Monetary Policy and Housing Prices in an Estimated DSGE Model for the US and the Euro Area

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- Empirical evidence on monetary policy and housing (Jarocinski and Smets (2008)): accounting for house prices may sharpen inference on monetary policy conduct over time
- Open economy: quantify degree of international spillovers and explore implications for monetary policy cooperation

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- Derive optimal monetary policy cooperation results

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- Conclusions

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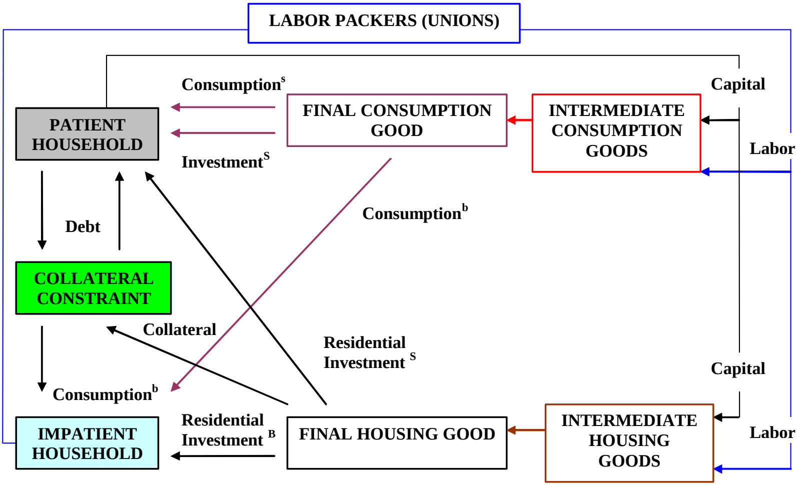
  - credit frictions: collateralized household debt

Model: closed economy



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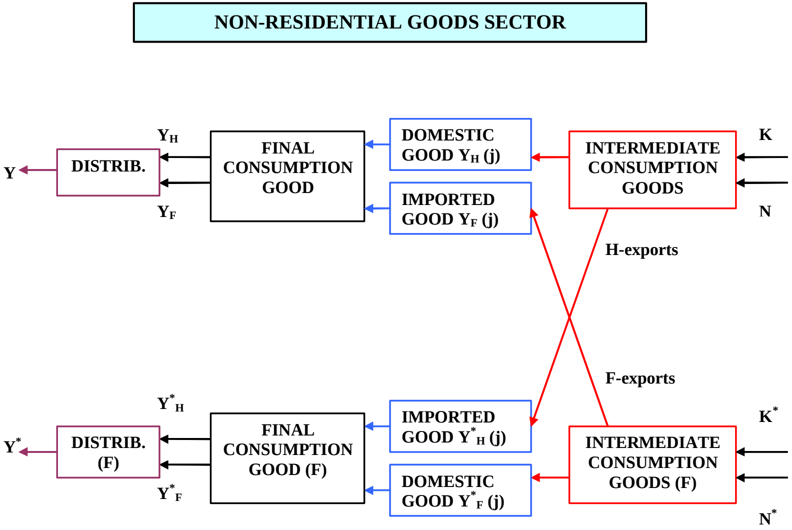

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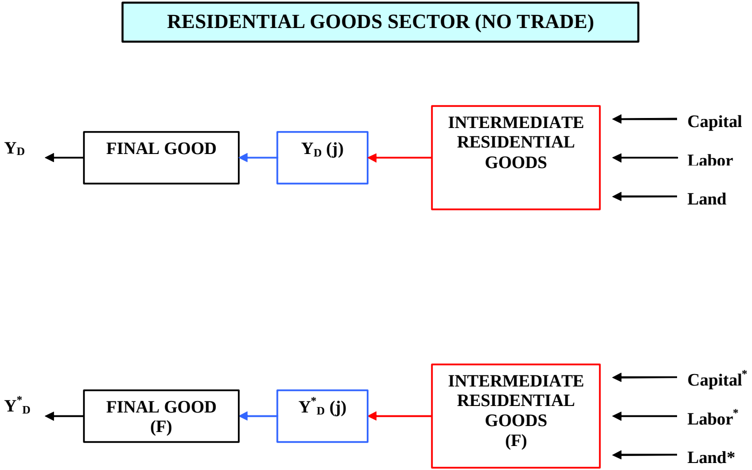

