

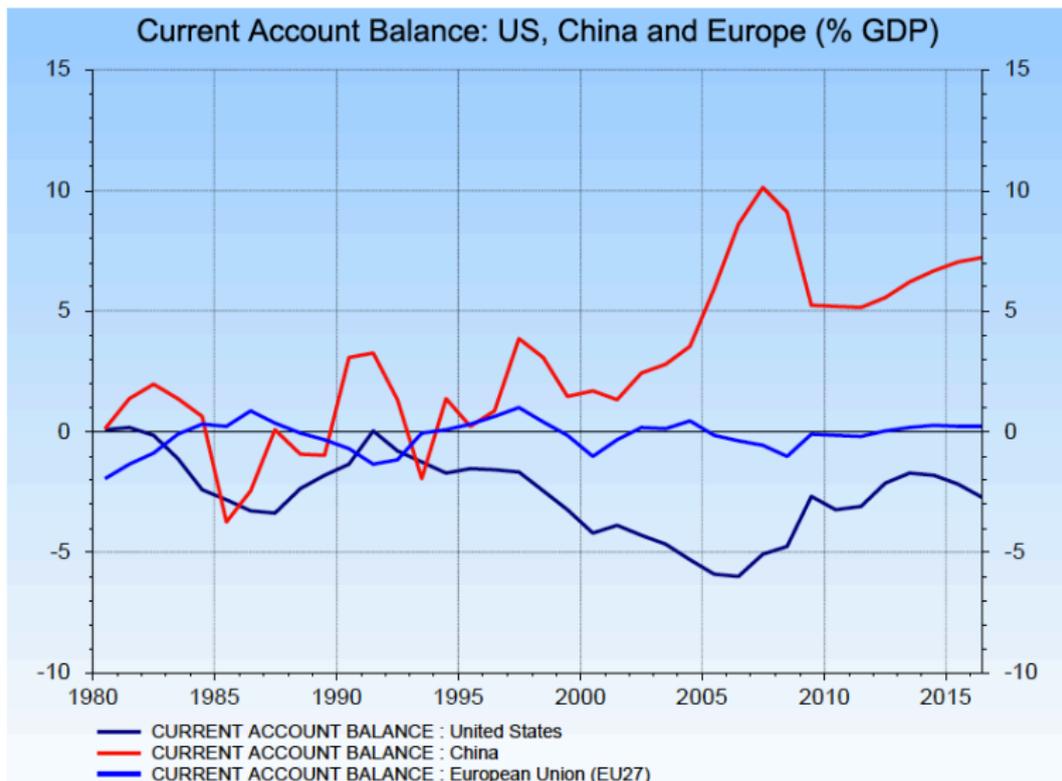
Debt Deleveraging and the Exchange Rate

Pierpaolo Benigno
Federica Romei

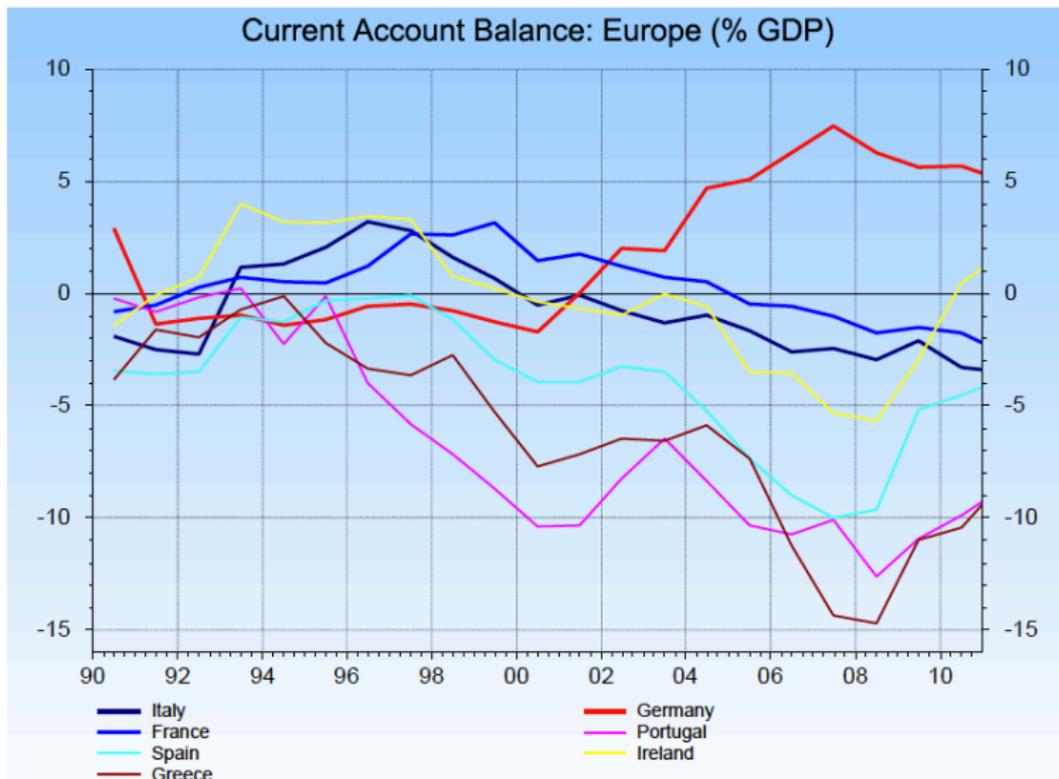
Conference on "Debt, Growth and Macroeconomic Policies"
December 6, 2012

