Inspecting the Mechanism:
Leverage and the Great Recession in the Eurozone
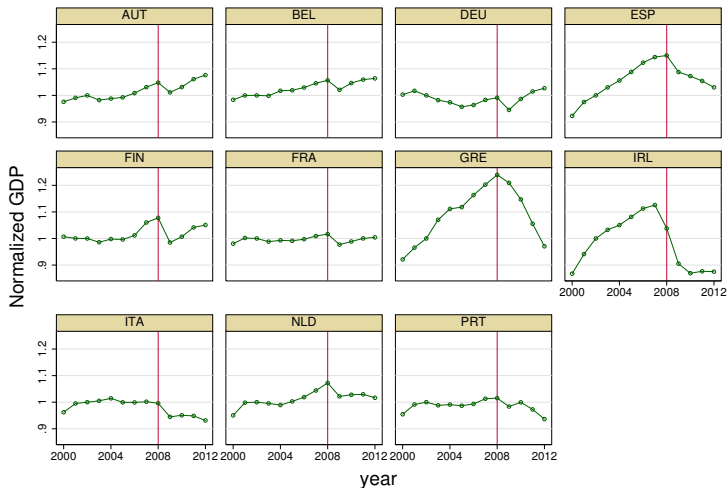
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Goals

- Provide quantitative account of the dynamics of Eurozone countries from 2000 to 2012
- Disentangle the shocks
- Run counter-factual experiments (fiscal policy)

Understand Eurozone Dynamics: Y (deviations to benchmark eurozone)

Graphs by country
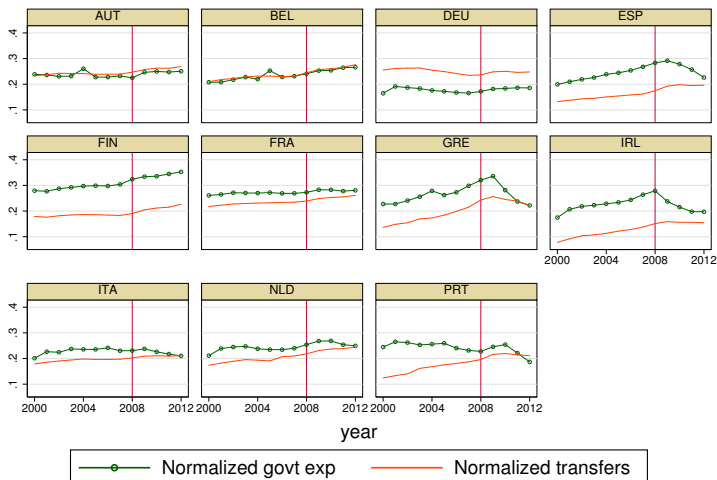
Disentangle the schocks

- Wide disagreement about interpretation of euro zone crisis
    - Private deleveraging
    - Fiscal indiscipline followed by fiscal austerity
    - External imbalances and sudden stops
- First we need to "measure" the shocks
    - Part 1: reduced form model