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  - high persistence of housing shocks

Matching moments

- Cross-country correlations

	data	baseline	high borr	augm.TR	data	baseline	high borr	augm.TR
Z_t, C_t	0.80	0.68	0.70	0.70	0.84	0.69	0.72	0.73
Z_t, I_t	0.64	0.72	0.67	0.74	0.65	0.65	0.60	0.72
Z_t, Z_{Dt}	0.52	0.17	0.15	0.12	0.62	0.08	0.08	-0.01
T_{Dt}, C_t	0.12	0.30	0.31	0.10	0.47	0.32	0.43	0.02
Z_{Dt}, T_{Dt}	0.25	0.40	0.41	0.38	0.35	0.49	0.50	0.45
Z_{Dt}, C_t	0.74	0.12	0.12	0.05	0.68	0.08	0.13	-0.05
Z_t^*, C_t^*	0.93	0.65	0.77	0.84	0.83	0.74	0.78	0.84
Z_t^*, I_t^*	0.92	0.65	0.72	0.87	0.90	0.71	0.68	0.85
Z_t^*, Z_{Dt}^*	0.24	0.04	0.04	0.05	0.14	0.00	0.04	0.04
T_{Dt}^*, C_t^*	0.52	0.11	0.16	0.16	0.57	0.15	0.31	0.08
Z_{Dt}^*, T_{Dt}^*	0.41	0.42	0.39	0.34	0.25	0.42	0.42	0.37
Z_{Dt}^*, C_t^*	0.34	-0.07	-0.06	-0.07	0.20	-0.02	0.05	0.01
Z_t, Z_t^*	0.22	0.09	0.14	0.14	0.27	0.13	0.17	0.16
C_t, C_t^*	-0.03	-0.17	-0.03	-0.06	0.09	-0.04	0.05	0.08
Z_{Dt}, Z_{Dt}^*	-0.47	0.00	0.01	0.00	0.23	0.00	0.02	0.03
T_{Dt}, T_{Dt}^*	0.15	-0.03	0.00	-0.01	0.06	-0.01	0.04	0.07
$\Delta S_t, CA_t$	-0.23	-0.34	-0.24	-0.28	-0.15	-0.34	-0.22	-0.22
C_t^{rel}, RER_t	-0.29	-0.21	-0.34	-0.25	-0.21	-0.26	-0.33	-0.16

