International Spillovers of Quantitative Easing

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Outline

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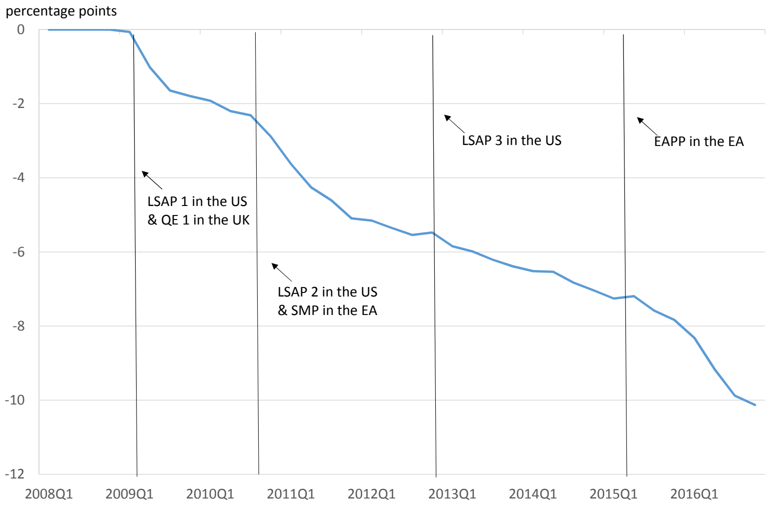
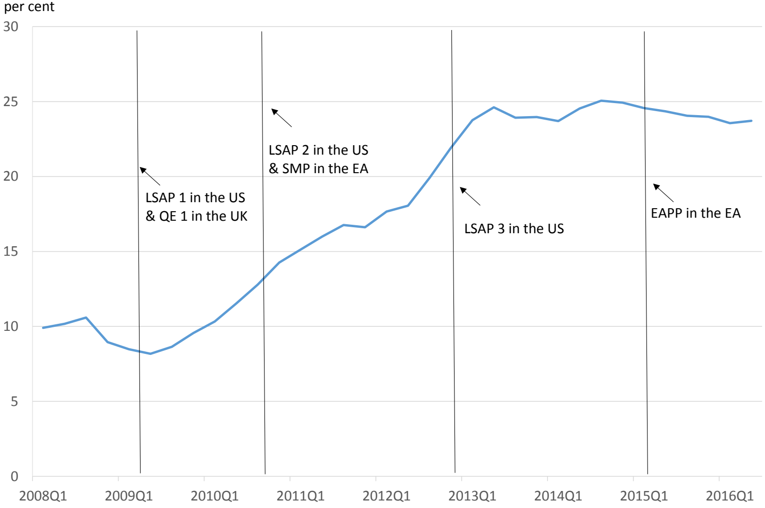
QE in Big3 (EA-UK-US): impact on share of long-term bonds in public sector liabilities



Effects of QE

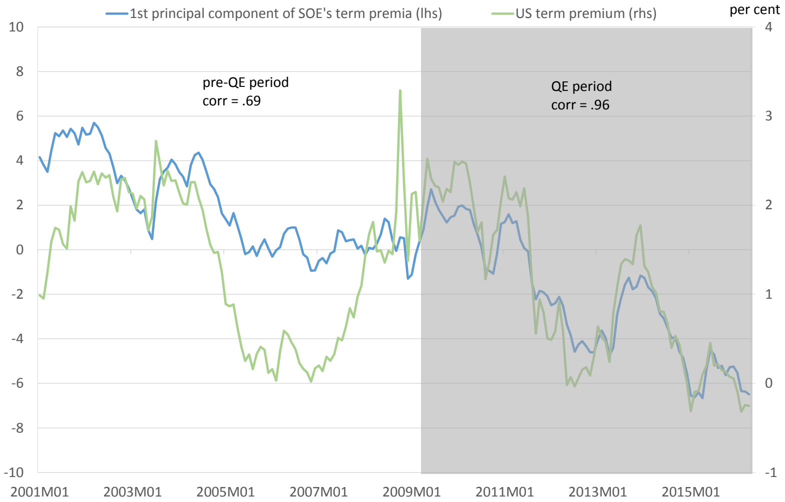
- B. Bernanke in 2013 (cited by Bhattarai et al., 2015):
  Among the advanced economies, the mutual benefits of monetary easing are clear. The case of **emerging market economies** *is more complicated [...] they* **may perceive themselves to be vulnerable to** *[...]* **heavy and volatile capital inflows**, *including those arising from low interest rates in the advanced economies.*
- S. Fisher in 2014 (cited by Bhattarai et al., 2015):
  There is little doubt that the aggressive actions the Federal Reserve took [...] signicantly affected asset prices at home and abroad as well as international capital flows [...] An easing of monetary policy in the United States benefits foreign economies from both stronger U.S. activity and improved global financial conditions. It also has an **offsetting contractionary effect on foreign economies** *because their currencies appreciate against the dollar.*
- M. Draghi in 2014 (cited by Falagiarda et al., 2015):
  QE has several effects. [...] If you buy euro-denominated assets, people who will get cash, will buy perhaps non-euro-denominated assets, and you have a **portfolio rebalancing effect** *through that channel.*

