Non-standard monetary policy, asset prices and macroprudential policy in a monetary union

L. Burlon A. Gerali A. Notarpietro M. Pisani

Banca d'Italia

1st Annual Workshop
ESCB Research Cluster 1 on Monetary Economics
Banco de España
Madrid, 9-10 October 2017

Goal

- Assess the macroeconomic and financial effects of the interaction between union-wide non-standard monetary policy measures and regional macroprudential policy in a monetary union framework

- Laboratory: Eurosystem's Asset Purchase Programme (APP) and its interaction with region-specific macroprudential policy

Motivation

- Concern: in the euro area, the combination of
  - announced intention to keep short-term interest rates at low levels for a prolonged period of time (forward guidance, FG)
  - reduction in long-term yields generated by APP

  may induce region-specific excessive increases in asset prices and private-sector borrowing
- Risks for region-specific financial stability

Motivation

"Should any threat to financial stability materialise, specific macro-prudential measures should be implemented by national authorities to deal with local risks, without the need to alter the expansionary stance of monetary policy."

Ignazio Visco, London, 6 May 2015.

"We are closely monitoring risks to financial stability, but we do not see them materialising for the moment. Should this be the case, macroprudential policy – not monetary policy – would be the tool of choice to address these risks."

Mario Draghi, Brussels, 23 September 2015.

Contribution

Build an open-economy two-region model of the euro area with:

- Financial market segmentation (real effects of APP)
- Region-specific real estate and collateral constraints
- Overly optimistic expectations about real estate prices (role for macroprudential intervention)
- Local macroprudential authority can change loan-to-value (LTV) ratio to stabilize (excessive) debt and favor financial stability

Preview of results

- Implementation of union-wide APP has positive effects on household borrowing, the more so the larger the regional LTV ratio (amplification effect)
- During APP implementation, overly optimistic (non-fundamental) expectations about local real estate prices can further foster regional household borrowing
- Region-specific macroprudential measures can stabilize private sector borrowing, counteracting effects of over-optimistm and favoring macroeconomic expansion driven by fundamentals
- No need to scale back APP if local macroprudential policy acts

Related literature

- Financial market segmentation and non-standard monetary policy: Chen et al. (2012), Andrs et al. (2004), Burlon et al. (2015, 2017)
- Local real estate "bubble": Dupor (2005), Aizenmann and Jinjarak (2014), In't Veld et al. (2014)
- Macroeconomic and financial effects of monetary and macroprudential policies: Angelini et al. (2014) , Beau et al. (2012), Collard et al. (2012), Quint and Rabanal (2014), Rubio and Carrasco-Gallego (2014), Brzoza-Brzezina et al. (2015), Gelain and Ilbas (2017)
- Our paper: first attempt to assess interaction between union-wide non-standard monetary policy and local macroprudential policy in a monetary union framework

Road map

- Model setup: most relevant features, calibration
- Simulated scenarios and results
- Conclusions

Model setup: general structure

- Large-scale New Keynesian open-economy DSGE model of the world economy
- Three-region model: Home, Rest of Euro Area (REA), and Rest of the World (RW)
- Full characterization of international trade flows and relative prices across regions
- Monetary policy: standard and non-standard measures (forward guidance, quantitative easing)

Crucial model features

We introduce three crucial features in the euro area:

- Financial markets segmentation, following Chen et al. (2012): imperfect substitutability among financial assets
- Region-specific real estate markets and collateral constraints (Iacoviello 2005) $\Longrightarrow$ allow for region-specific amplification effects of APP
- Hence: in each EA region, 3 types of households: unrestricted, restricted and borrowers
- Irrational, overly optimistic expectations about real estate prices (Dupor 2005) $\Longrightarrow$ excessive increase in households' borrowing, role for macroprudential policy
- Macroprudential authority: uses LTV ratio as instrument

Model setup: Unrestricted households

- Have access to the domestic short-term private bond and long-term sovereign bond markets and trade a riskless private bond with RW households
- Invest in domestic physical capital
- Lend to domestic borrowers

Model setup: Restricted households

- Hold long-term sovereign bonds
- Invest in domestic physical capital details
- Rationale: APP lowers long-term yields and stimulates restricted households' consumption and investment (as in Chen et al. 2012)
- Long-term sovereign bonds are perpetuities with price $P_{L,t}$, paying exponentially decaying coupon $\kappa \in (0, 1]$, as in Woodford (2001)

Model setup: Borrowers

- Borrow from unrestricted households subject to a collateral constraint:

$$-B_{D,t}^{S} R_{t}^{S} \leq m_{t} E_{t} \left(Q_{t+1}^{h} h_{D,t} \right)$$

where $0 \leq m_t \leq 1$ is the LTV ratio

- Housing demand from FOC:

$$\lambda_{D,t} Q_{t}^{H} = \chi \frac{1}{h_{D,t}} + \beta_{D} E_{t} \left(\lambda_{D,t+1} Q_{t+1}^{H} \right) + \gamma_{D,t} m_{t} E_{t} \left(Q_{t+1}^{H} \right)$$

Non-fundamental shock to expectations on real estate price

- Following Dupor (2005), assume people in the Home region have overly optimistic expectations on future house prices
- Borrowing constraint becomes:

$$-B_{D,t}^{S} R_t^{S} \leq m_t E_t \left(Q_{t+1}^{h} \theta_{t+1} h_{D,t} \right)$$

- Housing demand:

$$\begin{aligned} \lambda_{D,t} Q_t^{H} &= \chi \frac{1}{h_{D,t}} + \beta_D E_t \left(\lambda_{D,t+1} \theta_{t+1} Q_{t+1}^{H} \right) + \\ & \quad \gamma_{D,t} m_t E_t \left(\theta_{t+1} Q_{t+1}^{H} \right) \end{aligned}$$

Home macroprudential rule

- Allow for a Home-specific macroprudential rule

$$m_t = (1-\rho_m)\bar{m} + \rho_m m_{t-1} + \rho_{B_D}\left(\frac{B^S_{D,t}}{GDP_t} - \frac{B^S_{D,t-1}}{GDP_{t-1}}\right)$$

where $0 \leq \rho_m \leq 1$ and $\rho_{B_D} > 0$

- Rule is in line with existing literature (e.g., Angelini et al., 2014, Brzoza-Brzezina et al., 2015)

