International Debt Deleveraging

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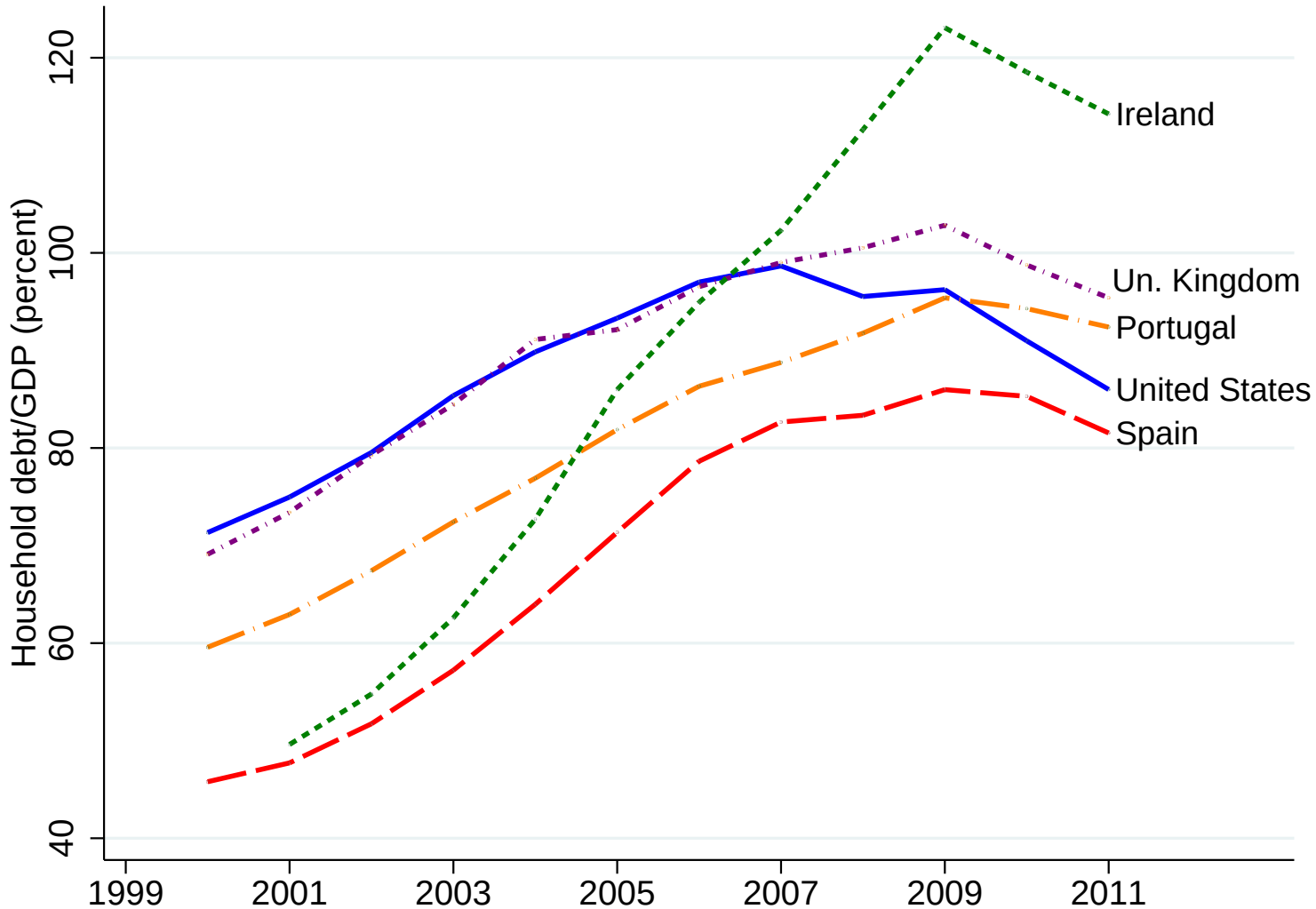
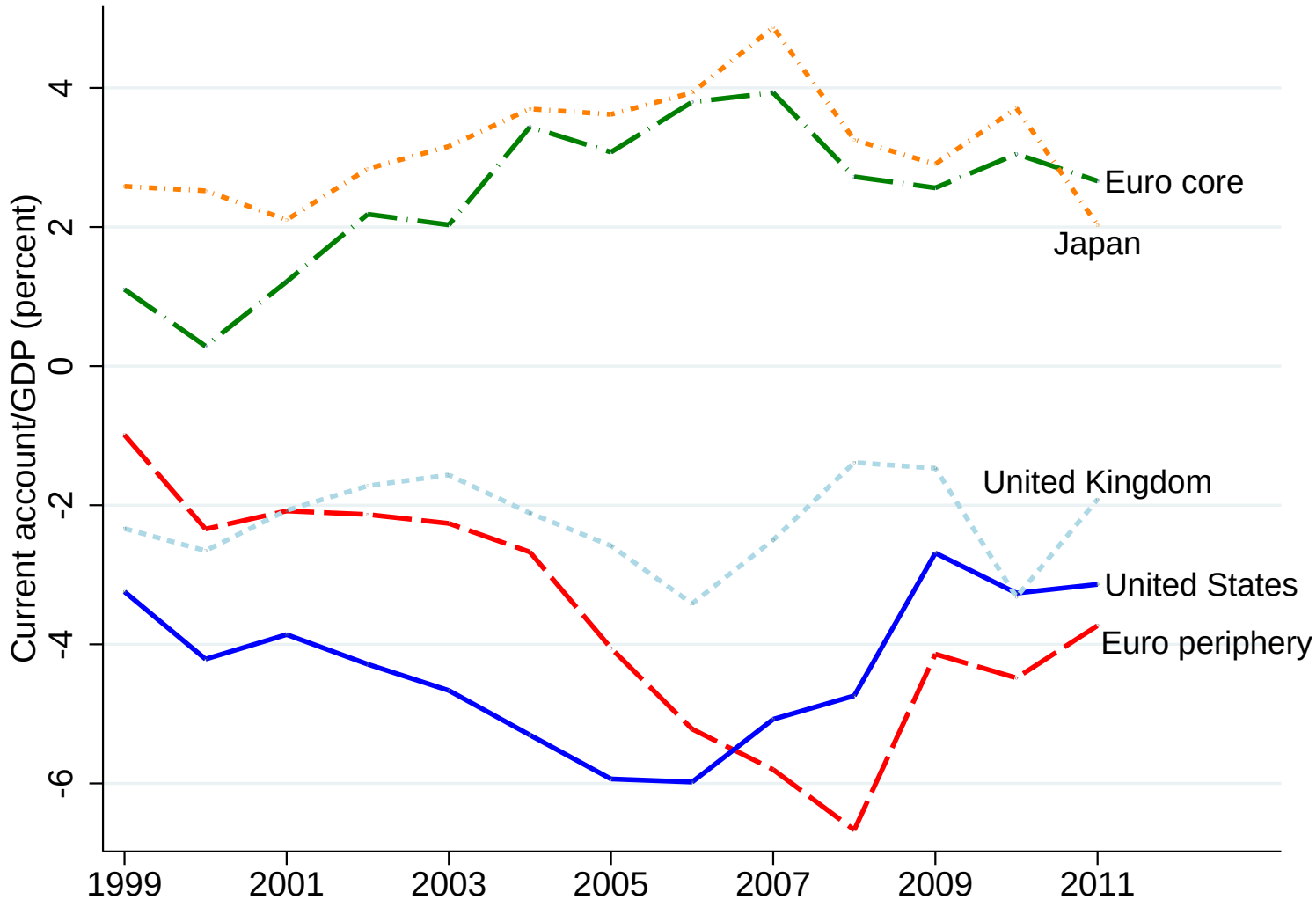
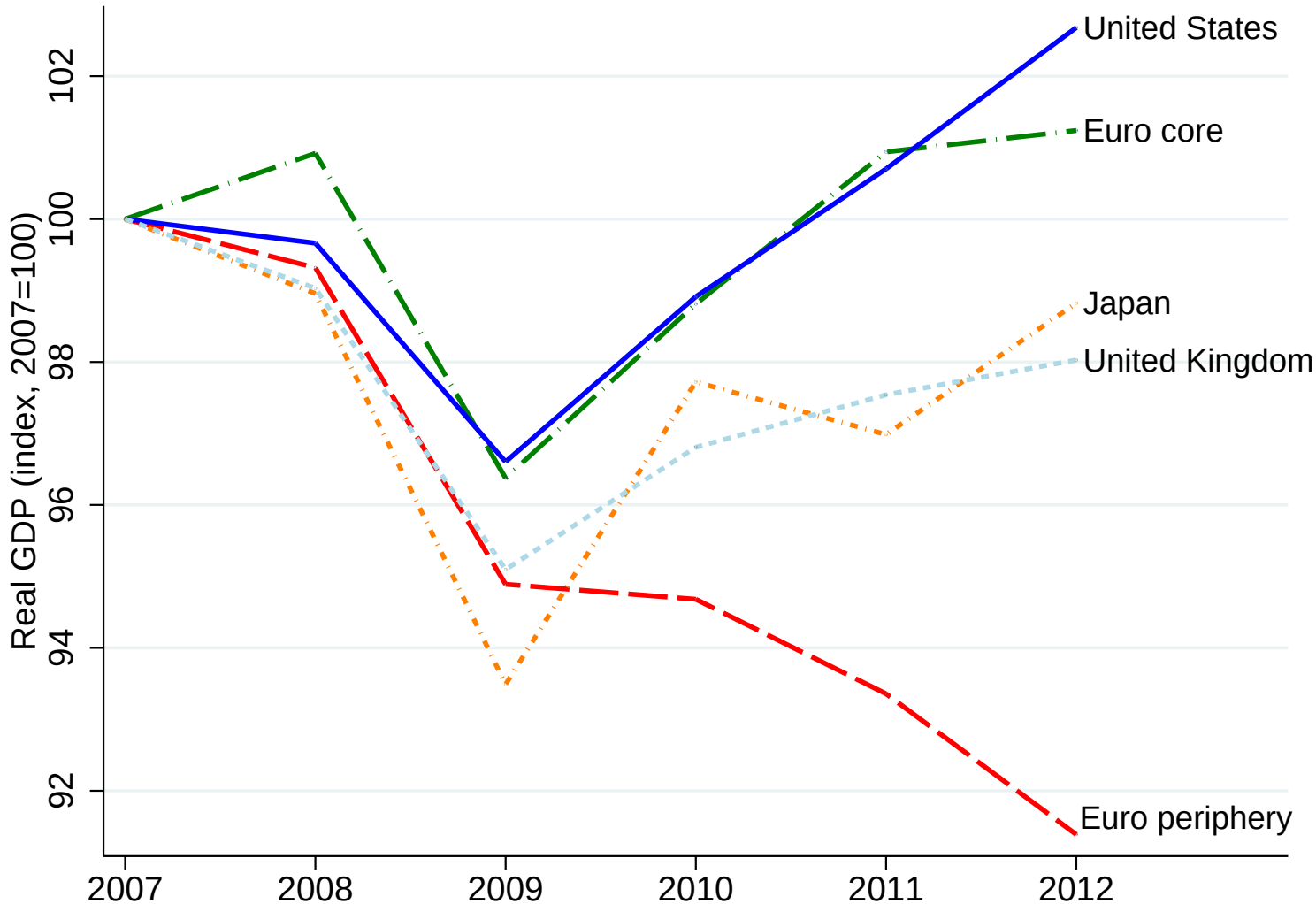
Motivating facts: Household debt/GDP



Motivating facts: Current account/GDP



Motivating facts: GDP



Research questions

- What happens when a group of financially integrated countries enters a process of debt deleveraging?
- What role does the exchange rate regime play?