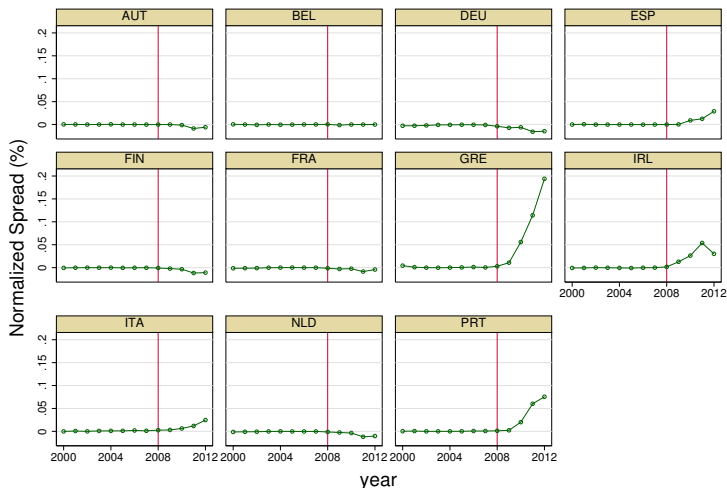# Driving Force (1): Household Debt
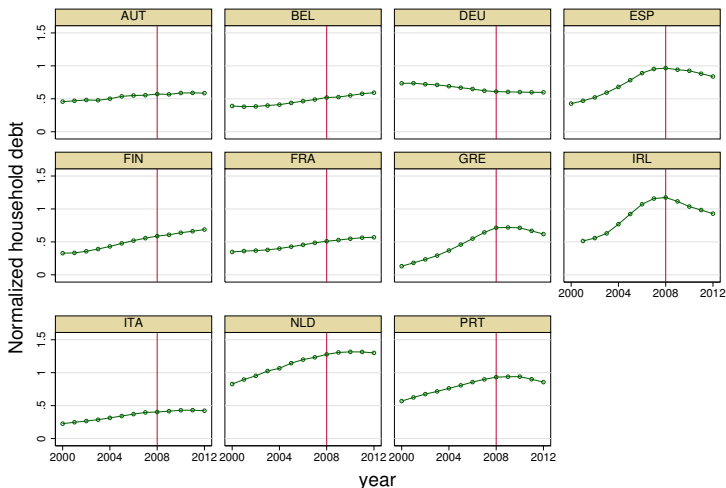
Graphs by country

Driving Forces (2): Fiscal Policy

Graphs by country

Driving Forces (3): Interest Rate Spreads

Graphs by country

Disentangle the shocks

- First we need to "measure" the shocks
  - Part 1: reduced form model
  - b^h, $\{g, T\}$, ρ

- Then we need to "identify" the shocks
  - Part 2: identify structural shocks
  - Use U.S as a control: a monetary union with deleveraging but without sudden stop

- Ultimate goal: What would have happened to $\{GR, ES, IR, PRT\}$ if they had
  - run a different fiscal policy?

US and Eurozone
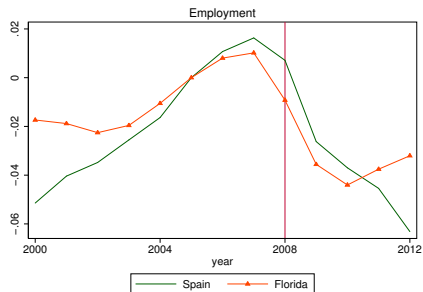
Main results

- More conservative fiscal policies during the boom would have helped to stabilize employment during bust
- Greece: a lot
- Ireland, Spain and Portugal: the policy would have had to be very conservative during the boom.
- Fiscal policy unlikely to be sufficient as a stabilization tool
- macro-prudential regulations

Related Literature

- *macroeconomic models with credit frictions*: Bernanke-Gertler (1989), Kiyotaki-Moore (1997)...

    - Friction on household side: Guerrieri-Lorenzoni (2011), Eggertson-Krugman (2011), Midrigan-Philippon (2011), Mian-Sufi (2010, 2012), Kaplan-Violante (2013)

- *cross-sectional macro*: Small open economies in a monetary union as in Midrigan-Philippon (2011), Nakamura-Steinsson (2011), Farhi-Werning (2013)

- *sudden stops*

    - Kehoe-Perri (2004), Neumeyer-Perri (2005), Aguiar and Gopinath (2007), Mendoza (2010), Korinek-Mendoza (2013)

- *sovereign debt:*

    - Eaton-Gersovitz (1982), Arellano (2008) and Mendoza-Yue (2012), Corsetti, Kuester, Meier and Muller (2011), Aguiar-Amador (2013)

Reduced-Form Model

- Agents
  - Patient and impatient households
  - Sticky wages

- Shocks:
  - Time-varying debt constraint
  - Fiscal policy
  - Interest rates

Model

- Borrower-Saver model as in Cambell-Mankiw (1989), Mankiw (2000), Eggertson and Krugman (2013)