Share of non-residents in gov. bonds issued by EMs



NBP, WSE; ECB

Term premium on 10-year government bonds



NBP, WSE; ECB

Empirical literature

- QE benefited economies that implemented them
  - Gagnon et al. (2011), Joyce et al. (2011), D'Amico et al. (2012), Baumesiter and Benati (2013), Kiley (2014)
- QE resulted in procyclical capital inflows to other (emerging market) countries
  - Fratzscher et al. (2013), Ahmed and Zlate (2014), Neely (2015), Falagiarda et al. (2015), Lim and Mohapatra (2016), Tillmann (2016)
- Effect on economic activity in other countries not clear
  - Bhattarai et al. (2015)

This paper

- Propose a model of international spillovers of QE
  - 2-country extension of segmented asset markets framework by Adres et al. (2004), Chen et al. (2012)
  - Agents in both countries trade long-term bonds issued by both governments (in contrast to Alpanda and Kabaca, 2015)
  - Explicit modelling of gross positions in assets (Passari and Rey, 2015)
- Use the model to study the effects of QE in large economies on small economies not engaged in QE

Main findings

- Model replicates salient features of data during QE
  - Inflow of foreign capital to small economy's sovereign bond markets
  - Strong international comovement in term premia
- Implications for economic activity in a small economy
  - Increase in domestic demand
  - Fall in net exports
  - (At least temporary) Fall in GDP
- QE spillovers different from conventional monetary policy spillovers
  - In line with empirical evidence in Mackowiak (2007) and Bhattarai et al. (2015)

Outline

Model overview

- 2 countries: small (home, size ω) and large (foreign, engaged in QE, size $1-\omega$)
- Two types of households in each country:
  - Restricted (mass ω_r): trade only in long-term bonds
  - Unrestricted (mass $\omega_u = 1 - \omega_r$): trade also in short-term bonds, subject to portfolio adjustment costs
- Sticky prices, local currency pricing
- Conventional monetary policy: Taylor-like rule
- Exogenous public spending and composition of public debt

Restricted households

- Maximize

$$U_t^r = E_t \sum_{s=0}^{\infty} \beta_r^s \exp\{\varepsilon_{t+s}^d\} \left[\frac{(c_{t+s}^r)^{1-\sigma}}{1-\sigma} - \frac{(n_{t+s}^r)^{1+\varphi}}{1+\varphi} \right]$$

- subject to budget constraint

$$P_t c_t^r + P_{L,t} B_{H,L,t}^r + T_t^r = P_{L,t} R_{L,t} B_{H,L,t-1}^r + W_t n_t^r + D_t^r$$

where

  - $B_{H,L,t}$ are perpetuities that pay exponentially decaying coupon κ^s every period $s+1$ ($s \geq 0$, $\kappa \in (0;1]$) after issuance
  - $R_{L,t} \equiv P_{L,t}^{-1} + \kappa$ is yield to maturity

- Foreign households: symmetric problem, but have access to both home and foreign bonds

Unrestricted households

- Maximize

$$U_t^u = E_t \sum_{s=0}^{\infty} \beta_u^s \exp\{\varepsilon_{t+s}^d\} \left[\frac{(c_{t+s}^u)^{1-\sigma}}{1-\sigma} - \frac{(n_{t+s}^u)^{1+\varphi}}{1+\varphi} \right]$$