This paper

- Provides a framework for understanding debt deleveraging in a group of financially integrated countries
- Key result: monetary unions are particularly prone to enter a liquidity trap during deleveraging

Overview of the framework

- World featuring a continuum of small open economies
- Foreign borrowing/lending is used to smooth the impact of idiosyncratic productivity shocks on consumption
- The deleveraging process is triggered by an unexpected permanent decrease in the (exogenous) borrowing limit

Overview of the results

- An unexpected drop in the borrowing limit generates a fall in the world interest rate
- With flexible exchange rates, production shifts toward high debt countries
- In a monetary union with nominal wage rigidities
  - The fall in the interest rate is amplified
  - Liquidity trap is associated with deep recession, especially in high-debt countries

Related literature

- **Exchange rate regime and crises:** Cespedes, Chang and Velasco (2004), Christiano, Gust and Roldos (2004), Gertler, Gilchrist and Natalucci (2007), Schmitt-Grohe and Uribe (2011)

- **Deleveraging and liquidity traps:** Eggertsson and Krugman (2010), Guerrieri and Lorenzoni (2010), Benigno and Romei (2012)

Outline

A model of international deleveraging

Deleveraging with flexible wages

Deleveraging in a monetary union with nominal wage rigidities

The zero lower bound

Policy experiments

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Model

- World composed of a continuum of small open economies
- Each economy is inhabited by a continuum of measure 1 of households and by a large number of firms

Household

- Expected lifetime utility in country i

$$E_0 \left[\sum_{t=0}^{\infty} \beta^t U \left(C_{i,t}^T, C_{i,t}^N, L_{i,t} \right) \right]$$

- Budget constraint

$$C_{i,t}^T + p_{i,t}^N C_{i,t}^N + \frac{B_{i,t+1}}{R_t} = w_{i,t} L_{i,t} + B_{i,t} + \Pi_{i,t}$$

- Borrowing constraint

$$B_{i,t+1} \geq -\kappa$$

Optimality conditions

Firms

- Tradable sector

$$Y_{i,t}^{T} = A_{i,t}^{T} \left(L_{i,t}^{T}\right)^{\alpha_T}$$

- $A_{i,t}^{T}$ is a country-specific productivity shock

- Non-tradable sector

$$Y_{i,t}^{N} = A^{N} \left(L_{i,t}^{N}\right)^{\alpha_N}$$

Market clearing

- Tradable consumption good

$$C_{i,t}^T = Y_{i,t}^T - \frac{B_{i,t+1}}{R_t} + B_{i,t}$$

- Non-tradable consumption good

$$C_{i,t}^N = Y_{i,t}^N$$

- Labor

$$L_{i,t} = L_{i,t}^T + L_{i,t}^N$$

- World market clearing

$$\int_0^1 C_{i,t}^T \, \mathrm{d}i = \int_0^1 Y_{i,t}^T \, \mathrm{d}i \iff \int_0^1 B_{i,t+1} \, \mathrm{d}i = 0$$

Some useful definitions

- The stock of net foreign assets owned by country i at the end of period t is

$$NFA_{i,t} = \frac{B_{i,t+1}}{R_t}$$

- Current account

$$NFA_{i,t} - NFA_{i,t-1} = CA_{i,t} = Y^T_{i,t} - C^T_{i,t} + B_{i,t}\left(1 - \frac{1}{R_{t-1}}\right)$$

Functional forms

- Preferences

$$U\left(C^T, C^N, L\right) = \frac{C^{1-\gamma}}{1-\gamma} - \frac{L^{1+\psi}}{1+\psi}$$

$$C = \left(C^T\right)^{\omega} \left(C^N\right)^{1-\omega}$$

- Productivity shock

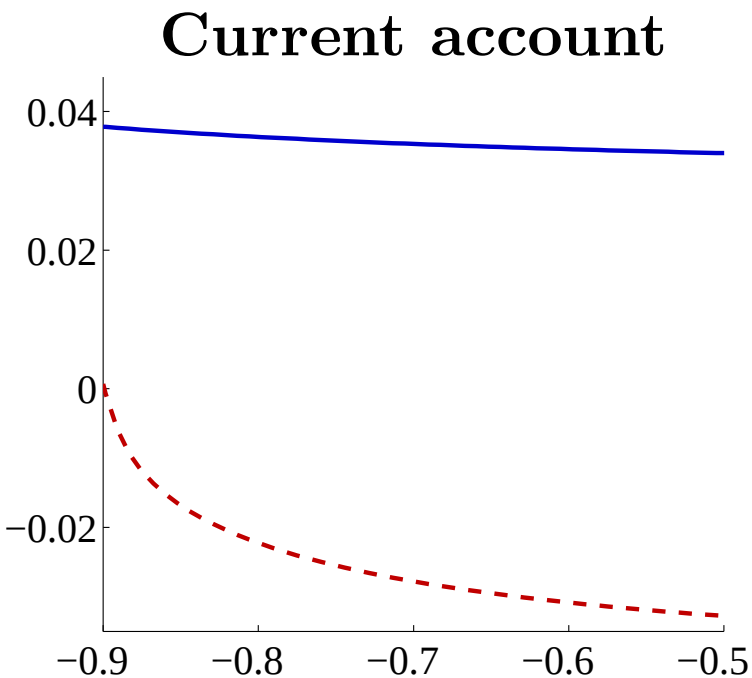
$$A^T_{i,t} = \rho A^T_{i,t-1} + \epsilon_{i,t}$$

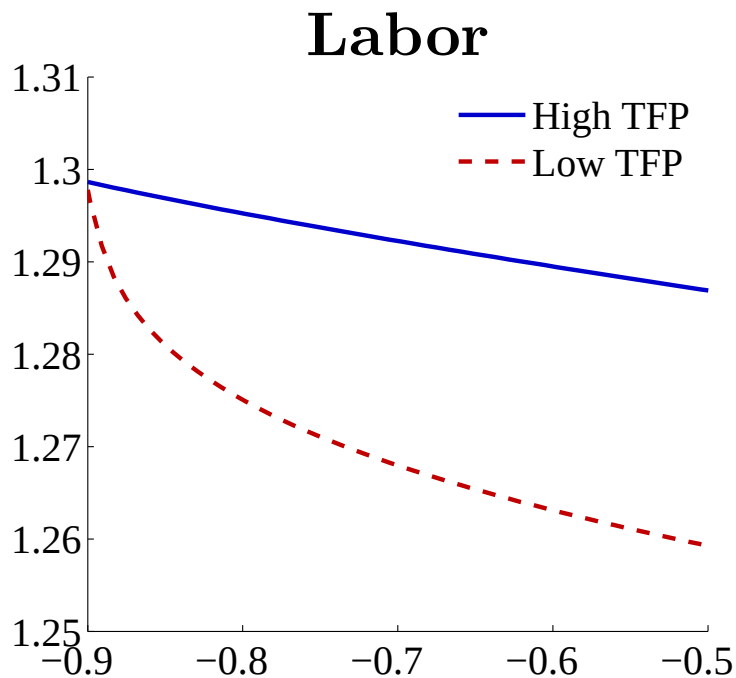
Parameters

Table 1: Parameters (annual)