- Divergences and disequilibria characterized the decade before the financial crisis.
- Piling up of private and public debt.
- Current account divergences.
- Financial crisis. Debt overhang. Deleveraging from private and public debt.

China vs US Current Account Balance over GDP



European Countries Current Account Balance over GDP



- What is the international transmission mechanism of a single country's deleveraging shock?
- Is the exchange rate important for the adjustment?
- Is there a role for monetary policy to facilitate a smooth adjustment to deleveraging? (zero-lower bound policies, exchange rate, inflation)
- Can monetary policy ease the costs of deleveraging in a multi-country monetary union?
- Should we depart inflation-targeting policies?

Key mechanism:

- Debts of some agents are the assets of others.
- Real rate should fall in the short run to stimulate consumption of savers.

- **Open Economy:** The exchange rate is not immune to the adjustment-> Transfer problem
 - ▶ **Short Term:**
Repaying debt in one country reduces demand. If there is home bias, demand falls more on domestic goods. Terms of trade should worsen and exchange rate depreciates;
 - ▶ **Long Term:**
Deleveraging country is richer since has less debt to pay, so demand of domestic good rises and terms of trade improve, exchange rate appreciates;

Exchange rate swings from a depreciation to an appreciation
Short-term real rate falls and more in the deleveraging country.
Is this feasible and/or efficient?

"Frictionless" Economy

Two-country, H and F , two-goods endowment economy where:

- each country is endowed with a good;
- goods are traded without frictions;
- home bias in consumption.

Domestic Agents

In the country H we have θ consumers with a discount factor β^s and $1 - \theta$ with a discount factor equal to β^b . With $\beta^s > \beta^b$.

Agents maximize:

$$\begin{aligned} \max_{C_t^j} \sum_{t=0}^{\infty} \beta^{j,t} u(C_t^j) \quad j = \{b, s\} \\ \text{s.t. } C_t^j = \left(\frac{C_{H,t}^j}{\alpha} \right)^{\alpha} \left(\frac{C_{F,t}^j}{1 - \alpha} \right)^{1-\alpha} \\ P_t C_t^j = P_{H,t} Y_{H,t} + \frac{D_{t+1}^j}{1 + i_t} - D_t^j \\ D_t^j \leq \mathbf{k} * (P_{H,t} Y_{H,t}) \end{aligned}$$

Terms of Trade and Real Exchange Rate

Law of one price holds:

$$P_F = S * P_F^* \quad \text{and} \quad P_H = S * P_H^*.$$

Home bias generates deviations from PPP. Terms of trade is defined as:

$$T = \frac{P_F}{P_H}$$

and real exchange rate:

$$Q = \frac{SP^*}{P} = T^{2*\alpha-1}$$

Solving the model, terms of trade can be re-written as:

$$T_t = \underbrace{\frac{Y_{H,t}}{Y_{F,t}}}_{\text{Relative Supply Mechanism}} * \underbrace{\frac{(1 - \alpha)C_t + \alpha C_t^*}{(\alpha)C_t + (1 - \alpha)C_t^*}}_{\text{Relative Demand Mechanism}}$$

Home bias is fundamental for relative demand mechanism.