  - Two types of households: $i = b$ more impatient than $i = s$

    $$\beta \equiv \beta_s > \beta_b$$

  - Fraction χ_j of impatient households in country j

Within Period Trade

- Consumption of home (h) and basket of foreign goods (f):

$$u_{i,j,t} = \alpha_j \log\left(\frac{c_{i,j,t}^h}{\alpha_j}\right) + (1 - \alpha_j)\log\left(\frac{c_{i,j,t}^f}{1 - \alpha_j}\right) - v\left(n_{i,j,t}\right)$$

- Linear production: $y_{j,t} = n_{j,t}, p_{j,t}^h = w_{j,t}$ and sticky wages

- Foreign demand for home good $\bar{c}_{f,t} = \bar{x}_{f,t}/p_{j,t}^h$ (unit price elasticity)

- $g_{j,t}$: government expenditures on home goods only

$$n_{j,t} = (1 - \chi_j)\, c_{s,j,t}^h + \chi_j c_{b,j,t}^h + \frac{\bar{x}_{f,t}}{p_{j,t}^h} + g_{j,t}$$

Budget Constraints

- Impatient

$$\frac{b_{j,t+1}}{1+r_{j,t}} + (1-\tau_{j,t})\,w_{j,t}n_{j,t} + T_{j,t} = x_{b,j,t} + b_{j,t}$$

subject to

$$b_{j,t} \leq \bar{b}_{j,t}$$

- Patient

$$\frac{1}{x_{s,j,t}} = \mathbb{E}_t \left[\frac{\beta\,(1+r_{s,j,t})}{x_{s,j,t+1}} \right]$$

- Government

$$\frac{b^g_{j,t+1}}{1+r_{j,t}} + \tau_j w_{j,t} n_{j,t} = p^h_{j,t} g_{j,t} + T_{j,t} + b^g_{j,t}$$
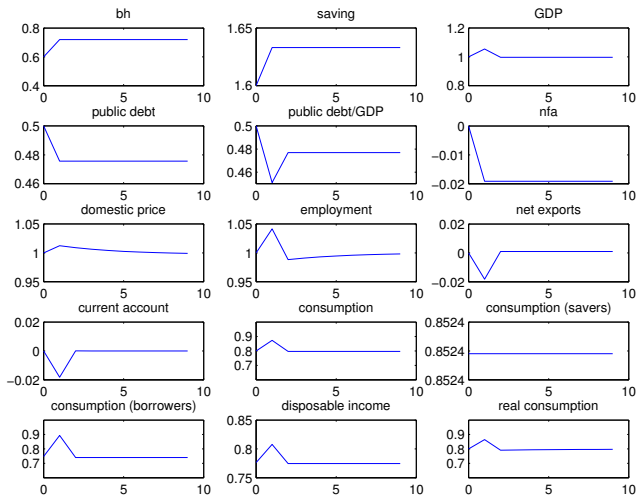
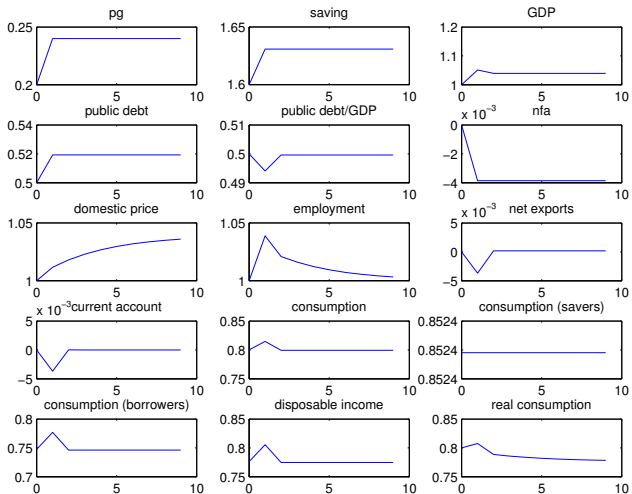## Employment and Inflation

- Employment:

$$n_{j,t} = \frac{y_{j,t}}{p_{j,t}^h}.$$

- Specify the dynamics of inflation.

