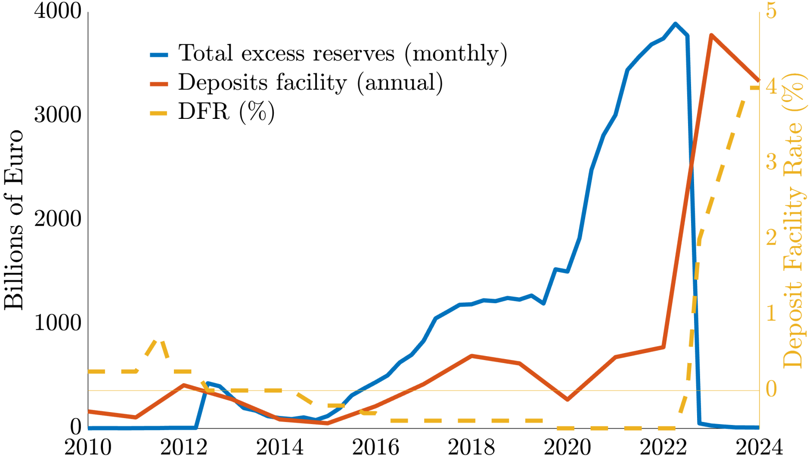
Conclusion

1. Balance sheet expansions stimulate the economy
   - On the long run due to distortive taxation and imperfect capital markets
   - On the short run by anticipation
2. The magnitude of the stimulus depends on
   - the size of the expected future balance sheet
   - the fiscal transmission of Central Bank losses
3. Welfare gains are unevenly distributed

Thank you !

Appendix

Behind the scene: deposits have replaced excess reserves



A simple model

- **Household**:

$$\max_{\{C_t, d_t, m_t\}_{t=0}^{\infty}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t Z_t u\left(C_t, \min\left\{\bar{m}, m_t\right\}\right)$$

$$\text{s.t. } C_t + d_t + m_t = \frac{1+i_{t-1}}{\pi_t} d_{t-1} + \frac{1}{\pi_t} m_{t-1} + (1-\tau_t) Y(\tau_t)$$

- **Government**:

$$\frac{1+i_{t-1}}{\pi_t} d_{t-1} + \frac{1}{\pi_t} m_{t-1} = \tau_t Y(\tau_t) + d_t + m_t$$

$$i_t = \text{exogenous}$$

$$m_t = \begin{cases} \text{FOC households} & \text{if} \quad i_t > 0 \\ \bar{m} + QE_t & \text{if} \quad i_t = 0 \end{cases}$$

$$d_t = \begin{cases} d_{t-1} & \text{if} \quad i_t > 0 \\ d_{t-1} - QE_t & \text{if} \quad i_t = 0 \end{cases}$$

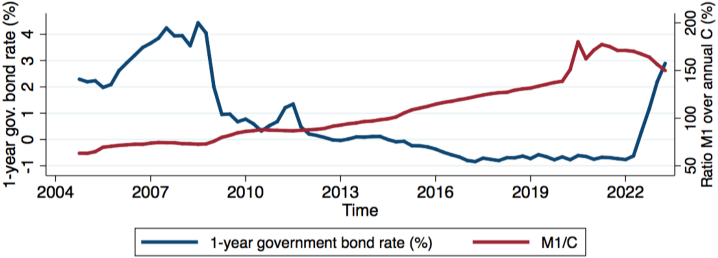
Calibration households

Parameter values and steady-state targets.			
Parameter	**Description**	**Value**	**Notes**
β	Discount factor	0.945	nominal interest rate: 3.5%
σ	Curvature w.r.t. C	1	intertemporal ES: 1
ν	Labor disutility scaling	1.3	initial output: 1
ψ	inverse Frisch elasticity	1	Frisch elasticity: 1
χ	weight of money	0.07	ratio consumption / M1 : 1.05
μ	Curvature w.r.t. m	1	Semi-elasticity of m to i: 4%.
$\bar{m}$	real money satiation	1.2	share at the satiation : 39%
ρ_z	persistence of prod shock	0.92	data wealth and income
σ_z	variance of prod shock	0.25	data wealth and income

Return

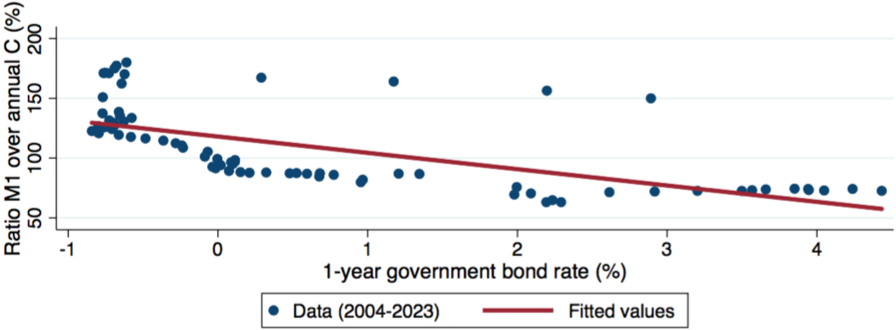
Calibration of money demand $\chi \frac{\min\{\bar{m}, \bar{m}\}^{1-\mu}}{1-\mu}$