If agents have different preferences wealth distribution matters for intra-temporal relative price.

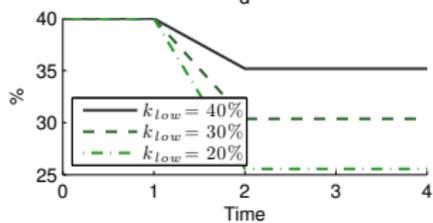
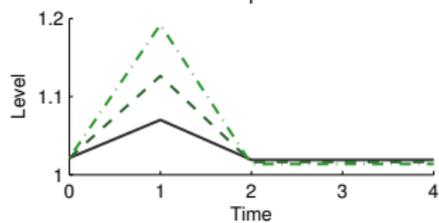
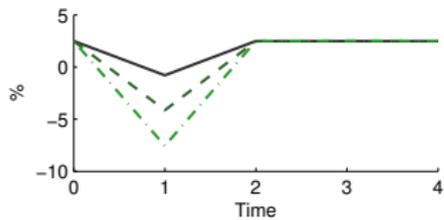
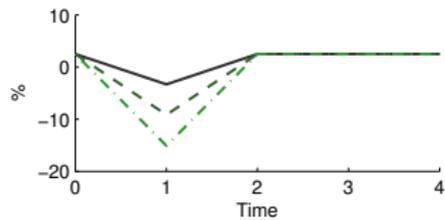
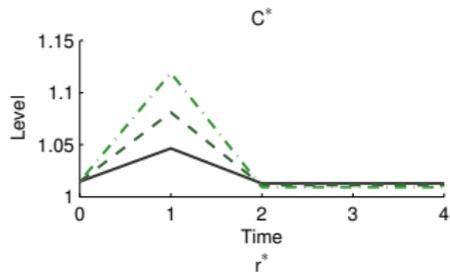
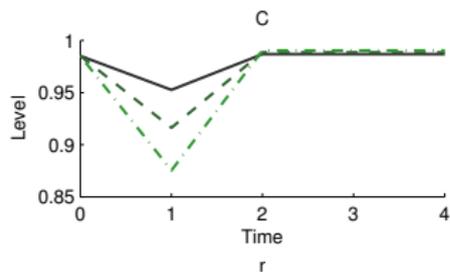
Calibration

- We force the domestic borrowers to deleverage in one period (1 year);
- **k** goes from 50% to 40%, 30%, 20%.

Calibration:

$\theta \frac{D^s}{P_H^* Y_H}$	-0.1	debt assets over GDP in US in 2008
$(1 - \theta) \frac{D^b}{P_H^* Y_H}$	0.5	debt liabilities over GDP in US in 2008
β^s	0.9756	real interest rate at 2.5%
α	0.76	share of US non-durable consumption spending to US-made product in 2008

Simulation



Deleveraging induces a natural adjustment through swings in relative prices and large changes in the real rate.

- Are these feasible?
 - ▶ zlb;
 - ▶ exchange-rate regime.

- Are these optimal?
 - ▶ large changes in relative prices with no change in relative productivity across countries can be inefficient;
 - ▶ big fluctuations can be inefficient.

We add to the simple model:

- Endogenous production->to study whether deleveraging is contractionary for output;
- Wage rigidities->dampen the response of relative price;
- Zero lower bound ;
- Debt deleveraging is on real debt, D_t/P_t and lasts 3 years-> debt to GDP ratio becomes an endogenous variable;
- Same β for borrowers and savers.

- What is the optimal international adjustment to a deleveraging shock?
- Maximize global welfare, where countries' weights are built in such a way that the steady state reached after deleveraging is unconstrained efficient.
- Assume that deleveraging is smooth. What is the optimal adjustment starting from an inefficient debt allocation?
- Solution method: can approximate the welfare function around efficient s.s. at the second order obtaining only quadratic terms. Having the same β is fundamental to have a recursive welfare structure.