- subject to budget constraint

$$P_t c_t^u + B_{H,t}^u + (1+\zeta_{H,t}) P_{L,t} B_{H,L,t}^u + (1+\zeta_{F,t}) S_t P_{L,t}^* B_{F,L,t}^u + T_t^u = R_{t-1} B_{t-1}^u + P_{L,t} R_{L,t} B_{H,L,t-1}^u + S_t P_{L,t} \Gamma_{t-1} R_{L,t}^* B_{F,L,t-1}^u + W_t n_t^u + D_t^u$$

- Transaction costs, for $h = \{H, F\}$

$$\frac{1+\zeta_{h,t}}{1+\zeta_h} = \left(\frac{P_{L,t} b_{h,L,t}^u}{P_L b_{h,L}^u} \right)^{\xi_h}$$

Firms

- Final goods

$$\tilde{y}_t = \left(\eta^{\frac{1}{\nu}} y_{H,t}^{\frac{\nu-1}{\nu}} + (1-\eta)^{\frac{1}{\nu}} y_{F,t}^{\frac{\nu-1}{\nu}} \right)^{\frac{\nu}{\nu-1}}$$

- Monopolistic competition at intermediate production stage, for $h = \{H, F\}$

$$y_{h,t} = \left(\int_0^1 y_{h,t}(i)^{\frac{1}{\mu_h}} di \right)^{\mu_h}$$

- Intermediate goods producers operate production function

$$y_{H,t}(i) + y^*_{H,t}(i) = \exp\{\varepsilon^z_t\} n_t(i) - \phi$$

- and are subject to Calvo price stickiness with local currency pricing

Government

- Interest rate rule

$$\frac{R_t}{R} = \left(\frac{R_{t-1}}{R}\right)^{\gamma_r} \left[\left(\frac{\pi_t}{\pi}\right)^{\gamma_\pi} \left(\frac{y_t}{y}\right)^{\gamma_y}\right]^{1-\gamma_r} \exp\{\varepsilon_t^r\}$$

- Government budget constraint

$$B_{H,t}^g + P_{L,t} B_{H,L,t}^g + T_t = R_{t-1} B_{H,t-1}^g + P_{L,t} R_{L,t} B_{H,L,t-1}^g + P_t g_t$$

- Constant real market value of total government debt

$$\frac{B_{H,t}^g + P_{L,t} B_{H,L,t}^g}{P_t} = b^g$$

- Composition of debt exogenous or follows a rule rule

$$\frac{P_{L,t} b_{H,L,t}^g}{P_L b_{H,L}^g} = \left(\frac{P_{L,t-1} b_{H,L,t-1}^g}{P_L b_{H,L}^g}\right)^{\gamma_L} \exp\{\varepsilon_t^L\}$$

Market clearing and net foreign assets

- Standard market clearing for goods and factor markets
- Bond market clearing

$$(1-\omega_r)B^u_{H,t} = B^g_{H,t}$$

$$\omega_r B^r_{H,L,t} + (1-\omega_r)B^u_{H,L,t} + \frac{1-\omega}{\omega}\omega^*_r B^{r*}_{H,L,t} + \frac{1-\omega}{\omega}(1-\omega^*_r)B^{u*}_{H,L,t} = B^g_{H,L,t}$$

- Net foreign assets position

$$A_t = R^*_{L,t}\frac{S_t}{S_{t-1}}\frac{P^*_{L,t}}{P^*_{L,t-1}}A^+_{t-1} - R_{L,t}\frac{P_{L,t}}{P_{L,t-1}}A^-_{t-1} + NX_t$$

where

$$A^+_t = (1-\omega_r)S_t P^*_{L,t} B^u_{F,L,t}$$

$$A^-_t = \frac{1-\omega}{\omega}P_{L,t}\left((1-\omega^*_r)B^{u*}_{H,L,t} + \omega^*_r B^{r*}_{H,L,t}\right)$$

$$NX_t = \frac{1-\omega}{\omega}S_t P^*_{H,t} y^*_{H,t} - P_{F,t} y_{F,t}$$

Term premium

- Term premium defined as in Chen et al. (2012)

$$TP_t = R_{L,t} - R_{L,t}^{EH}$$

where $R_{L,t}^{EH}$ is counterfactual yield to maturity on a long-term bond in the absence of transaction costs

