Effectiveness and Addictiveness of Quantitative Easing

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The views expressed here are personal and do not reflect any official ECB views.

Motivation

- Central banks around the world have built up large balance sheets
- Balance sheets remain large despite improved conditions ▸ US ▸ Euro
- How effective is QE in fighting crises?
- How persistent should QE policies be?
- How to use QE in the future?

This paper

- Optimal QE policy in a dynamic general equilibrium model
  - Featuring banks with balance sheet constraints that bind occasionally following Gertler and Karadi (2013)
- Financial shock reduces bank equity
- Full commitment Ramsey problem

Findings

- QE can be very effective in response to financial shocks
- Optimal QE is very persistent ($\rho \approx 1$)
  - Banks rebuild balance sheets slowly when premia are low
  - Slack constraints can become binding if exit is quicker
- Future use of QE
  - after large financial shocks
  - after very large non-financial shocks (that trigger the ELB)
  - may be ineffective for small non-financial shocks

Related literature

- QE in DSGE models
  - Gertler and Karadi (2011); Carlstrom, Fuerst and Paustian (2017); Harrison (2017); Darracq-Paries and Kuehl (2017)
  - In our model QE is not always effective
- QE policy
  - Gertler and Karadi (2011): simple rules
  - Harrison (2017): discretionary optimization
  - We study optimal commitment

Overview

- Dynamic general equilibrium model
  - Representative family with consumption habits
  - Intermediate good producers with credit demand
  - Capital producers with investment adjustment costs
  - Retailers with Calvo pricing
- Balance sheet constrained financial intermediaries
- Central bank follows interest rule and QE policy

Financial Intermediaries

- Subject to agency problem as in Gertler and Karadi (2011)
- Assets
  - Loans s_t to firms (at price Q_t)
  - Hold government bonds b_t (at price q_t)
- Liabilities
  - Net worth n_t: retained earnings and equity issuance ξ_t
  - Deposits limited by agency friction
- Survive with probability σ, maximize expected net worth at exit

Agency problem

- Bankers can run away with fraction θ of loans and $\Delta\theta$ of gov't bonds
  - Depositors limit their deposits (bank leverage) to prevent default
- Aggregate leverage with occasionally binding constraint

$$\phi_t \equiv \frac{Q_t S_{pt} + \Delta q_t B_{pt}}{N_t} \leq \overline{\phi}_t$$

where S_{pt} and B_{pt} are banks' aggregate asset holdings and $\overline{\phi}_t$ is an endogenous maximum leverage ratio.

  - Δ determines the weight of government bonds

Agency problem, cont.

- Aggregate net worth evolves as

$$N_t = \sigma\left[(R_{kt} - R_t)Q_{t-1}S_{pt-1} + (R_{bt} - R_t)q_{t-1}B_{pt-1} + R_t N_{t-1} + \xi_{t-1}N_{t-1}\right] + \omega_t,$$

  where $R_{it} - R_t, i = k, b$ are excess returns, σ is the banks' survival probability and ω_t is start-up funds.

- Implications
  - $1 - \sigma$ can be interpreted as proportional dividend payout
  - Banks' net worth growth is high when excess returns are high (credit is scarce) and low when credit is abundant.

Household Asset Holdings

- Households can buy long-term gov't bonds subject to transactions costs
  - Gov't bonds holding cost: $\frac{1}{2}\kappa(B_{ht} - \overline{B}_h)^2$ for $B_{ht} \geq \overline{B}_h$
- Household asset demand:

$$B_{ht} = \overline{B}_h + \frac{E_t \Lambda_{t,t+1}(R_{bt+1} - R_{t+1})}{\kappa}$$

- Elasticity $\kappa > 0$
  - Determines the level of financial frictions in the economy

Credit policy

- Reduces private holdings of long-term government bonds
- Banks
  - Can offload part of their government bond holdings
  - This relaxes their balance-sheet constraint
  - They extend extra credit to the private sector
  - Laxer credit conditions reduce excess returns and stimulate economy
  - This raises asset prices and improves banks' balance sheets further

Credit policy, cont.

- Households
  - Sell part of their bond holdings due to lower excess returns
  - Depending on κ this can reduce the effectiveness of QE policy

Credit Policy Trade-off

- The central bank faces quadratic efficiency cost of QE
  - $\tau(q_t B_{g,t})^2$
- Central bank is not balance-sheet constrained!

Central bank

- Sets QE to maximize household welfare

$$E_t \sum_{i=0}^{\infty} \beta^i \left[\ln(C_{t+i} - hC_{t+i-1}) - \frac{\chi}{1+\varphi} L_{t+i}^{1+\varphi} \right]$$

subject to the optimizing behavior of the private sector (households, firms, banks) under full commitment

Central bank, cont.