Loss Function

Loss function under log-utility (variables are in deviation with respect to initial s.s.):

$$L_t = E_t \sum_{t=0}^{\infty} (\beta^*)^t \left[\frac{\varphi_1}{2} (\hat{Y}_{H,t} - y_H)^2 + \frac{\varphi_2}{2} (\hat{Y}_{F,t}^* - y_F^*)^2 + \frac{\varphi_3}{2} (\pi_{H,t} - \bar{\pi}_H)^2 + \frac{\varphi_4}{2} (\pi_{F,t}^* - \bar{\pi}_F^*)^2 \right]$$

- Planner dislikes deviations of the producer inflation rates from their respective target and outputs' deviations from the efficient level. Notice $y_H < 0$ and $y_F > 0$.
- A smooth macroeconomic adjustment requires a non-smooth adjustment in deleveraging.
- But, a smooth deleveraging implies a significant macroeconomic adjustment and important trade-offs.

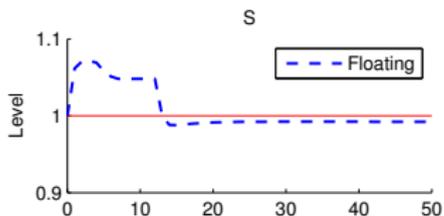
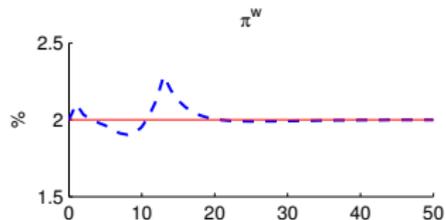
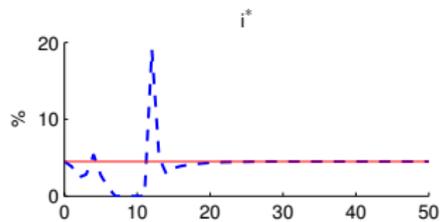
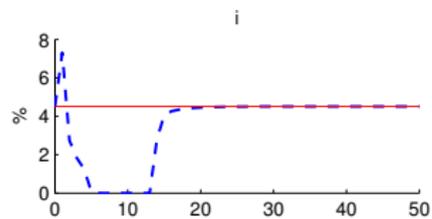
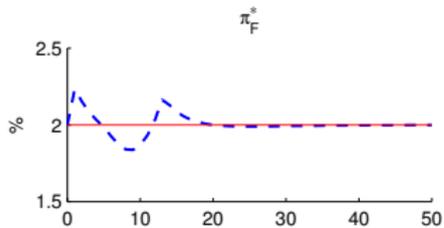
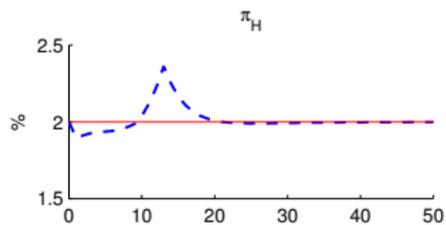
Simulations are on quarterly basis:

θ	0	All borrowers
k_{high}	1.598	US debt liabilities - debt assets over GDP (40%)
β^s	0.9938	real interest rate at 2.5%
α	0.76	share of US non-durable consumption spending to US-made product
ρ	2	Risk Aversion Parameter
η	1.5	Labor disutility (De Walque et al (2005))
$\lambda = \lambda^*$	0.8	Wage flexibility (De Walque et al (2005))
μ	1.15	Mark up equal to 15%
π	0.005	Inflation at 2%

