Asset Purchases in a Monetary Union with Default and Liquidity Risks

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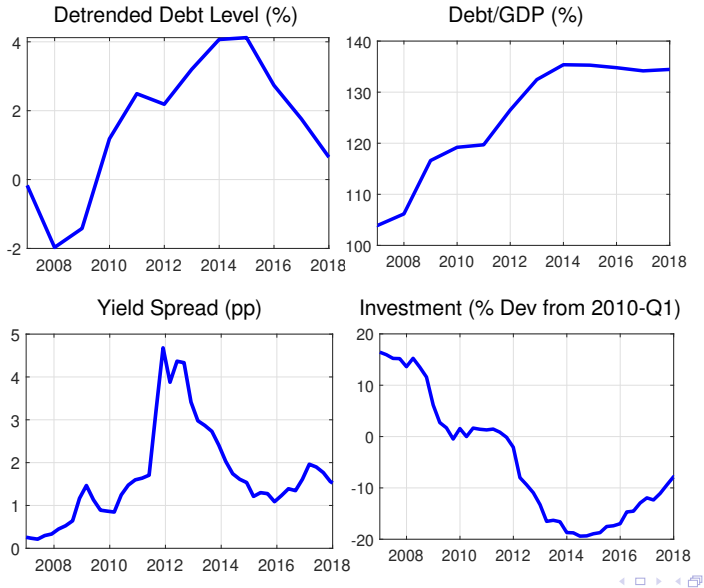
This Paper

- Motivation: ECB's 2012 OMT and 2022 TPI programs.
  - Targeted asset purchases to counter sovereign stress and financial fragmentation.
  - Announced but unused.
- How do sovereign default risks, when interacted with financial market liquidity risks, transmit to the economy and across borders?
- How does the anticipation of targeted asset purchases affect the economy, even if never used?

This Paper

- Build a two-country monetary-union model with default & liquidity risks:
  - A large debt increase plus a downward shift in the fiscal limit (Italy).
  - Allow cross-border holdings of government debt.
- Findings:
  - Both risks dampen economic & financial conditions in the affected country, while spillovers depend on cross-country holdings of government debt.
  - During a crisis, targeted asset purchases (or their anticipation) can help stabilize the economy.
  - In normal times, expectations of a crisis and credit intervention can distort the economy via a risk-taking channel, raising bank's holding of government bonds and crowding out investment.

Modeling a Debt Crisis: Italian Data



Model Overview

- Home country (Italy):
  - Government
    - Sets taxes and public expenditures, and issues bonds.
    - Default risks: endogenous regime switching process.
  - Financial intermediaries
    - Channel funds from households to Home firms and Home & Foreign governments.
    - Liquidity risks: tightness of financial friction varies with default probability.
- Foreign country (Germany):
  - Segmented financial markets without default and liquidity risks.
- Central bank: follows Taylor rule and can purchase government bonds.

Home Government

- Budget constraint:

$$\rho_{H,t} g + (1 - \Delta_t)(1 + \kappa^b Q_t^b) \frac{b_{t-1}}{\pi_t} = Q_t^b b_t + t_t + \tau^i p_t^w y_t + \tau^c c_t$$

- Lump-sum tax follows a fiscal rule:

$$\frac{t_t - t}{t} = \phi^T \frac{Q_{t-1}^b b_{t-1} - Q^b b}{Q^b b}$$

- Government may default by imposing a haircut δ_b:

$$\Delta_t = \begin{cases} \delta_b, & \text{if default} \\ 0, & \text{otherwise} \end{cases}$$

Modeling Default

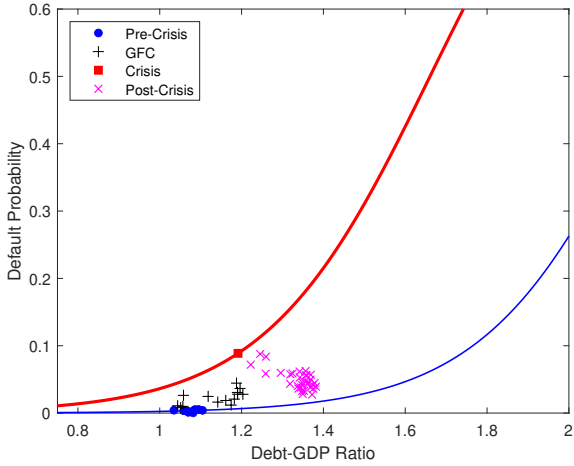
- Modeling default through regime switching
- Probability of default follows a logistic function of debt-to-GDP ratio s_t and sentiment shock ϵ_t^p:

$$P(def_t = 1 | s_{t-1}, \epsilon_t^P) = \frac{\exp[\eta_0^{FL} + \eta_s^{FL}(s_{t-1} + \epsilon_t^P)]}{1 + \exp[\eta_0^{FL} + \eta_s^{FL}(s_{t-1} + \epsilon_t^P)]}$$