- Follows the Taylor rule

$$\exp\{i_t\} = \exp\{i_{t-1}\}^{\rho_i} \left[R^* \left(\frac{\Pi_t}{\Pi^*} \right)^{\kappa_\pi} \left(\frac{Y_t}{Y^*} \right)^{\kappa_Y} \right]^{1-\rho_i}$$

subject to

$$i_t \geq 0$$

Deterministic steady state is efficient

- Subsidy offsets steady-state monopolistic distortion (Woodford, 2011)
- Financial constraints loose in steady-state
  - Steady-state equity buffer $N > N^*$
  - Motivated by precautionary behavior or by regulation
- Optimal QE is zero in steady-state

Results

- Model is calibrated to Euro Area based on estimated parameters of Coenen, Karadi, Schmidt and Warne (2018) ▸ Parameters
- Impact of QE ▸

Optimal costless QE

- Financial shock ($e_{\omega,t}$) reduces banks' net worth
- Optimal policy is (piecewise) linear in the 'net worth gap'

$$\Gamma_t = \begin{cases} \frac{\bar{\phi}}{\Delta}(N^* - N_t) & \text{if } N_t \leq N^* \\ 0 & \text{otherwise} \end{cases}$$

- Optimal policy is more aggressive
  - The higher the maximum leverage $\bar{\phi}$ (more 'missing' credit)
  - The lower the bonds' weight (less BS relaxation)

Optimal costless QE, cont.

- Relaxes banks' balance sheet constraints, so that banks can fully satisfy credit demand
- Fully offsets the financial shock (effectiveness)
  - Banks' balance sheet constraints remain loose
  - Excess returns are fully eliminated
  - Output at its first best, inflation is zero

Optimal costless QE, cont.

- Addictiveness due to slow recapitalization of the banking sector

$$N_t = \sigma R N_{t-1} + \omega_t,$$

  - Because excess returns are zero
  - Persistence depends on σR (close to 1): dividend payouts

Optimal costless QE, cont.

- Path of optimal QE: AR(1) with a drift (Φ) while positive

$$qB^*_{gt} = \begin{cases} \sigma R \left(qB^*_{gt-1} \right) - \Phi - \frac{\bar{\phi}}{\Delta} e_{\omega,t} & \text{if } N_t \leq N^* \\ 0 & \text{otherwise} \end{cases}$$

  - $\Phi = (1 - \sigma R) \frac{\bar{\phi}}{\Delta} (N - N^*)$
  - Mirrors the slow recapitalization of the banking sector

Optimal costless QE, cont.

- Alternative implementation ▸ Simple rule

$$\Gamma_t = \nu_R \left(R_{k,t} - R_t \right)$$

as $\nu_R \uparrow \infty$

Robustness

- Gradual exit is optimal under
  - Positive QE costs (gradual entry)
  - Optimal interest rate setting
  - Lower equity issuance costs
  - Higher steady-state equity buffers

Non-financial downturn

- Downturn caused by savings' preference shock (β_t)
  - Shock large enough to bring interest rate to its lower bound
  - QE is ineffective: interest rate easing appreciates asset prices, financial constraints remain slack
  - For a severe enough shock: QE becomes effective

Conclusion

- We study a model with banks facing occasionally binding balance sheet constraints
- QE can be very effective in response to financial shocks
- Optimal QE is very persistent (addictive)
- Use QE in response to
  - Large financial shocks
  - Very large non-financial shocks