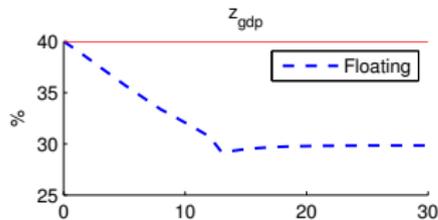
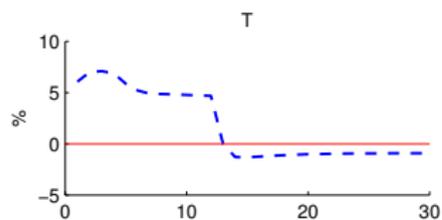
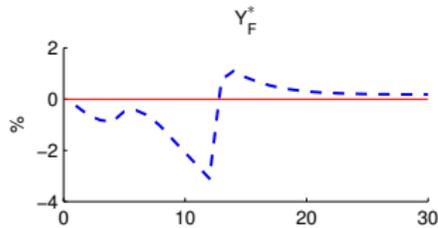
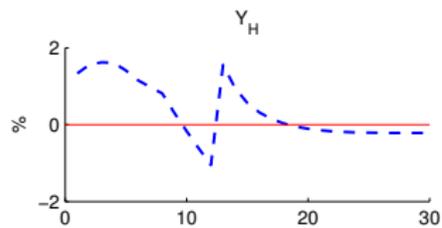
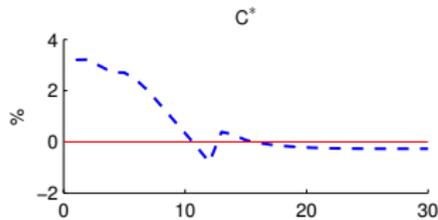
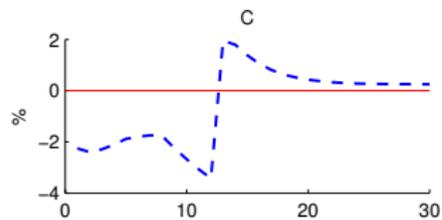
Optimal Policy: Floating Exchange-Rate Regime

- **Nominal Exchange Rate:** Deleverager's currency depreciates in short run and appreciates in medium run; so the terms of trade and real exchange rate.
- **Nominal Interest Rate:** Deleverager goes to zlb from 6th quarter to 13th, Non-Deleverager from 7th to 11th.
- **Consumption:** Consumption recession in the deleveraging country, expansion in the other country.
- **Output:** Output recessions and expansions are muted, given terms of trade movements.
- **Inflation:** Stable around target, but higher in non-deleveraging country at the start and in the deleveraging country at the end of deleveraging.