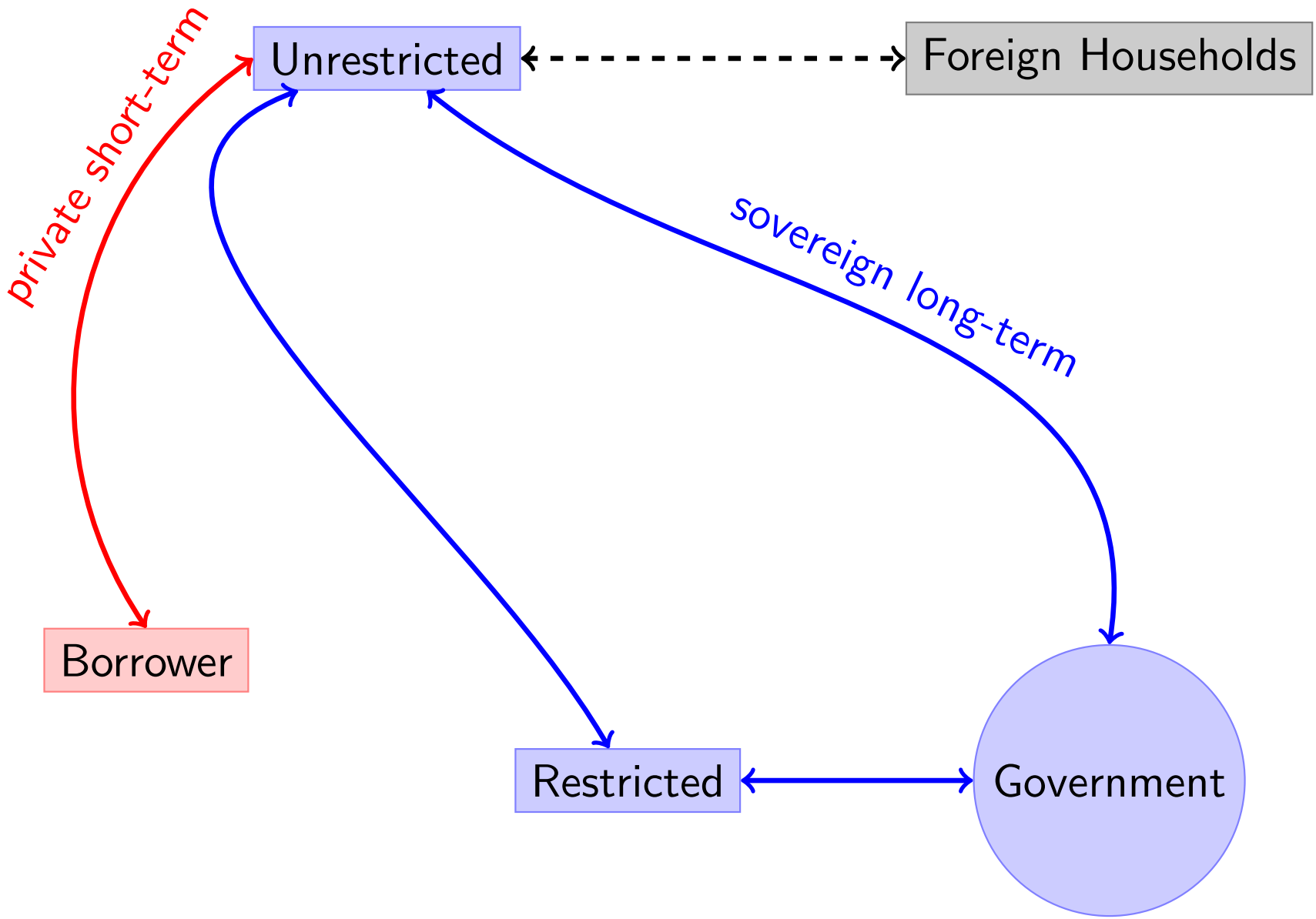
Model setup: monetary policy

- EA monetary authority can resort to:
- Standard (Taylor-rule based) monetary policy

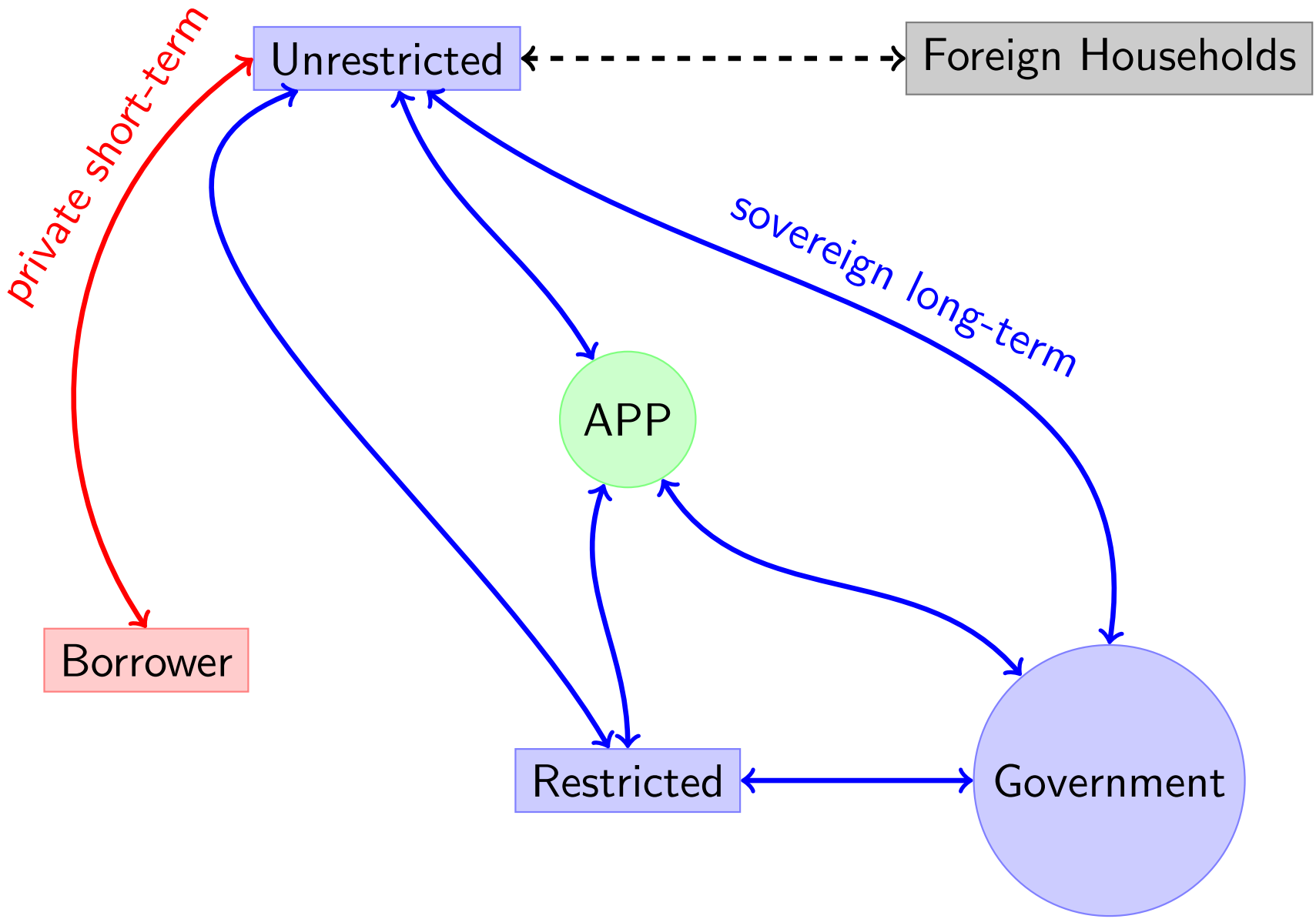
$$\left(\frac{R_t}{\bar{R}}\right)^4 = \left(\frac{R_{t-1}}{\bar{R}}\right)^{4\rho_R} \left(\frac{\Pi_{EA,t,t-3}}{\bar{\Pi}^4}\right)^{(1-\rho_R)\rho_\pi} \left(\frac{GDP_{EA,t}}{GDP_{EA,t-1}}\right)^{(1-\rho_R)\rho_{GDP}}$$

- and non-standard monetary policy measures, including
  - forward guidance (FG) on short-term interest rate
  - purchasing of EA long-term sovereign bonds

Wrapping up: market clearing



Wrapping up: APP



Calibration

- Calibration of standard parameters follows literature and existing evidence, match "great ratios"
- Specifically: Home GDP is 20% of EA GDP
- Less standard parameters set in line with literature and with Eurosystem evidence on long-term interest rate response to APP (Altavilla et al., 2015)
- Home LTV ratio is 90%, REA LTV is 50%
- In each EA region share of restricted households is 0.1, indebted households: 0.4 details

Simulations

- Scenario 1: APP (purchases of EA sovereign bonds, euro 180 billion per quarter, for 7 quarters, bonds are held to maturity (8 years); 2-year FG; Home and REA LTV ratios set at their steady-state values (90% and 50%, respectively)
- Scenario 2: Scenario 1 + Home-specific non-fundamental expectational shock
- Scenario 3: Scenario 2, but Home LTV ratio is modified by the Home macroprudential authority to stabilize households' borrowing
- All scenarios are simulated under perfect foresight