Parameters

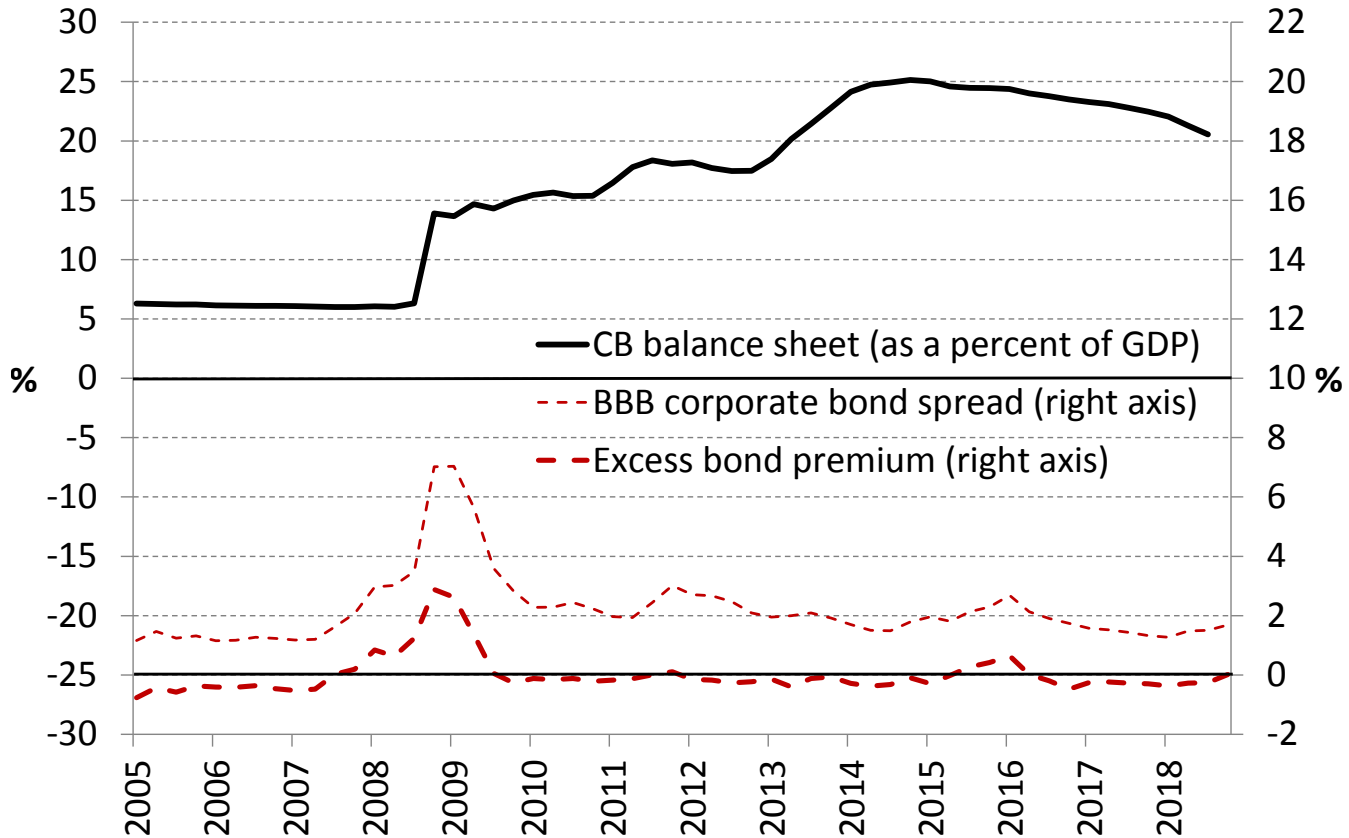
Table: Parameter values

	Households	
β	0.995	Discount rate
h	0.62	Habit parameter
χ	35	Relative utility weight of labor
B/Y	0.700	Steady state Treasury supply
ϱ	0.97	Geometric decay of government bond
$\bar{B}^h/B$	0.75	Proportion of long term Treasury holdings of the HHs
κ	0.009	Portfolio adjustment cost
φ	2	Inverse Frisch elasticity of labor supply
	Financial Intermediaries	
θ	0.166	Fraction of capital that can be diverted
Δ	0.83	Proportional advantage in absconding rate of government debt
ω	0.067	Transfer to the entering bankers
σ	0.972	Survival rate of the bankers
ζ	28	Parameter of cost of equity issuance
	Intermediate good firms	
α	0.36	Capital share
δ	0.025	Depreciation rate

