



Macro Modelling: From the Financial Crisis to the Long Slump in the EA

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The views expressed in this presentation are those of the author and should not be attributed to the European Commission.

- Large parts of this presentation are based on a joint paper: **The post crisis slump in the EA and the US**
- **Authors: R. Kollmann, B. Pataracchia, R. Raciborski, M. Ratto, W. Roeger and L. Vogel**

The EA entered a severe recession and has stayed in a long slump. Only recently there are some signs that growth is picking up. However, the debate on whether the EA has entered a period of low growth (secular stagnation) is ongoing.

Macro modelling in the EU Commission since the outbreak of the financial crisis was mostly concerned with the following issues:

- Increased indebtedness and deleveraging of the private and the government sector.
- Fiscal policy (incl. measures to support the banking system) under ZLB and financial frictions
- Regulatory measures on the financial system. (various Commission Communications on financial sector reforms)
- Evaluation of the impact of structural reforms (in the context of the European Semester).
- Estimating potential output and output gaps

In order to deal with these issues a number of model variants were developed in order to better deal with these issues

Overview of QUEST 3 model variants

| Model | Country disaggregation | Sector disaggregation | Note |
|-------------------------|------------------------|--|---|
| QUEST3 | EA; EA-US-RoW | Core model | Estimated |
| QUEST3H | Euro area,US,ES,DE | Adds housing | Estimated |
| QUEST3TNT(H) (G) | Flexible | Tradable-nontrad. Housing Property tax Government empl. | Fiscal policy, Credit constraints, Financial crisis |
| QUEST3B | Euro area | Adds banking sector | Estimated/Calib. Bubbles Financial crisis |
| QUEST3(RD) | All E28 | Final/interm./R&D | Structural reforms Cohesion Policy |
| QUEST3sec (CLIM/SEC) | E27 RoW | IO-structure,energy | Carbon tax/oil Services Dir. |

A quantitative assessment of the long slump in the EA (and US)

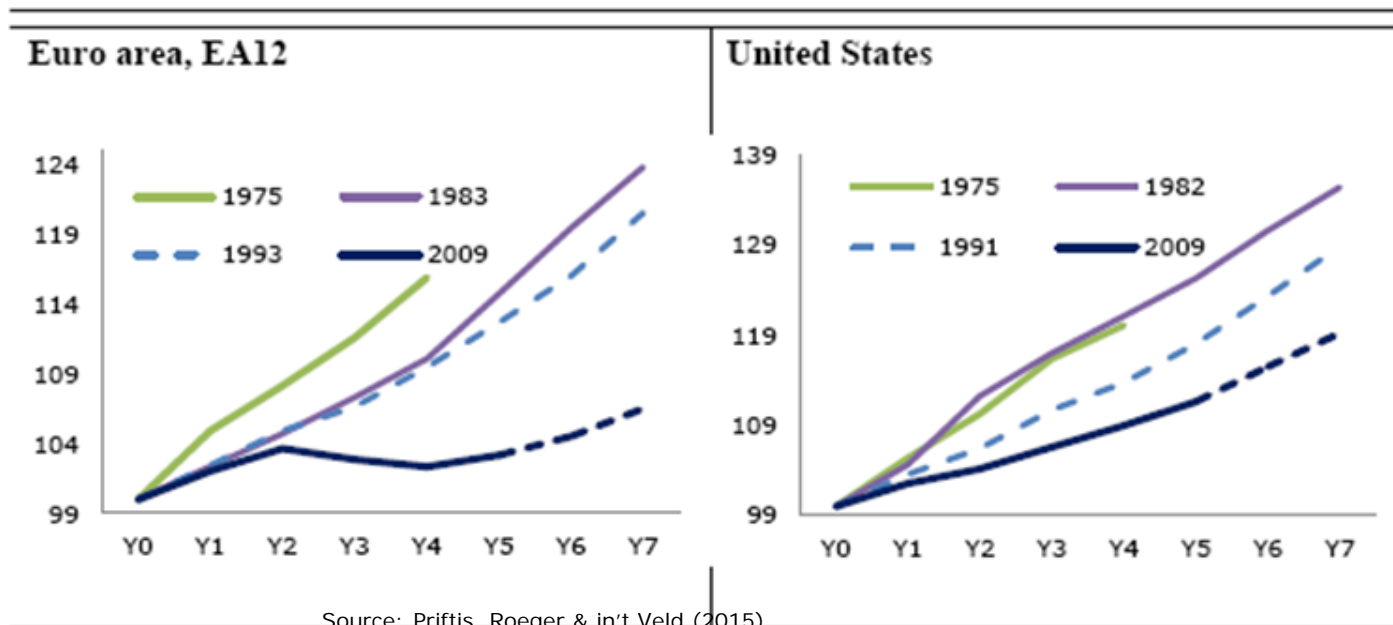
The standard DSGE model has remained an important workhorse for macroeconomic policy analysis especially in the context of the forecasting exercise.

International dimension (e. g. oil prices)

However, restrictions on monetary policy are better incorporated.

In light of the experience gained with models including financial frictions the interpretation of investment and consumption shocks has changed.

Recoveries after Major Recessions, real GDP (Y0=100)



Note: Y0 marks the year of the cyclical trough as measured by ECFIN's output gap estimate. For the recovery after 2009, Y6 and Y7 are based on the Winter Forecast. EA 12 comprises of BE, DE, IE, EL, ES, FR, IT, LU, NL, AT, PT, FI.

Different views about sources of long slump.

Restrictive fiscal policy ('austerity'): see, e.g., International Monetary Fund (2012), De Grauwe (2014) and Stiglitz (2015).

Household deleveraging: e.g., Rogoff (2015)

Financial constraints for investors:

Mostly seen as EA problem, more rapid and aggressive non-conventional central bank policy the US.

EA banks rebuilt their capital much more gradually than US banks, after the crisis (OECD (2014)).

EA bank balance sheets weakened by sovereign debt crisis (Acharya et al. (2014), Kalemli-Özcan et al. (2015)).

Reduced productivity growth:

Slowing down sectoral redeployment and the adoption of new technologies (e.g., Hall (2014), Fernald (2015), Anzoategui et al. (2015)).

International organizations: reduction of potential output (see IMF WEO 2014): declining trend TFP, low investment rates, rising NAWRU.

The contribution of this presentation

Quantify the importance of alternative hypotheses using a rich *estimated* DSGE model, 1999q1-2014q4

Explain the post-crisis divergence between the EA and the US (controlling for RoW) => jointly model EA-US-RoW.

The EA and US have the same structure, but parameters are allowed to differ across the blocks.

So far, little empirical model-based research on the EA post-crisis slump.

Studies on the post-crisis dynamics in the US, using estimated *closed economy* DSGE models:

Christiano, Eichenbaum and Trabandt (2015), Fratto and Uhlig (2015), Lindé, Smets and Wouters (2015) and Del Negro, Giannoni and Schorfheide (2015)

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Key contribution: **estimation** of large-scale multi-country model

Most large multi-country models are **calibrated**.

Jacob & Peersman (2012) and Kollmann (2013) estimate two-country models (US-ROW; US-EU): more stylized, abstract from key frictions and shocks considered here.

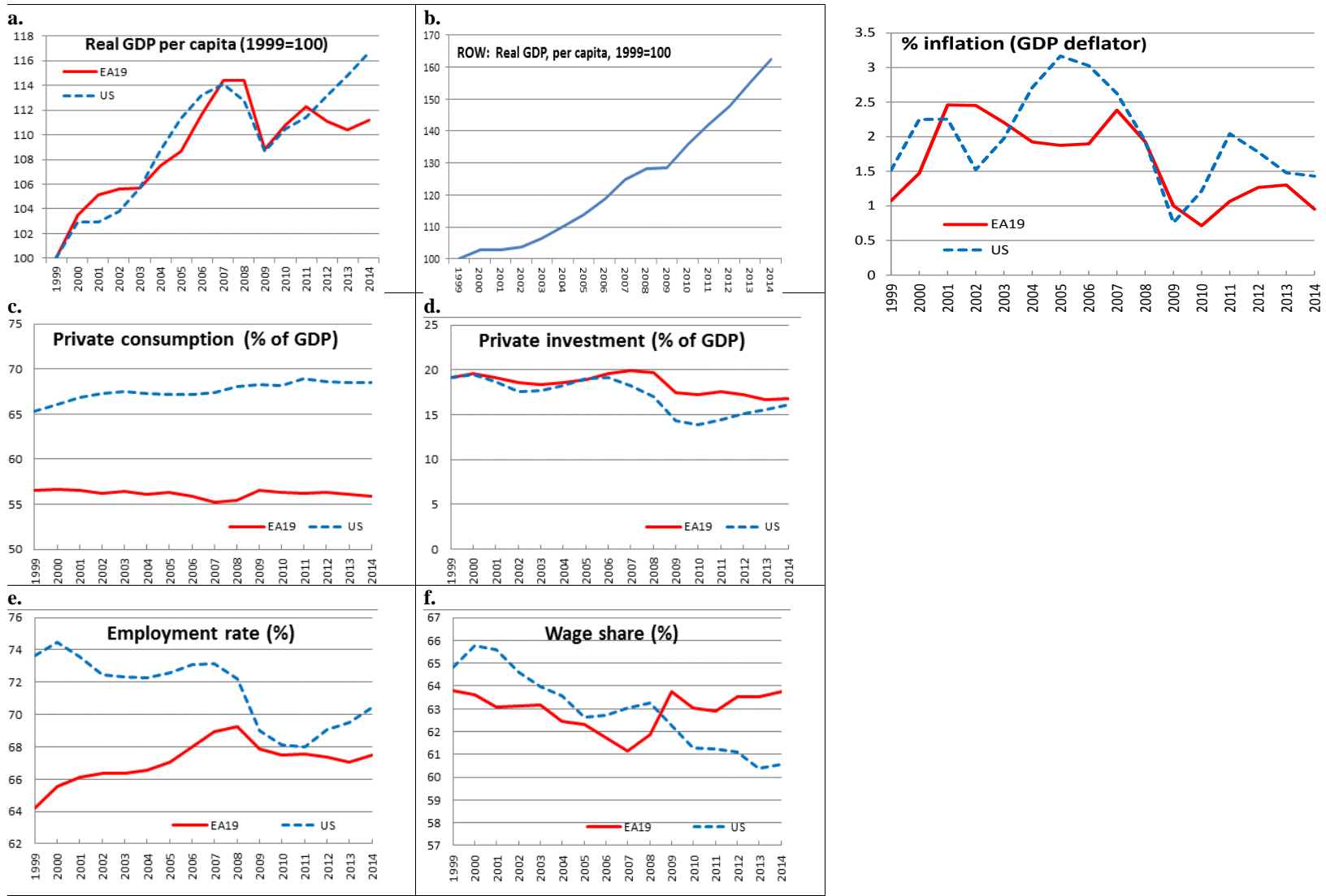
Summary:

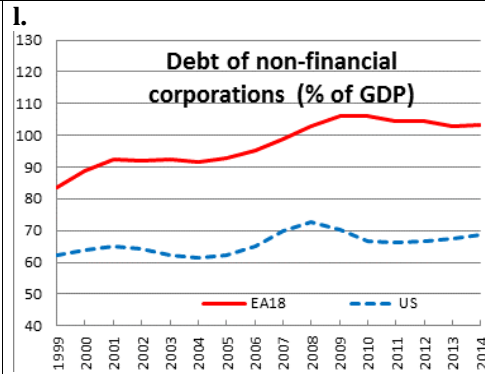
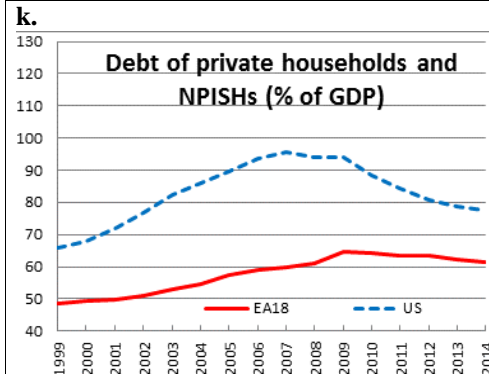
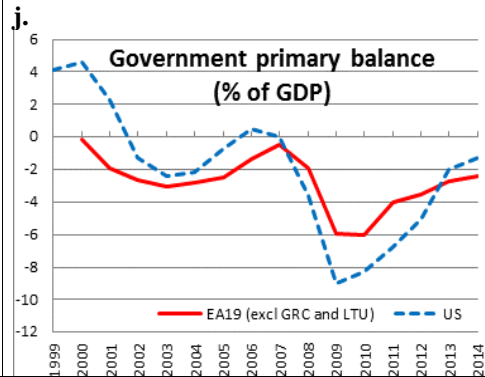
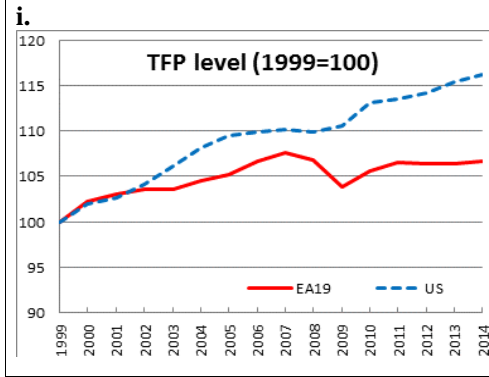
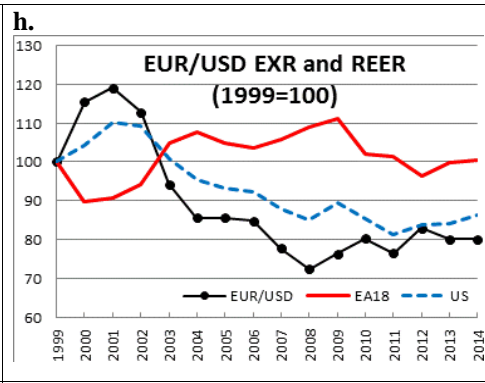
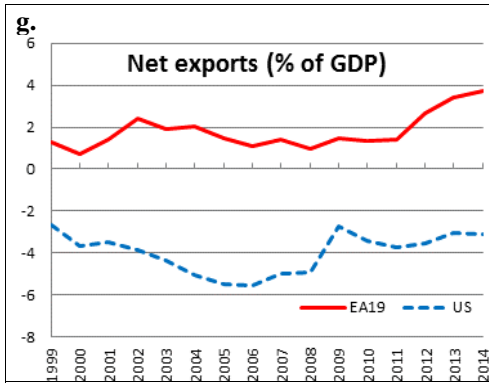
- Persistent EA slump: due to combination of adverse supply AND demand shocks: negative shocks to TFP growth; adverse investment shocks linked to poor health of EA banking system.
- Fiscal policy (austerity) has NOT been key driver of EA slump.
- Faster post-crisis rebound of US economy due to lower investment risk premia, linked to faster improvement in health of US financial system.
- Financial shocks were the key driver of the Great Recession in the US. Those shocks matter a great deal for the persistence of the EA slump.

EA and US differ:

- Rise in US investment risk premium less persistent
- Persistent TFP decline in EA
- Differences in wage and price adjustment => ws responds differently

Historical time series

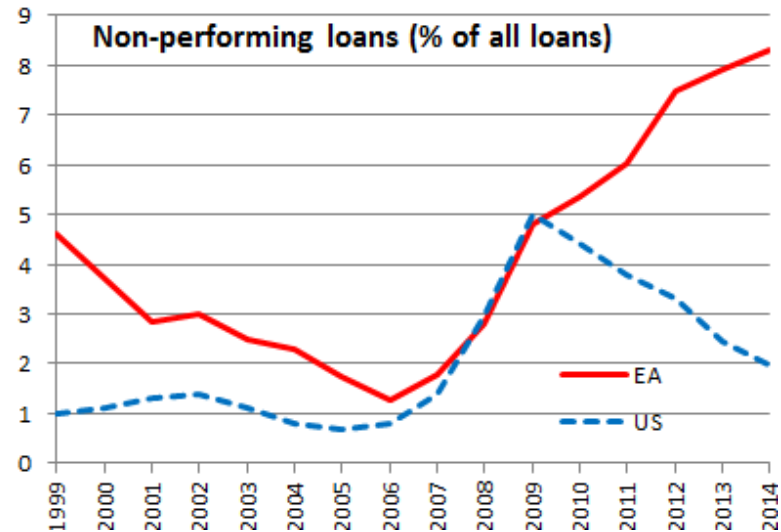
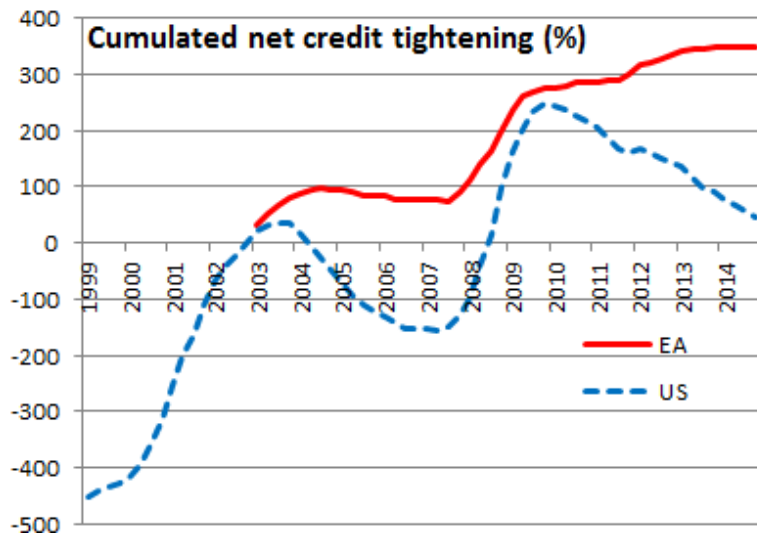




Testing different views about sources of long slump: the hypotheses and data (IIIb)



EA & US cumulated net credit tightening and estimated inv. risk premia



Model description

The EA and US blocks assume constrained and unconstrained households, firms and a government.

Nominal intermediate good prices and wages are sticky.

Government in the EA and the US levy distortive taxes and issue debt.

Domestic and foreign goods are imperfect substitutes.

Nearly perfect international capital mobility across countries (up to a risk premium which depends on the net foreign asset position of the country).

Exchange rates among all three regions are flexible.

Monetary policy is conducted using a Taylor rule.

Public expenditure (G , IG , TR) responds to the government balance.

Shocks to investment/financial frictions:

- We follow Hall (2013, 2014) and define a financial friction f_t as a spread between the period return earned on business investment rk_t and the return earned by savers rs_t .

- $f_t = rk_t - rs_t$

- The period return on capital is defined as the sum of marginal product on capital plus a capital gain on the end of period value of investment

- $rk_t = \frac{1}{q_t} [MPK_t + (1 - \delta)q_{t+1}]$

- q_t : Price of a unit of installed capital (incl. adjustment costs)

- Wedge f_t is identified as a risk premium to FOC for capital

- $q_t(1 + rs_t + f_t) = MPK_t + (1 - \delta)q_{t+1}$

Alternative interpretations:

Bernanke & Gertler (1997), Jerman & Quadrini (2012), Christiano et al (2014).