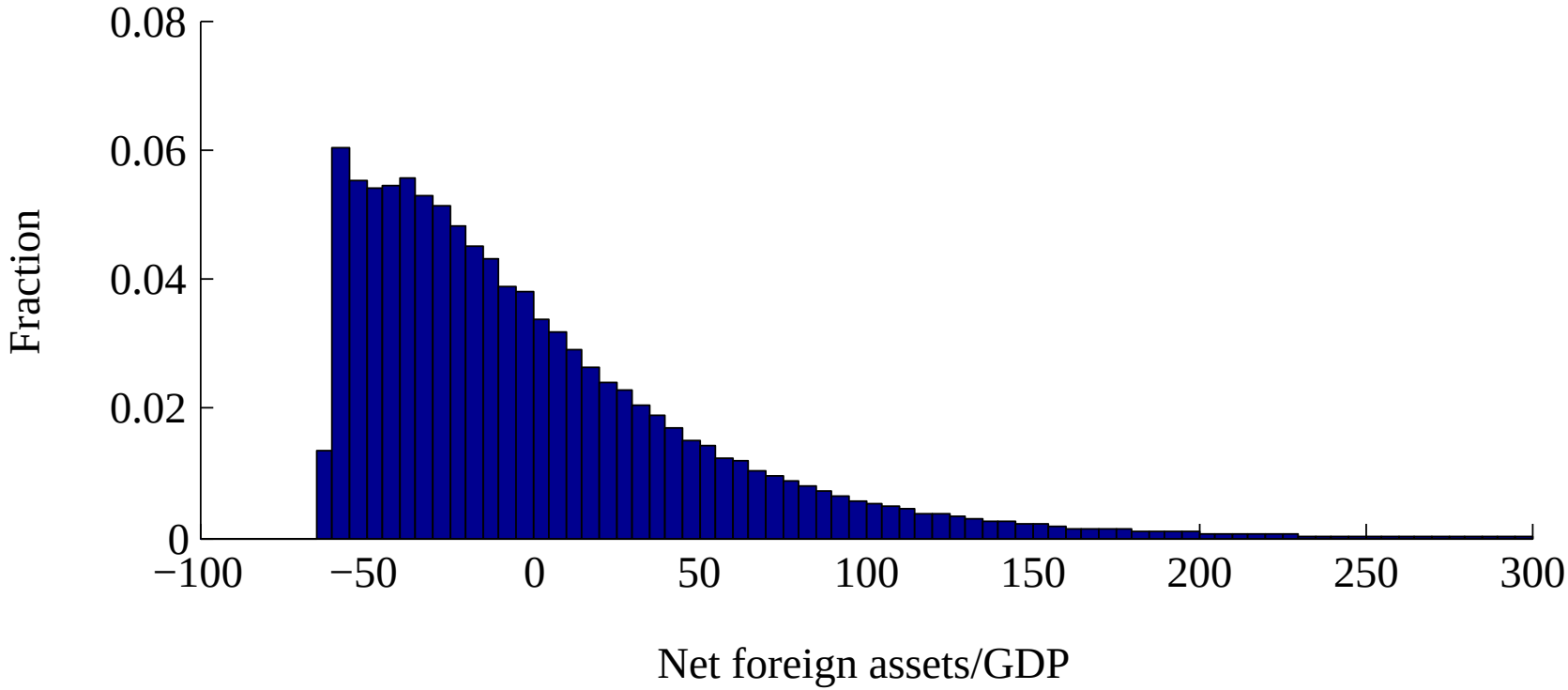
	Value	Source/Target
Risk aversion	$\gamma = 4$	Standard value
Discount factor	$\beta = 0.9756$	$R = 1.025$
Frisch elasticity of labor supply	$1/\psi = 1$	Kimball and Shapiro (2008)
Labor share in trad. sector	$\alpha_T = 0.65$	Standard value
Labor share in non-trad. sector	$\alpha_N = 0.65$	Standard value
Share of trad. in consumption	$\omega = 0.5$	Stockman and Tesar (1995)
TFP process	$\sigma_\epsilon = 0.0194$	Benigno and Thoenissen (2008)
	$\rho = 0.84$	
Initial borrowing limit	$\kappa = 0.9$	Debt/GDP= 20%

Policy functions





Distribution of net foreign assets/GDP



Deleveraging shock

- Start from steady state with $\kappa = \kappa^H$
- Unexpected permanent drop to $\kappa = \kappa^L < \kappa^H$
- I set $\kappa^L = 0.75\kappa^H$ (in the final steady state world debt/GDP is 15 percent) graph

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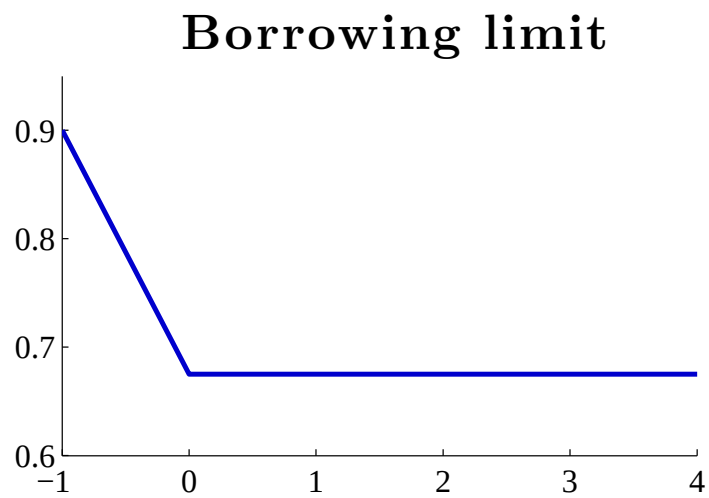
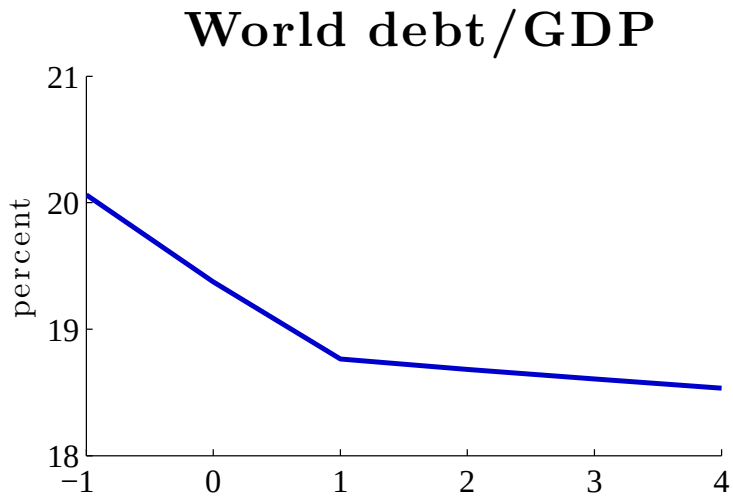
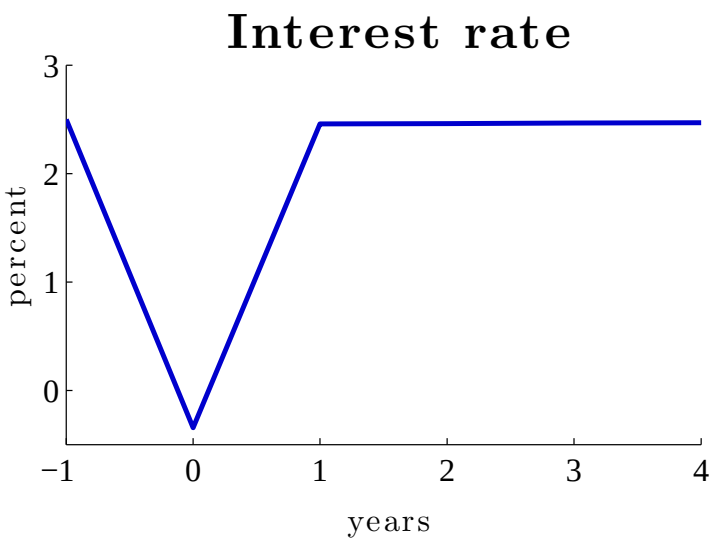
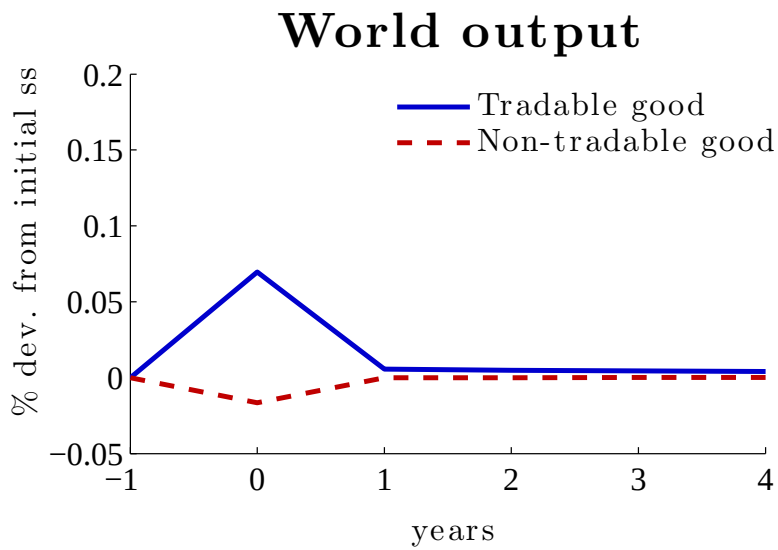
Transitional dynamics