Scenario 1: APP

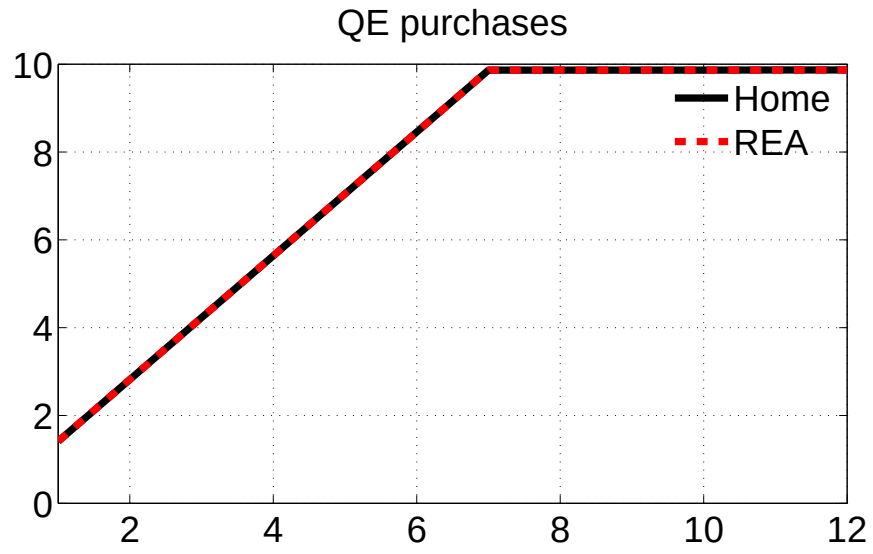
Transmission mechanism:

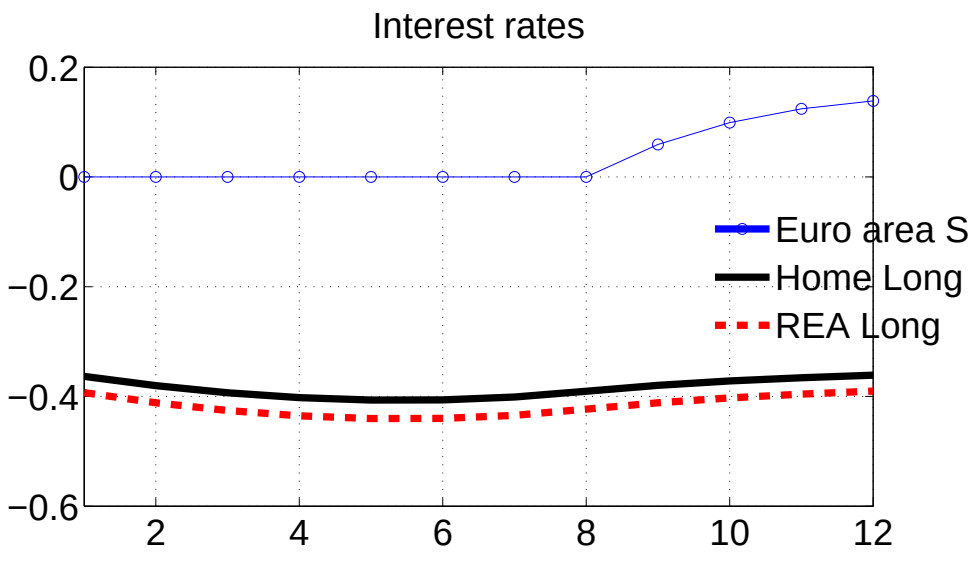
- Restricted households sell long-term sovereign bonds to the central bank, $\uparrow$ consumption and investment $\Longrightarrow$ initial positive effect on aggregate demand and inflation

- Borrowers face low short-term (real) interest rate: $\uparrow$ demand for consumption and real estate $\Longrightarrow$ $\uparrow$ real estate price $\Longrightarrow$ $\uparrow$ borrowing and consumption by borrowers, because of borrowing constraint (collateral effect)

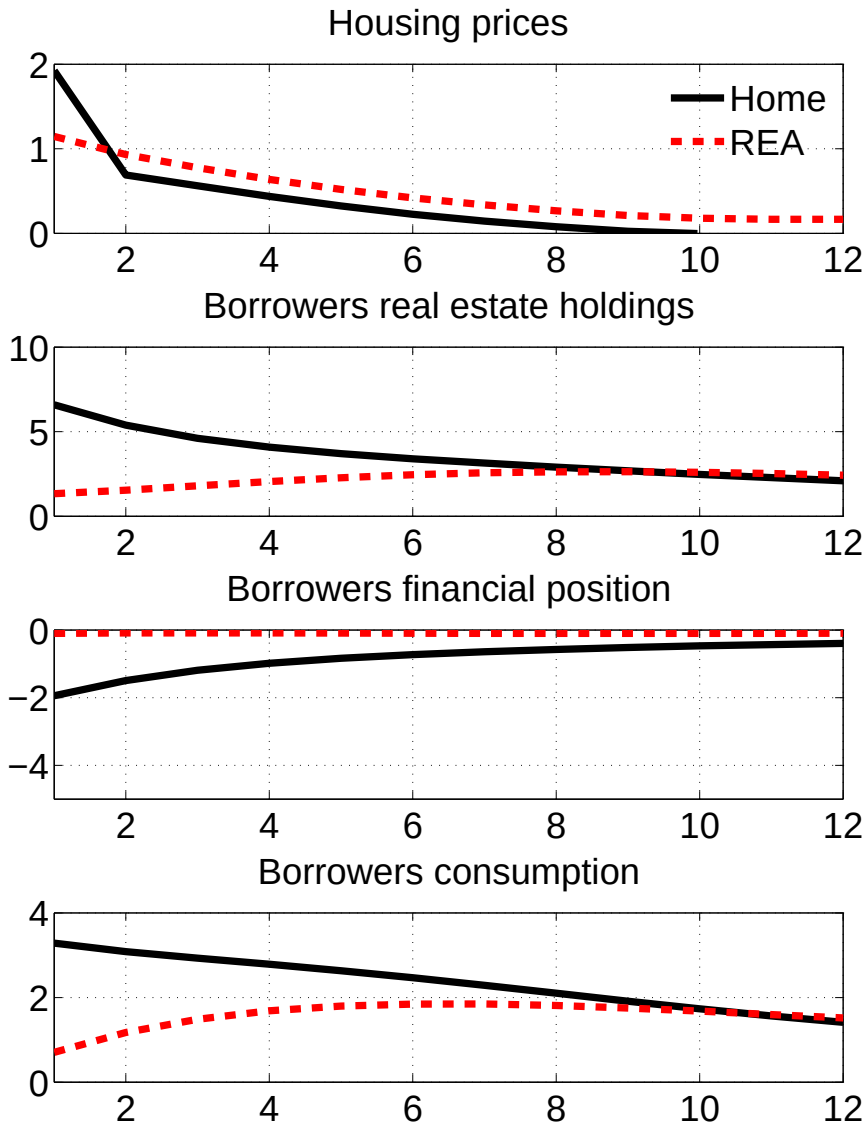
- Collateral effect is larger in Home region than in the REA, because of higher Home LTV ratio