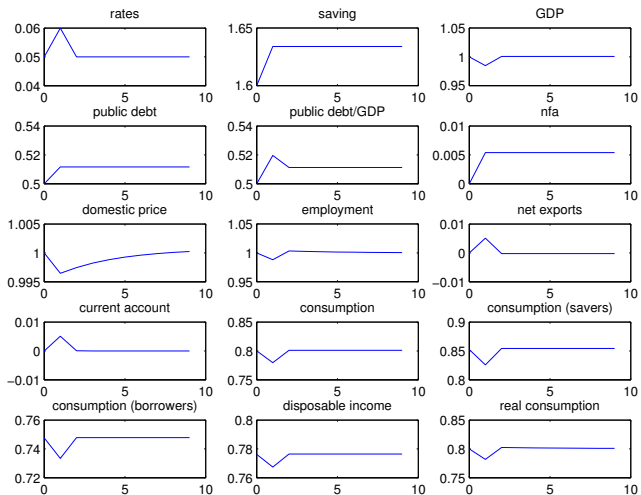$$\frac{p_{j,t}^h - p_{j,t-1}^h}{p_{j,t-1}^h} = \kappa \left(n_{j,t} - n^\star \right)$$

Shock to $\bar{b}_j$

Shock to pg_j

Savers consumption

Theorem
When interest rates are the same within a country, nominal spending of patient agents $x_{s,j}$ does not react to private credit expansion or to fiscal policy. Nominal spending only reacts to interest rates and export demand shocks.

Shock to r_j

The Experiment

- Feed exogenous processes
    1. Household debt $\bar{b}_{j,t}$
    2. Fiscal policy $\tau_{j,t}$, $T_{j,t}$, $pg_{j,t}$
    3. Interest rate spreads $\rho_{j,t}$

- Simulate: $y_{j,t}, x_{j,t}, n_{j,t}, w_{j,t}, b^g_{j,t}$

Data

- 11 Eurozone countries: Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, Netherlands and Portugal

- Rebase data to map into model (model has no eurozone inflation, TFP and population growth)

- Benchmark GDP (also consumption, government spending ...): for each year, GDP country would have experienced if had same growth as whole eurozone during period 2001-2007 and 2008-2012

- Normalized data = ratio of observed data to benchmark (deviations from benchmark)

- Foreign demand: value added based exports (OECD-WTO)

Country-Specific Parameters Data

- α_j : domestic share of consumption (Bussiere et al. 2011) ; import content of expenditures (inclusive of value of indirect imports)

- χ_j: share of credit constrained consumers; Use Eurosystem Household Finance and Consumption Survey (HFCS) as in Mendicino (2014); fraction of households with liquid assets below 2 months of household total income

Country-Specific Parameters
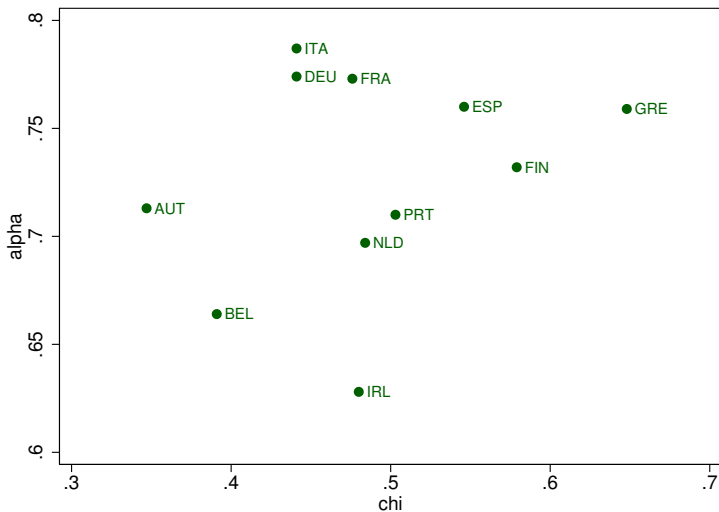
From model to data