Floating



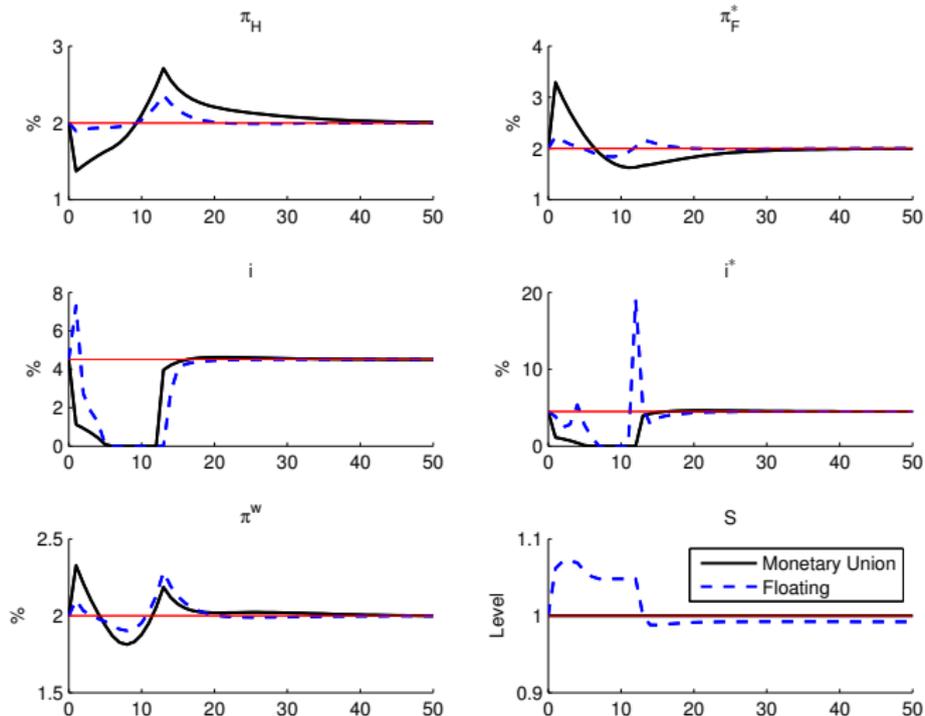
Floating



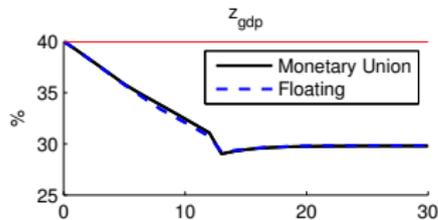
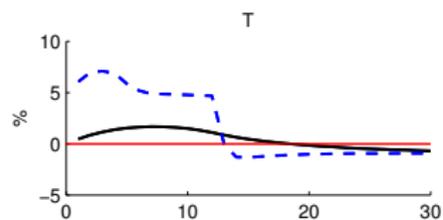
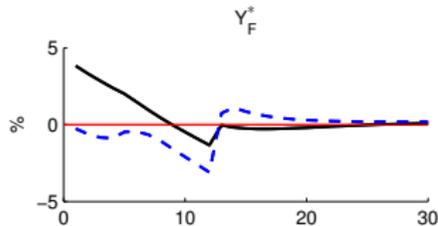
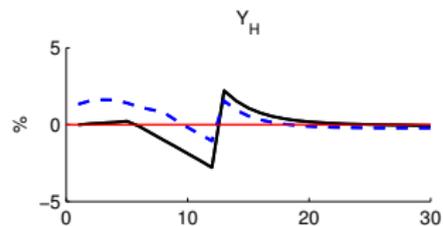
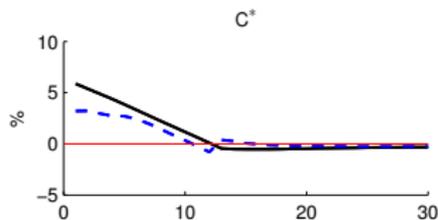
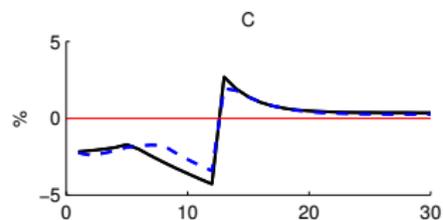
Optimal Monetary Policy in a Monetary Union

- **Nominal Interest Rate:** entry in zlb from 6th quarter to 12th, lower variability than floating;
- **Consumption:** Same variability than under floating.
- **Output:** Deeper recession in the deleveraging country, and expansion abroad. Stagnation abroad when deleveraging ends. Prolonged adjustment.
- **Inflation:** Larger movements in the inflation rates to bring about correct adjustment in international relative prices.
- **Real Exchange Rate-Term of Trade:** Smoothed adjustment due to fixed exchange rate.