Housing shocks and economic fluctuations

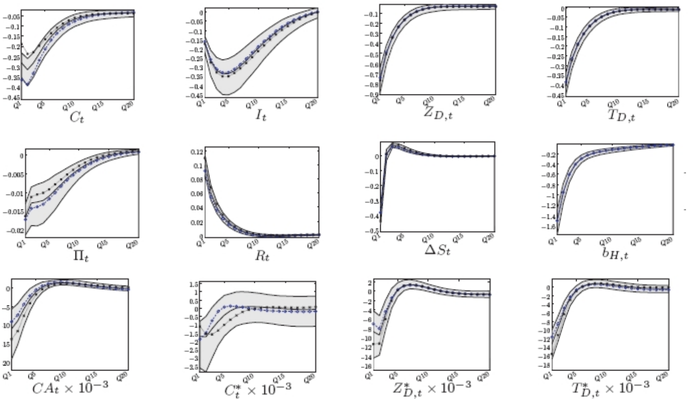
- Variance decomposition

	Domestic Housing			Other Domestic	Non Domestic
	$\epsilon_t^{A_D}$	ϵ_t^{LTV}	ϵ_t^{D}		
US					
Z_t	0.34	0.39	2.45	87.61	9.21
C_t	1.32	1.30	2.99	74.60	19.79
Z_{Dt}	57.65	0.04	31.93	9.98	0.40
T_{Dt}	7.87	0.08	80.11	9.37	2.57
Π_t	0.15	0.01	0.02	66.21	33.61
R_t	0.09	0.48	2.11	87.53	9.79
B_t	2.94	36.16	49.26	10.55	1.09
Euro Area					
Z_t^*	0.09	0.25	4.79	84.97	9.90
C_t^*	0.68	0.92	4.54	71.47	22.39
Z_{Dt}^*	59.51	0.04	34.36	5.62	0.47
T_{Dt}^*	5.62	0.08	85.36	5.37	3.57
Π_t^*	0.03	0.01	3.42	56.89	39.65
R_t^*	0.05	0.14	8.97	75.13	15.71
B_t^*	1.97	31.16	42.92	23.18	0.77
ΔS_t	0.01	0.00	0.57	17.60	81.82
CA_t	0.00	0.01	0.84	11.24	87.91

- Sensitivity to ω Table

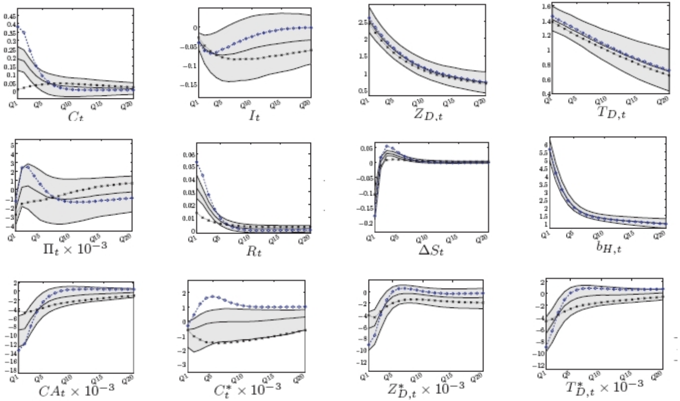
The propagation of US monetary policy shocks

- Benchmark (plain and shaded area), high ω (dotted, blue), $\omega = 0$ (cross, black)



The propagation of US housing demand shocks

- Housing preference Def : Benchmark (plain and shaded area), high ω (dotted, blue), $\omega = 0$ (cross, black)



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- Housing-specific shocks generate sizeable effects on non-residential consumption (*collateral channel*)
- Open economy: *small* international spillovers (housing sector is flex-price, nontraded)
- However, housing shocks help capturing observed cross-correlations in residential investment and housing prices
- Credit frictions alter the relative responses of aggregate consumption and output to exogenous shocks (e.g. G shocks)

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- *Positive* perspective: estimate model under *augmented* Taylor rules (allow for *systematic* response to house price fluctuations)
- *Normative* perspective: compare estimated rules with optimal monetary policy cooperation (focus on housing demand shocks)

Historical conduct of monetary policy (I)

- *Positive* perspective: estimate model under *augmented* Taylor rules

$$\begin{aligned} r_t &= \rho r_{t-1} + r_{\Delta\pi}(\pi_t - \pi_{t-1}) + (1-\rho)(r_\pi \pi_{t-1} + r_y y_{t-1}) \\ &\quad + r_{\Delta y}\Delta y_t + r_{\Delta T_D}\Delta t_{D,t} + \log(\varepsilon_t^R) \end{aligned}$$

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- Estimated posterior modes: $r_{\Delta T_D} = 0.10$, $r^*_{\Delta T_D} = 0.17$ (other parameters robust)
- Large improvement in fit: log marginal density = -2450.12 (benchmark: -2485.19)