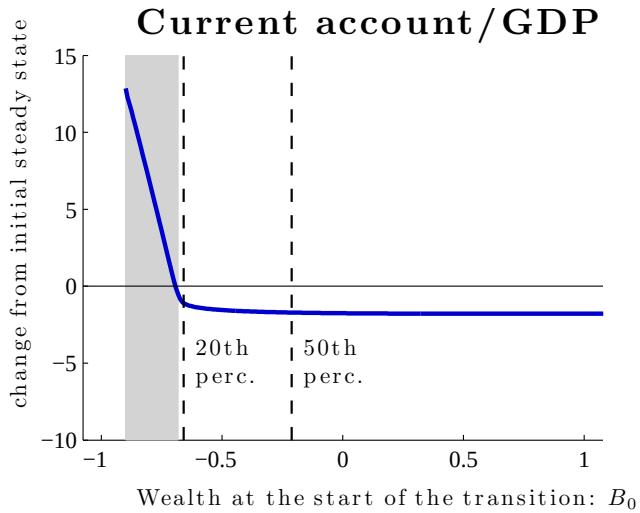


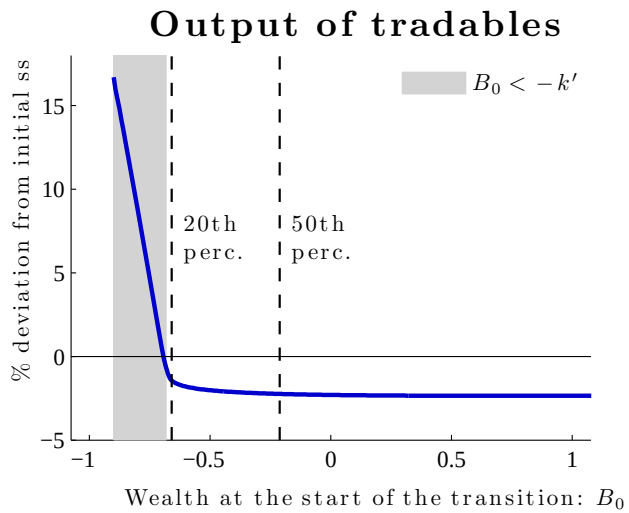


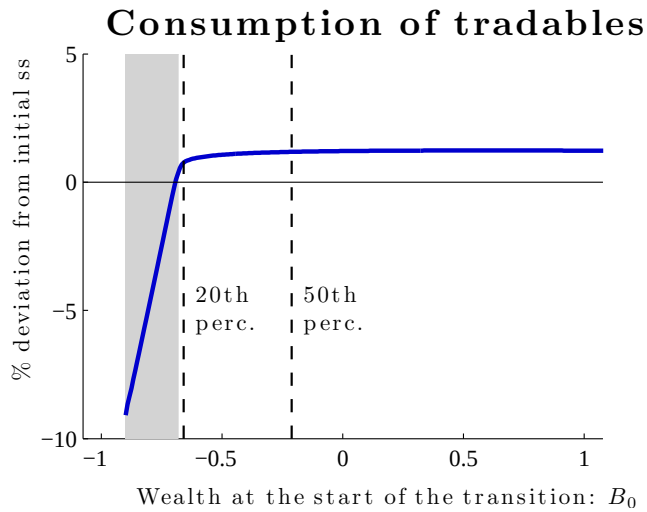


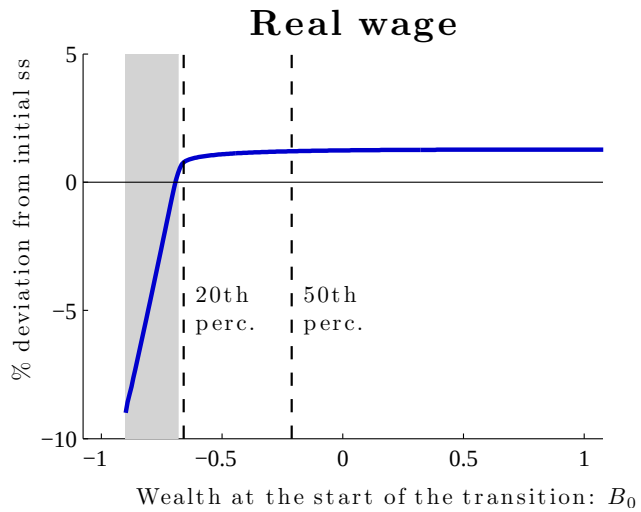


Impact response across the NFA distribution









Current account equation

Wage rigidities and the nominal exchange rate

- Nominal wages adjust slowly to shocks
- Movements in the nominal exchange rate can act as a substitute for nominal wage flexibility Equations

Proposition

From the perspective of a single country the flexible wage equilibrium attains the constrained optimum.

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A monetary union

- Budget constraint in terms of currency

$$P_t^T C_{i,t}^T + P_{i,t}^N C_{i,t}^N + \frac{B_{i,t+1}}{R_t^N} = W_{i,t} L_{i,t} + B_{i,t} + \Pi_{i,t}$$

- Bonds are denominated in units of currency

- Borrowing limit

$$\frac{B_{i,t+1}}{P_{t+1}^T} \geq -\kappa$$

Central bank

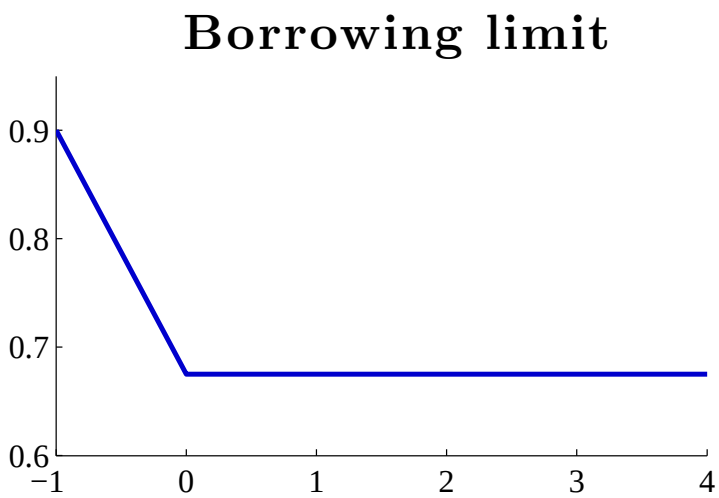
- There is a single central bank that uses R^N as its policy instrument
- Start by considering a central bank that targets zero inflation in the tradable sector

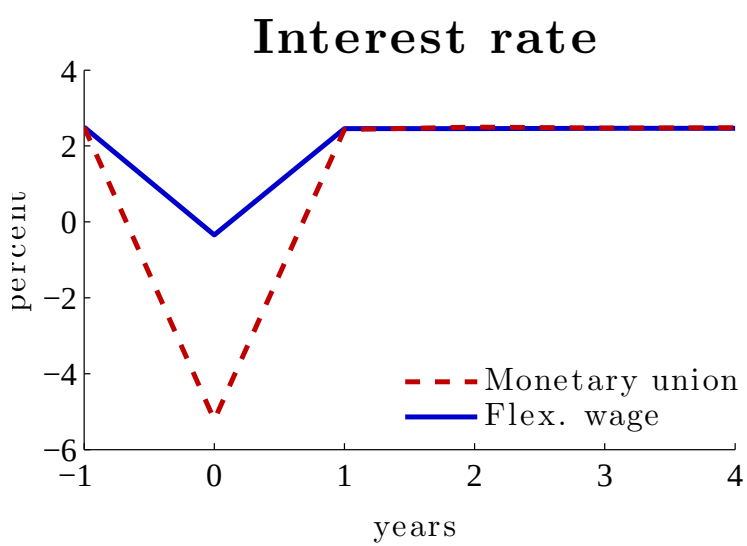
$$P^T_{t+1} = P^T_t$$

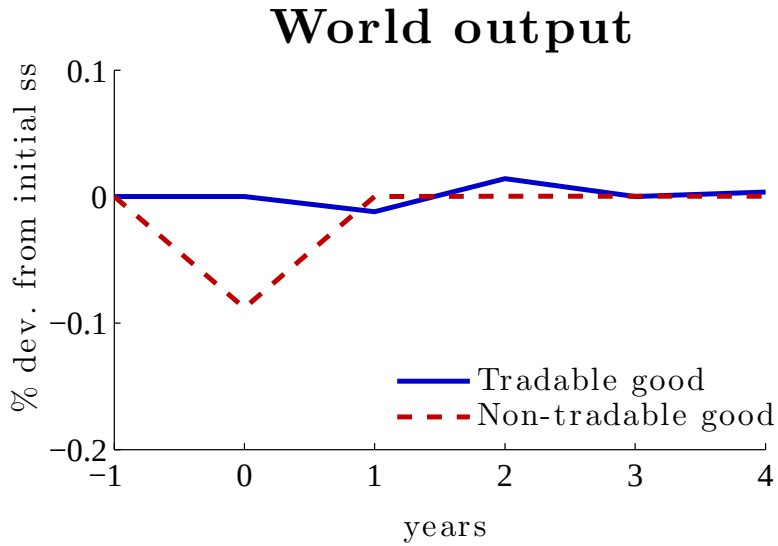
Nominal wage rigidities

- Nominal wages are fixed in the short run (period 0)
- From period $t = 1$ wages are fully flexible

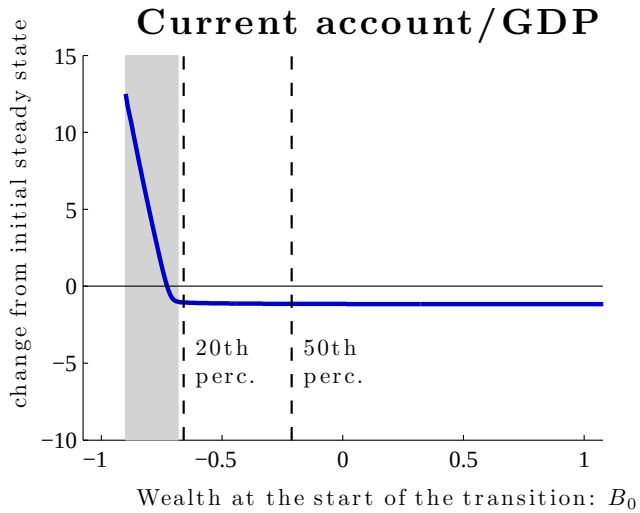
Transitional dynamics in a monetary union