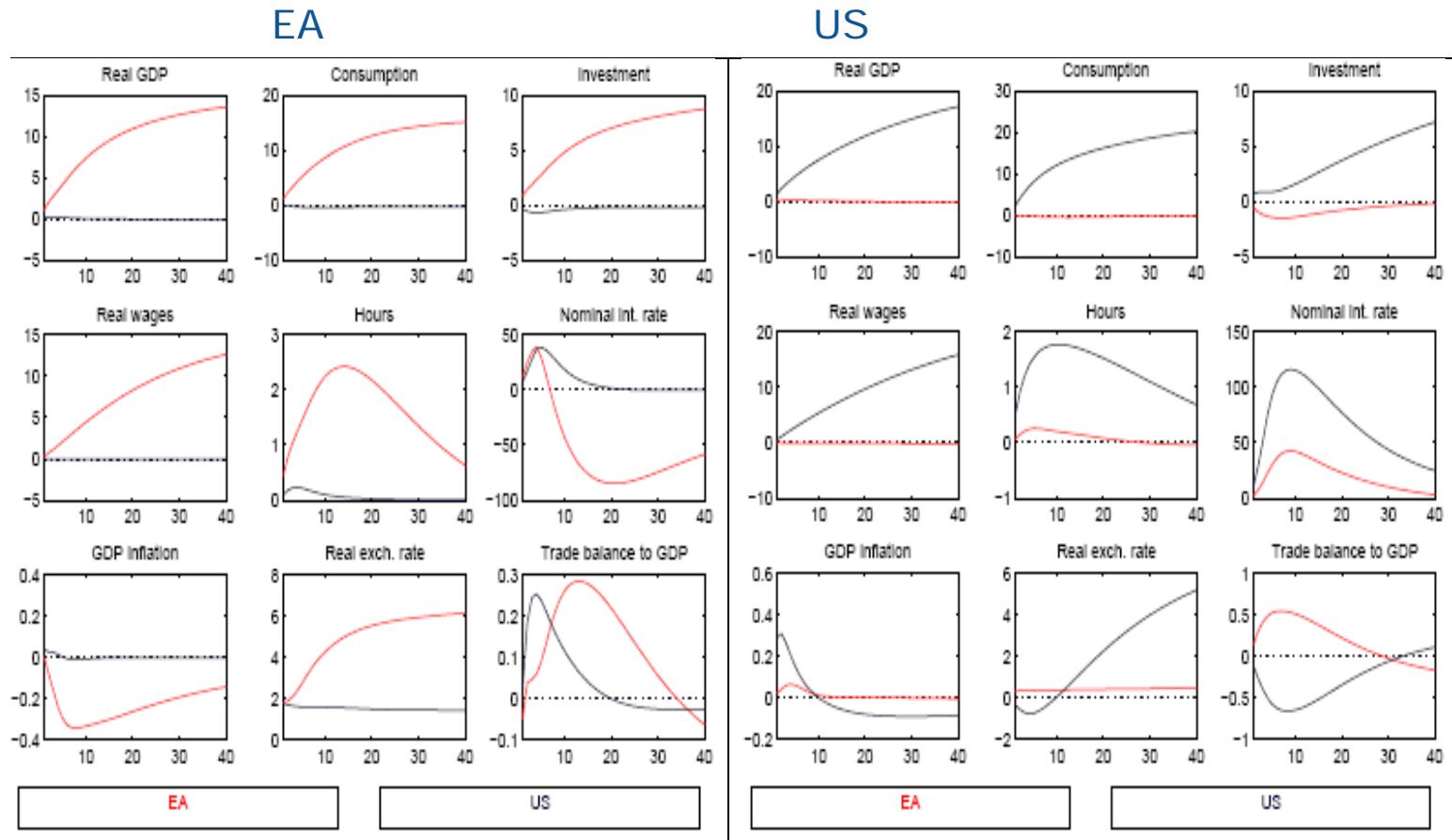
Table 1. Prior and posterior distributions of key estimated model parameters

| | | Posteriors | | | | Priors | | |
|-----------------------------------|---------------|-------------|------------|-------------|------------|---------------------|-------------|------------|
| | | EA | | US | | | | |
| | | Mode (1) | Std (2) | Mode (3) | Std (4) | Distribution (5) | Mean (6) | Std (7) |
| Preferences | | | | | | | | |
| Consumption habit | η_C | 0.89 | 0.03 | 0.85 | 0.03 | Beta | 0.5 | 0.2 |
| Labour habit | η_L | 0.39 | 0.22 | 0.86 | 0.08 | Beta | 0.5 | 0.2 |
| Risk aversion | σ | 1.41 | 0.17 | 1.39 | 0.17 | Gamma | 1.5 | 0.2 |
| Labor supply | κ | 2.31 | 0.45 | 2.14 | 0.41 | Gamma | 2.5 | 0.5 |
| Import price elasticity | ν | 4.11 | 0.43 | 4.26 | 0.45 | Gamma | 2 | 1 |
| Import source elasticity | ν_1 | 0.60 | 0.22 | 0.16 | 0.07 | Gamma | 2 | 1 |
| Oil demand elasticity | ν_O | 0.33 | 0.02 | 0.33 | 0.03 | Beta | 0.5 | 0.08 |
| Nominal and real frictions | | | | | | | | |
| NLC household share | s^r | 0.66 | 0.05 | 0.75 | 0.02 | Beta | 0.65 | 0.05 |
| Price adj. cost | γ_P | 28.6 | 6.64 | 62.2 | 14.8 | Gamma | 60 | 40 |
| Forward-looking prices | sfp | 0.54 | 0.04 | 0.77 | 0.05 | Beta | 0.5 | 0.1 |
| Import price rigidity | ρ_{PM} | 0.24 | 0.10 | 0.19 | 0.10 | Beta | 2 | 0.8 |
| Nominal wage adj. cost | γ_W | 4.84 | 1.33 | 2.94 | 0.83 | Gamma | 5 | 2 |
| Forward-looking wages | sfw | 0.52 | 0.10 | 0.51 | 0.11 | Beta | 0.5 | 0.1 |
| Real wage rigidity | ρ_w | 0.96 | 0.01 | 0.96 | 0.01 | Beta | 0.5 | 0.2 |
| Import demand inertia | ρ_M | 0.33 | 0.06 | 0.45 | 0.05 | Beta | 0.7 | 0.1 |
| Oil demand inertia | ρ_O | 0.26 | 0.08 | 0.19 | 0.05 | Beta | 0.7 | 0.1 |
| Labour adj. cost | γ_L | 4.69 | 1.01 | 12.1 | 3.60 | Gamma | 60 | 40 |
| Capital adj. cost | γ_K | 41.8 | 22.6 | 51.9 | 22.2 | Gamma | 60 | 40 |
| Investment adj. cost | γ_I | 91.2 | 31.5 | 49.2 | 21.3 | Gamma | 60 | 40 |
| Capacity util. adj. cost | γ_{UC} | 0.04 | 0.02 | 0.07 | 0.02 | Gamma | 0.1 | 0.04 |
| Monetary policy | | | | | | | | |
| Interest persistence | ρ_R | 0.87 | 0.02 | 0.85 | 0.03 | Beta | 0.7 | 0.12 |
| Response to inflation | $T_{R,\pi}$ | 2.37 | 0.37 | 2.09 | 0.31 | Beta | 2 | 0.4 |
| Response to GDP | $T_{R,y}$ | 0.02 | 0.01 | 0.02 | 0.00 | Beta | 0.5 | 0.2 |
| Fiscal policy | | | | | | | | |
| Transfer persistence | ρ_T | 0.97 | 0.01 | 0.97 | 0.01 | Beta | 0.7 | 0.1 |
| Response to deficit | $T_{T,d}$ | 0.01 | 0.00 | 0.01 | 0.00 | Beta | 0.03 | 0.008 |
| Response to debt | $T_{T,b}$ | 0.00 | 0.00 | 0.00 | 0.00 | Beta | 0.001 | 0.001 |
| Consumption persistence | ρ_{GC} | 0.95 | 0.01 | 0.95 | 0.02 | Beta | 0.7 | 0.1 |
| Investment persistence | ρ_{IG} | 0.83 | 0.05 | 0.92 | 0.02 | Beta | 0.7 | 0.1 |

Impulse responses of the model

Which key shocks explain the post-crisis slump?

Dynamic responses to a positive permanent TFP (growth rate) shock:



Persistent co-movement of GDP and domestic demand components

Persistent change of employment (real wage rigidity)

Counterfactual post crisis slump implications:

=> persistent fall in TFP is slightly inflationary in EA but deflationary in US.