- Captures the idea of a "fiscal limit":
  - Can arise from dynamic Laffer curves (Bi, 2012)
  - May depend on nonfundamental ϵ_t^p (investor sentiment)

Default Risks

- Logistic function estimated from Italian 5-yr sovereign CDS.
- 2011Q4 lies far above $\rightarrow$ a downward shift in the perceived fiscal limit (contagion from Greece).



Financial Intermediary

- Extension of Gertler & Karadi (2011) and Sims & Wu (2021).
- Collect deposits; hold government & private bonds:

$$Q_t^b b_t^{H,j} + Q_t^{b,*} b_t^{F,j} + Q_t^f f_t^j = d_t^j + n_t^j$$

- Net worth depends on realized returns on bonds:

$$R_t^b = (1 - \Delta_t) \frac{1 + \kappa^b Q_t^b}{Q_{t-1}^b}, \qquad R_t^f = \frac{1 + \kappa^f Q_t^f}{Q_{t-1}^f}$$

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- Domestic and foreign govt bond are imperfect substitutes.
  - Intratemporal portfolio decision from CES composite [Alpanda and Kabaca (2018), Krenz (2022)]:

$$\max \qquad E_t \left(R_{t+1}^b Q_t^b b_t^{H,j} + R_{t+1}^{b,*} Q_t^{b,*} b_t^{F,j} \right)$$

$$s.t. \quad m_t^{b,j} = \left[\gamma_b^{\frac{1}{\sigma_b}} \left(Q_t^b b_t^{H,j} \right)^{\frac{\sigma_b - 1}{\sigma_b}} + (1 - \gamma_b)^{\frac{1}{\sigma_b}} \left(Q_t^{b,*} b_t^{F,j} \right)^{\frac{\sigma_b - 1}{\sigma_b}} \right]^{\frac{\sigma_b}{\sigma_b - 1}}$$

Financial Intermediary

- Maximize expected terminal net worth with a survival rate σ:

$$\begin{aligned} \max \quad & V_t^j = E_t \Theta_t \Lambda_{t,t+1} \left((1-\sigma) n_{t+1}^j + \sigma V_{t+1}^j \right) \\ \text{s.t.} \quad & V_t^j \geq \eta_t^v \left(Q_t^f f_t^j + \theta^b m_t^{b,j} \right) \end{aligned}$$

- Liquidity risk channel: divertibility η_t^v rises with default risk:

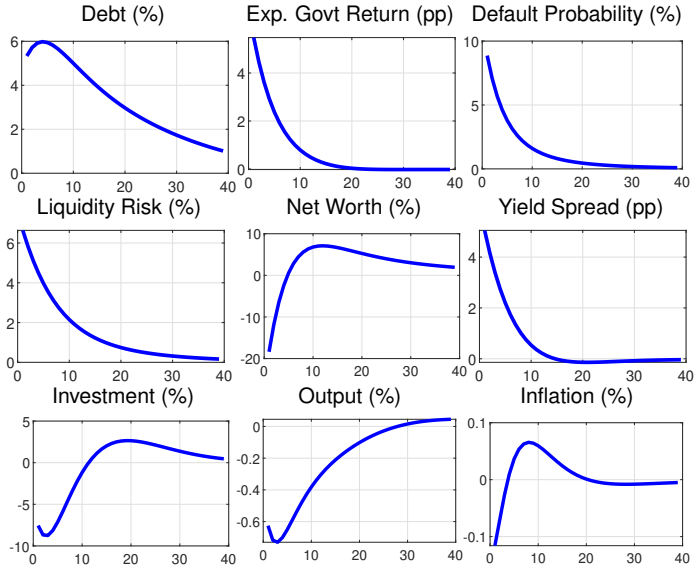
$$\frac{\eta_t^v}{\bar{\eta}^v} = 1 + \phi^\eta \left[P(s_{t-1}) - P(\bar{s}) \right]$$