- To first-order

$$\hat{TP}_t = D_L^{-1} \sum_{s=0}^{\infty} \left(\frac{D_L - 1}{D_L} \right)^s E_t \xi_{H,t+s}$$

where $D_L = \frac{R_L}{R_L - \kappa}$ is steady state bond duration

Calibrated parameters

Parameter	Value
Size of domestic economy; ω	0.014
Share of restricted households; ω_r, ω_r^*	0.1
Inv. elasticity of intertemporal substitution; σ, σ^*	2
Inv. Frisch elasticity of labor supply; φ, φ^*	2
Discount factor, unrestricted households; β^u, β^{u*}	0.992
Discount factor, restricted households; β^r, β^{r*}	0.995
Coupon; κ, κ^*	0.929, 0.979
Transaction cost on long-term bonds (unrestricted households); ξ_H, ξ_F	0.015
Calvo probability; θ_H, θ_H^*, θ_F, θ_F^*	0.75
Elasticity of substitution btw. home and imported goods; ν, ν^*	3
Home-bias; η	0.75
Interest rate smoothing; γ_r, γ_r^*	0.9
Interest rate response to inflation; γ_π, γ_π^*	2
Interest rate response to output gap; γ_y, γ_y^*	0.125

Targeted steady-state ratios

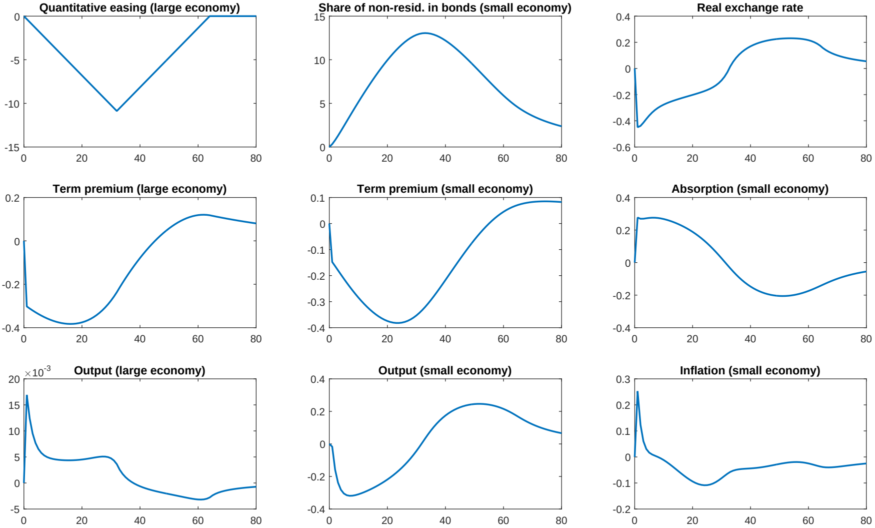
Steady state ratio	Value
Share of government spending in GDP	0.2
Share of government bonds in GDP (home, foreign)	1.25; 2.65
Share of long-term bonds in total bonds (home, foreign)	0.71; 0.65
Share of residents in total domestic long-term bonds (home)	0.76
Share of foreign bonds in domestic portfolio (home)	0.05