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- Intuition: $\uparrow$ housing demand $\Rightarrow \uparrow t_D \Rightarrow \uparrow r \Rightarrow \uparrow$ cost of borrowing $\Rightarrow$ counteract initial $\uparrow$ housing demand
- Thus: larger fluctuations in r, smaller response of housing quantities and prices

Optimal monetary policy cooperation

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Definitions

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Definitions

- Definitions:

$$\mathcal{W}_{H,t} \equiv \omega \mathcal{W}^{B}_{H,t} + (1-\omega)\mathcal{W}^{S}_{H,t} + \lambda_R \mathbb{E}_t \sum_{j=0}^{\infty} \beta^j (R_{t+j} - R^*)^2$$

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- Optimal policy cooperation (Ramsey): max conditional expected welfare

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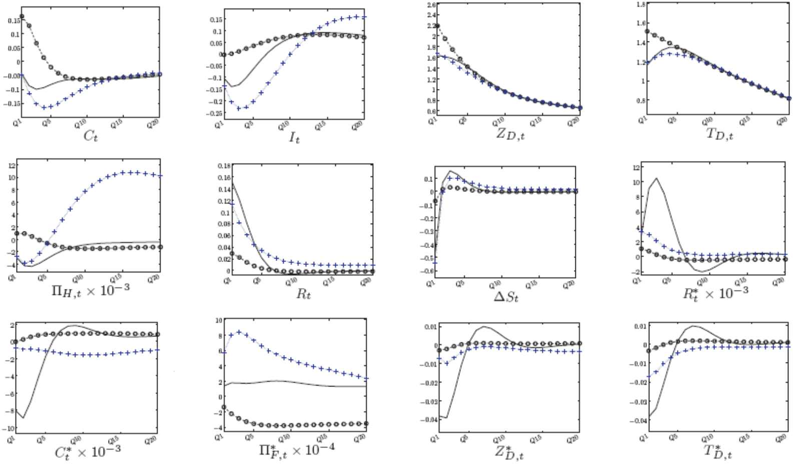
- Restrict attention to optimal response to housing demand shocks
- Do not provide systematic analysis of all factors that affect optimal cooperation (future research)

Optimal response to housing preference shock

- Optimal response (plain) with benchmark (dotted) and augmented estimated Taylor rule (cross, blue)



- Optimal and augmented Taylor rule quite similar in US (less so in EA) EA

Optimal simple rules

- Additional exercise: compute optimal (welfare-max) simple rules: $r_{\Delta T_{D,t}} = 0.04, r^*_{\Delta T_{D,t}} = 0.02$

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- Results are conditional on type of structural disturbances considered

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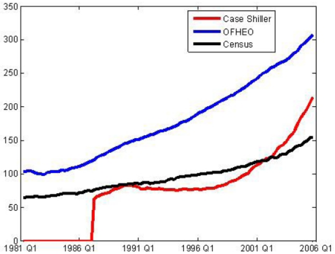
  2. Deeper analysis of optimal monetary policy cooperation may reinforce preliminary results

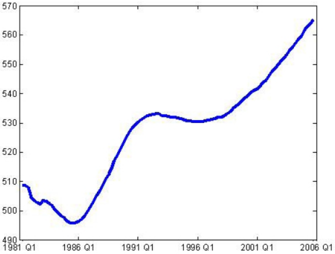
The End

THANKS

Housing sector data

- US: Census index (quality-adjusted, price of new one-family houses sold including value of lot); alternatives: OFHEO (Conventional Mortgage House Price Index): repeat sales, upward biased; Case-Shiller-Weiss: repeat sales, shorter period