Scenario 1: Effects on interest rates

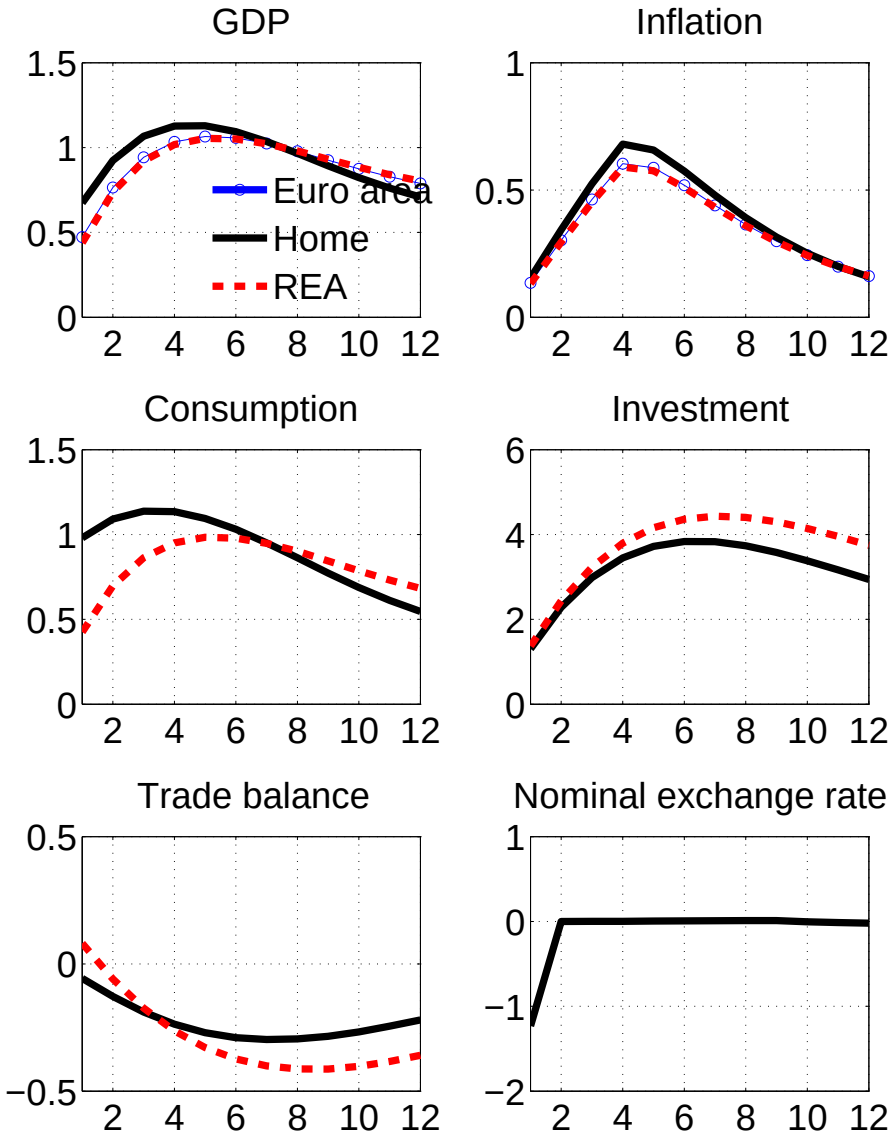




Scenario 1: Effects on Home real estate and borrowing



Scenario 1: Macroeconomic effects



Scenario 2: APP + Home-specific non-fundamental expectational shock

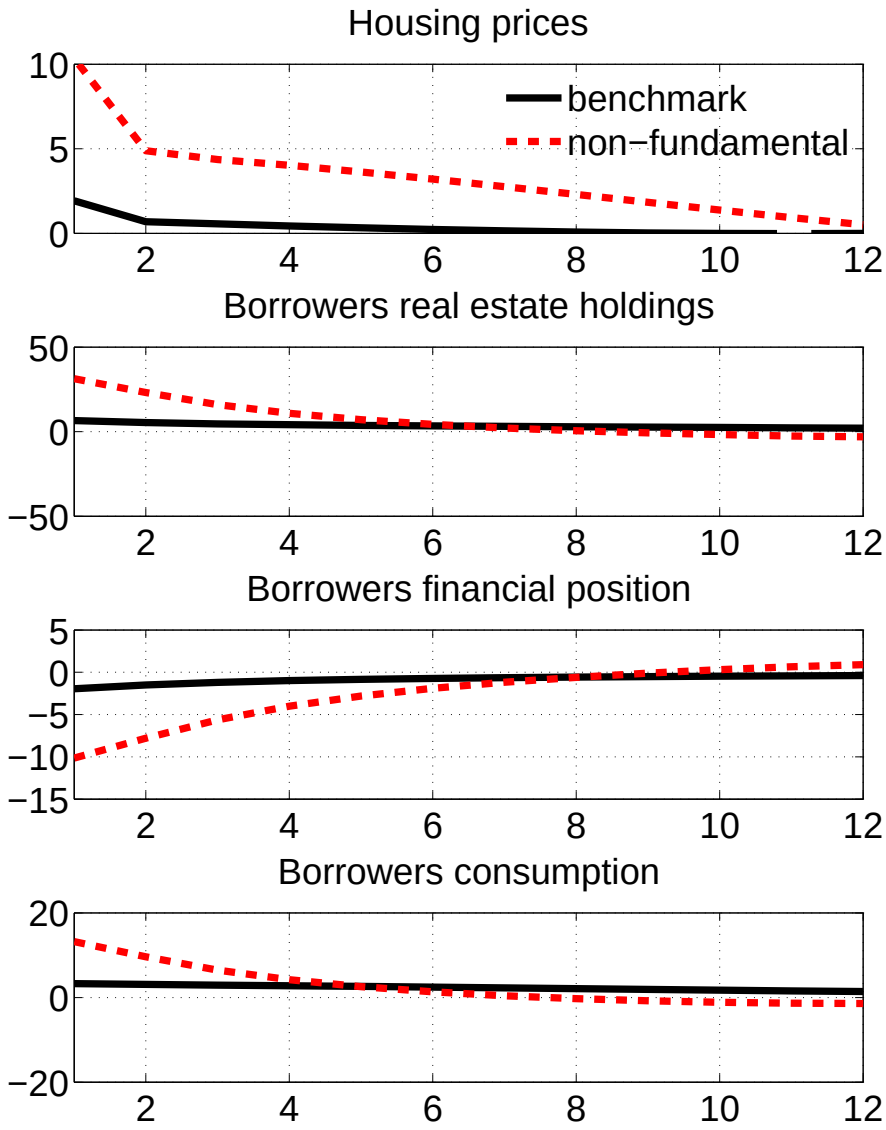
- Non-fundamental shock is calibrated to get, on top of APP-induced increase in Home real estate price, an additional increase of around 5% on average in the first year
- Such value is line with evidence provided by Hartmann (2015): average increase in the overvalued component of housing prices of around 5% per year over the 2002-2007 run-up in EA house prices