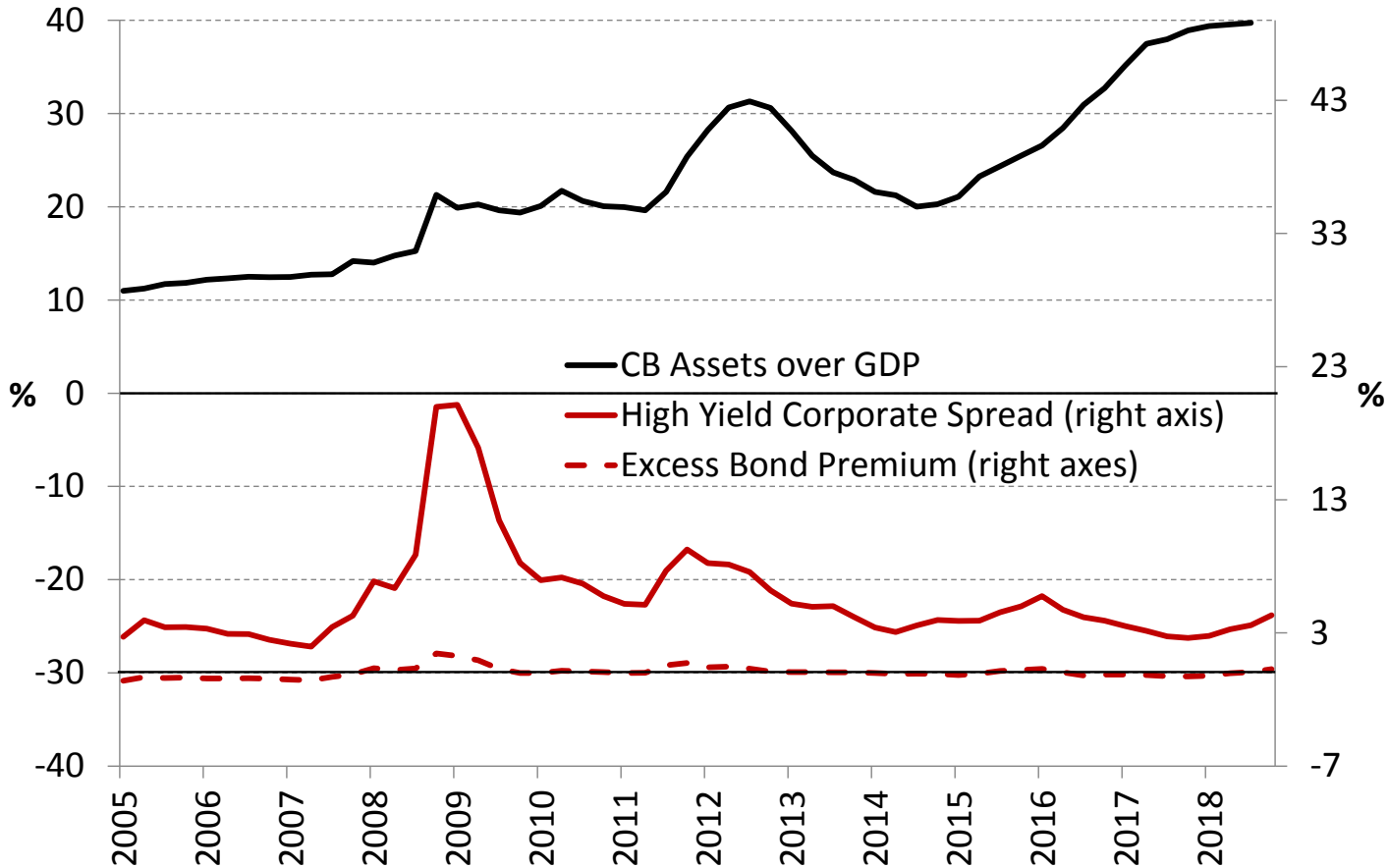
Parameters, cont.

Capital Producing Firms		
η_i	5.17	Inverse elasticity of investment to the price of capital
Retail Firms		
ϵ	3.86	Elasticity of substitution
γ_P	0.92	Probability of keeping the price constant
$\gamma_{P,-1}$	0.23	Price indexation parameter
Government		
$\frac{G}{Y}$	0.200	Steady state proportion of government expenditures
τ	0.01 basis point	Cost of QE