  - Sovereign risk $\uparrow \rightarrow$ tighter constraint $\rightarrow$ flight from risky assets, bond prices and private lending $\downarrow$ (before default occurs)

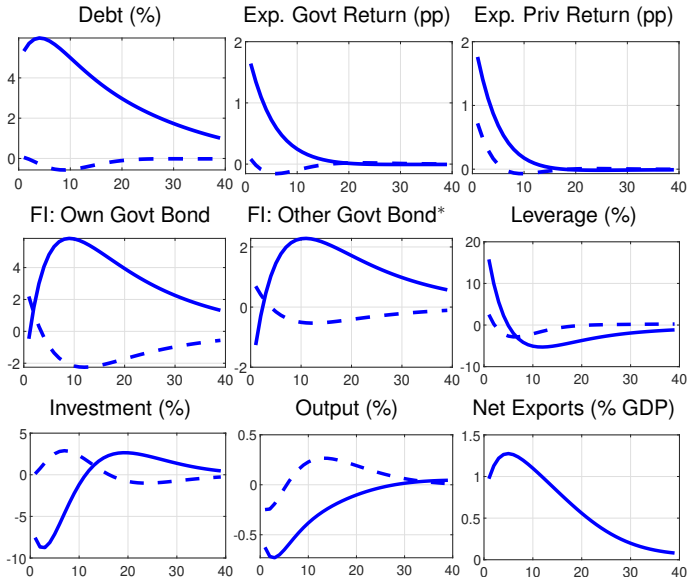
Solution Method & Experiment

- Our model is large: 64 equations/unknowns, 26 state variables.
- Use perturbation approach for solving endogenous regime-switching models (Benigno, Foerster, Otrok & Rebucci, 2025).
- Calibrate Home country to Italy and Foreign to Germany. Calibration
- Consider a case with increase in Home debt level combined with a downward shift in the fiscal limit.

Baseline: Debt Crisis Tightens Financial Markets (Home)