- Euro Area: interpolate original (annual) data to obtain quarterly series

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Housing preference shock

$$\widetilde{X}_t^b \equiv \left[\left(1-\varepsilon_t^D \omega_D\right)^{\frac{1}{\eta_D}} \left(\widetilde{C}_t^b - h_b \widetilde{C}_{t-1}^b\right)^{\frac{\eta_D-1}{\eta_D}} + \left(\varepsilon_t^D \omega_D\right)^{\frac{1}{\eta_D}} \left(\widetilde{D}_t^b\right)^{\frac{\eta_D-1}{\eta_D}} \right]^{\frac{\eta_D}{\eta_D-1}}$$

$$X_t^s \equiv \left[\left(1-\varepsilon_t^D \omega_D\right)^{\frac{1}{\eta_D}} \left(C_t^s - h_s C_{t-1}^s\right)^{\frac{\eta_D-1}{\eta_D}} + \left(\varepsilon_t^D \omega_D\right)^{\frac{1}{\eta_D}} \left(D_t^s\right)^{\frac{\eta_D-1}{\eta_D}} \right]^{\frac{\eta_D}{\eta_D-1}}$$

$$\varepsilon_t^D = \rho_D \varepsilon_{t-1}^D + u_t^D$$

▸ Back

Loan-to-value ratio shock

$$\widetilde{b}_{H,t} \leq \varepsilon_t^{LTV} (1-\chi)\, \mathbb{E}_t \left\{ T_{D,t+1} \widetilde{D}_t \frac{\pi_{t+1}}{R_t} \right\}$$

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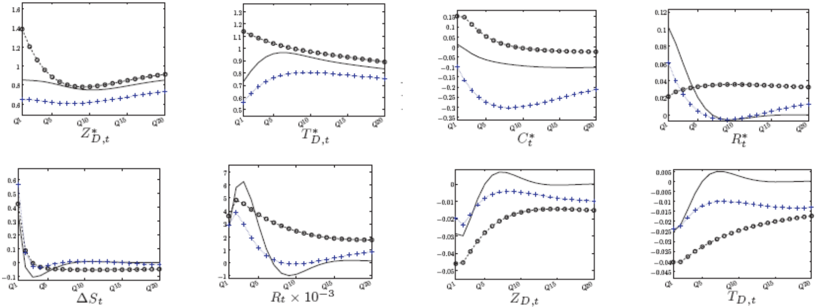
Optimal monetary policy response to housing demand shocks

- Euro Area



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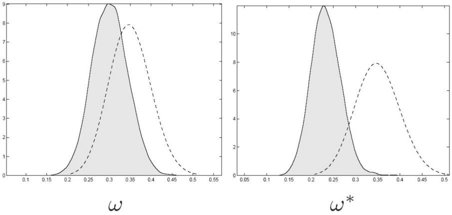
Estimation results: Priors and posteriors

- borrowers' shares: benchmark priors



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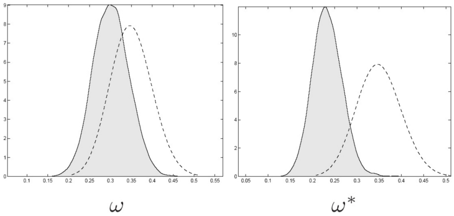
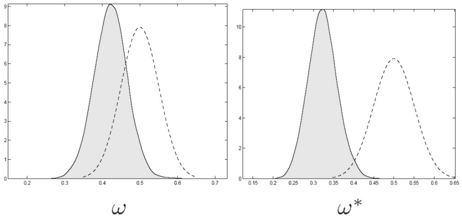


- borrowers' shares: high priors



Housing market and collateral constraints

- Two household types in each country:

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- Residential goods sector: dual role
  - housing (durable good) can be consumed and pledged as collateral
  - housing good *cannot* be internationally *traded*