Scenario 2: APP + Home-specific non-fundamental expectational shock

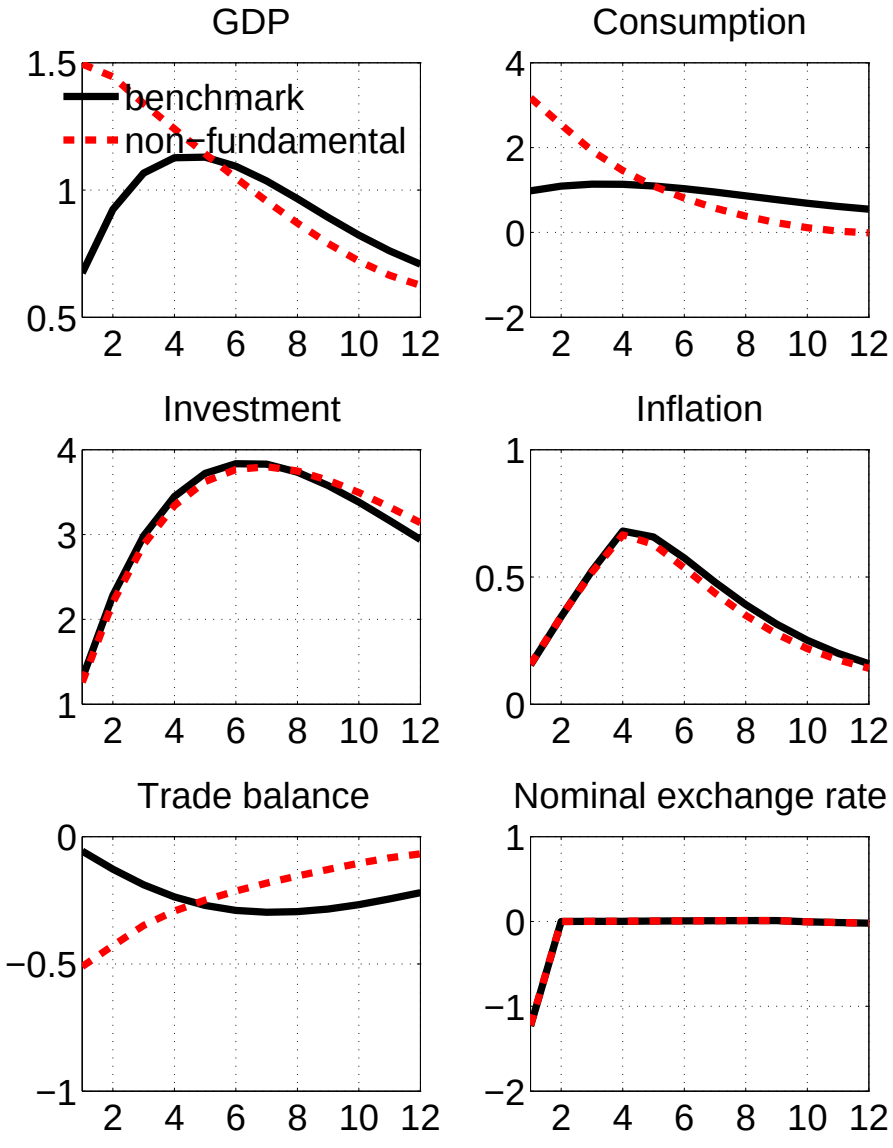
Transmission mechanism:

- Real estate overvaluation is an additional incentive for borrowers to increase debt $\Longrightarrow$ $\uparrow$ consumption and real estate demand
- Larger collateral effect than in scenario 1

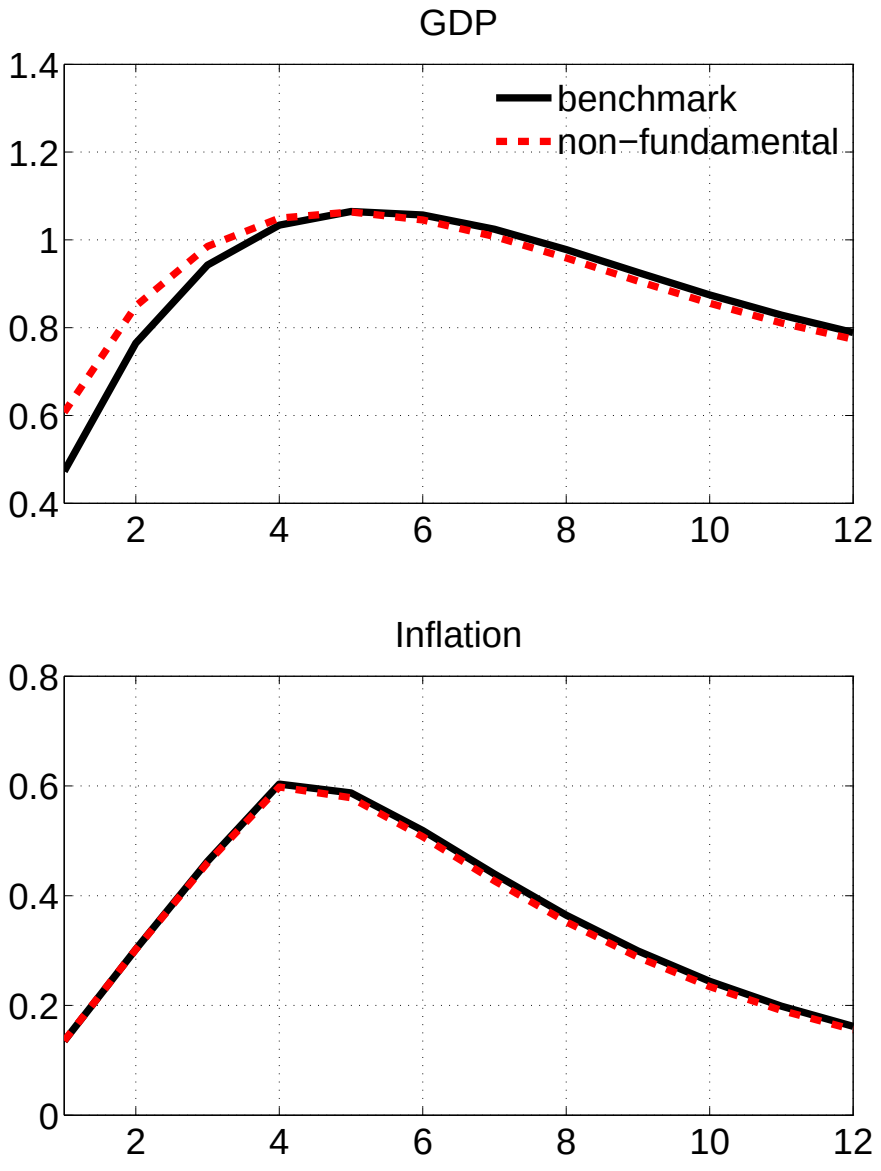
Scenario 2: Effects on Home real estate and borrowing



Scenario 2: Macroeconomic effects (Home)



Scenario 2: Macroeconomic effects (EA)