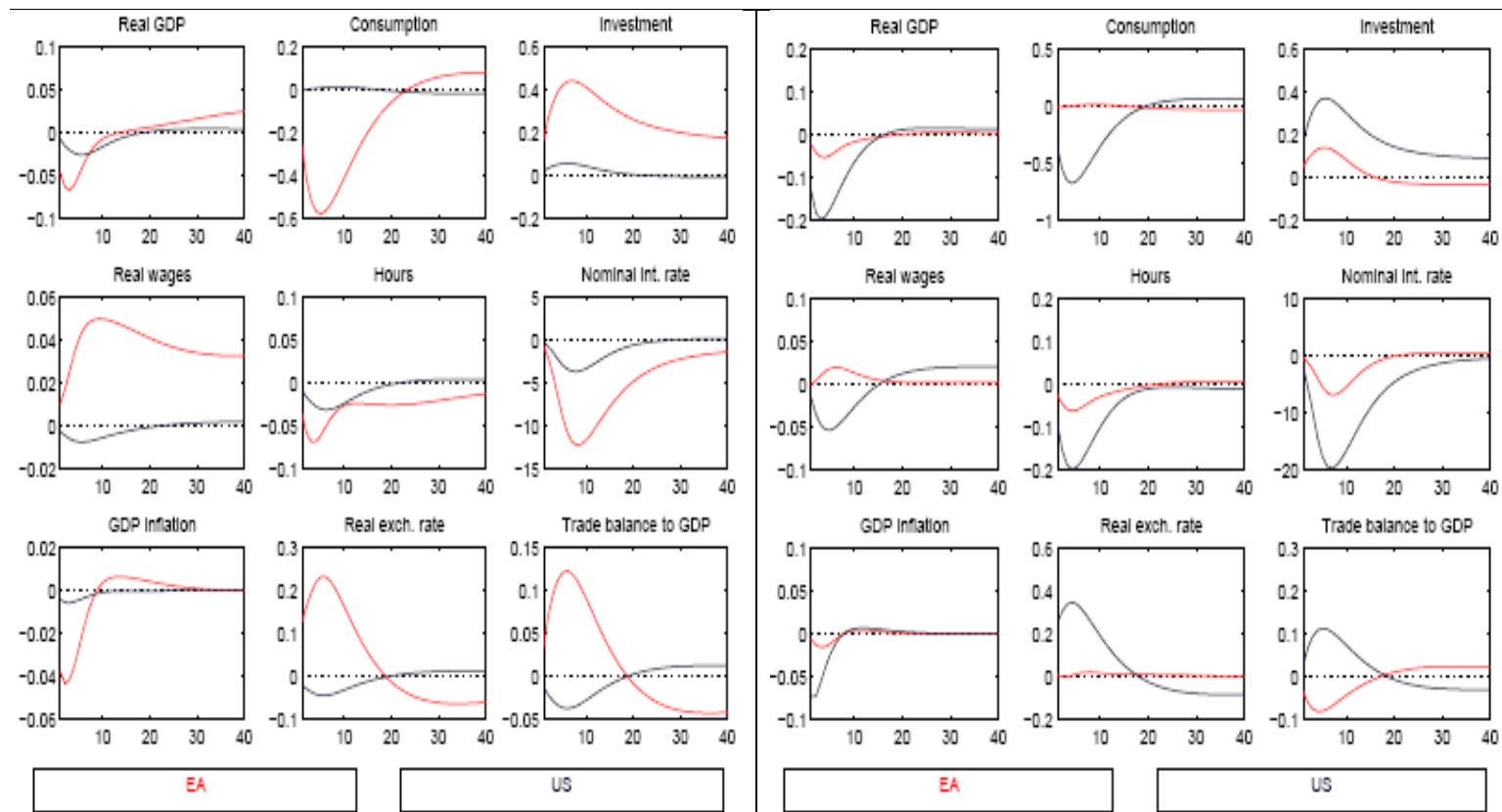
I and Y change at a similar order of magnitude

Cannot explain improvement in TB

Dynamic responses to positive private saving shock

EA

US



Lowers GDP (not persistent)
Deflationary
TB improves

Counterfactual implications:

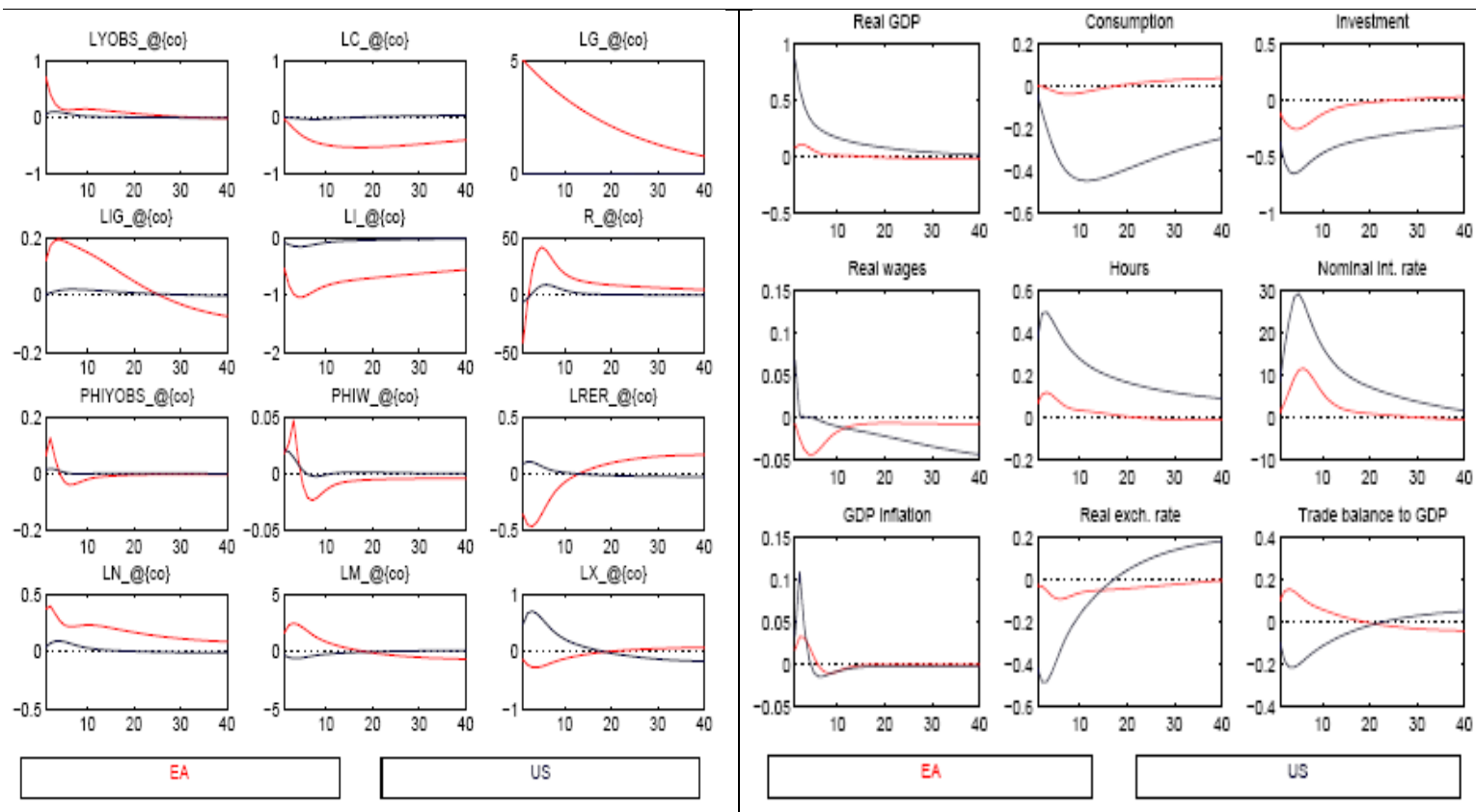
Increases IY ratio

Real wage/wage share increases in EA and falls in US

Dynamic responses to positive government purchases shock

EA

US



Multiplier ca 0.5 increases to ca 1 in case of 2 year expected ZLB

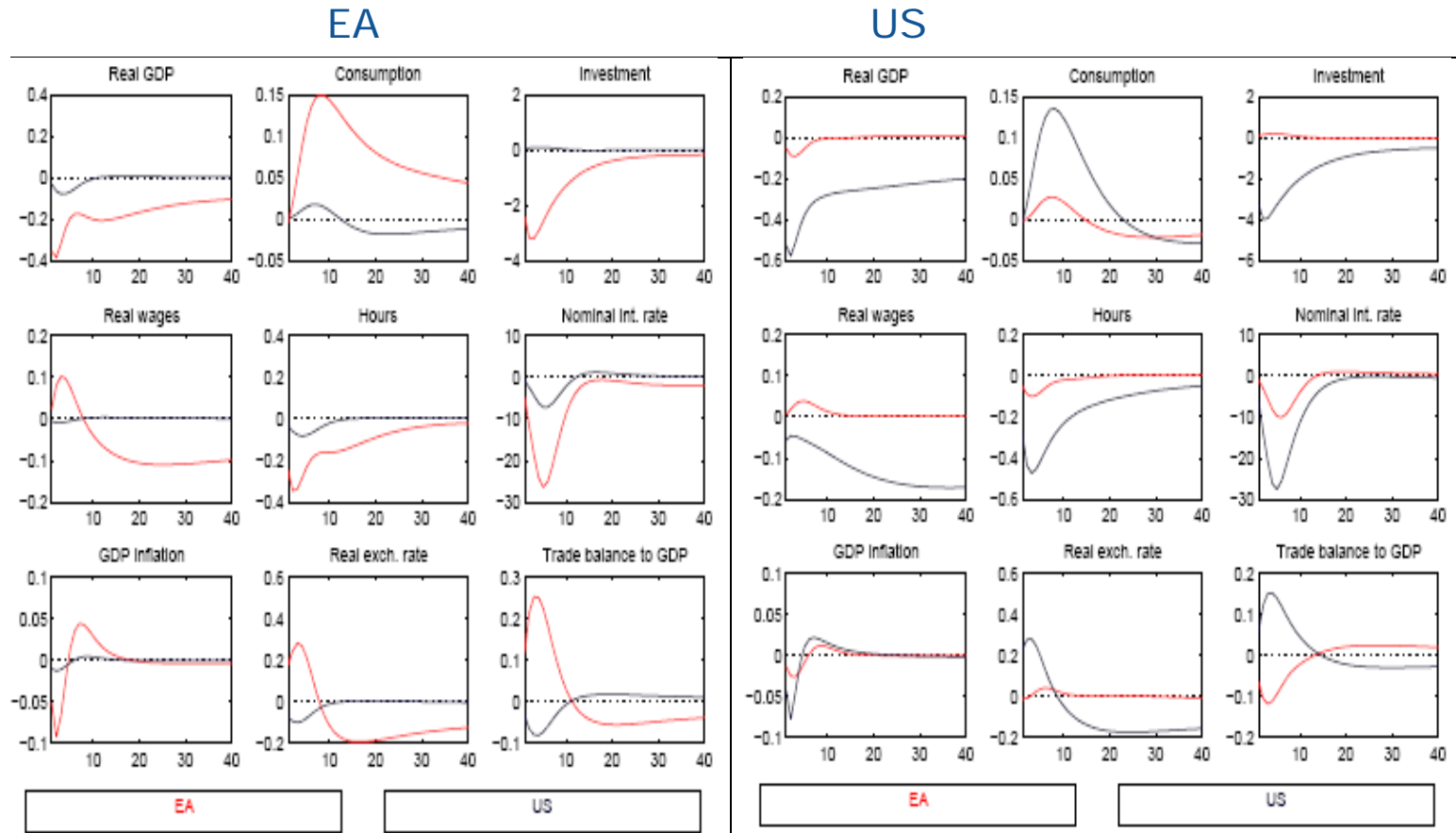
Deflationary

TB improves

Counterfactual implications:

Crowding in of domestic demand (disappears with sufficiently long ZLB constraint)

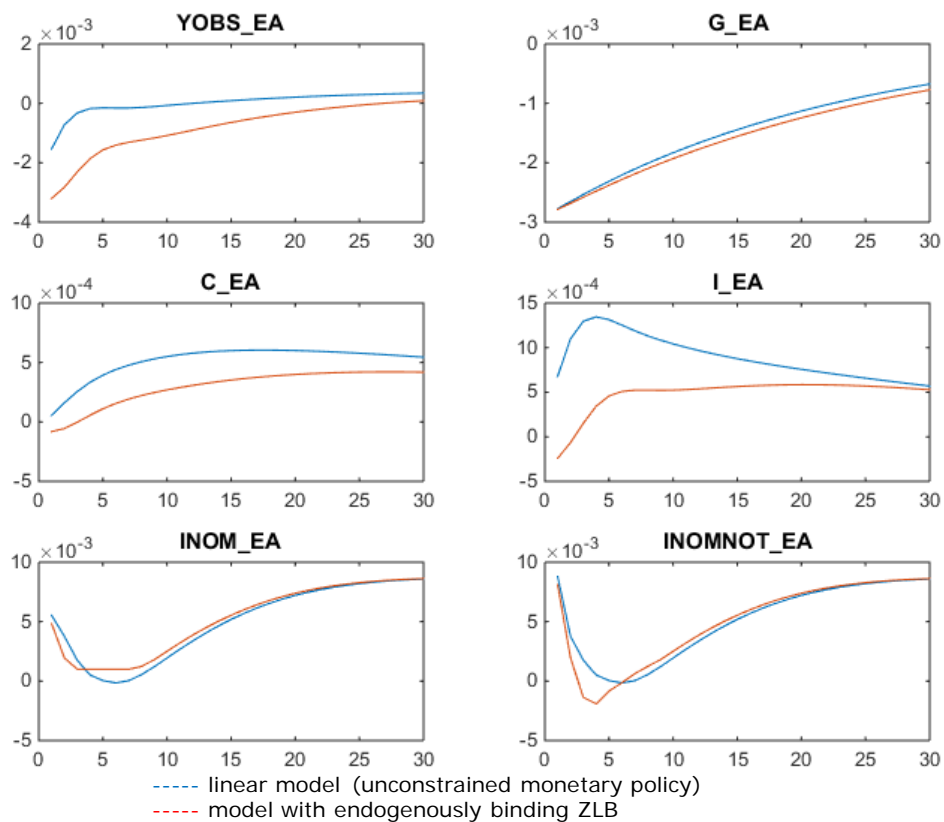
Dynamic responses to positive shock to investment risk premium



Lower domestic IY ratio , lowers GDP and L (persistently)
 But: Private consumption is crowded *in* by this shock.
 In the short term, the shock lowers inflation.

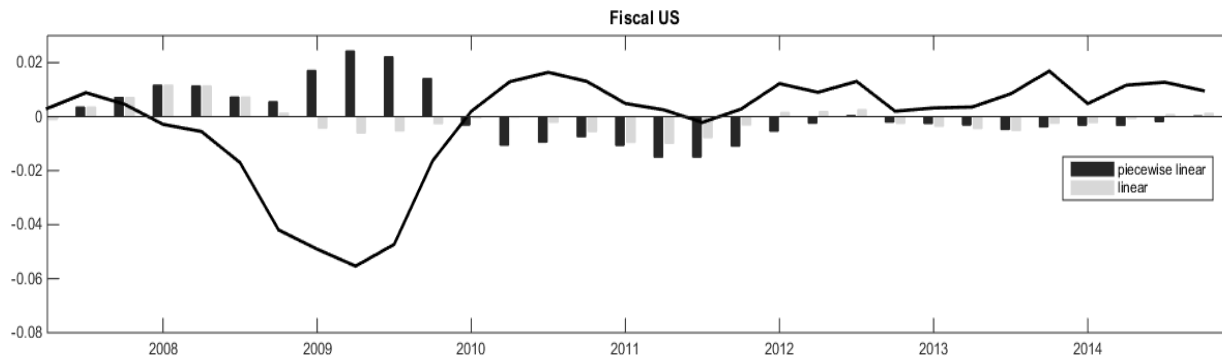
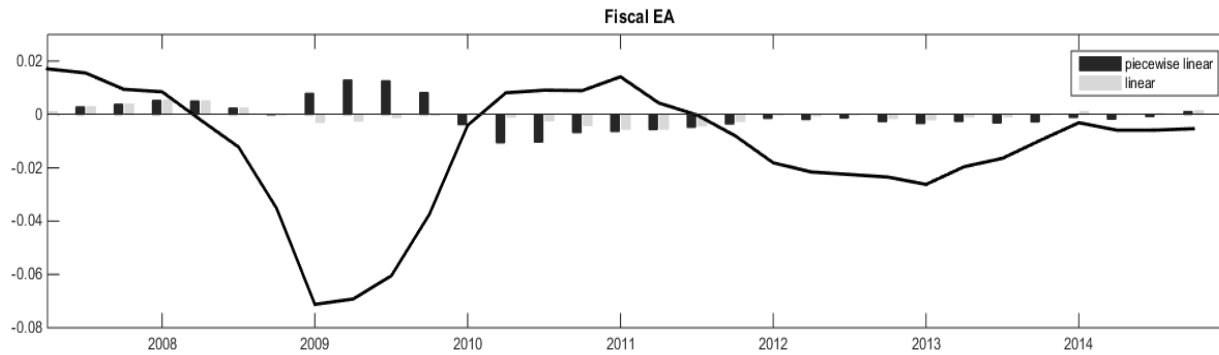
Fiscal policy with and without ZLB

Negative fiscal shock of 0.25% of GDP in EA in 2009q1

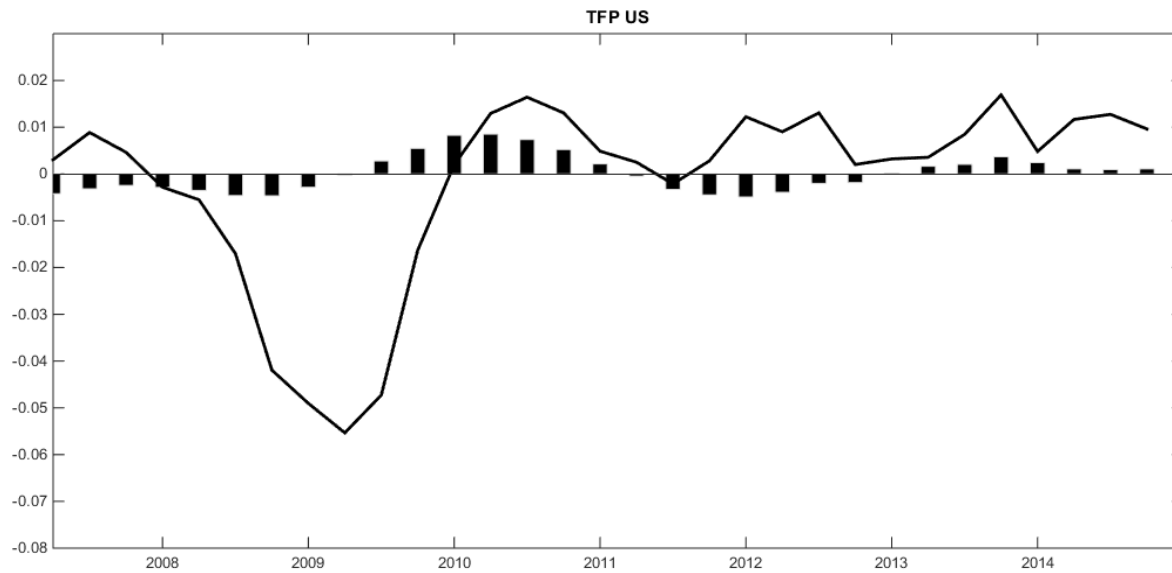
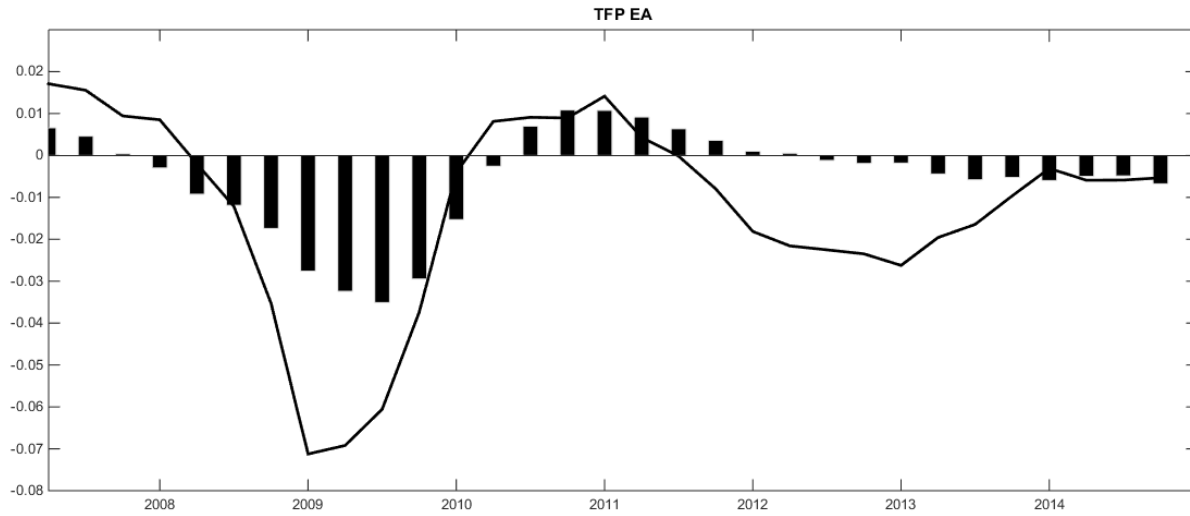