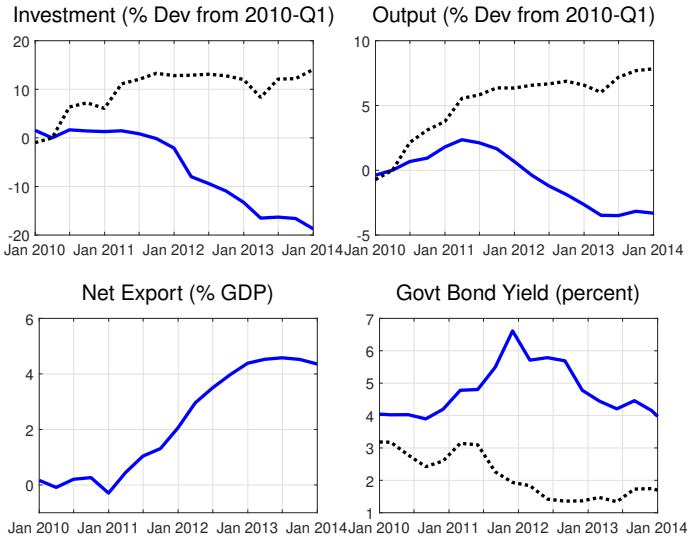


Home (solid) vs. Foreign (dashed): Periphery – Core Divergence

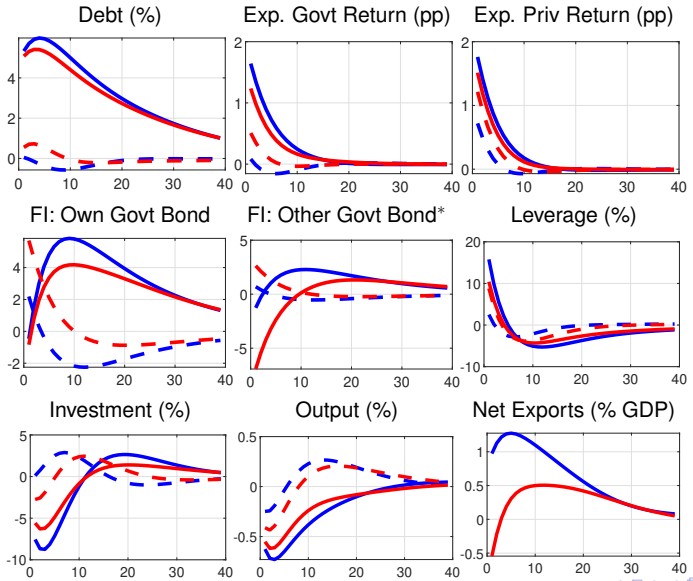


Italy (solid) vs. Germany (dotted): Periphery – Core Divergence

- Home/Foreign model simulations are in line with Italy/Germany data.



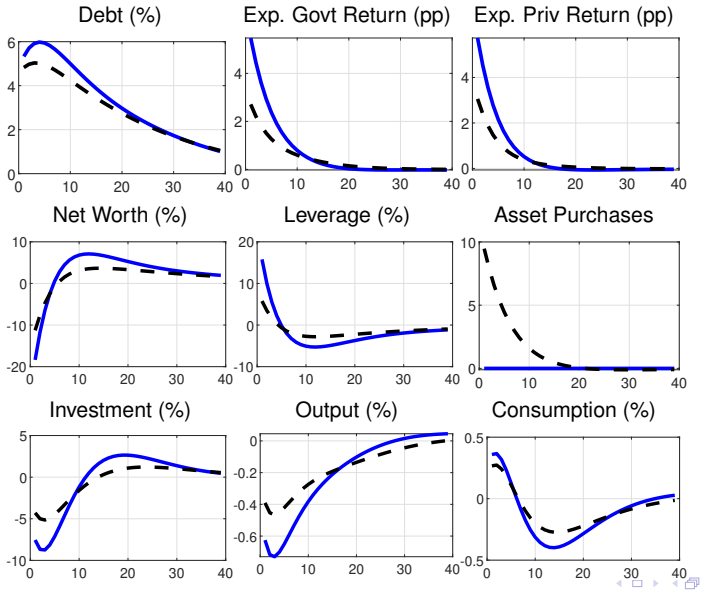
Higher Bond Substitutability Redistributes the Burden of Crisis



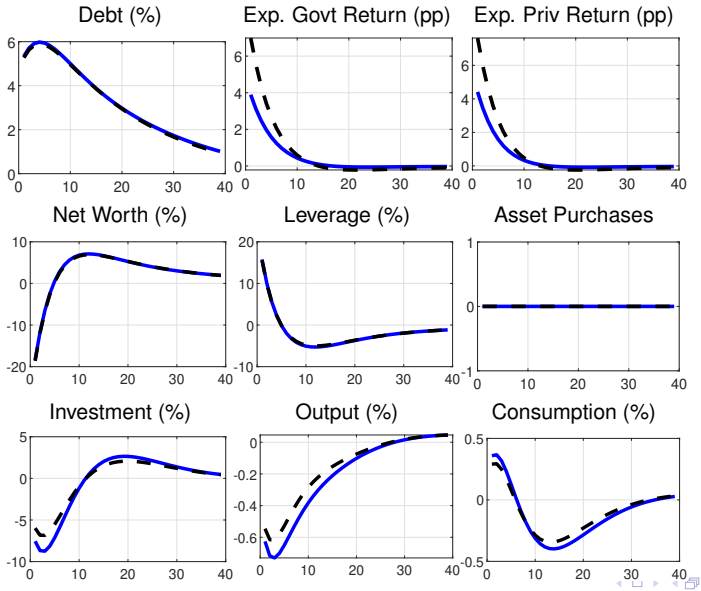
Asset Purchases

- Implemented asset purchases.
- Anticipated asset purchases during a crisis.
- Anticipated asset purchases in normal times.

Implemented Asset Purchases Lessen the Effect of a Debt Crisis



Anticipation of Asset Purchases Dampens the Recession: 0% vs. 50% Prob (black)



Anticipation Effects in Normal Times: Stochastic Steady State

- Agents assign probability p_c to a future crisis: a one-time large increase in debt coupled with a leftward shift in fiscal limit.
- Compare stochastic steady state relative to the case with no crisis ($p_c = 0$).