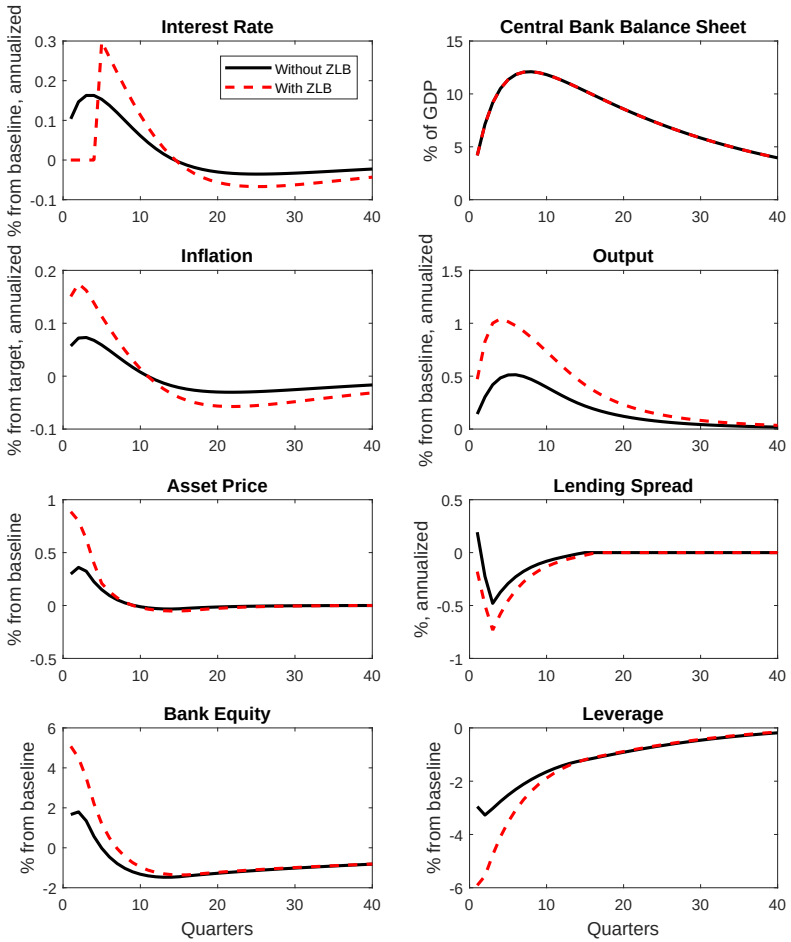
Fed Balance Sheet and Corporate Spreads



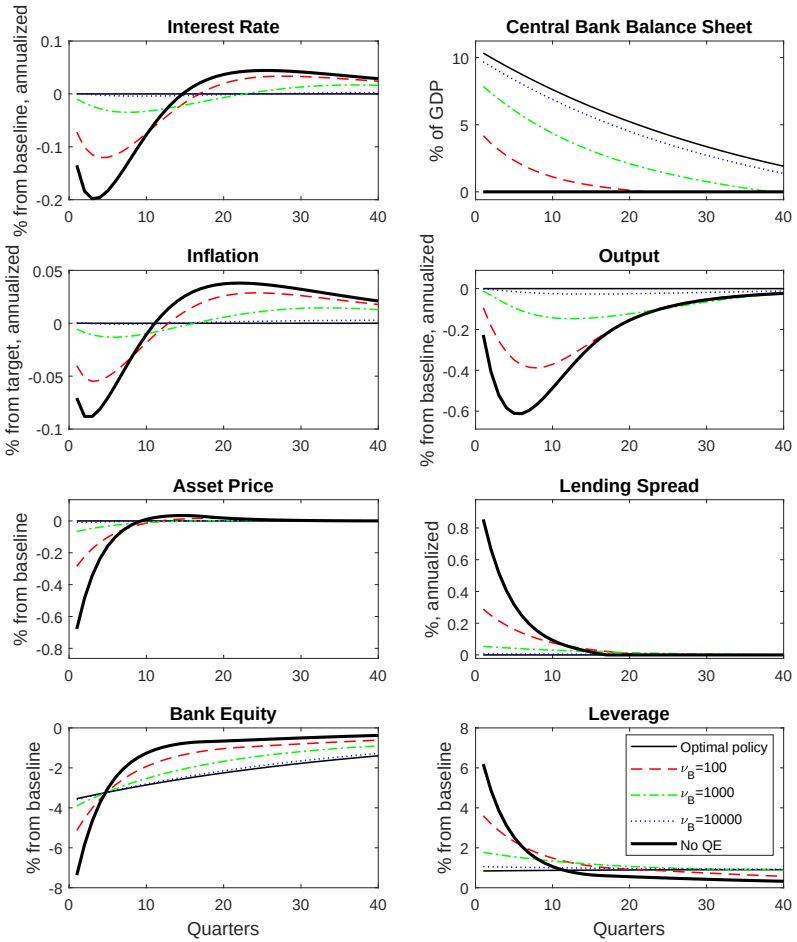
ECB Balance Sheet and Corporate Spreads



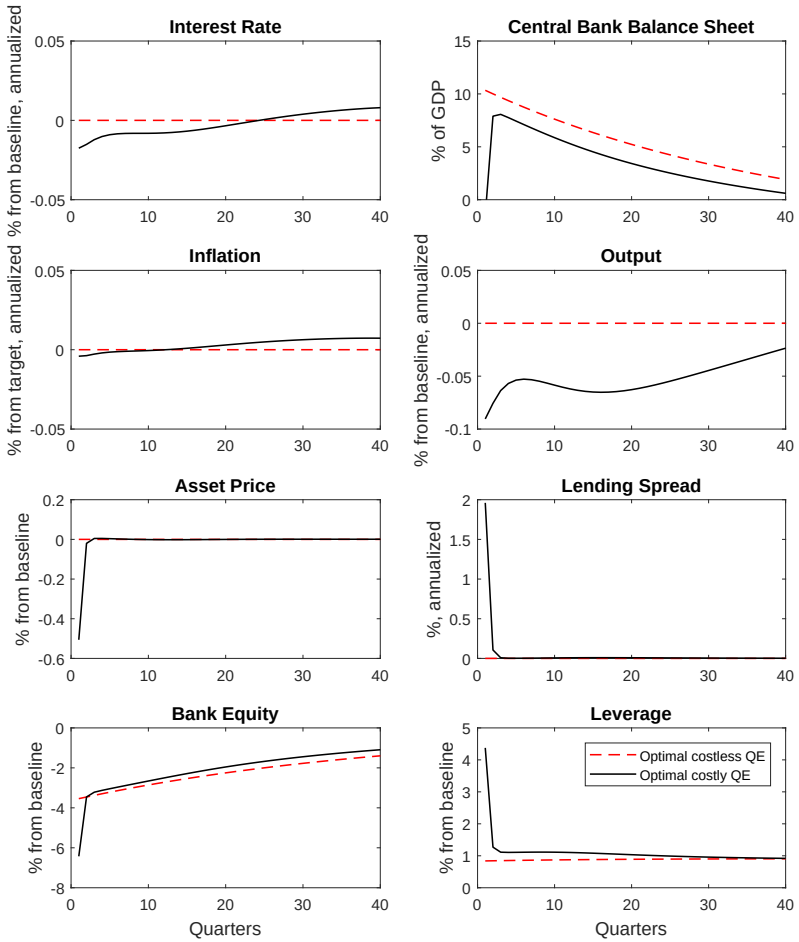
Responses to QE with and without the ZLB