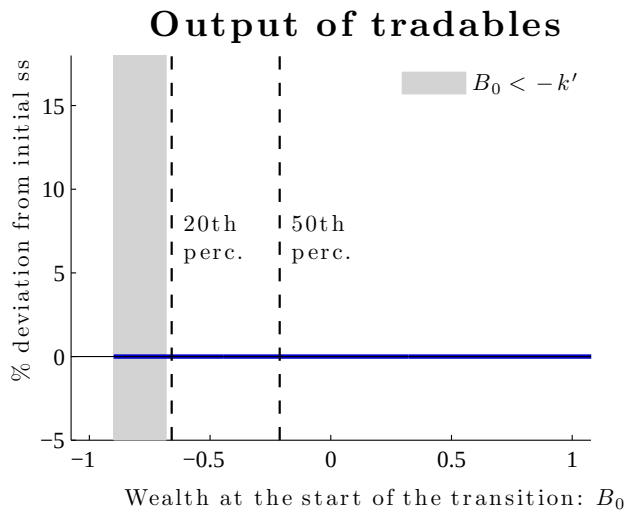


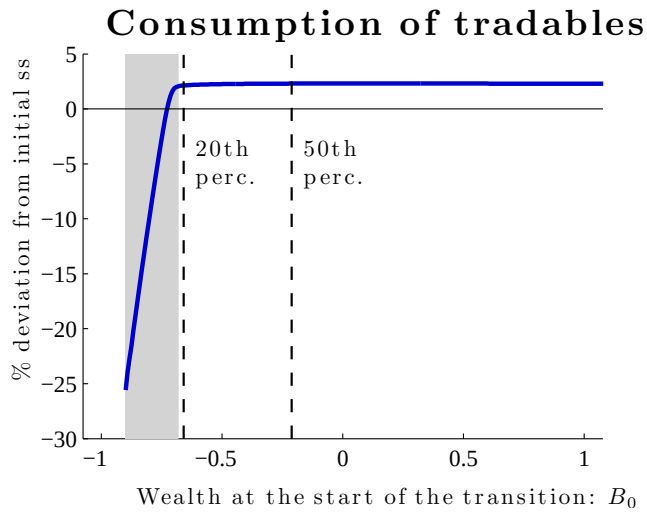


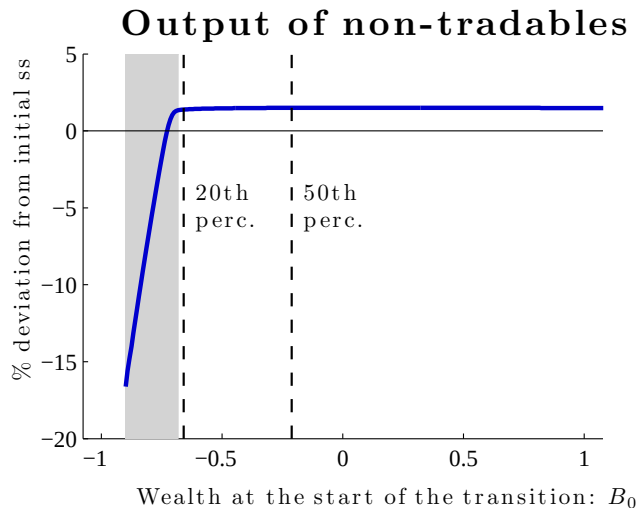


Impact response across the NFA distribution









Production of non-tradables

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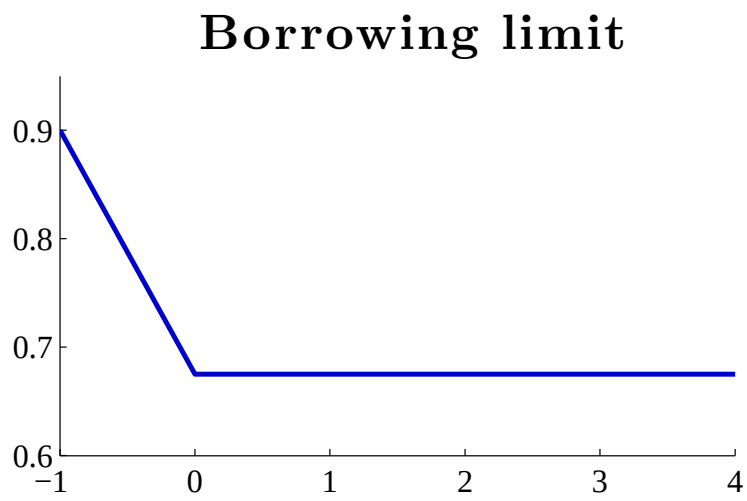
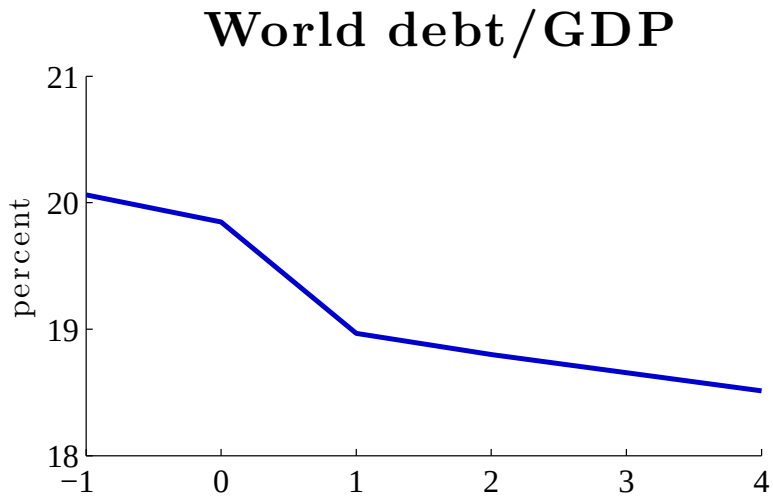
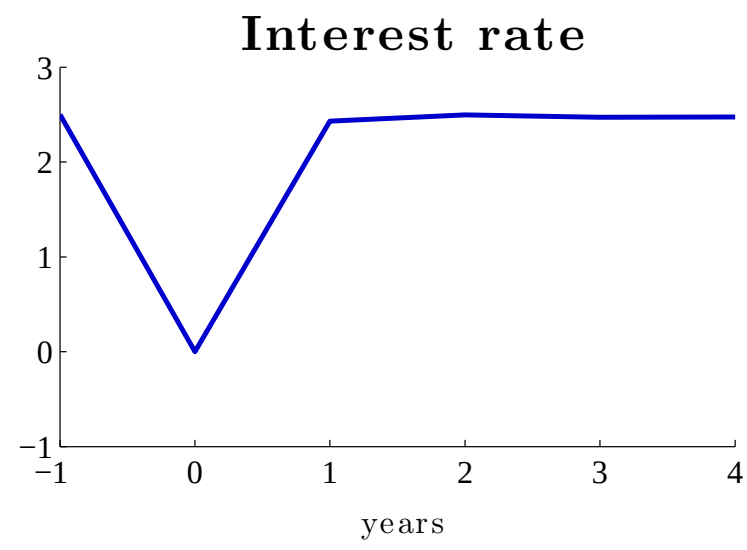
The zero lower bound

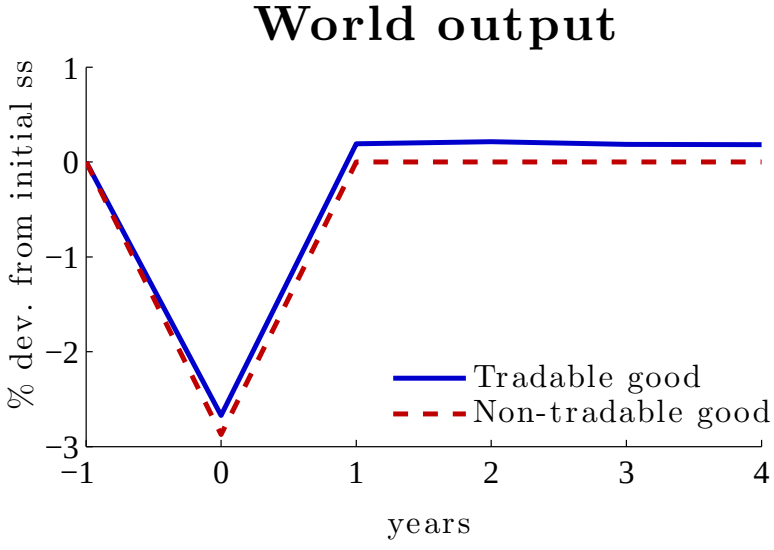
- Define $\hat{R}_t^N$ as the nominal interest rate consistent with the inflation target
- Now monetary policy is given by $R_t^N = MAX\left(\hat{R}_t^N, 1\right)$
- During period 0, the price of the tradable good has to fall to guarantee market clearing
- Two effects
  - Employment in the tradable sector decreases
  - Fisher's debt-deflation: the real debt burden increases

Transitional dynamics in a liquidity trap









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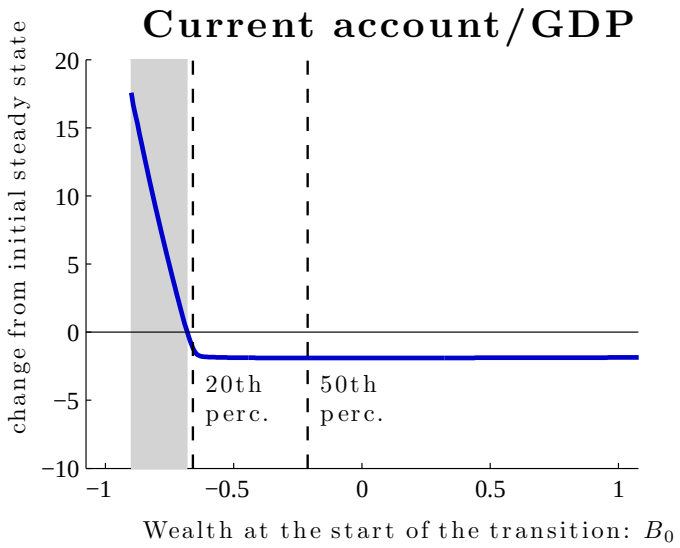
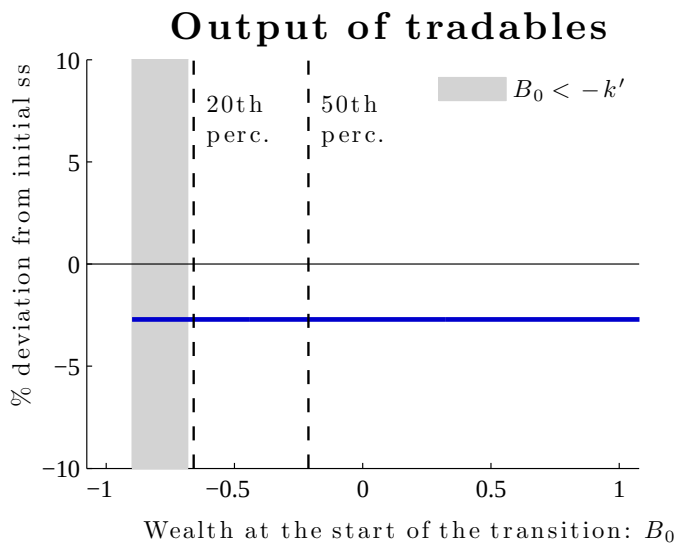
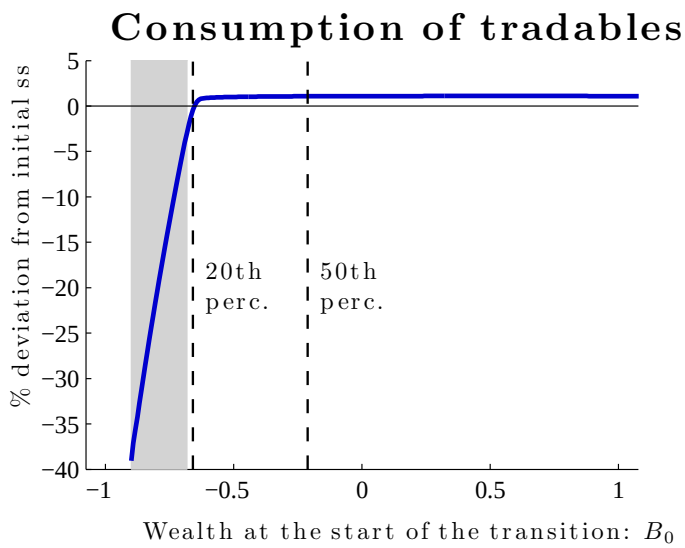
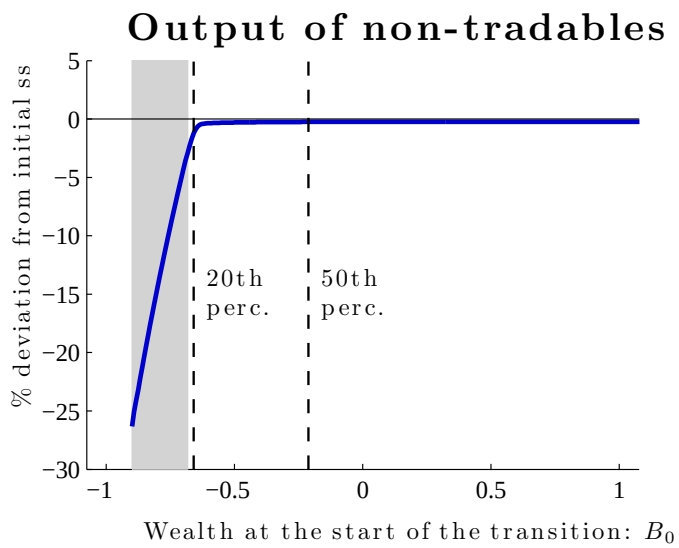