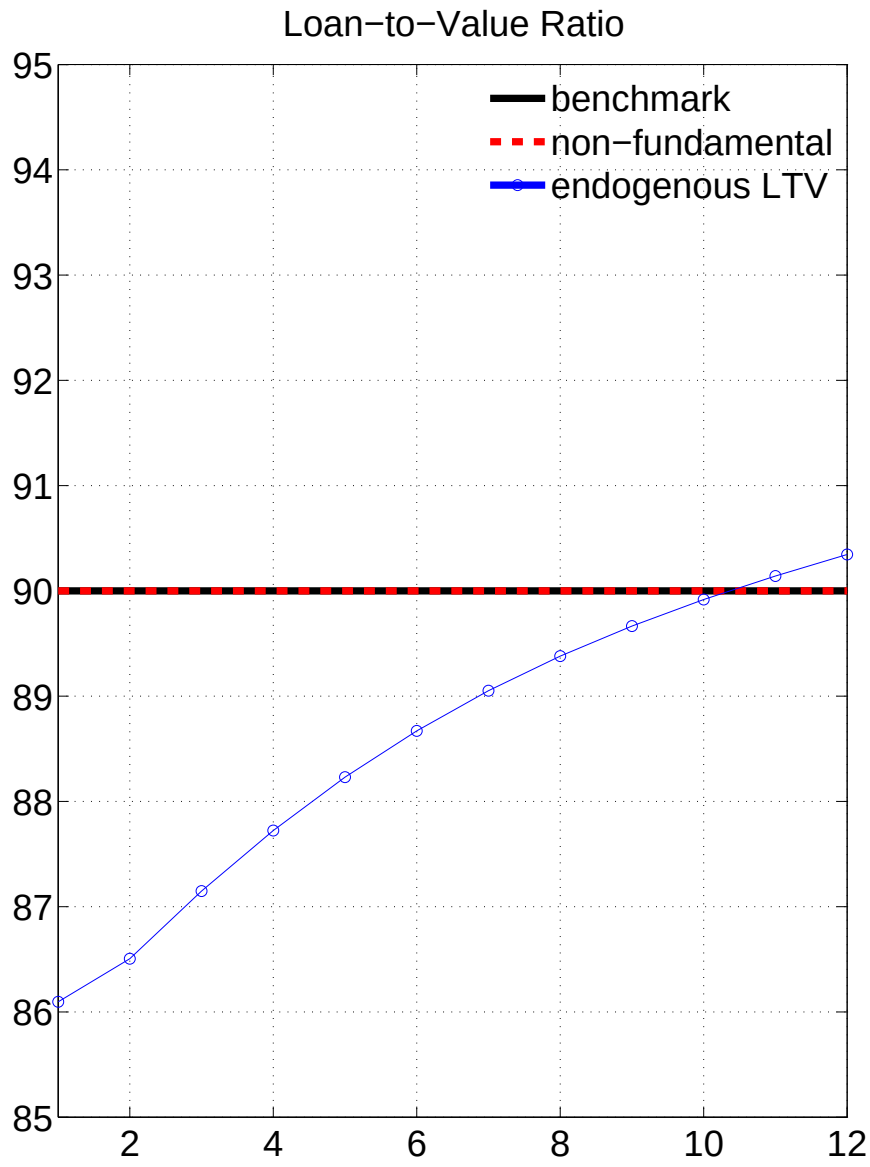
Scenario 3: Macroprudential policy

- Starting point: Scenario 2, i.e. APP + Home-specific non-fundamental expectational shock
- Home macroprudential authority can modify LTV ratio to limit increase in borrowing, according to a feedback rule

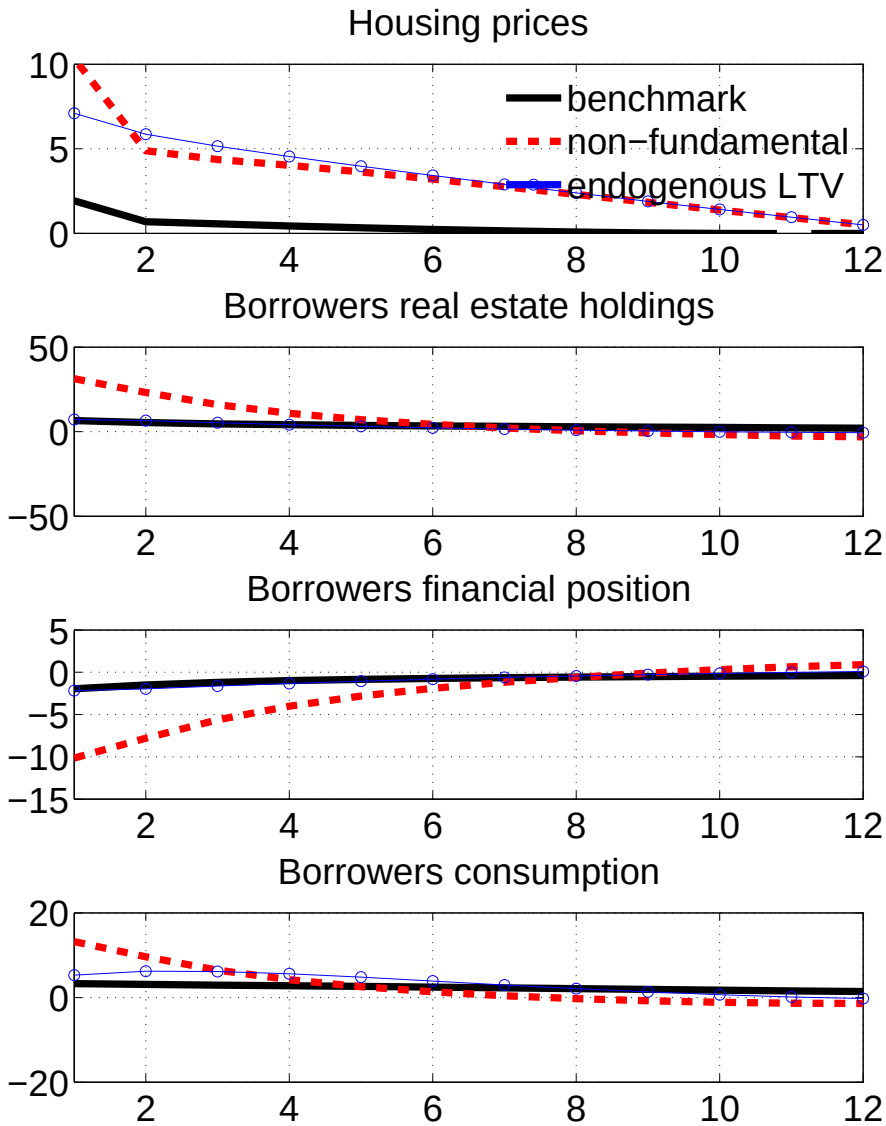
$$m_t = (1-\rho_m)\bar{m} + \rho_m m_{t-1} + \rho_{B_D}\left(\frac{B^S_{D,t}}{GDP_t} - \frac{B^S_{D,t-1}}{GDP_{t-1}}\right)$$

- Reverse-engineer rule parameters so that the chosen value of m_t is such that the "excess" increase in household debt (due to APP + non-fundamental shock) is completely undone and household debt grows as in Scenario 1