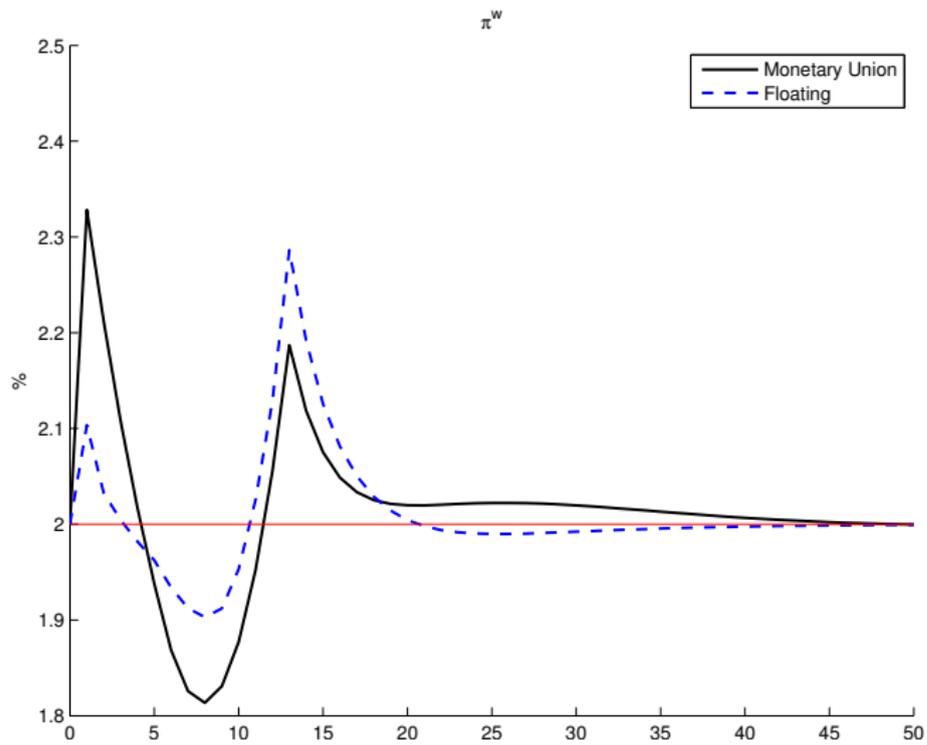
Monetary Union vs Floating



Monetary Union vs Floating

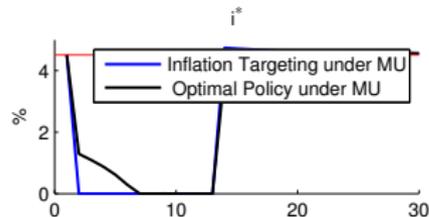
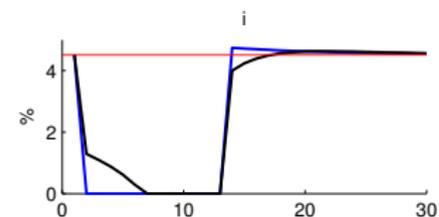
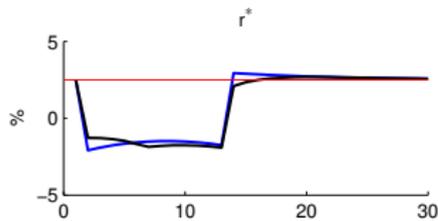
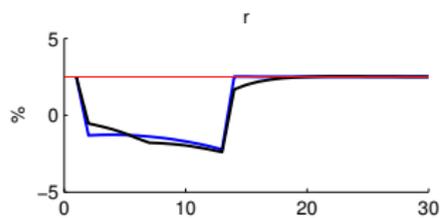
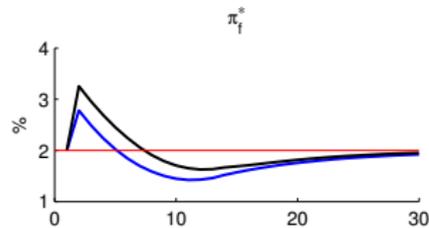
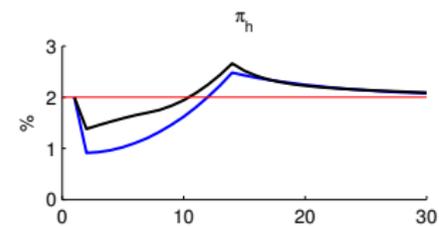


World and Union Inflation

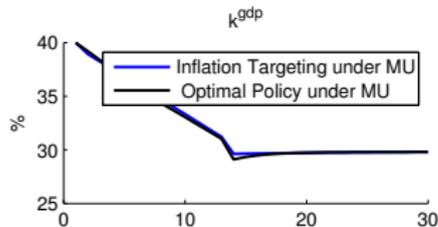
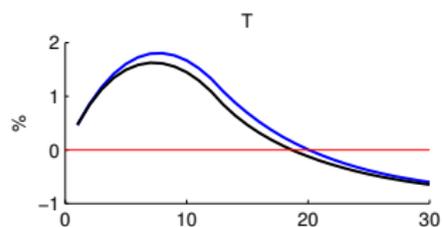
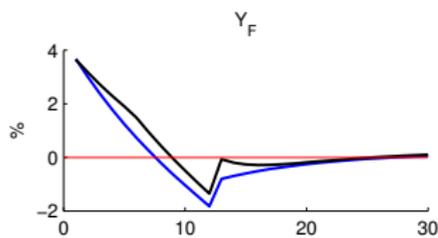
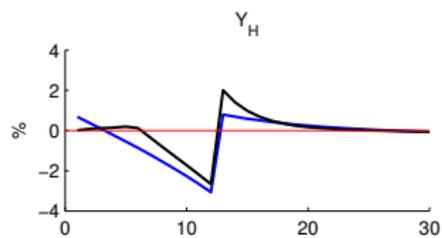
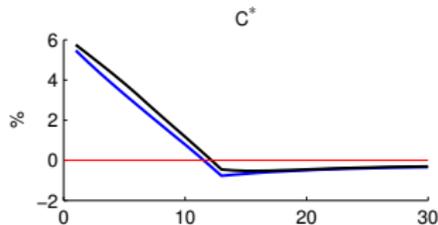
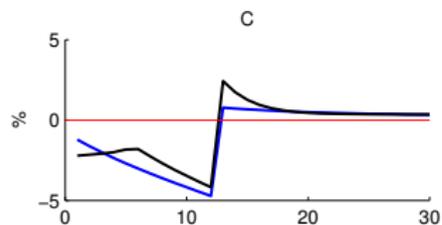