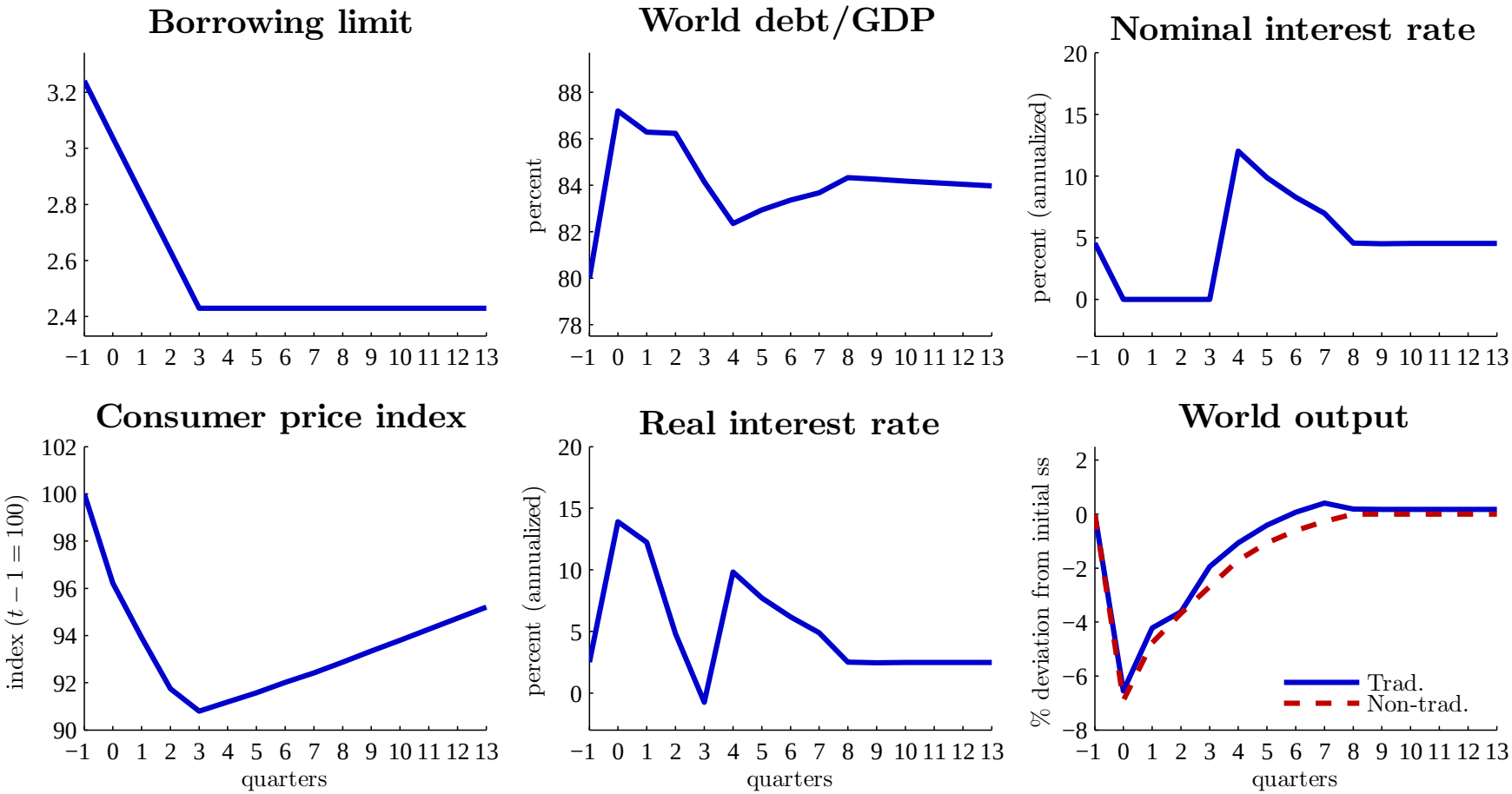


Outline

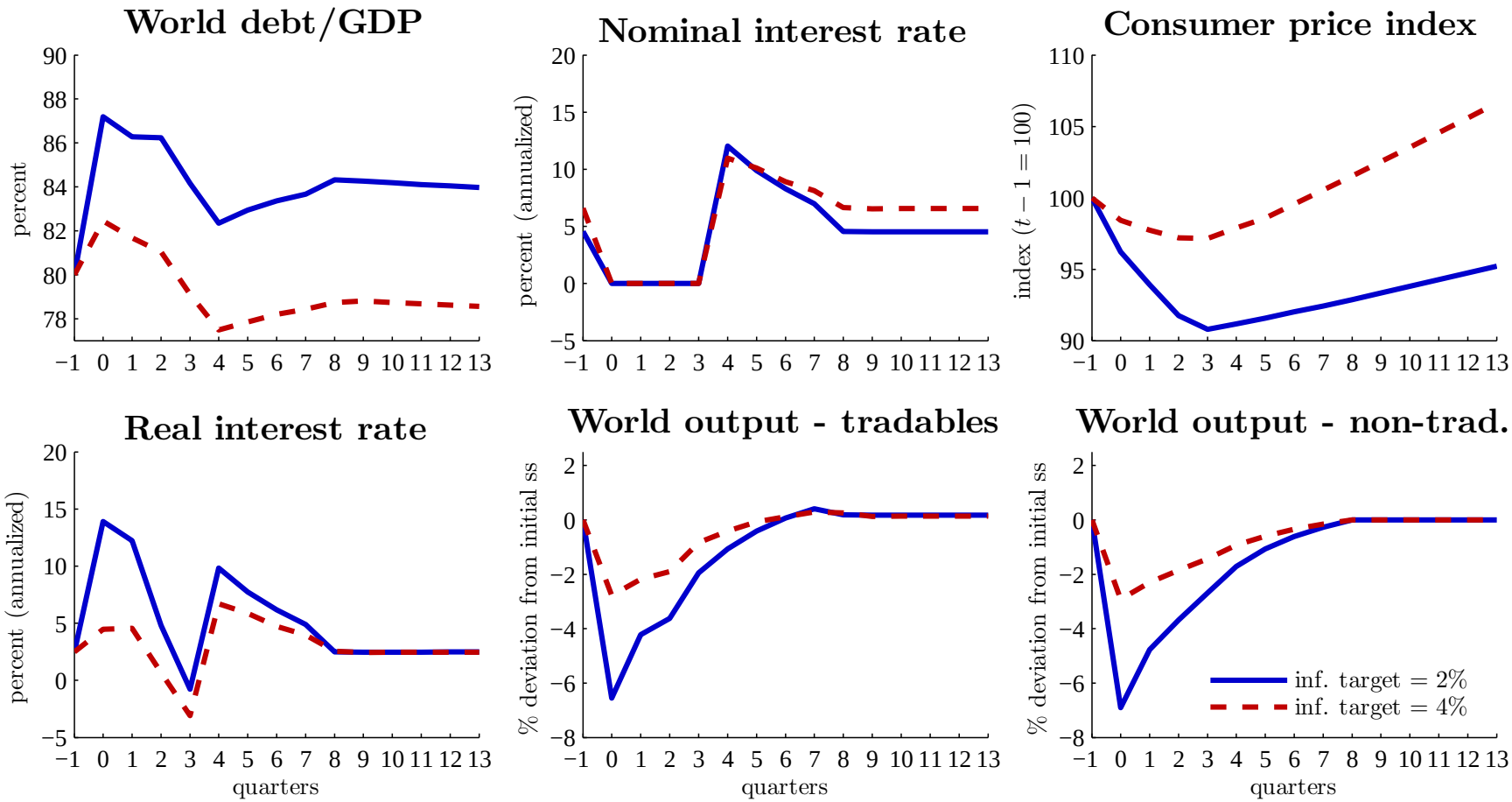
Policy experiments

- One period is a quarter
- Persistent nominal wage rigidities
- Gradual tightening of the borrowing limit