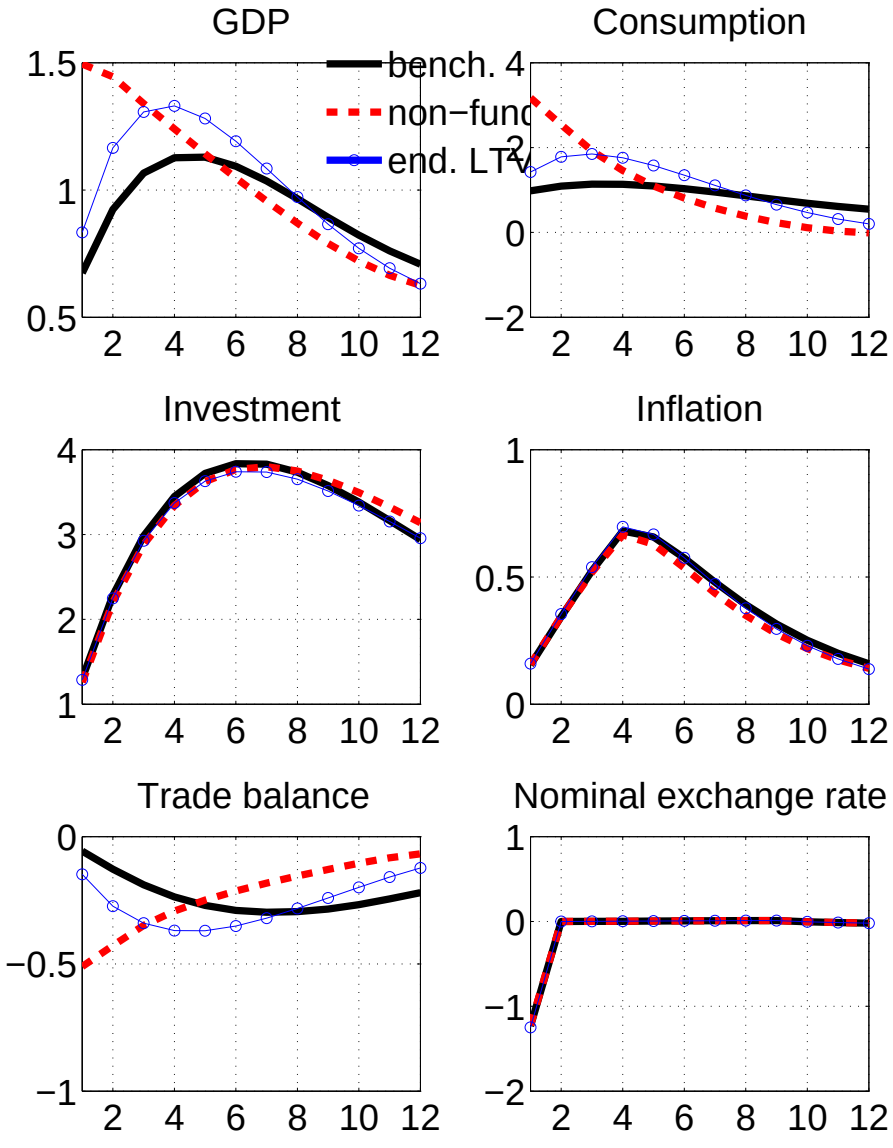
Scenario 3: Home LTV ratio



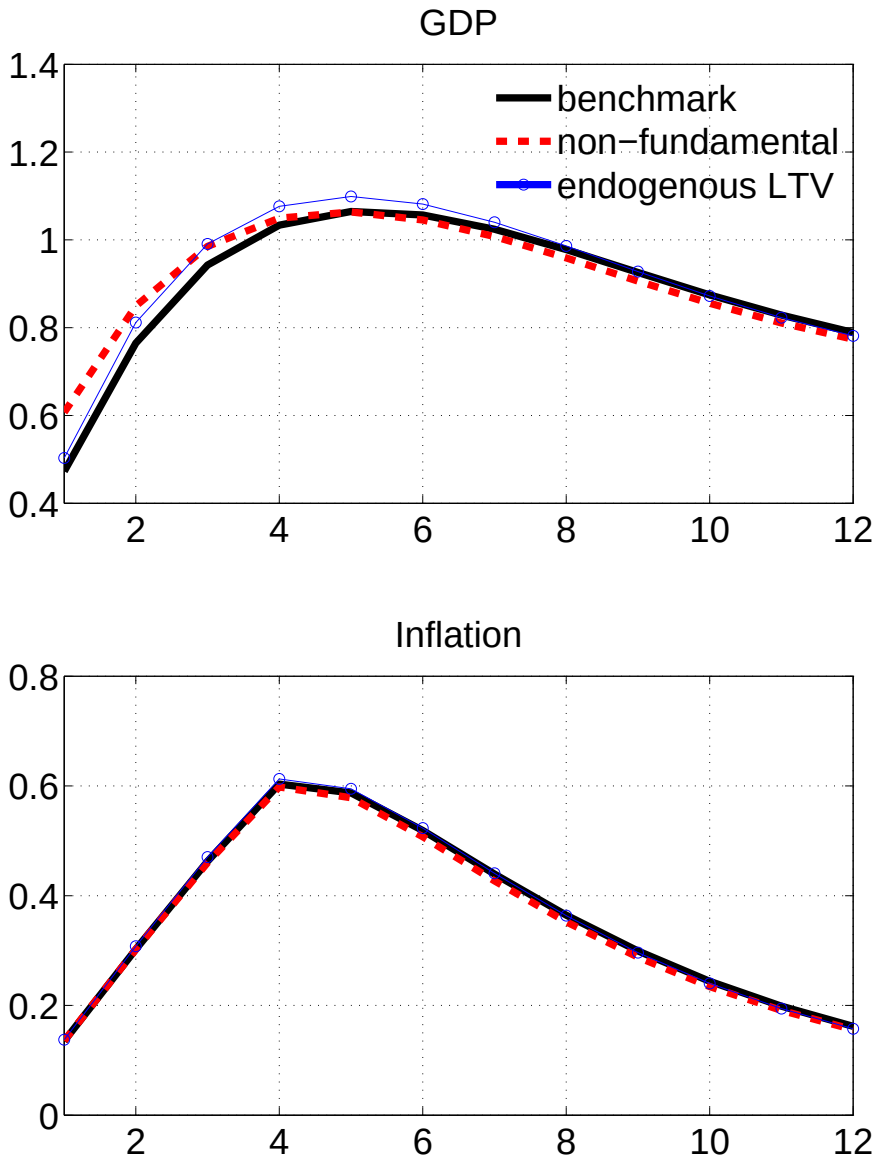
Scenario 3: Effects on Home real estate and borrowing



Scenario 3: Effects on Home macroeconomic variables



Scenario 3: Effects on EA variables



Scenario 3: Results

- GDP and inflation not greatly affected
- Macroprudential policy can effectively preserve financial stability without jeopardizing APP's effectiveness:
  - Home LTV ratio $\downarrow$ to counterbalance excess increase in borrowing
  - Demand for consumption and real estate $\uparrow$ to a lower extent
  - Unrestricted households substitute investment in physical capital for lending to borrowers
  - Larger increase in investment compensates for lower increase in consumption

Conclusions

- During APP and FG implementation, region-specific macroprudential measures can stabilize excessive private sector borrowing, with limited negative effects on regional economic activity and almost no impact on inflation
- Possible synergies between non-standard monetary and macroprudential policies in a monetary union
- Monetary policy focuses on union-wide macroeconomic conditions
- Region-specific macroprudential policies maintain financial stability at regional level

Model setup: capital producers

- Capital producers accumulate physical capital by demanding final investment goods subject to quadratic adjustment costs on investment change
- Rent out capital to the domestic firms
- Maximize profits with respect to capital and investment taking prices as given
- Evaluate returns according to a weighted average of restricted and unrestricted households' stochastic discount factors (weights are the corresponding population shares)
- Net revenues are rebated (lump-sum) to domestic restricted and unrestricted households according to their corresponding shares

Back

Borrowers

$$E_0 \left\{ \sum_{t=0}^{\infty} {\beta_D}^t \left[\begin{array}{l} \dfrac{\left(C_{D,t}\left(j'\right) - \varsigma C_{D,t-1} \right)^{1-\sigma}}{\left(1-\sigma\right)} + \\ \\ \chi \log h_{D,t}\left(j'\right) - \dfrac{L_{D,t}\left(j'\right)^{1+\tau}}{1+\tau} \end{array} \right] \right\},$$

$$\begin{array}{rl} & B^S_{D,t}\left(j'\right) - B^S_{D,t-1}\left(j'\right) R^S_{t-1} \\ = & W_{D,t}\left(j'\right) L_{D,t}\left(j'\right) - Q^h_t \left(h_{D,t}\left(j'\right) - h_{D,t-1}\left(j'\right) \right) \\ & -P_t C_{D,t}\left(j'\right), \end{array} \tag{1}$$

Restricted households

$$
\begin{aligned}
& P_t^L B_{R,t}^L \left(j''\right) - P_t^L R_t^L B_{R,t-1}^L \left(j''\right) \\
= \quad & \omega \Pi_t + W_{R,t} \left(j''\right) L_{R,t} \left(j''\right) \\
& - P_t C_{R,t} \left(j''\right) - AC_{R,t}^W \left(j''\right),
\end{aligned}
$$

$$
R_t^L = \frac{1}{P_t^L} + \kappa.
$$

Unrestricted households

$$
\begin{aligned}
& P_t^L B_{U,t}^L(j) - P_t^L R_t^L B_{U,t-1}^L(j) \\
& + B_{U,t}^S(j) - B_{U,t-1}^S(j) R_{t-1}^S \qquad (2) \\
& + B_t^G(j) - B_{t-1}^G(j) R_{t-1} \\
& + B_t^P(j) - B_{t-1}^P(j) R_{t-1}^P (1-\phi_t) \\
= \quad & W_{U,t}(j) L_{U,t}(j) + (1-\omega) \Pi_t^{prof} + \Pi_t^P(j) - P_t C_{U,t}(j) \\
& - Q_t^h (h_{U,t}(j) - h_{U,t-1}(j)) \\
& - TAX_t(j) - AC_{U,t}^W(j) - AC_{U,t}^B(j) - AC_{U,t}^h(j),
\end{aligned}
$$