Money utility scaling χ: to have $\frac{m}{c} = 1.05$

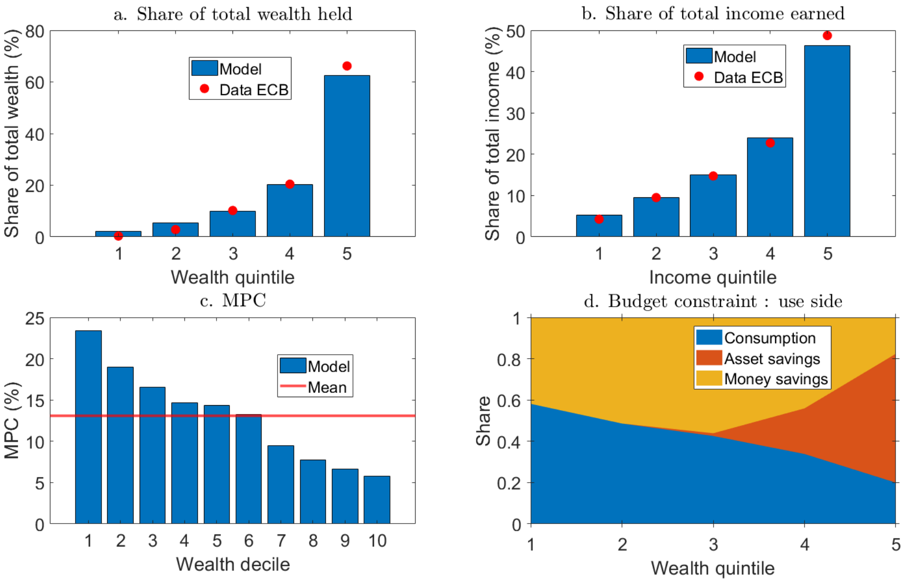


Calibration of money demand $\chi \frac{\min\{\bar{m},\bar{m}\}^{1-\mu}}{1-\mu}$

Semi-elasticity of money demand to the interest rate μ:



Calibration of households heterogeneity



Calibration Firm

Parameter values and steady-state targets.			
Parameter	**Description**	**Value**	**Notes**
ϵ	elasticity of substitution	7	markup: 14%
θ	price adjustment cost parameter	50	average price duration: X quarters

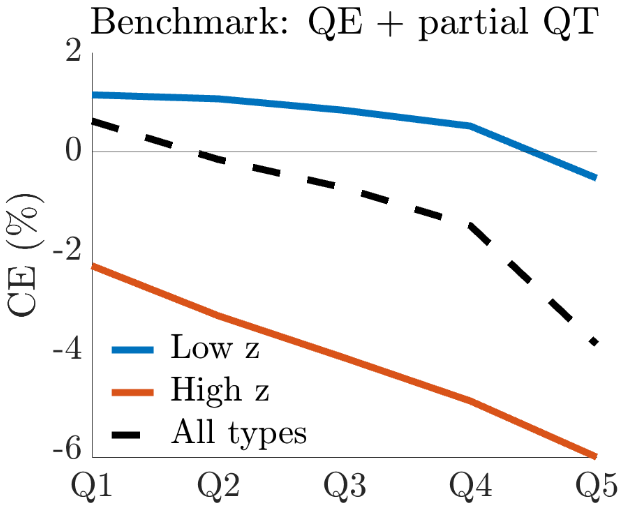
Retour

Calibration Government and Central Bank

Parameter values and steady-state targets.			
Parameter	**Description**	**Value**	**Notes**
$\bar{G}$	real gov expenditures	0.28	income tax rate: 30%
$\bar{d}$	real debt	1	debt-to-output ratio: 100%
ϕ	reaction to inflation	1.5	
$\bar{\pi}$	long-run inflation target	1.02	net inflation rate: 2%

Retour

Welfare and distributive effects – Return – CE

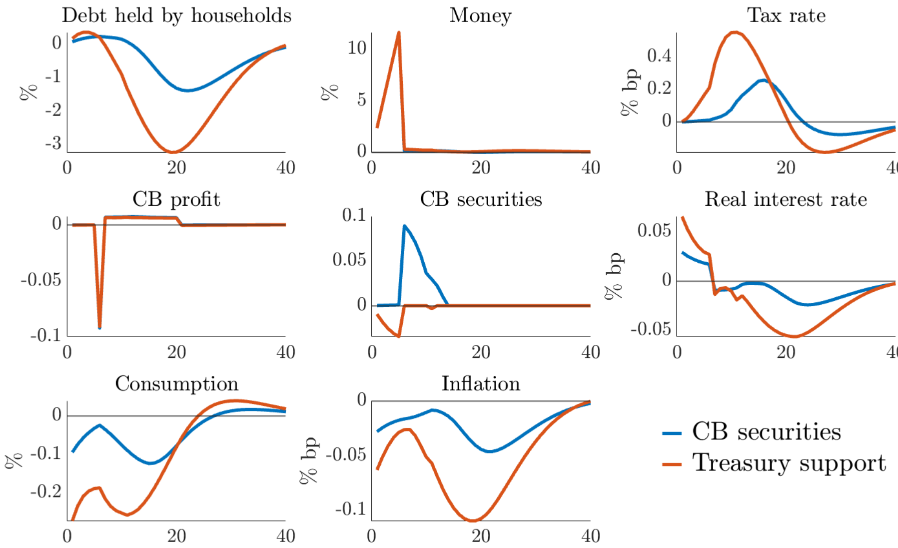


Consumption equivalent along the transition (%) – Return

$$\mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t u \left(c_t^{\text{No QE}} (1 + \text{CE}(a_0, z_0)), m_t^{\text{No QE}}, n_t^{\text{No QE}} \right) | a_0, z_0 \right]$$

$$= \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t u \left(c_t^{\text{QE}}, m_t^{\text{QE}}, n_t^{\text{QE}} \right) | a_0, z_0 \right]$$

Fiscal-monetary mix: QE + complete QT – Return



Fiscal-monetary mix: permanent QE – Return