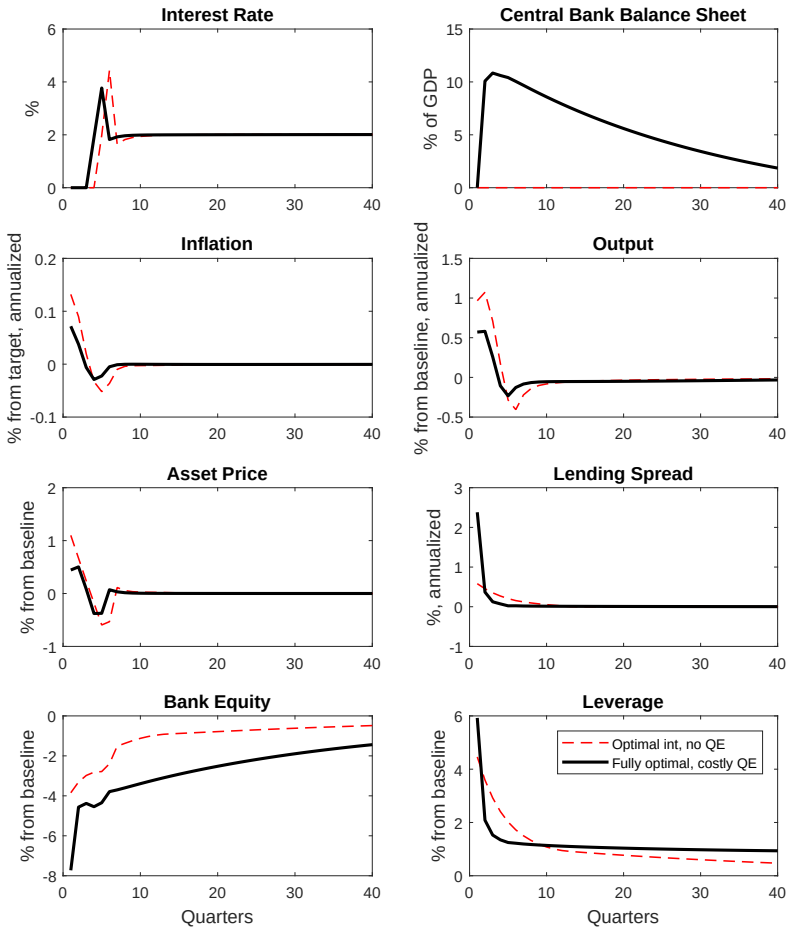
Responses to a financial shock under different QE rules