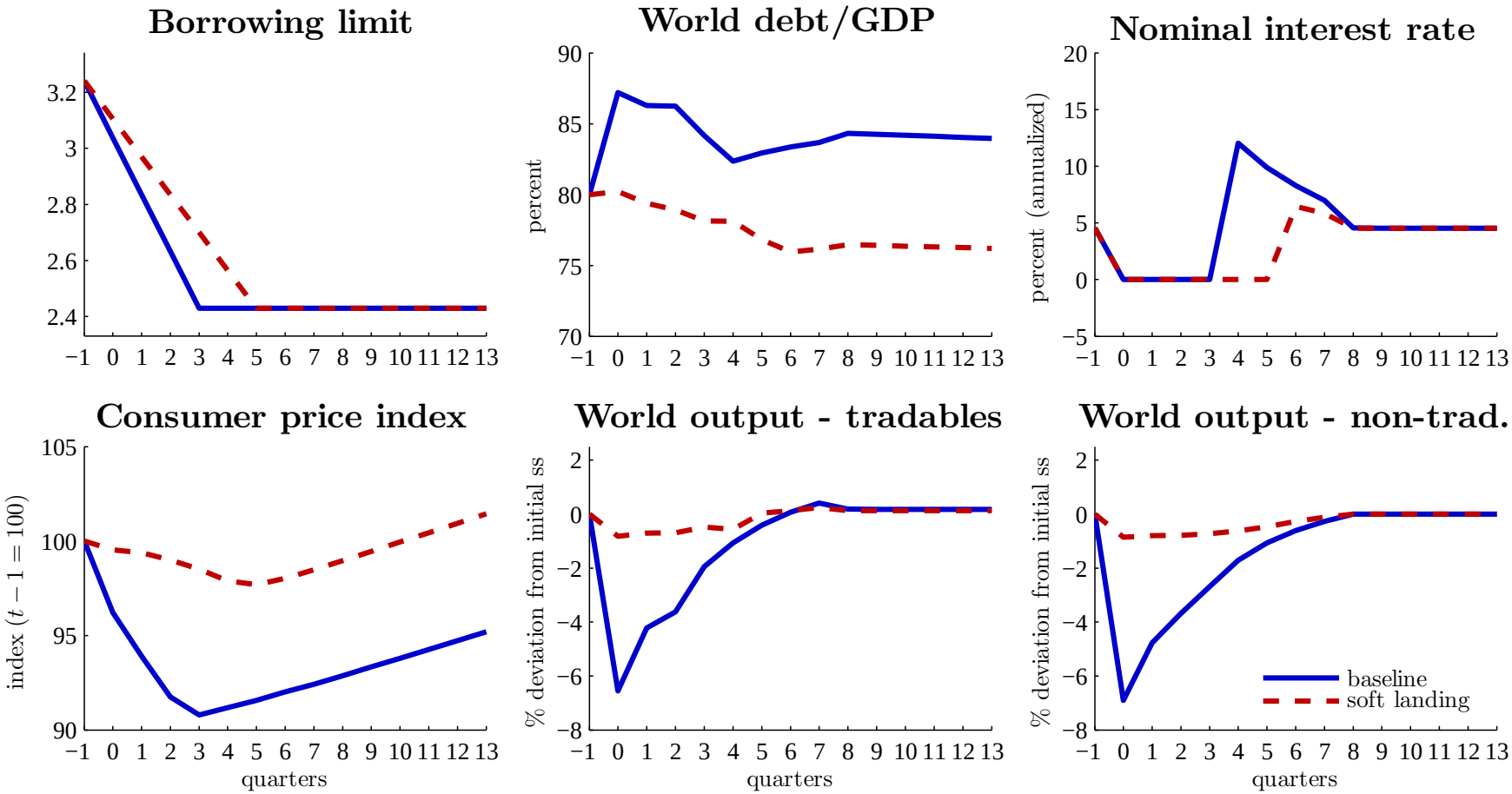
Transitional dynamics



Changing the inflation target



"Soft landing"



Conclusion

- Main message: monetary unions are particularly prone to enter a liquidity trap during deleveraging
- Other policy tools
  - Fiscal transfers and debt relief policies (Fornaro 2013)

Thank you

Household's optimality conditions

$$p_{i,t}^N = \frac{U_{C_{i,t}^N}}{U_{C_{i,t}^T}}$$

$$-U_{L_{i,t}} = w_{i,t}\, U_{C_{i,t}^T}$$

$$\frac{U_{C_{i,t}^T}}{R_t} = \beta E_t \left[U_{C_{i,t+1}^T} \right] + \mu_{i,t}$$

$$B_{i,t+1} \geq -\kappa, \quad \text{with equality if } \mu_{i,t} > 0,$$

Back

Nominal wage rigidities and the exchange rate

- Define S_i as country i nominal exchange rate against the key international currency

$$P_{i,t}^T = S_{i,t} P_t^T$$

- Normalize $P^T = 1$, firms' labor demand implies

$$L_{i,t}^T = \left(\alpha_T A_{i,t}^T \frac{S_{i,t}}{W_{i,t}} \right)^{\frac{1}{1-\alpha_T}}$$

Back

The current account

$$CA_{i,t} = Y_{i,t}^{T} - C_{i,t}^{T} + B_{i,t}\left(1 - \frac{1}{R_{t-1}}\right)$$

Back

Real exchange rate and production of non-tradables

- Real exchange rate

$$P_{i,t}^N = \frac{1-\omega}{\omega} \frac{C_{i,t}^T}{C_{i,t}^N} P_t^T$$

- Equilibrium labor in the non-tradable sector

$$L_{i,t}^N = \left(\alpha_N A^N \frac{P_{i,t}^N}{W_{i,t}} \right)^{\frac{1}{1-\alpha_N}}$$

Back

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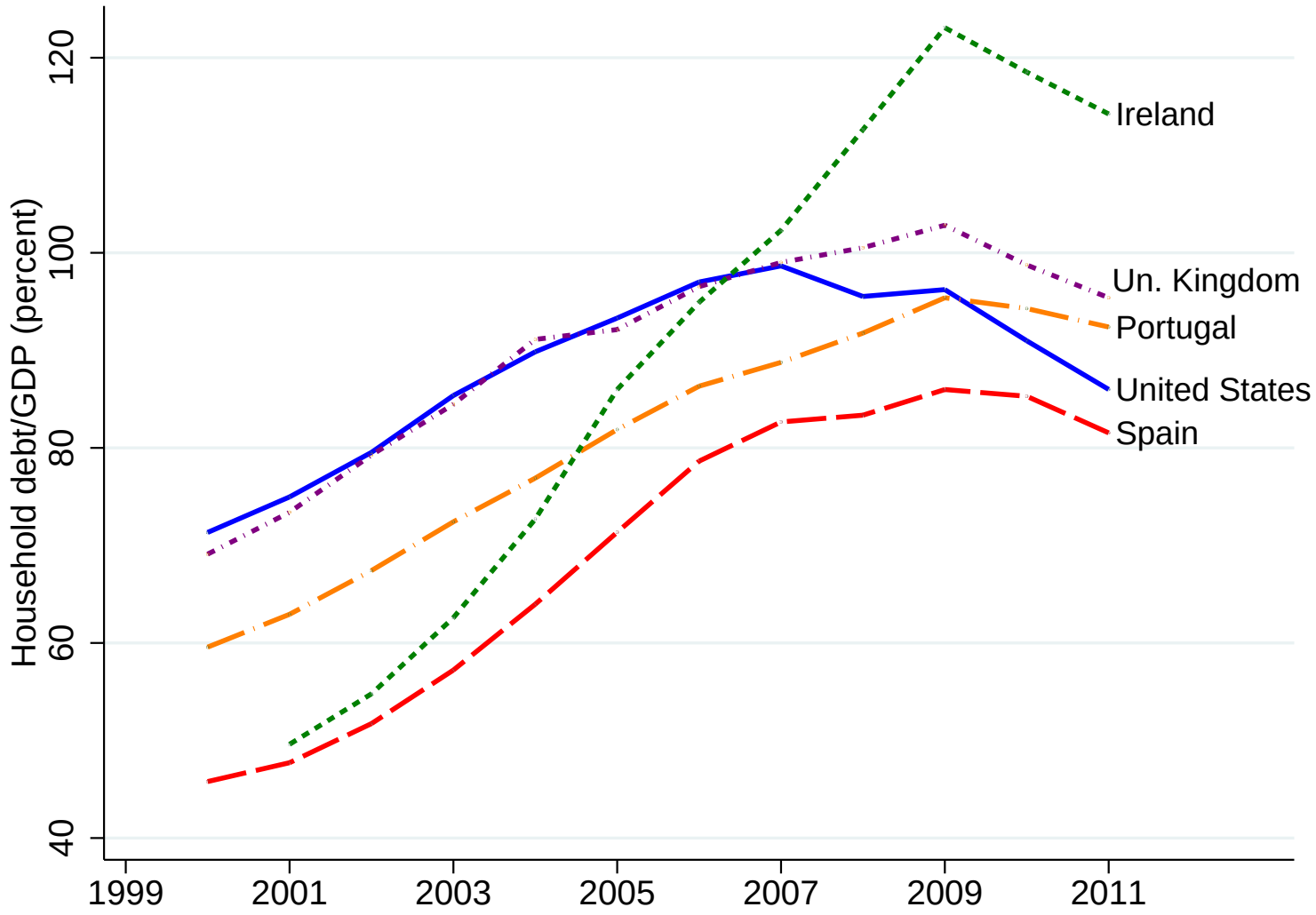