INOM = nominal int. rate; INOMNOT = shadow int. rate

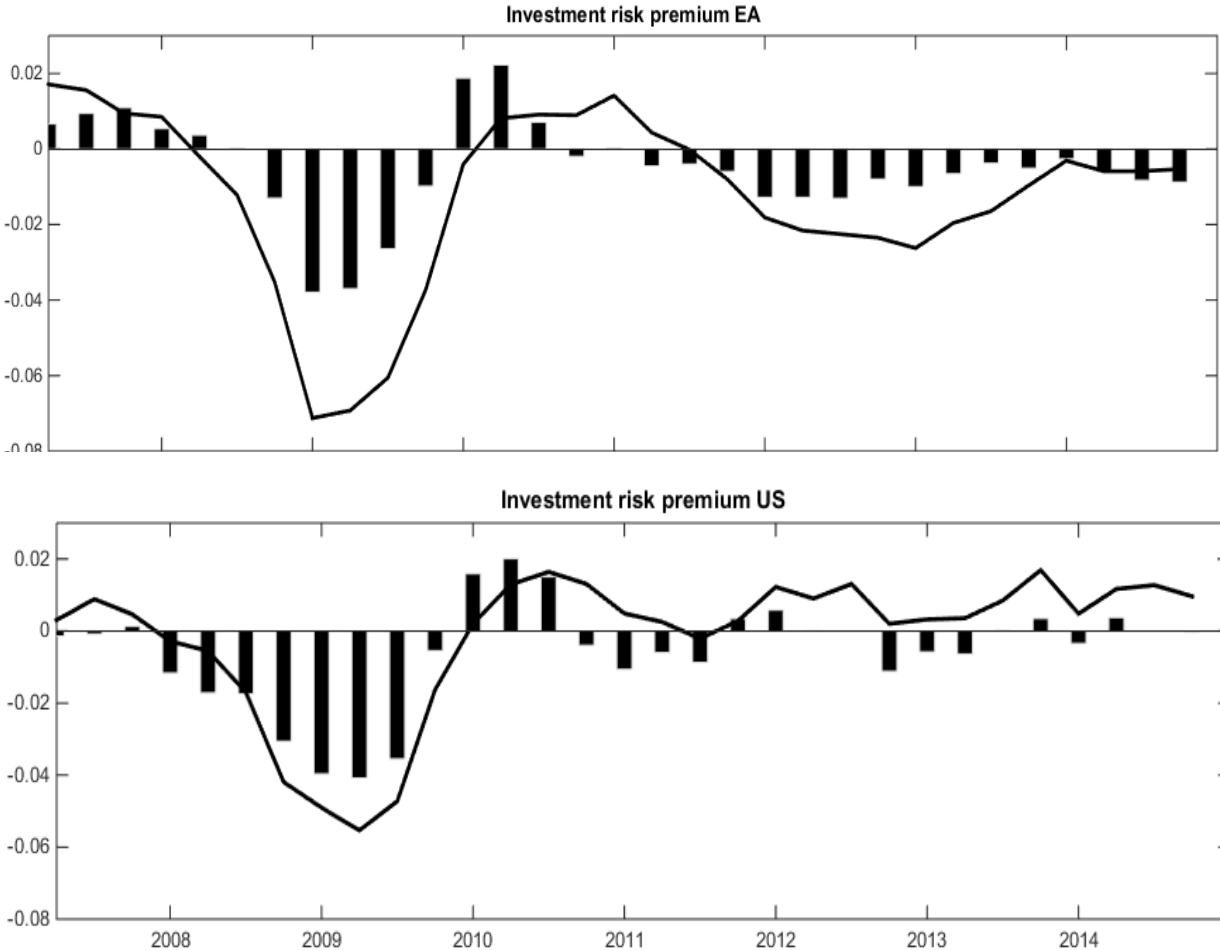
Fiscal contribution to growth with and without ZLB:



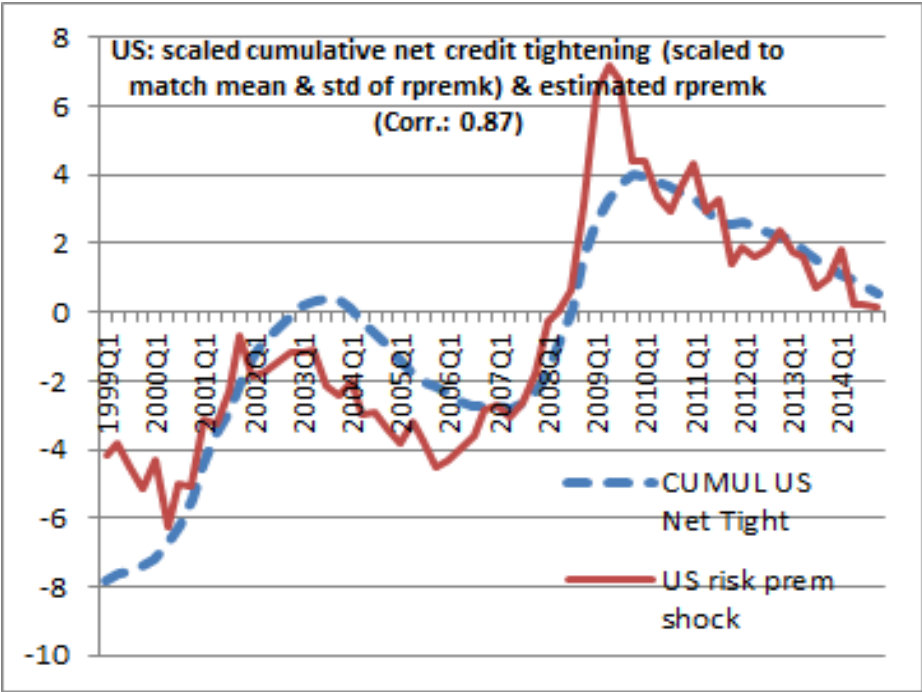
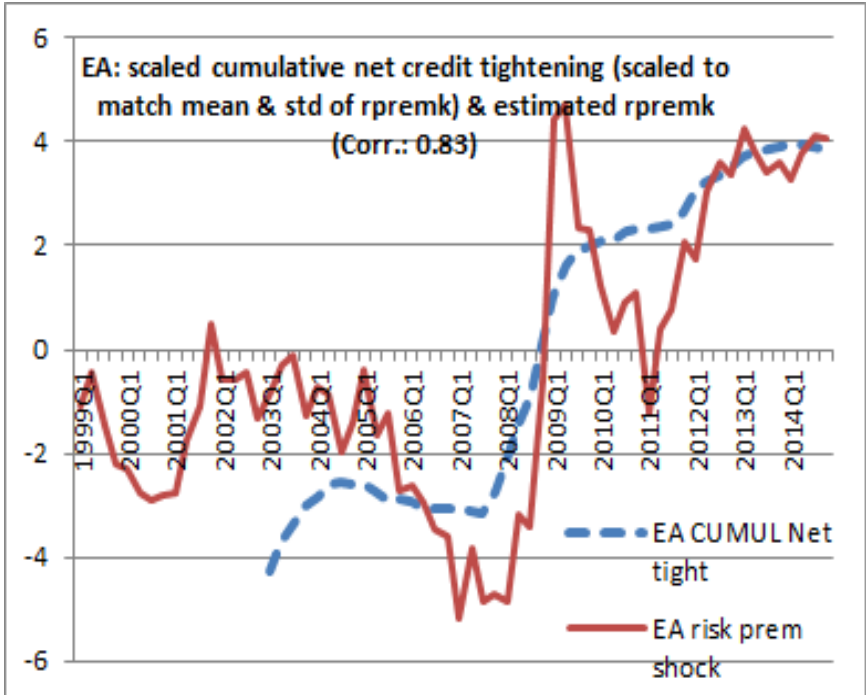
Contribution of TFP to growth



Investment frictions:



EA & US cumulated net credit tightening and estimated investment risk premia



Conclusion

TFP and investment wedges important for the decline of GDP growth in the EA.

The importance of risk premia appears consistent with various performance indicators of EA financial system.

More work is needed to properly understand why TFP growth has slowed down so strongly.

Public deleveraging is less important but non negligible, especially if ZLB constraints are taken into account.