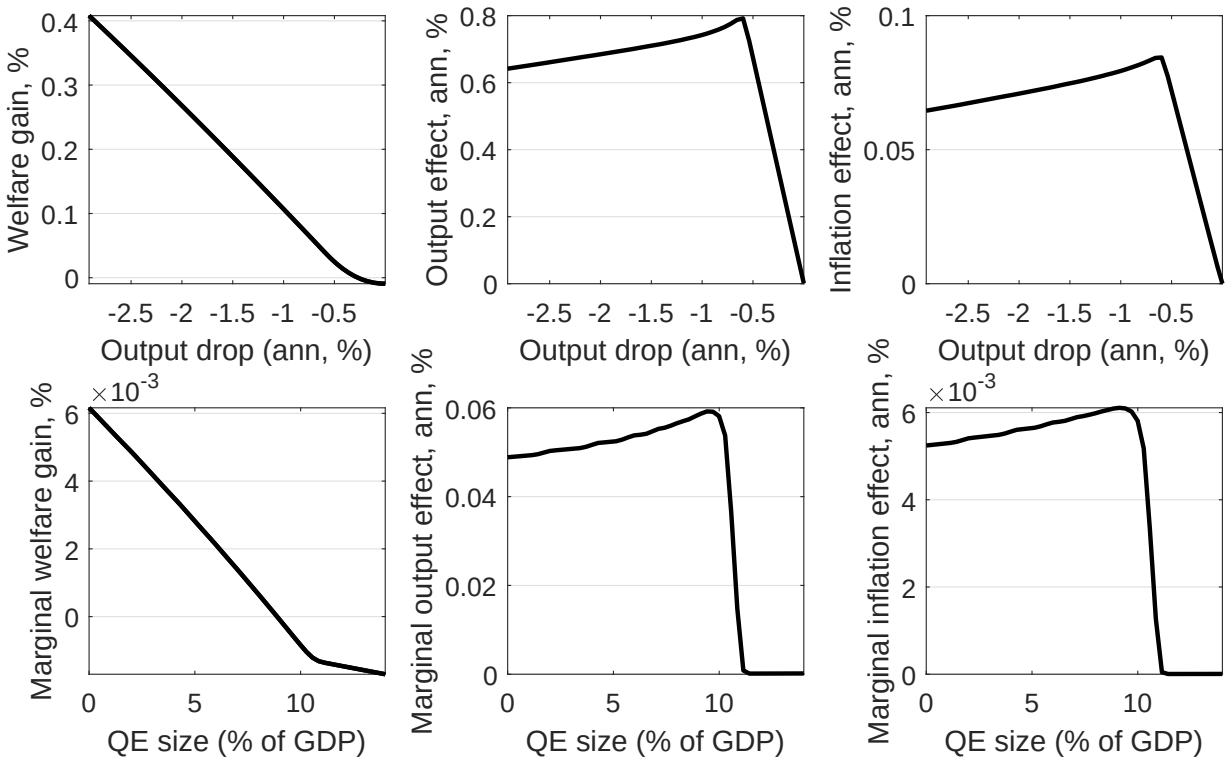
Costless versus costly QE



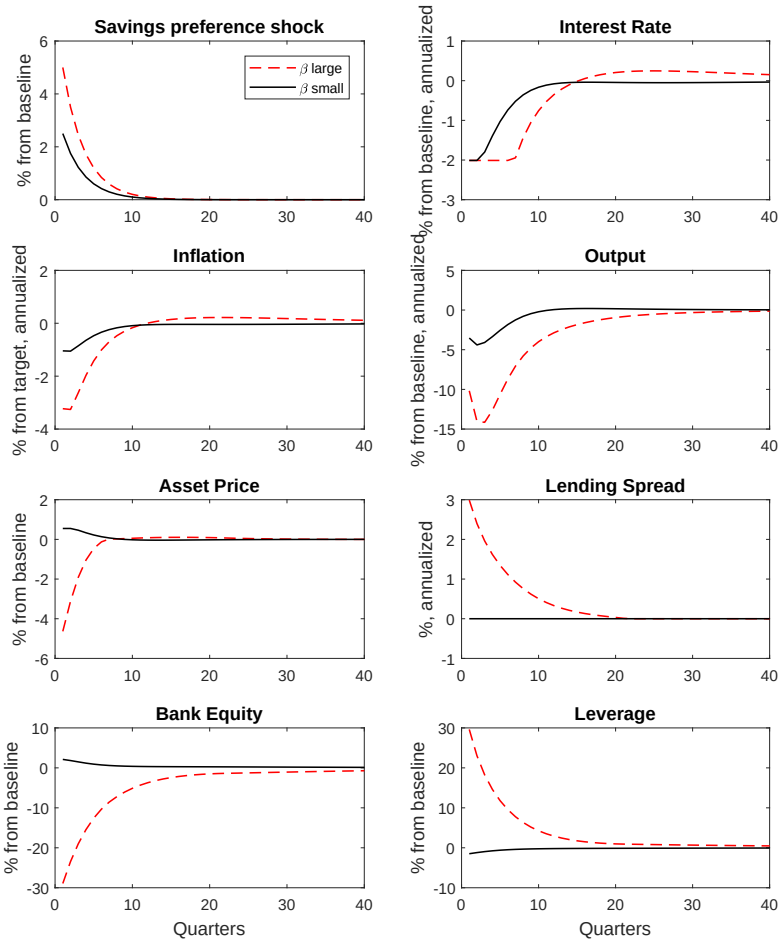
Optimal joint interest rate and QE response