Outline

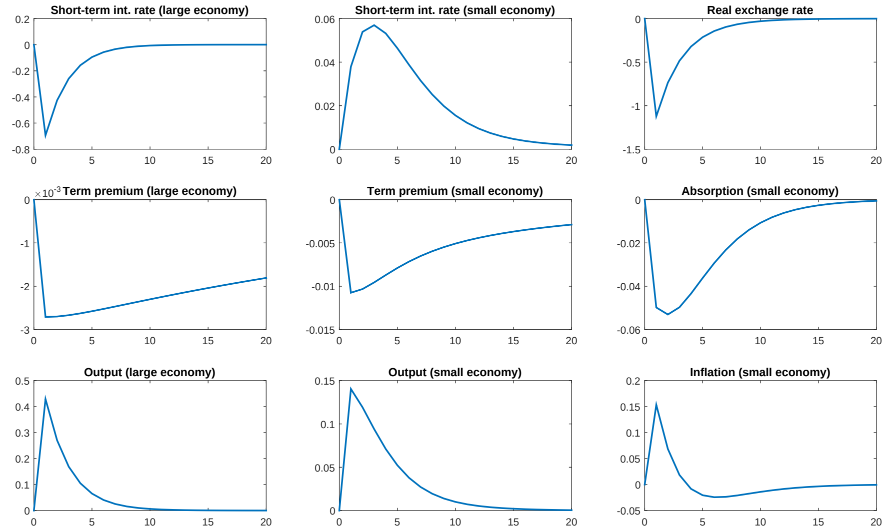
QE spillovers: Key transmission channels

- Large economy
  - Fall in supply of long-term bonds, increase in bond prices (fall of long-term interest rates), increase in economic activity
  - Portfolio rebalancing -> increase in demand for small economy's long-term bonds
- Spillovers to small economy
  - Fall in long-term interest rates
  - Increase in foreign demand
  - Exchange rate appreciation
- Effects on small economy
  - Increase in absorption
  - Fall in net exports
  - Negative effect on GDP (at least short-run)

QE scenario


Quantitative easing (large economy)
Share of non-resid. in bonds (small economy)
Real exchange rate
Term premium (large economy)
Term premium (small economy)
Absorption (small economy)
Output (large economy)
×10^-3
Output (small economy)
Inflation (small economy)

Foreign monetary policy shock



Conventional and unconventional monetary policy spillovers - summary

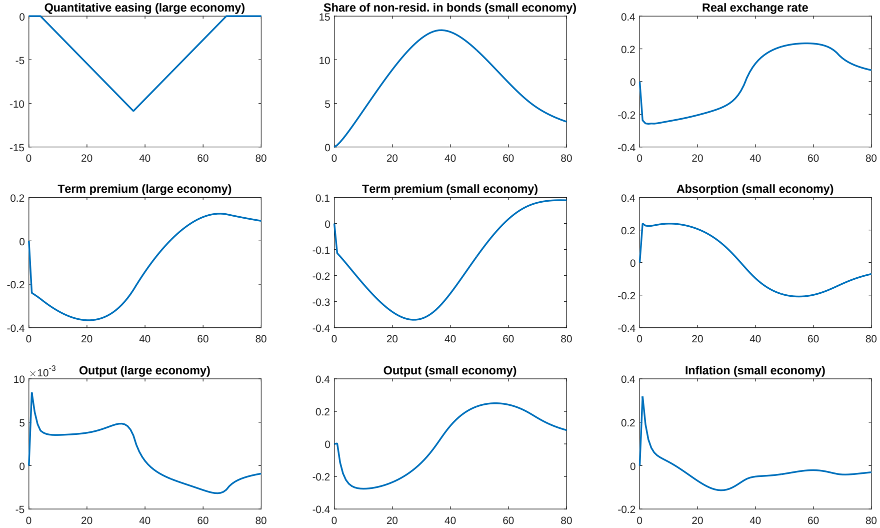
Reaction in small economy	Conventional	Unconventional
Long-term rates	$\leftrightarrow$	$\downarrow$
Foreign purchases of bonds	$\leftrightarrow$	$\uparrow$
Exchange rate (fall means appreciation)	$\downarrow$	$\downarrow\downarrow$
Absorption	$\leftrightarrow$	$\uparrow$
Net exports	$\uparrow$	$\downarrow$
Output	$\uparrow$	$\downarrow$

Correlation of term premia - other shocks?