- Should we rethink inflation-targeting policies in a monetary union which is partially deleveraging?
- A strict 2% target for the whole union is clearly a sub-optimal policy.
 - ▶ It is not a feasible policy: zero-lower bound is binding.
 - ▶ To minimize short-run costs, need to set interest rates at zlb. But union inflation rate remains below target during deleveraging.
- Optimal policy requires union inflation to exceed target at the beginning and at the end of deleveraging. This is to accommodate right adjustment in relative prices. No need to go to the zlb so early.
- On average (across time) union inflation is closer to 2% target under optimal policy than under a policy of 2% strict inflation targeting!!

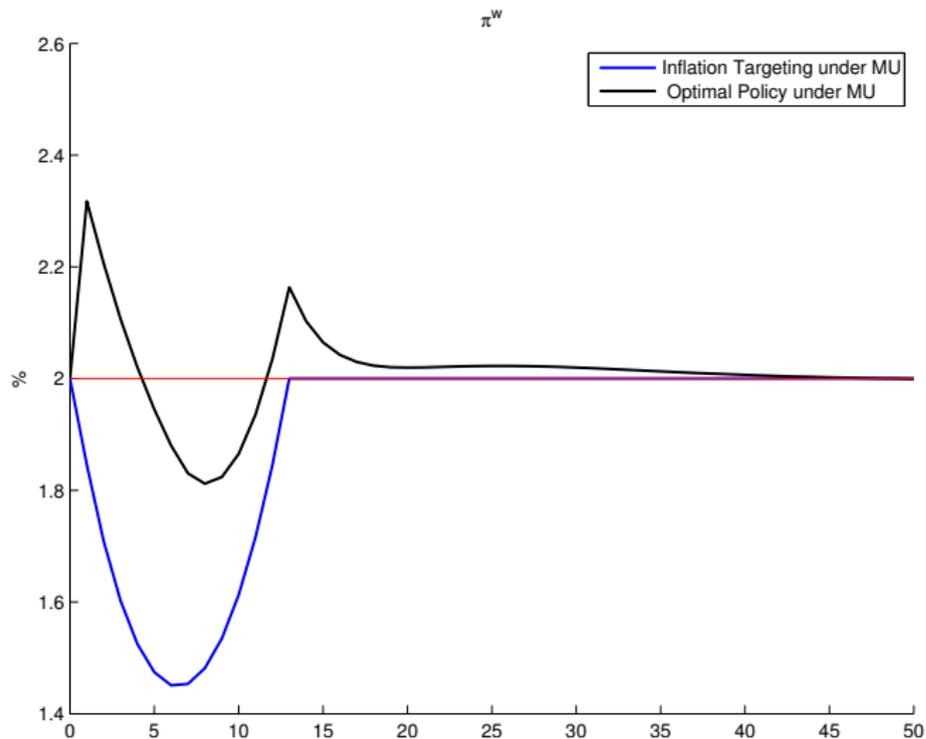
Monetary Union



Monetary Union



Monetary Union



Debt deleveraging is going to be one of the main themes driving the macro outlooks for the next years.

- There are international spillovers and important adjustments in international relative prices;
- Exchange-rate regime is critical for an efficient distributions of the costs of deleveraging;
- Monetary policy can ease costs of deleveraging;
- But, even in a monetary union, there is still room for an appropriately-designed monetary policy to ease the adjustment. No need to depart from an inflation-targeting regime.
- However, even an orderly deleveraging can be consistent with weak and fragile economies.