- $b_{j,t}$ per capita debt in model: $\chi_j b_{j,t} \equiv \frac{B_{j,t}}{\hat{Y}_{j,t}}$

- $t_0 = 2002$ base year

- variables = observed values for household debt $\bar{b}_{j,t}$, fiscal policy $pg_{j,t}$, $T_{j,t}$, interest rate spreads $\rho_{j,t}$ and foreign demand $\bar{x}_{f,t}$

- Equilibrium conditions:
  $s_{j,t} = (1 + \rho_{j,t})(s_{j,t-1} + \tilde{y}_{j,t}) - \mathbb{E}_t [\tilde{y}_{j,t+1}]$

- Disposable income $\tilde{y}_{j,t} \equiv (1 - \tau_{j,t}) y_{j,t} + T_{j,t}$:

- $(1 - \alpha_j) \tilde{y}_{j,t} = \alpha_j \chi_j \left(\frac{\bar{b}_{j,t+1}}{1+r_{j,t}} - \bar{b}_{j,t} \right) + \alpha_j (1 - \chi_j) \left(s_{j,t} - \frac{s_{j,t+1}}{1+r_{j,t}} \right) + \frac{b^g_{j,t+1}}{1+r_{j,t}} - b^g_{j,t} + \bar{x}_{f,t}$
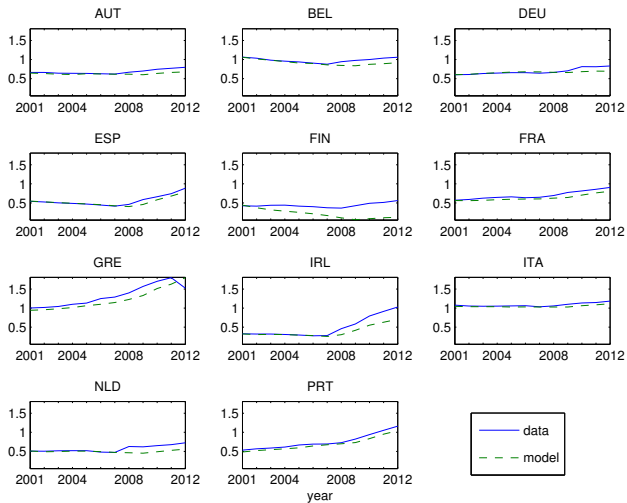
GDP: All shocks
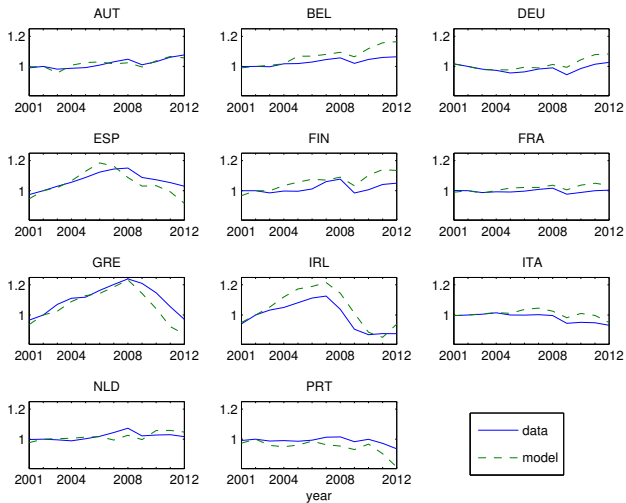
Employment
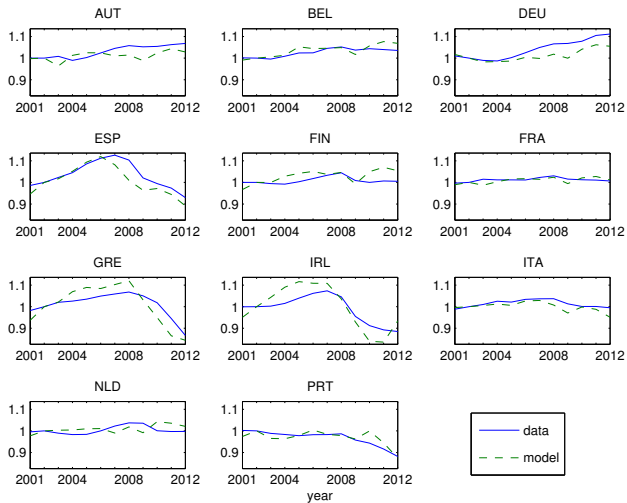
Government Debt