Variable	Low Crisis Prob $\phi_{cb} = 0$ (A)
Deposit	1.43
Investment	0.53
Output	0.25
Net worth	2.31
$Q_b b$	1.02
R^b	0.09
R^f	-0.04
Inflation	0.00
Fgn Investment	-0.57
Fgn output	-0.16
$R^b - R^{b,*}$	-0.69

Anticipation Effects in Normal Times: Low Crisis Probability

- Precautionary saving motive: agents save more to smooth consumption.
- Crowding out channel: default risks raise govt debt financing and crowd out private investment.

Variable	Low Crisis Prob $\phi_{cb} = 0$ (A)
Deposit	1.43
Investment	0.53
Output	0.25
Net worth	2.31
$Q_b b$	1.02
R^b	0.09
R^f	-0.04
Inflation	0.00
Fgn Investment	-0.57
Fgn output	-0.16
$R^b - R^{b,*}$	-0.69

Anticipation Effects in Normal Times: High Crisis Probability

- Precautionary saving motive: agents save more to smooth consumption.
- Crowding out channel: default risks raise govt debt financing and crowd out private investment.

Variable	Low Crisis Prob $\phi_{cb} = 0$ (A)	High Crisis Prob $\phi_{cb} = 0$ (C)
Deposit	1.43	1.96
Investment	0.53	-0.03
Output	0.25	0.14
Net worth	2.31	4.12
$Q_b b$	1.02	1.68
R^b	0.09	0.14
R^f	-0.04	-0.06
Inflation	0.00	0.02
Fgn Investment	-0.57	-1.07
Fgn output	-0.16	-0.31
$R^b - R^{b,*}$	-0.69	-1.42

Anticipation Effects in Normal Times: Asset Purchases

- Funding side: agents have weakened precautionary motive.
- Asset side: FI increases exposure to risky govt debt to increase net worth through a risk-taking Channel.

	Low Crisis Prob		High Crisis Prob
Variable	$\phi_{cb} = 0$ (A)	$\phi_{cb} > 0$ (B)	$\phi_{cb} = 0$ (C)
Deposit	1.43	1.11	1.96
Investment	0.53	0.31	-0.03
Output	0.25	0.16	0.14
Net worth	2.31	2.89	4.12
$Q_b b$	1.02	1.74	1.68
R^b	0.09	0.12	0.14
R^f	-0.04	-0.02	-0.06
Inflation	0.00	0.01	0.02
Fgn Investment	-0.57	-0.52	-1.07
Fgn output	-0.16	-0.15	-0.31
$R^b - R^{b,*}$	-0.69	-0.30	-1.42

Asset Purchases under Different Haircuts

- Effect of expected asset purchases relative to an economy with no purchases.
- Isolates the risk-taking channel: it activates only when default risk is present ($\delta = 0.4$).

Variable	$\delta = 0$ (no default risk)	$\delta = 0.4$ (Baseline)
Deposit	-0.13	-0.31
Investment	-0.25	-0.22
Output	-0.04	-0.10
Net worth	-0.89	0.58
$Q_b b$	-0.25	0.73
R^b	0.01	0.03
R^f	0.02	0.03
Inflation	0.02	0.00
Fgn Investment	-0.56	0.05
Fgn output	-0.17	0.01
$Q_b^* b^*$	-0.01	-0.02
$R^b - R^{b,*}$	-0.28	0.39

Conclusion

- Default and liquidity risks dampen Home economic & financial conditions, while spillovers depend on cross-country bond adjustments.
- Targeted asset purchases, or anticipation of purchases, help stabilize the economy during a crisis.
- But a standing crisis-time backstop distorts normal times: a risk-taking channel can lower output and investment even when purchases are never used.

Appendix

Households

- Consumption c_t aggregates Home and Foreign consumption sub-baskets, $c_{H,t}$ and $c_{F,t}$, in Armington form:

$$c_t = \left[\alpha_H^{\frac{1}{\phi^c}} \left(c_{H,t} \right)^{\frac{\phi^c - 1}{\phi^c}} + (1 - \alpha_H)^{\frac{1}{\phi^c}} \left(c_{F,t} \right)^{\frac{\phi^c - 1}{\phi^c}} \right]^{\frac{\phi^c}{\phi^c - 1}}$$