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Borrower's problem

$$\max E_t \left\{ \sum_{j\geq 0} \beta^j \left[\begin{array}{c} \frac{1}{1-\sigma_X} \left(\widetilde{X}^b_{t+j} \right)^{\frac{1}{1-\sigma_X}} - \frac{\varepsilon^L_{t+j} \widetilde{\overline{L}}_C}{1+\sigma_{L_C}} \left(L^b_{C,t+j} \right)^{\frac{1}{1+\sigma_{LC}}} \\ - \frac{\varepsilon^L_{t+j} \widetilde{\overline{L}}_D}{1+\sigma_{L_D}} \left(L^b_{D,t+j} \right)^{\frac{1}{1+\sigma_{LD}}} \end{array} \right] \right\}$$

consumption index:

$$\widetilde{X}^b_t \equiv \left[\left(1-\varepsilon^D_t \omega_D\right)^{\frac{1}{\eta_D}} \left(\widetilde{C}^b_t - h_B \widetilde{C}^b_{t-1} \right)^{\frac{\eta_D - 1}{\eta_D}} + \left(\varepsilon^D_t \omega_D \right)^{\frac{1}{\eta_D}} \left(\widetilde{D}^b_t \right)^{\frac{\eta_D - 1}{\eta_D}} \right]^{\frac{\eta_D}{\eta_D - 1}}$$

s.t.

$$\begin{aligned} & \widetilde{C}^b_t + T_{D,t} \left(\widetilde{D}^b_t - (1-\delta) \widetilde{D}^b_{t-1} \right) + \frac{R_{t-1} \widetilde{B}^b_{H,t-1}}{\pi_t P_{t-1}} \\ = \quad & \frac{\widetilde{B}^b_{H,t}}{P_t} + \frac{\widetilde{A}^b_t}{P_t} + \frac{W^b_{C,t} L^b_{C,t} + W^b_{D,t} L^b_{D,t}}{P_t} \end{aligned}$$

and

$$\widetilde{b}_{H,t} \leq \varepsilon^{LTV}_t (1-\chi) \mathbb{E}_t \left\{ T_{D,t+1} \widetilde{D}_t \frac{\pi_{t+1}}{R_t} \right\}$$

Saver's problem

$$\max \mathbb{E}_t \left\{ \sum_{j\geq 0} \gamma^j \left[\begin{array}{c} \frac{1}{1-\sigma_X} \left(X^s_{t+j} \right)^{1-\sigma_X} - \frac{\varepsilon^{L,s}_{t+j} \overline{L}_C}{1+\sigma_{LC}} \left(L^s_{C,t+j} \right)^{1+\sigma_{LC}} \\ - \frac{\varepsilon^{L,s}_{t+j} \overline{L}_D}{1+\sigma_{LD}} \left(L^s_{D,t+j} \right)^{1+\sigma_{LD}} \end{array} \right] \right\}$$

consumption index:

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s.t.

$$C^s_t + T_{D,t} \left(D^s_t - (1-\delta) D^s_{t-1} \right) + I^s_t + \frac{B^s_{H,t}}{P_t} + \frac{S_t B^s_{F,t}}{\varepsilon^{\Delta S}_t \Psi \left(\frac{\mathbb{E}_t S_{t+1}}{S_{t-1}} - 1, \frac{S_t \left(B_{F,t} - \overline{\overline{B}}_F \right)}{P_t} \right)}$$

$$= \frac{R_{t-1} B^s_{H,t-1}}{\pi_t P_{t-1}} + \frac{S_t R^*_{t-1} B^s_{F,t-1}}{\pi_t P_{t-1}} + \sum_{j=C,D} \left[R^{k,j}_t u^j_t K^j_t - \Phi \left(u^j_t \right) K^j_t \right]$$

$$+ \frac{\left(W^s_{C,t} L^s_{C,t} + W^s_{D,t} L^s_{D,t} \right) + A^s_t + \Pi^s_t}{P_t}$$

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Structural shocks

- efficient: technology ($\varepsilon_t^A, \varepsilon_t^{A^*}, \varepsilon_t^{A_D}, \varepsilon_t^{A_D *}$), investment ($\varepsilon_t^I, \varepsilon_t^{I*}$), labor supply ($\varepsilon_t^L, \varepsilon_t^{L*}$), public expenditure ($\varepsilon_t^G, \varepsilon_t^{G*}$), taste ($\varepsilon_t^B, \varepsilon_t^{B*}$), housing preference ($\varepsilon_t^D, \varepsilon_t^{D*}$), loan-to-value ratio ($\varepsilon_t^{LTV}, \varepsilon_t^{LTV*}$), relative home bias ($\varepsilon_t^{\Delta n}$)