Structural Experiments

- Counter-factual simulations: what would have happened with different fiscal policy?

- Main identification strategy : US as a control group. Estimate deleveraging *without sudden stop* in panel of U.S. states

- $b_{j,t}^{h,US} = \sum_{k=1}^{K} \alpha_k^{US} b_{j,t-k}^{h,US} + \varepsilon_{j,t}$ for $t = 2008,..,2012$ and $j = 1,..52$,

- Use estimated coefficients α_k^{US} to construct predicted deleveraging in Eurozone countries:

- $\hat{b}_{j,t}^{h} = \sum_{k=1}^{K} \alpha_k^{US} b_{j,t-k}^{h,}$ for t= 2008,..., 2012 and j= 1...11

Structural model

- Private leverage: $b_{j,t}^h = \lambda^{bh} \hat{b}_{j,t}^h + \lambda^{\rho h} \rho_{j,t}$
- Bond pricing: $\rho_{j,t} = \sigma_{j,t} \times \left(\lambda^{g\rho} b_t^g + \lambda^{h\rho} b_t^h \right)$

Estimate λ's (2008-2012). Instruments: $\hat{b}_{j,t}^h$ for $b_{j,t}^h$; debt lagged 3 years for $b_{j,t}^g$

| λ^{bh}	$\lambda^{\rho h}$	$\lambda^{g\rho}$	$\lambda^{h\rho}$
0.967	−0.418	6.05	3.2
(0.007)	(0.071)	(0.96)	(0.015)

Counterfactual fiscal policies

- Assumption: goal to stabilize the economy but cost of funds constraint
- Potentially asymmetric reaction to increase/decrease of household debt

$$b_{j,t+1}^{g} - b_{j,t}^{g} = -\gamma^{hU}\alpha_j\chi_j\left(b_{j,t+1}^{h} - b_{j,t}^{h}\right) - \gamma^{\rho}\rho_{j,t} \text{ if } b_{j,t+1}^{h} > b_{j,t}^{h}$$

$$b_{j,t+1}^{g} - b_{j,t}^{g} = -\gamma^{hD}\alpha_j\chi_j\left(b_{j,t+1}^{h} - b_{j,t}^{h}\right) - \gamma^{\rho}\rho_{j,t} \text{ if } b_{j,t+1}^{h} < b_{j,t}^{h}$$
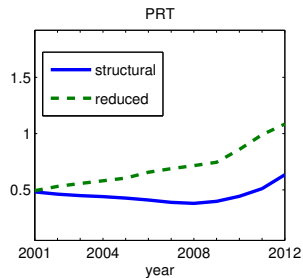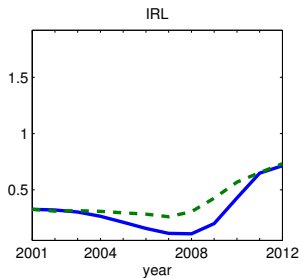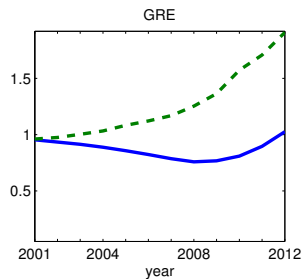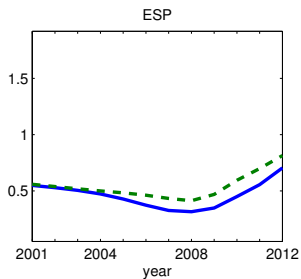
- Choice of policy parameters $\gamma^{hU} = 0.5; \gamma^{hD} = 2.5; \gamma^{\rho} = 2$ such that:

1. absent sudden stops the government would have stabilized employment
2. impact of sudden stops forces predicted policy to be close to the actual ones

Employment
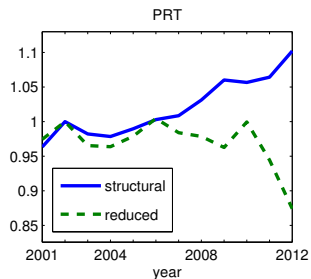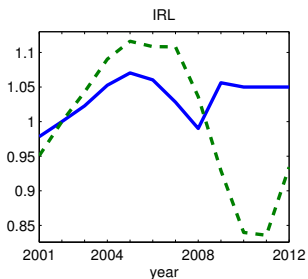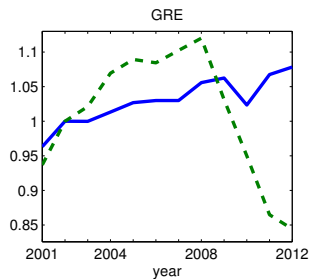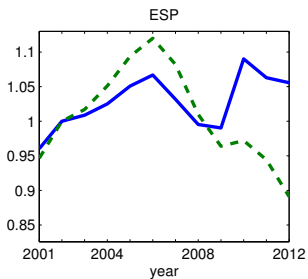
Government debt

Counterfactual experiments

Simulated (reduced form) and counterfactual debt to benchmark
GDP ratio in 2008

Country	Actual (reduced form)	Counter-factual	Difference
Spain	0.5	0.35	0.15
Ireland	0.35	0.05	0.3
Greece	1.2	0.8	0.4
Portugal	0.7	0.4	0.3

Conclusions

- More conservative fiscal policies during the boom would have helped to stabilize employment during bust
- Greece: a lot
- Ireland, Spain and Portugal: the policy would have had to be very conservative during the boom.
- Ireland: counterfactual fiscal policy not realistic (buying back almost all of the public debt)
- Fiscal policy unlikely to be sufficient as a stabilization tool
- macro-prudential regulations

Assumptions on shocks

- Shocks
  - Define $1 + r_{j,t} \equiv \beta \left(1 + \rho_{j,t}\right)$ and assume iid interest rate shocks

    $$\mathbb{E}_t \left[\rho_{j,t+1}\right] = 0$$

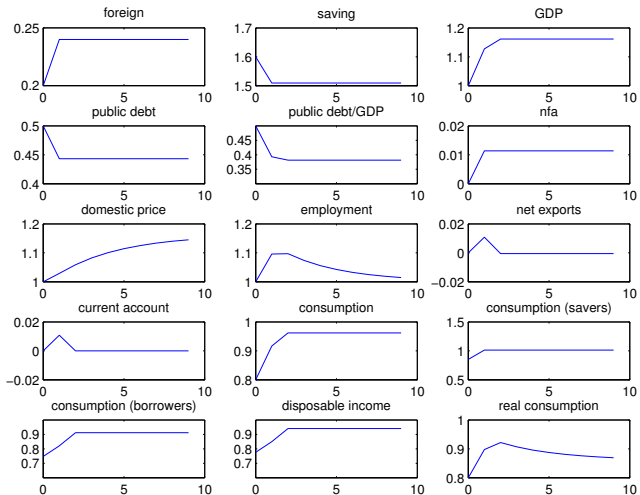 - Borrowers are constrained $b_{j,t+1} = \bar{b}_{j,t+1}$ and