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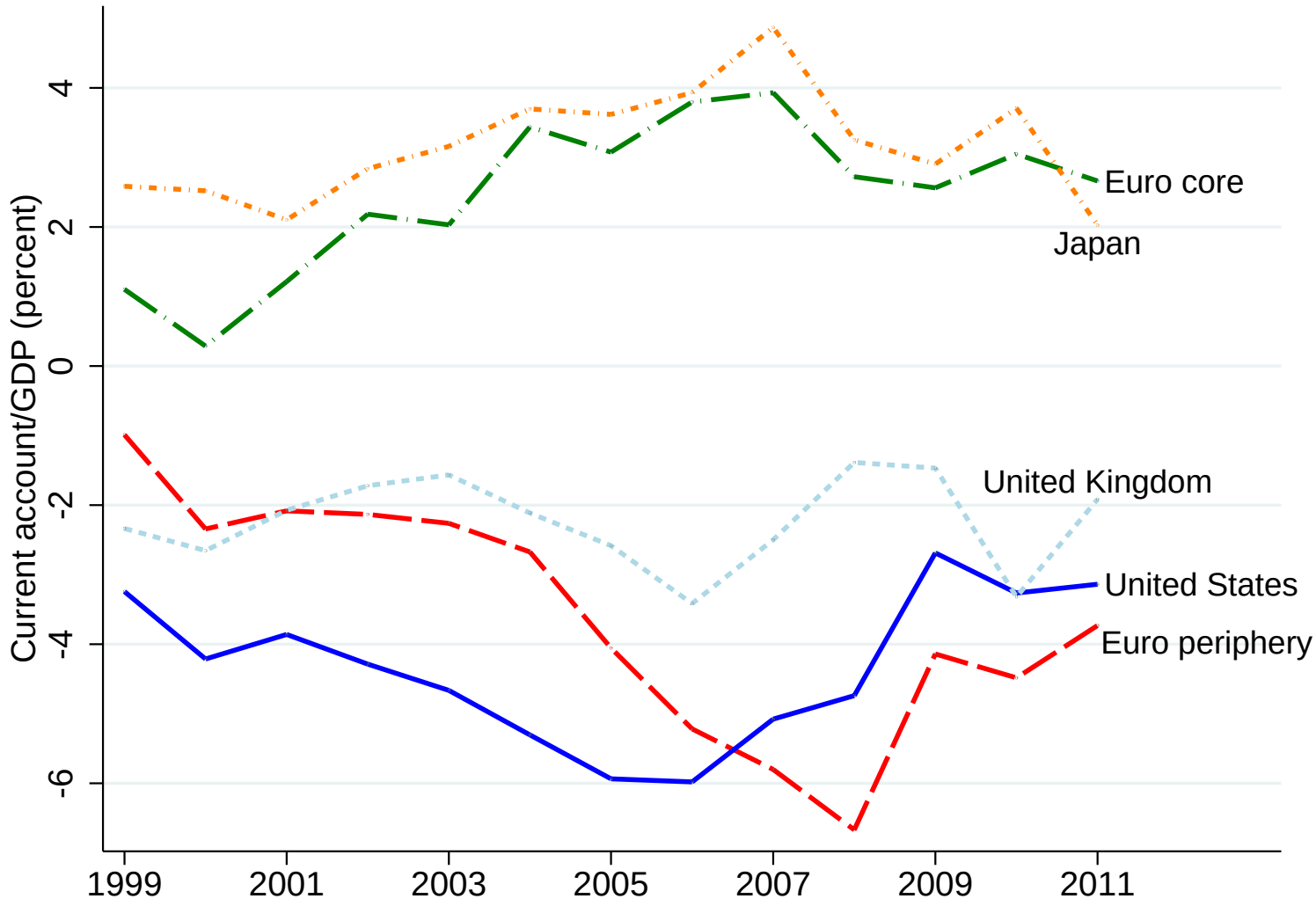
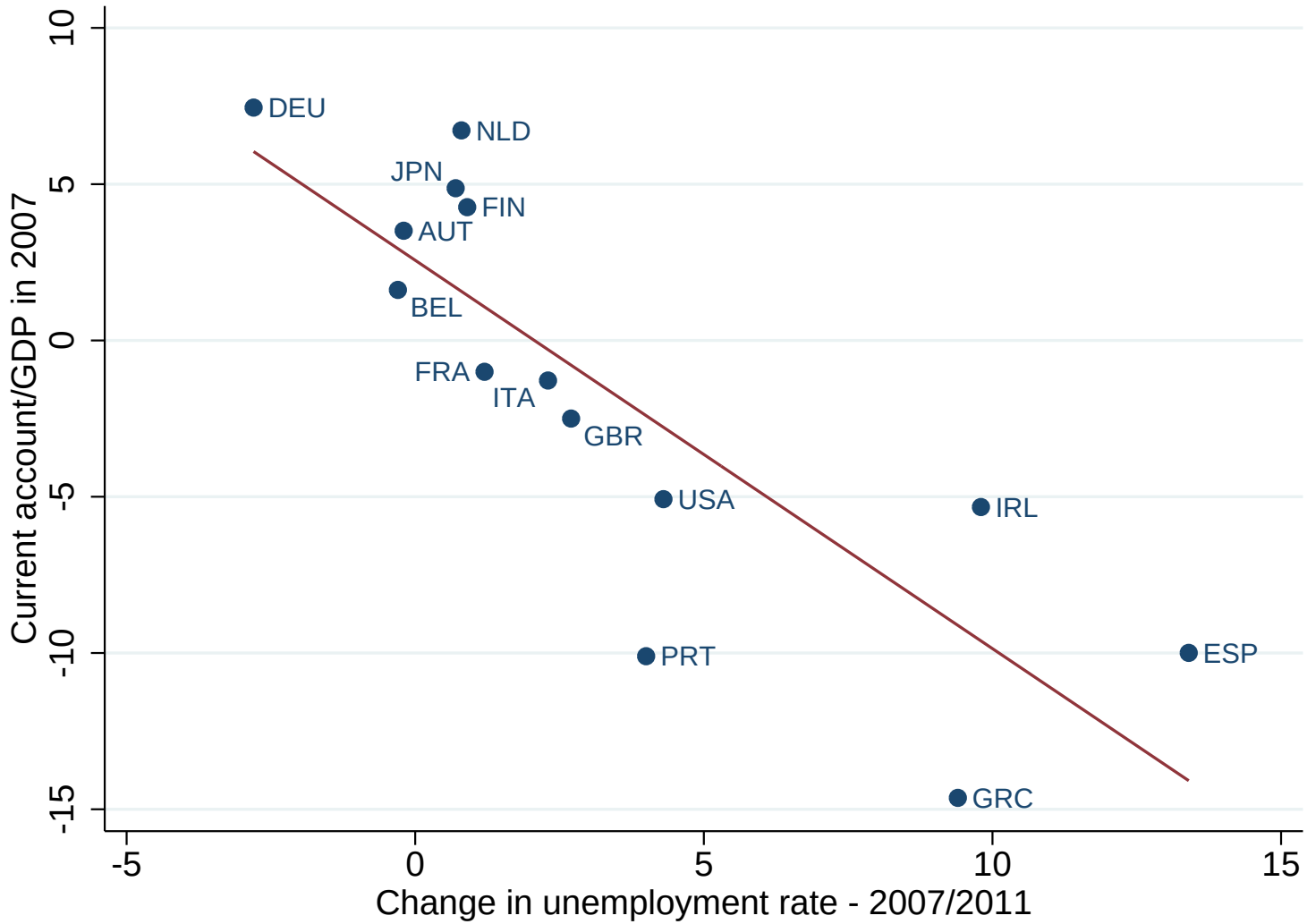
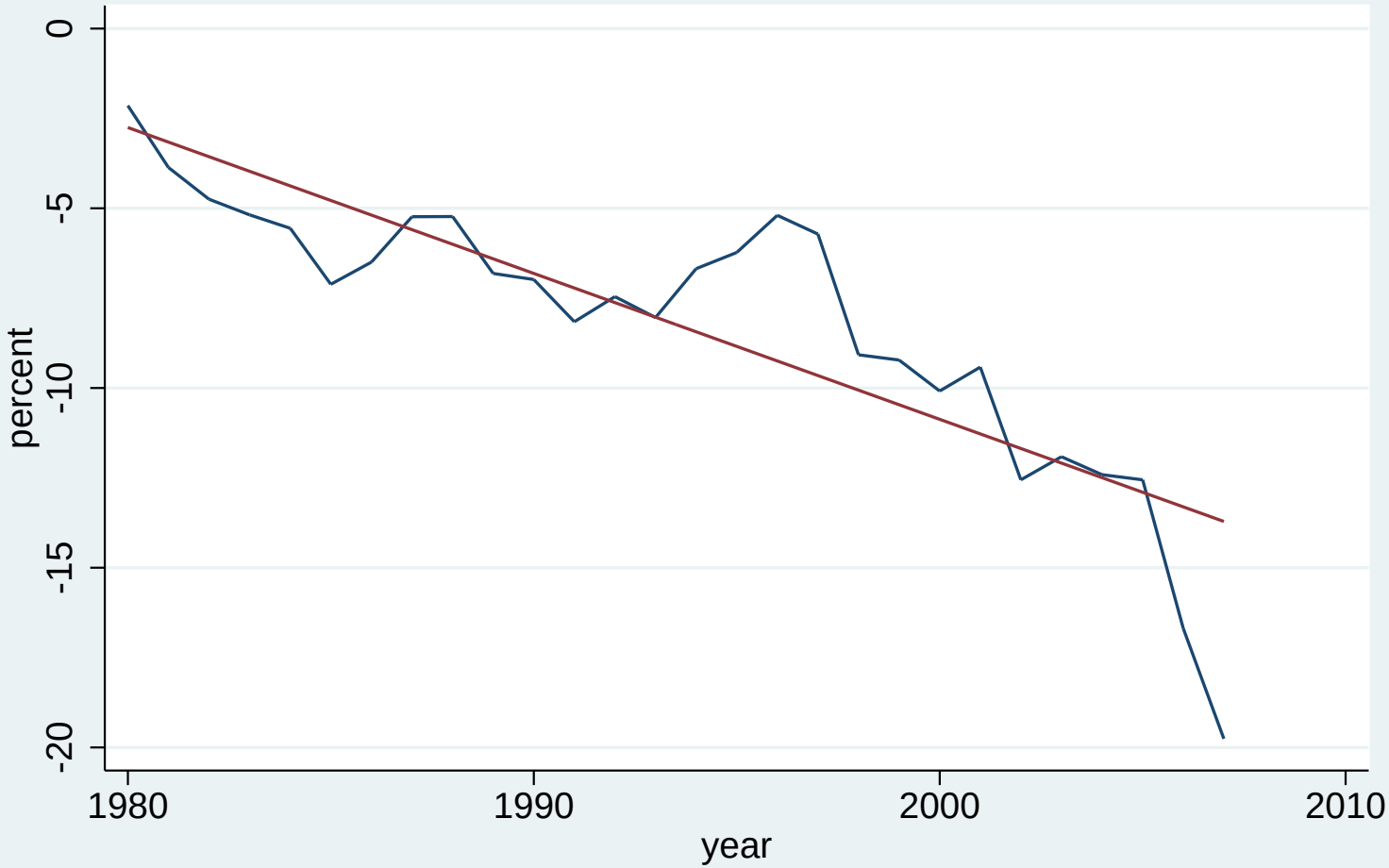


Motivating facts: CA deficits and unemployment



Eurozone: net debtors NFA/GDP



Source: data from Milesi-Ferretti and Lane (2009)

Back

A model with interest rate spreads

- Suppose households in country i are charged the interest rate $R_{i,t}$

$$U_{C_{i,t}^T} = R_{i,t}\beta E_t\left[U_{C_{i,t+1}^T}\right]$$

- Assuming the borrowing constraint in the main text

$$U_{C_{i,t}^T} = \frac{R_t}{1-\frac{\mu_{i,t}R_t}{U_{C_{i,t}^T}}}\beta E_t\left[U_{C_{i,t+1}^T}\right]$$

- The two models are isomorphic if

$$R_{i,t} = \frac{R_t}{1-\frac{\mu_{i,t}R_t}{U_{C_{i,t}^T}}}$$

- and if the spread $R_{i,t} - R_t$ is rebated to households in country i through lump-sum transfers