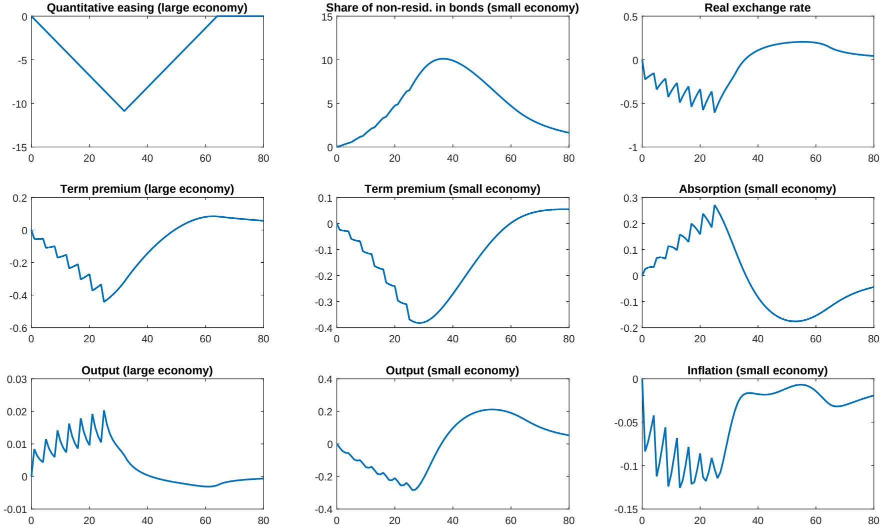
Shock	Correlation
QE in large economy ε_t^{L*}	0.94
Productivity; ε_t^{z}, ε_t^{z*}	-0.20
Time preference; ε_t^{d}, ε_t^{d*}	0.22
Government spending; ε_t^{g}, ε_t^{g*}	0.24
Monetary policy; ε_t^{r}, ε_t^{r*}	0.60
Country risk premium; ε_t^{Γ}	0.73

QE helps explain tighter international comovement of term premia

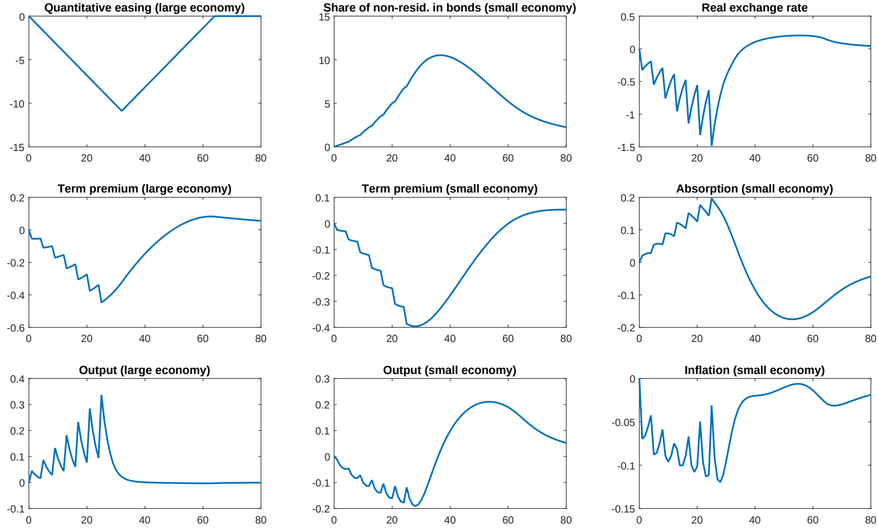
QE announced 1 year in advance



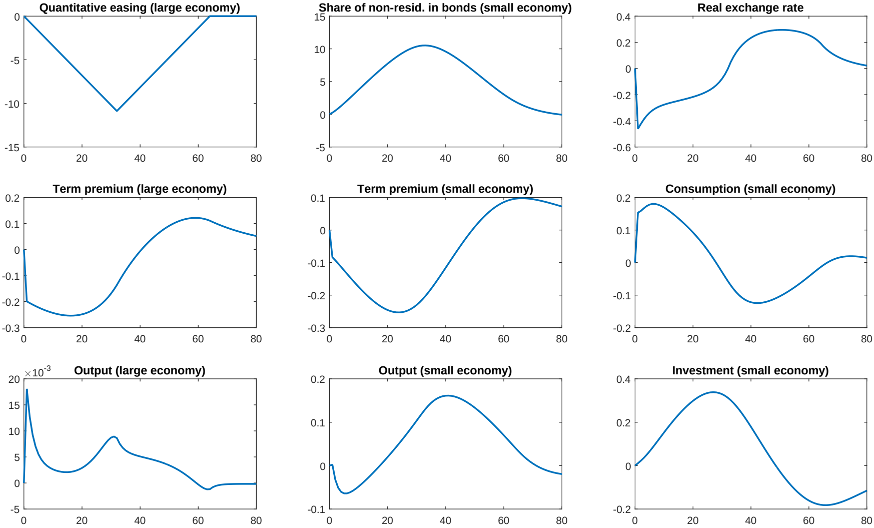
QE with surprises (extension every year by 1 year)