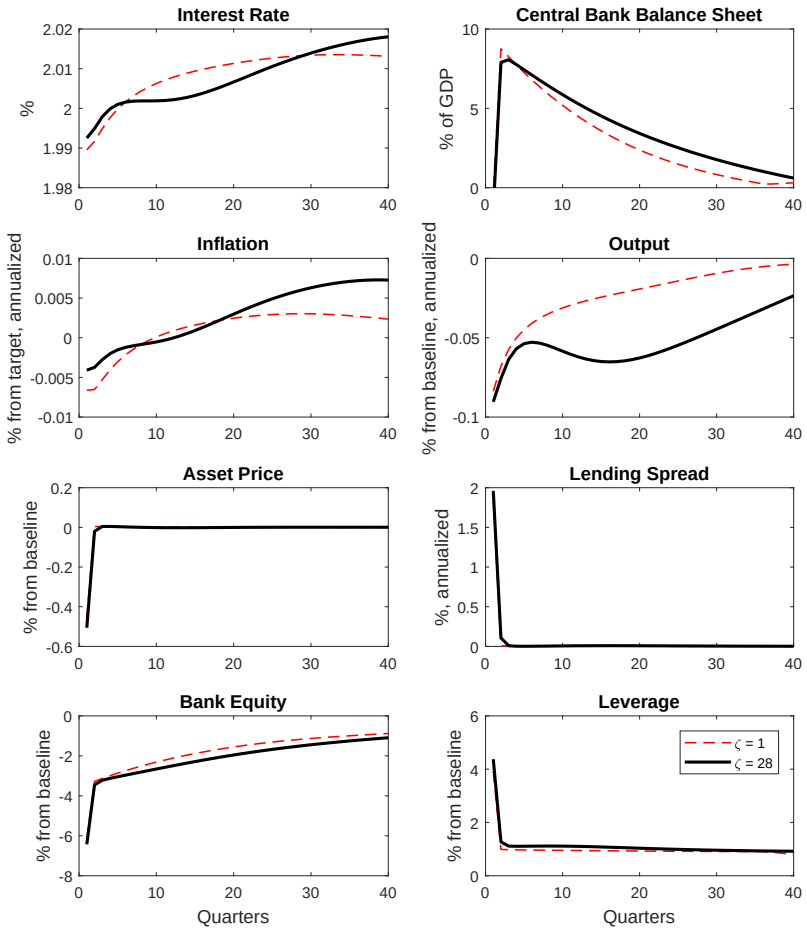
Welfare effects of QE



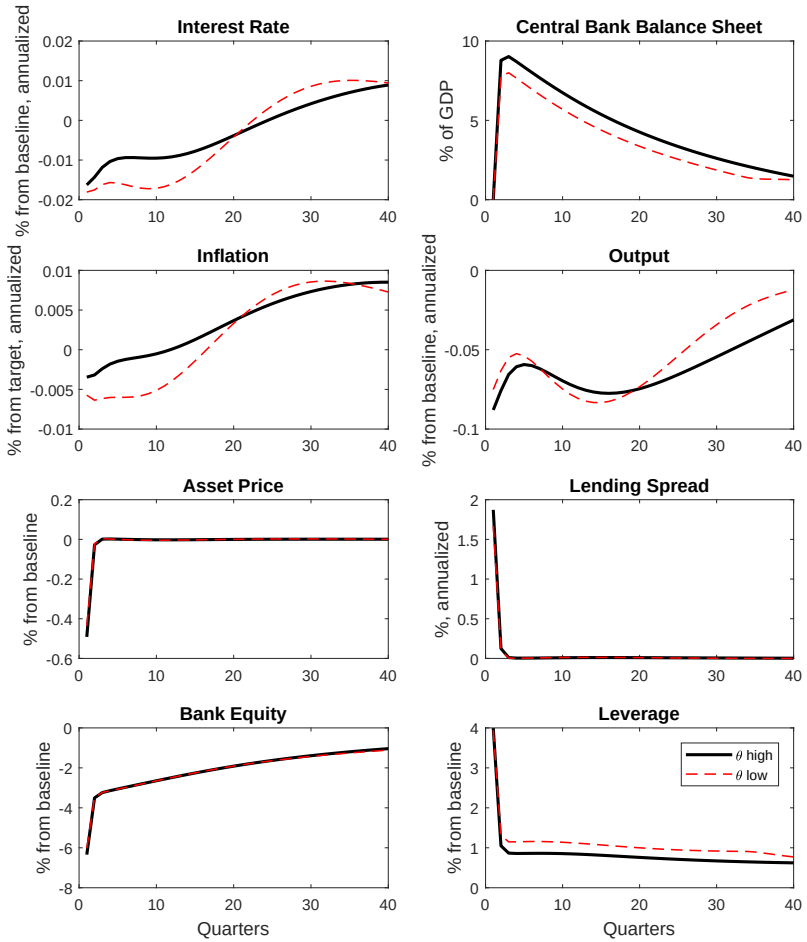
Responses to a savings' preference shock



Robustness to equity issuance costs



Robustness to steady state equity buffer



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