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- allow for some covariance between shocks, to capture rest-of-the-world dynamics

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  - Prior specification: symmetric distributions across countries

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Housing shocks and economic fluctuations

- variance decomposition: sensitivity to ω

	No Borrowers			High Borrowers' share		
	Domestic housing	Other Domestic	Non Domestic	Domestic housing	Other Domestic	Non Domestic
US						
Z_t	1.35	89.85	8.80	9.76	80.90	9.34
C_t	0.94	78.62	20.44	22.65	61.25	16.10
Z_{Dt}	89.74	9.83	0.43	89.47	10.13	0.40
T_{Dt}	87.42	9.68	2.90	88.70	9.07	2.23
Π_t	0.20	65.22	34.58	0.26	67.38	32.36
R_t	0.59	89.16	10.25	10.21	80.92	8.87
B_t	-	-	-	89.10	9.92	0.98
Euro Area						
Z_t^*	4.37	84.61	11.02	9.44	82.41	8.15
C_t^*	0.63	73.95	25.42	16.91	69.90	13.19
Z_{Dt}^*	94.04	5.54	0.42	93.54	5.95	0.51
T_{Dt}^*	91.01	5.50	3.49	91.16	5.31	3.53
Π_t^*	5.40	54.02	40.58	2.52	60.61	36.87
R_t^*	13.77	68.58	17.65	8.38	79.64	11.98
B_t^*	-	-	-	76.95	22.25	0.80
ΔS_t	0.72	17.35	81.93	0.65	18.33	81.02
CA_t	1.23	10.23	88.54	0.80	13.19	86.01

Welfare criteria: definitions

$$\mathcal{W}_t^b \equiv E_t \left\{ \sum_{j \geq 0} \beta^j \left[\begin{array}{c} \frac{1}{1-\sigma_X} \left(\widetilde{X}_{t+j}^b \right)^{\frac{1}{1-\sigma_X}} - \frac{\varepsilon_{t+j}^L \widetilde{\overline{L}}_C}{1+\sigma_{L_C}} \left(L_{C,t+j}^b \right)^{\frac{1}{1+\sigma_{LC}}} \\ - \frac{\varepsilon_{t+j}^L \widetilde{\overline{L}}_D}{1+\sigma_{L_D}} \left(L_{D,t+j}^b \right)^{\frac{1}{1+\sigma_{LD}}} \end{array} \right] \right\}$$

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Inference on ω

- Sensitivity analysis on (ω, ω^*):

Prior	B(0.35,0.05)	B(0.5,0.035)	U[0,1]
ω	0.24	0.46	0.05
ω^*	0.19	0.42	0.05
Marginal Loglik.	-2485.19	-2509.12	-2478.30

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ω	0.24	0.46	0.05
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Marginal Loglik.	-2485.19	-2509.12	-2478.30

- Model comparison: lower shares of borrowers improve fit
- However: ω, ω^* never set to 0
- Posterior modes strongly dependent on priors: weak identification

Distributions

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Inference on ω

- Sensitivity analysis on (ω, ω^*):

Prior	B(0.35,0.05)	B(0.5,0.035)	U[0,1]
ω	0.24	0.46	0.05
ω^*	0.19	0.42	0.05
Marginal Loglik.	-2485.19	-2509.12	-2478.30

- Model comparison: lower shares of borrowers improve fit
- However: ω, ω^* never set to 0
- Posterior modes strongly dependent on priors: weak identification
  Distributions
- *Aggregate* observables vs. type-specific model-generated series

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Optimal response to a LTV ratio shock

- Optimal response (plain) with benchmark (dotted, red) and augmented estimated Taylor rule (cross, blue)