Monetary and fiscal policy

$$\frac{R_t}{\bar{R}} = \left(\frac{R_{t-1}}{\bar{R}}\right)^{\rho_R} \left(\frac{\Pi_{EA,t}}{\bar{\Pi}_{EA}}\right)^{(1-\rho_R)\rho_\pi} \left(\frac{GDP_{EA,t}}{GDP_{EA,t-1}}\right)^{(1-\rho_R)\rho_{GDP}},$$

$$\begin{aligned} & B^S_{g,t} - B^S_{g,t-1} R_{t-1} + P^L_t B^L_{g,t} - P^L_t R^L_t B^L_{g,t-1} \\ = \quad & P_{N,t} C^g_t - TAX_t, \end{aligned}$$

$$\frac{TAX_t}{TAX_{t-1}} = \left(\frac{b^S_{g,t}}{\bar{b}^S_g}\right)^{\phi_1} \left(\frac{b^S_{g,t}}{b^S_{g,t-1}}\right)^{\phi_2}.$$

Market clearing

Short-term private bond:

$$\int_0^{n\lambda_D} B^S_{D,t}(j')dj' + \int_{n(\lambda_D+\lambda_R)}^{n} B^S_{U,t}(j)dj = 0.$$

Long-term sovereign bond:

$$\int_{n\lambda_D}^{n(\lambda_D+\lambda_R)} B^L_{R,t}(j'')dj'' + \int_{n(\lambda_D+\lambda_R)}^{n} B^L_{U,t}(j)dj + B^L_{APP,t} = B^L_{g,t}.$$

Real estate:

$$\int_0^{n\lambda_D} h^S_{D,t}(j')dj' + \int_{n(\lambda_D+\lambda_R)}^{n} h^S_{U,t}(j)dj = \bar{h}.$$

Parametrization

Parameter	H	REA	RW
Discount factor $\beta_U, \beta_U^*, \beta^{**}$	0.995	0.995	0.995
Discount factor β_R, β_R^*	0.991	0.991	–
Discount factor β_D, β_D^*	0.945	0.945	–
Intertemporal elasticity of substitution $1/\sigma$	1.0	1.0	1.0
Inverse of Frisch Elasticity of Labor Supply τ	3.0	3.0	3.0
Habit ς	0.75	0.75	0.75
Depreciation rate of capital δ	0.025	0.025	0.025
Housing weight χ,	0.1	0.1	–
Share of restricted households λ_R	0.10	0.10	–
Share of unrestricted households λ_U	0.50	0.50	–
Share of cap. producers held by restr. households ω, ω^*	1/6	1/6	–
Tradable Intermediate Goods			
Subst. between factors of production $\xi_T, \xi_T^*, \xi_T^{**}$	0.95	0.95	0.95
Bias towards capital $\alpha_T, \alpha_T^*, \alpha_T^{**}$	0.55	0.55	0.55
Non-tradable Intermediate Goods			
Subst. between factors of production $\xi_N, \xi_N^*, \xi_N^{**}$	0.95	0.95	0.95
Bias towards capital $\alpha_N, \alpha_N^*, \alpha_N^{**}$	0.5	0.5	0.5
Final consumption goods			
Subst. between domestic and imported goods $\phi_A, \phi_A^*, \phi_A^{**}$	1.50	1.50	1.50
Bias towards domestic tradable goods a_H, a_G^*, a_F^{**}	0.45	0.55	0.90
Subst. between tradables and non tradables $\rho_A, \rho_A^*, \rho_A^{**}$	0.50	0.50	0.50
Bias towards tradable goods a_T, a_T^*, a_T^{**}	0.70	0.60	0.60
Final investment goods			
Subst. between domestic and imported goods $\phi_E, \phi_E^*, \phi_E^{**}$	1.50	1.50	1.50
Bias towards domestic tradable goods v_H, v_G^*, v_F^{**}	0.45	0.55	0.90
Subst. between tradables and non tradables $\rho_E, \rho_E^*, \rho_E^{**}$	0.50	0.50	0.50
Bias towards tradable goods v_T, v_T^*, v_T^{**}	0.80	0.70	0.70

Gross mark-ups

Mark-ups and Elasticities of Substitution			
	Tradables	Non-tradables	Wages
H	1.2 $(\theta_T = 6)$	1.5 $(\theta_N = 3)$	1.30 $(\psi = 4.3)$
REA	1.2 $(\theta_T^* = 6)$	1.5 $(\theta_N^* = 3)$	1.30 $(\psi^* = 4.3)$
RW	1.2 $(\theta_T^{**} = 6)$	1.5 $(\theta_N^{**} = 3)$	1.30 $(\psi^{**} = 4.3)$

Fiscal, Monetary, and Macroprudential Policy Rules

Parameter	H	REA	EA	RW
Fiscal policy rule				
$\phi_1, \phi_1^*, \phi_1^{**}$	1.01	1.01	-	1.01
$\phi_2, \phi_2^*, \phi_2^{**}$	1.01	1.01	-	1.01
Common monetary policy rule	-	-		
Lagged interest rate ρ_R, ρ_R^{**}	-	-	0.87	0.87
Inflation ρ_Π, ρ_Π^{**}	-	-	1.70	1.70
GDP growth $\rho_{GDP}, \rho_{GDP}^{**}$	-	-	0.10	0.10
Macroprudential rule				
LTV ratio m	90%	50%	–	
Lagged LTV ratio ρ_m	0.99	–	–	
Households' debt to GDP ρ_{B_D}	0.50	–	–	

Real and Nominal Adjustment Costs

Parameter	H	REA	RW
Real Adjustment Costs			
Investment ϕ_I, ϕ_I^*, ϕ_I^{**}	5.00	5.00	5.00
Adjustment Costs on Bonds			
Households' long-term bond positions ϕ_{b^L}, $\phi_{b^L}^*$	0.000104	0.000104	–
Households' private bond positions			
ϕ_{b1}, ϕ_{b1}^{**}	0.0055	–	0.0055
ϕ_{b2}, ϕ_{b2}^{**}	0.0055	–	0.0055
Adjustment Costs on Real Estate			
ϕ_h, ϕ_h^*	1.00	1.00	–
Nominal Adjustment Costs			
Wages κ_W, κ_W^*, κ_W^{**}	400	400	400
H produced tradables κ_H, k_H^* k_H^{**}	300	300	50
REA produced tradables κ_G, k_G^* k_G^{**}	300	300	50
RW produced tradables κ_F, k_F^* k_F^{**}	50	50	300
Non-tradables κ_N, κ_N^*, κ_N^{**}	600	600	600

Main macroeconomic variables (ratio to GDP)

	H	REA	RW
Private consumption	59.1	59.8	59.3
Public consumption	20.0	20.0	20.0
Private investment	20.9	20.2	20.7
Imports	29.0	20.6	4.3
Home Imports from	–	7.5	21.5
REA Imports from	2.4	–	18.1
Net Foreign Asset Position	0.0	0.0	0.0
GDP (share of world GDP)	2.7	15.9	81.4
Private debt (ratio to annual GDP)	116.7	22.0	–
Short-term public debt (ratio to annual GDP)	8.0	8.0	–
Long-term public debt (ratio to annual GDP)	93.3	93.3	–

Back