- Budget constraint:

$$d_t + b_t^i + c_t \left(1 + \tau^c\right) = \frac{R_{t-1}^d d_{t-1}}{\pi_t} + \frac{R_{t-1}^d b_{t-1}^i}{\pi_t} + w_t l_t + \Pi_t^f + div_t - x - t_t + T_t^{cb}$$

- Endogenous discount factor ensures stationarity [Uzawa (1968); Schmitt-Grohé & Uribe (2003)]

Wholesale Firms

- Issue long-term private bonds to finance investment with loan-in-advance constraint [Sims & Wu (2021)]:

$$
\begin{aligned}
(\zeta_t^1) \qquad & K_t = I_t^w + (1-\delta)K_{t-1} \\
(\zeta_t^2) \qquad & Q_t^f \left(f_t - \kappa^f \frac{f_{t-1}}{\pi_t} \right) \geq \eta^I p_t^k I_t^w
\end{aligned}
$$

- Produce output using labor and private capital:

$$
y_t^w = I_t^{1-\alpha} K_{t-1}^{\alpha}
$$

- Optimality conditions:

$$
\begin{aligned}
\zeta_t^1 &= p_t^k (1 + \eta^I \zeta_t^2) \\
Q_t^f (1 + \zeta_t^2) &= \beta E_t \Lambda_{t,t+1} \frac{1}{\pi_{t+1}} \left(1 + \kappa^f Q_{t+1}^f (1 + \zeta_{t+1}^2) \right) \\
\zeta_t^1 &= \beta E_t \Lambda_{t,t+1} \left(\frac{p_{t+1}^w \alpha y_{t+1}}{K_t} (1 - \tau^i) + (1-\delta)\zeta_{t+1}^1 \right)
\end{aligned}
$$

Calibrated Parameters

Back

Parameter	Value	Description
κ^f	$1-40^{-1}$	Coupon decay, private bonds (10-yr maturity)
κ^b	$1-28^{-1}$	Coupon decay, government bonds (7-yr maturity)
η^l	0.65	Fraction of investment financed by debt
ϕ	4	Steady-state leverage ratio
η^v	0.59	Recoverability / divertibility parameter
$\frac{Q^f f}{4y}$	1.1	Private bonds as share of GDP
$\frac{Q^b b}{4y}$	1.05	Government bonds as share of GDP
τ^c	0.22	Consumption tax rate
τ^i	0.20	Income tax rate
γ_b	0.7	Home bias in sovereign holdings
δ_b	0.4	Default haircut
$\kappa^{f,*}$	$1-40^{-1}$	Coupon decay, private bonds (10-yr maturity)
$\kappa^{b,*}$	$1-24^{-1}$	Coupon decay, government bonds (6-yr maturity)
$\eta^{l,*}$	0.75	Fraction of investment financed by debt
$\frac{Q^{f,*} f^*}{4y^*}$	1.2	Private bonds as share of GDP
γ_b^*	0.8	Home bias in sovereign holdings
σ_b	-2	Interest-rate elasticity of asset demand
ϕ^c	1.3	Elasticity of subst. Home/Foreign goods
σ	0.95	FI survival probability

Breaking Down a Crisis

Table: Changes Following a Debt Crisis

	Data	Baseline	No liquidity risk	No FL shift	No debt change
Debt	6.1	6.0	4.5	4.3	2.0
Investment	-34	-8.8	-2.3	-2.6	-6.1
Yield Spread	5.0	6.3	2.0	1.2	5.0
Excess Return	5.1	5.0	1.0	0.9	4.0

Connections to Literature

- Central-bank asset purchases with financial frictions:

  Gertler & Karadi (2011); Carlstrom, Fuerst & Paustian (2017); Sims & Wu (2021); Kirchner & van Wijnbergen (2016); Krenz (2022)

- Sovereign–bank nexus & sovereign stress:

  Gennaioli, Martin & Rossi (2014); Bocola (2016); Pérez (2021); Arellano, Bai & Bocola (2026); Acharya & Steffen (2015); Acharya, Eisert, Eufinger, & Hirsch (2018)

- Intermediary liquidity & risk-bearing capacity:

  Brunnermeier & Pedersen (2009); Adrian & Shin (2010); He & Krishnamurthy (2013); Brunnermeier & Sannikov (2014)

- Monetary unions & international transmission:

  Erceg & Lindé (2013); Nakamura & Steinsson (2014); Farhi & Werning (2017); Bianchi & Melosi (2022)