QE with surprises and ZLB (lift-off expected in 1 year)



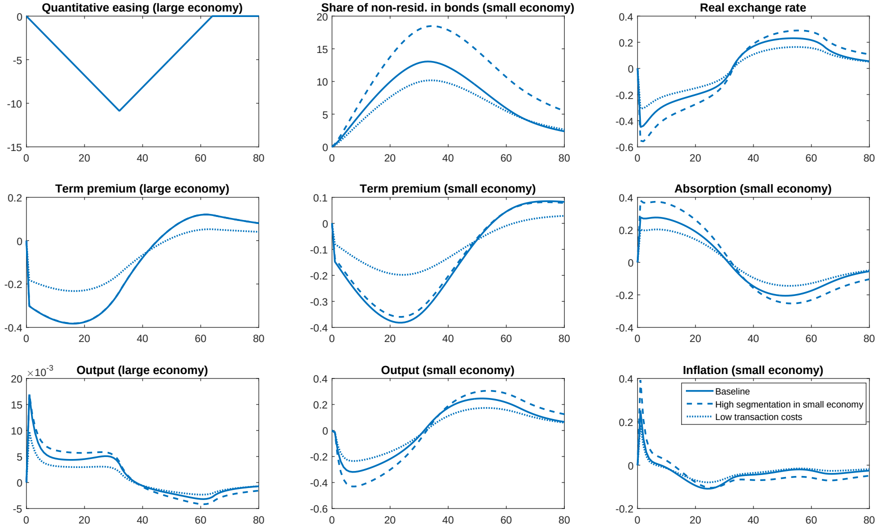
QE scenario - model with productive capital



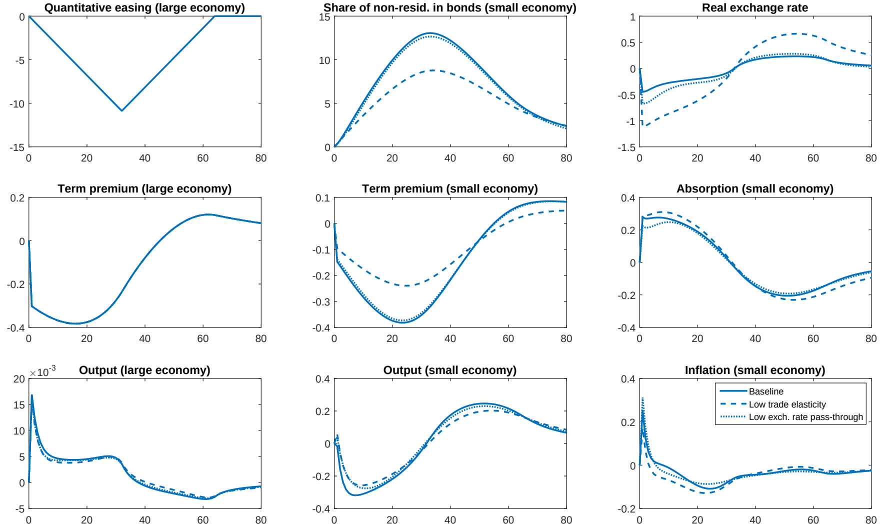
Robustness

- Higher market segmentation in small economy
    - stronger capital inflow
    - stronger exchange rate appreciation
    - deeper fall in output
- Lower trade elasticity
    - smaller capital inflow
    - stronger exchange rate appreciation
    - similar fall in output
- Lower exchange rate pass-through: small differences

QE scenario - role of financial frictions



QE scenario - role of trade block parametrization



Outline

Conclusions

- QE pursued by major central banks increases domestic demand abroad ...
- ... but may generate (at least temporary) fall in output abroad
- Spillovers from conventional and unconventional monetary policy are qualitatively different