    $$\mathbb{E}_t \left[\bar{b}_{j,t+2}\right] = \bar{b}_{j,t+1}$$
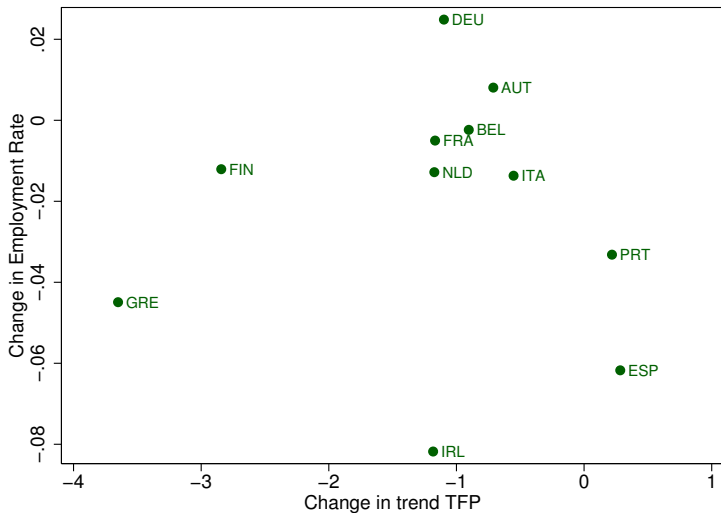
  - Foreign demand

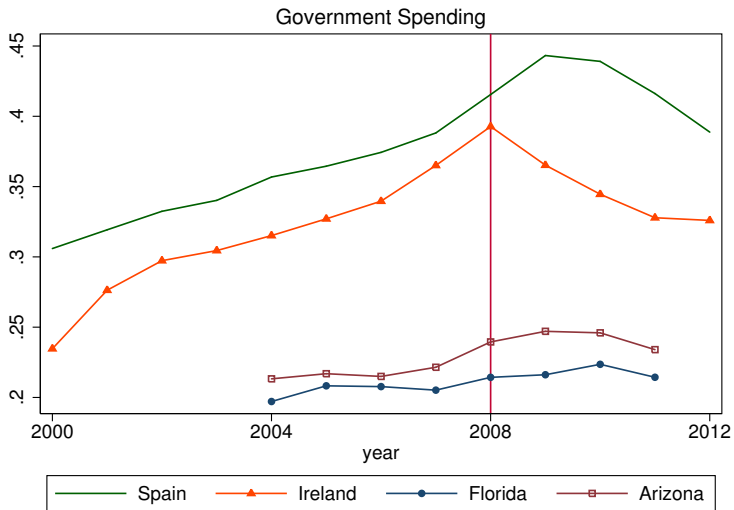 $$\mathbb{E}_t \left[\bar{x}_{f,t+1}\right] = \bar{x}_{f,t}$$

- Policy rules

  $$\mathbb{E}_t \left[b^g_{j,t+2}\right] = b^g_{j,t+1}$$

Shock to $\bar{x}_f$

TFP shock?

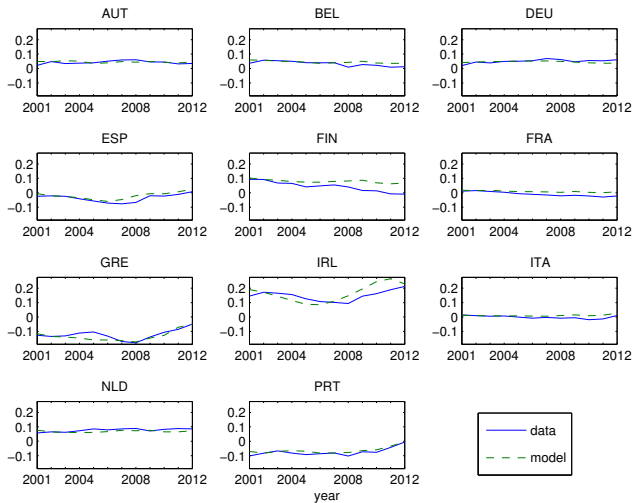# Fiscal policy more neutral (cross section) in US

Government Spending

Net exports

US vs EZ, 2007-2010