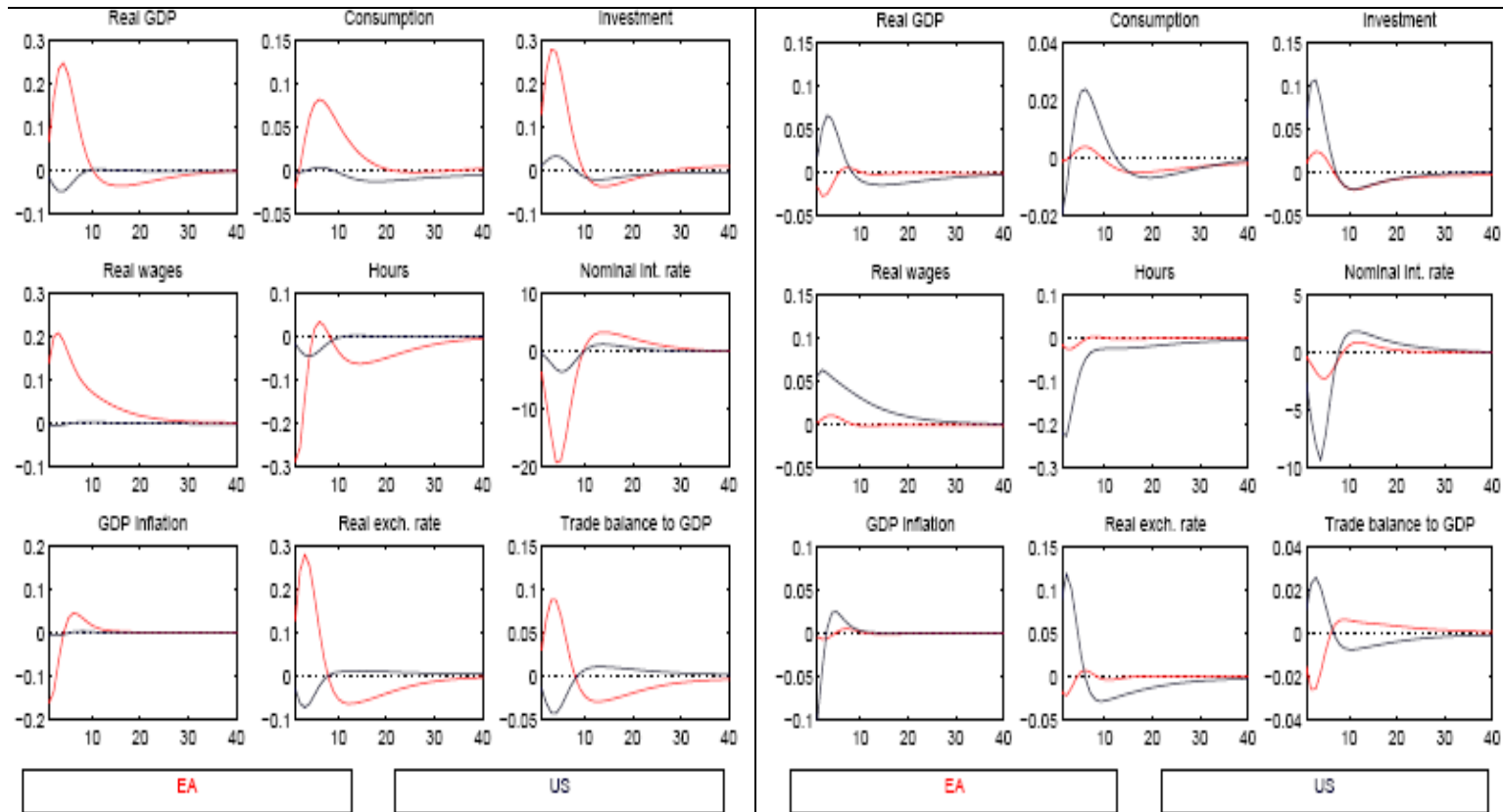
These results largely confirm the view that financial crisis had a strong impact on potential growth.

Reserve Slides

Dynamic responses to a transitory positive TFP shock:

EA

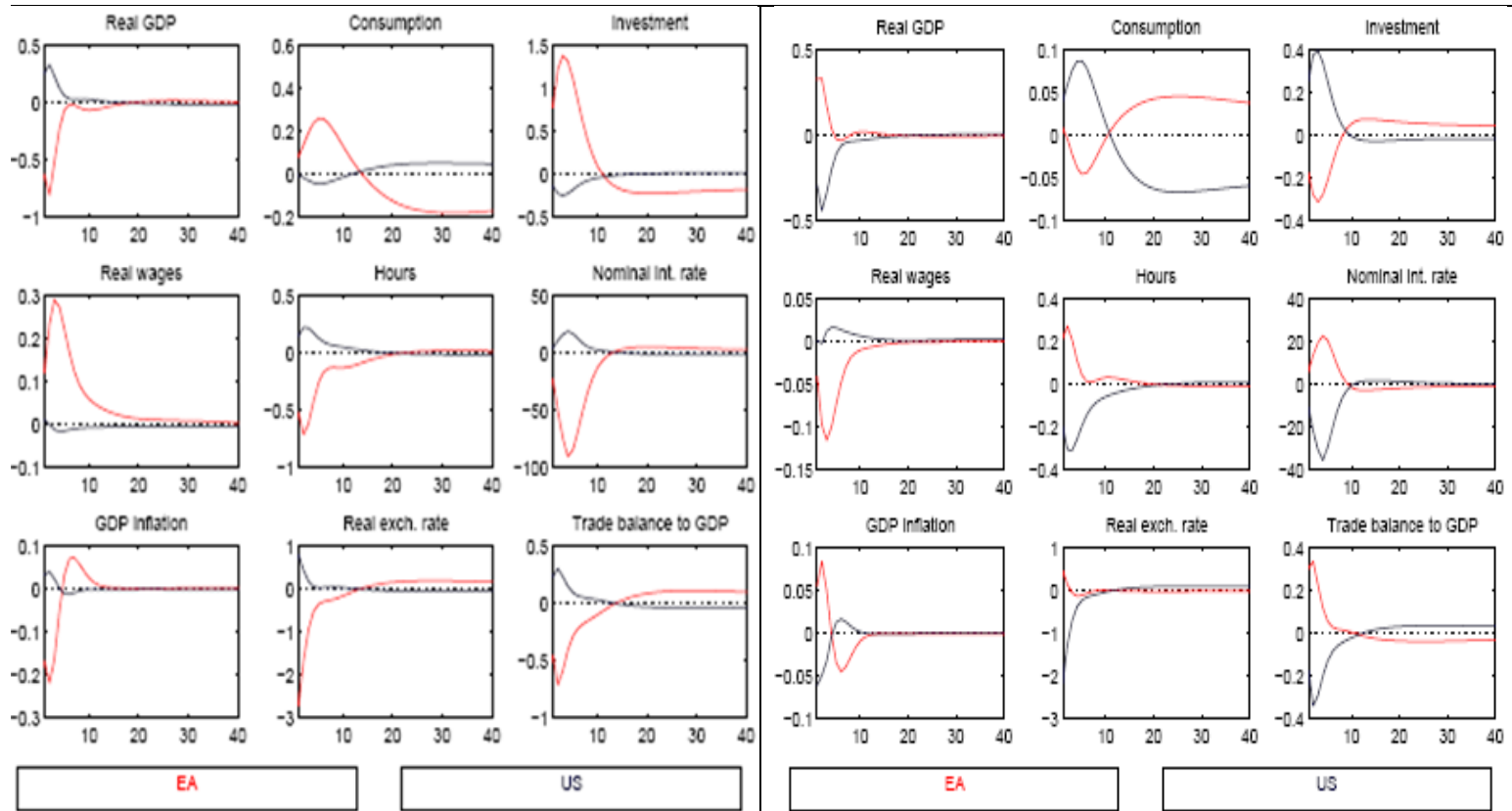
US



Dynamic responses to UIP shock wrt ROW currency

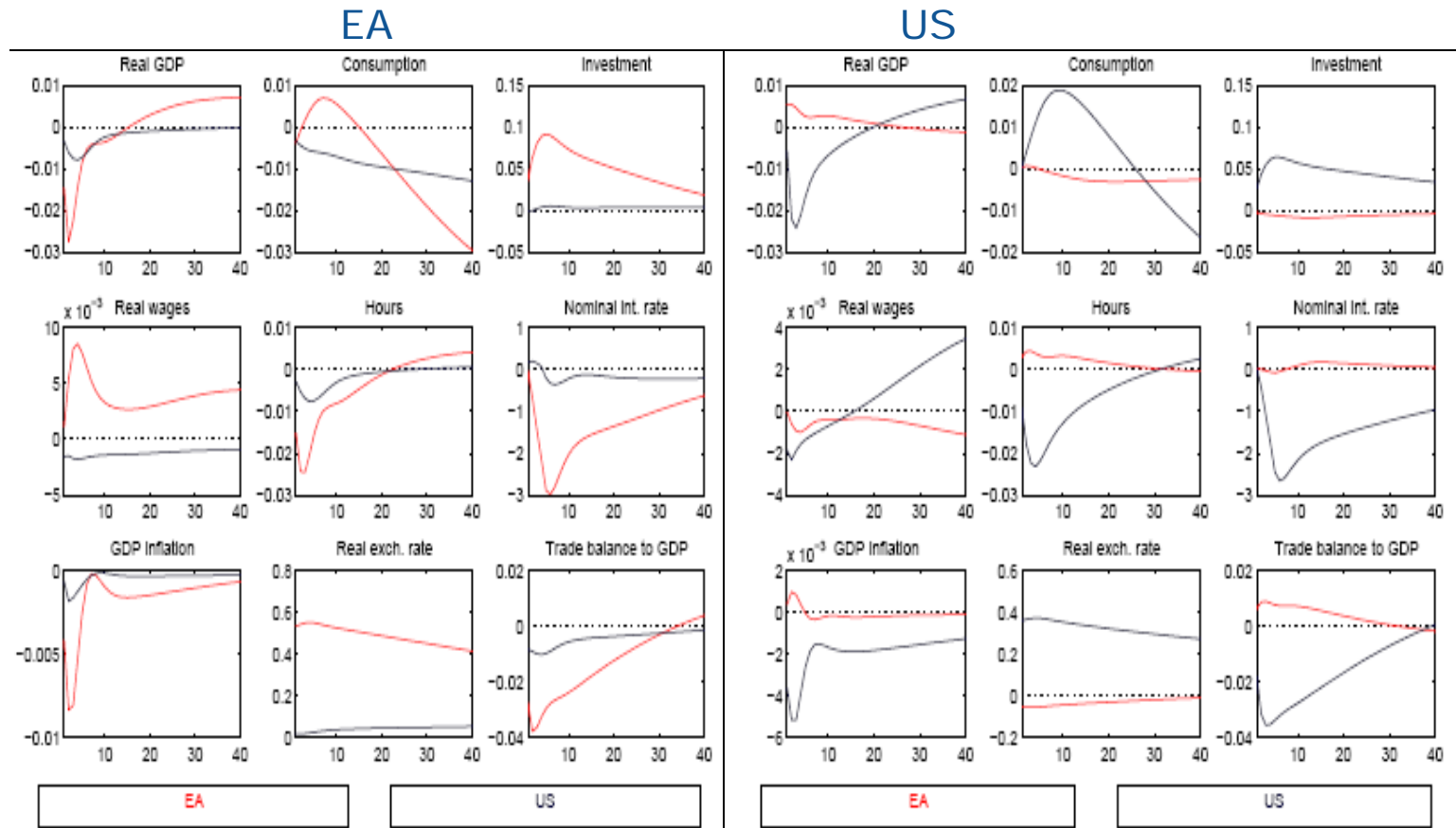
EA

US



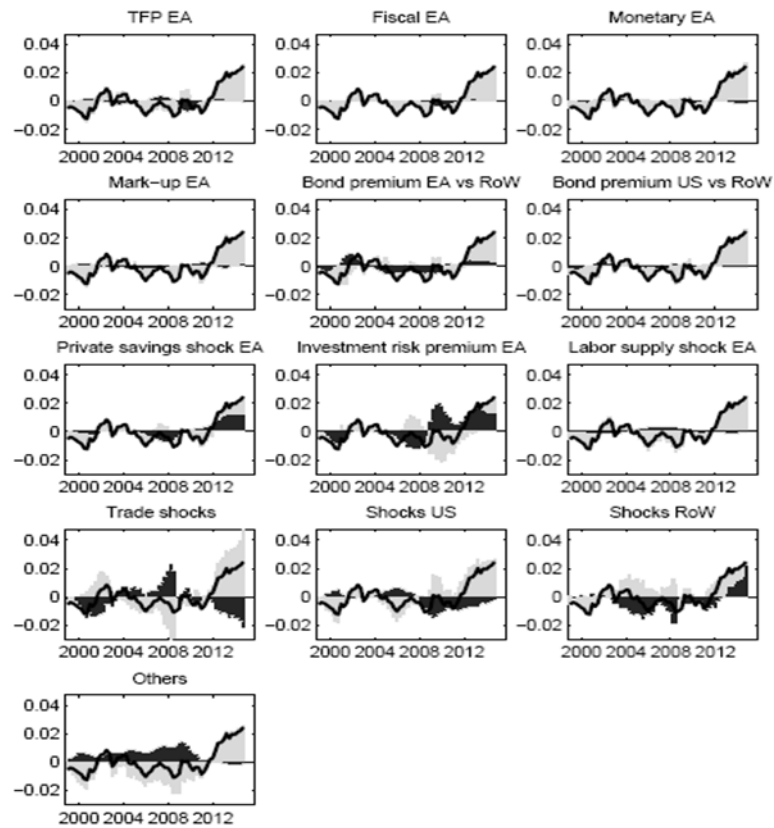
Helps explaining Euro depreciation, improved TB, I and C decline

Dynamic responses to negative export competitiveness shock of ROW

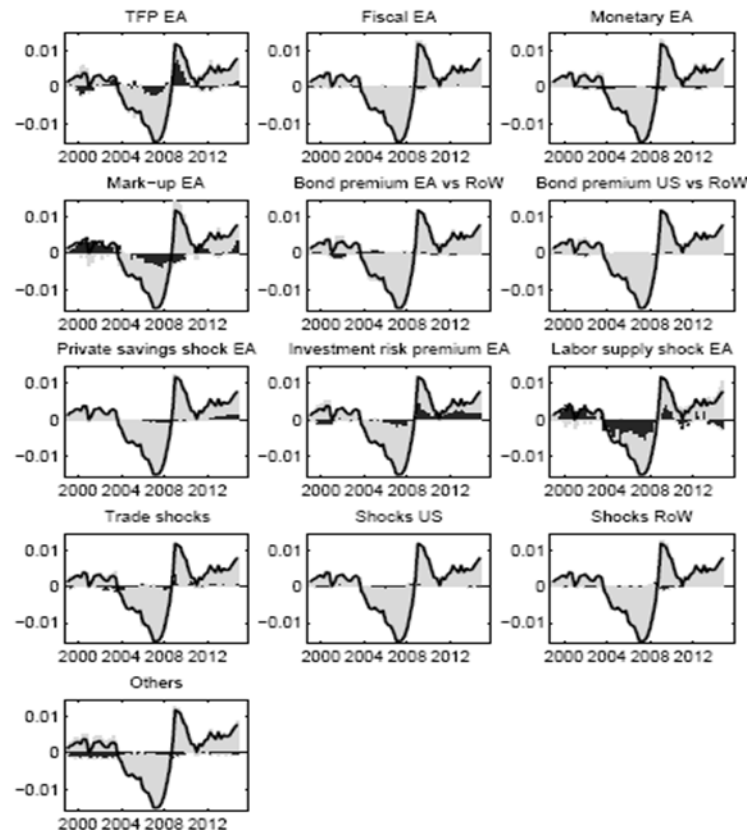


EA inflation falls, imports increase, positive effect on C+I, TB declines

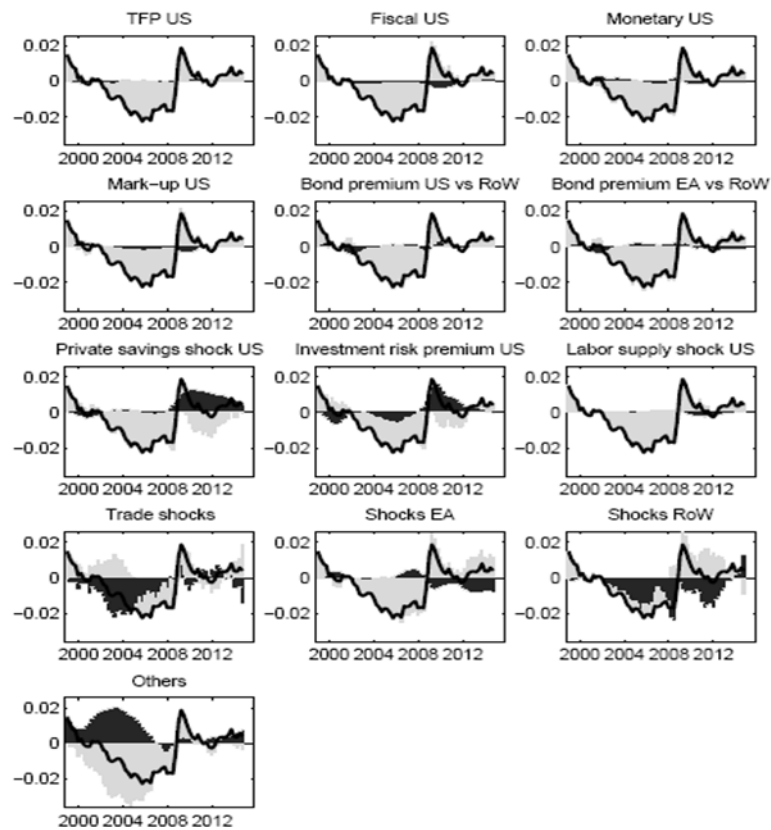
Historical decompositions of trade balance/GDP ratio in EA



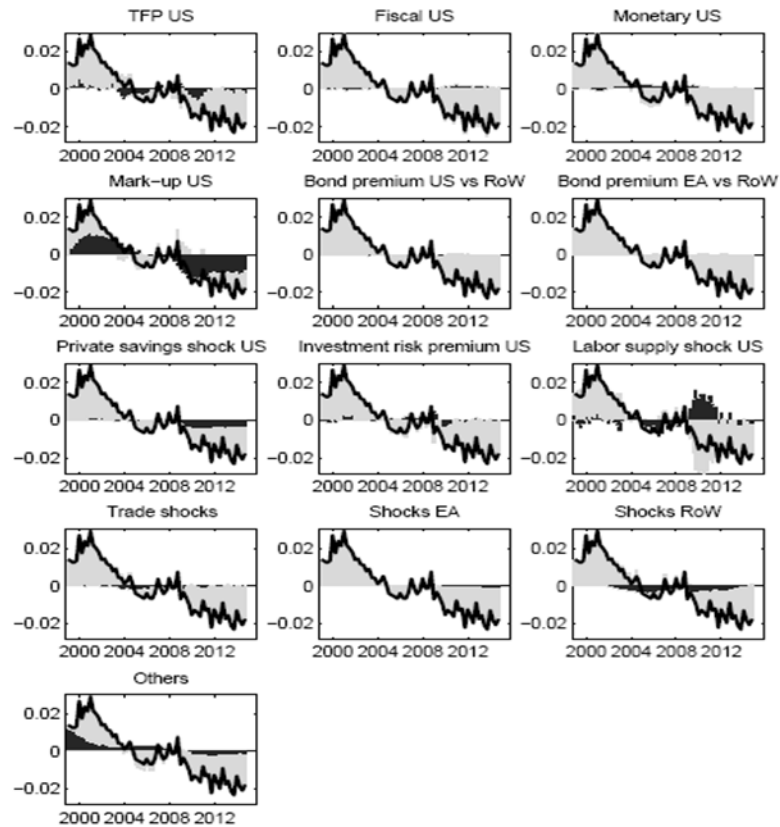
Historical decompositions of labor share in EA



Historical decompositions of trade balance/GDP ratio in US



Historical decompositions of labor share in US



Shocks to investment:

Bernanke & Gertler (1997), Jerman & Quadrini (2012), Christiano et al (2014).

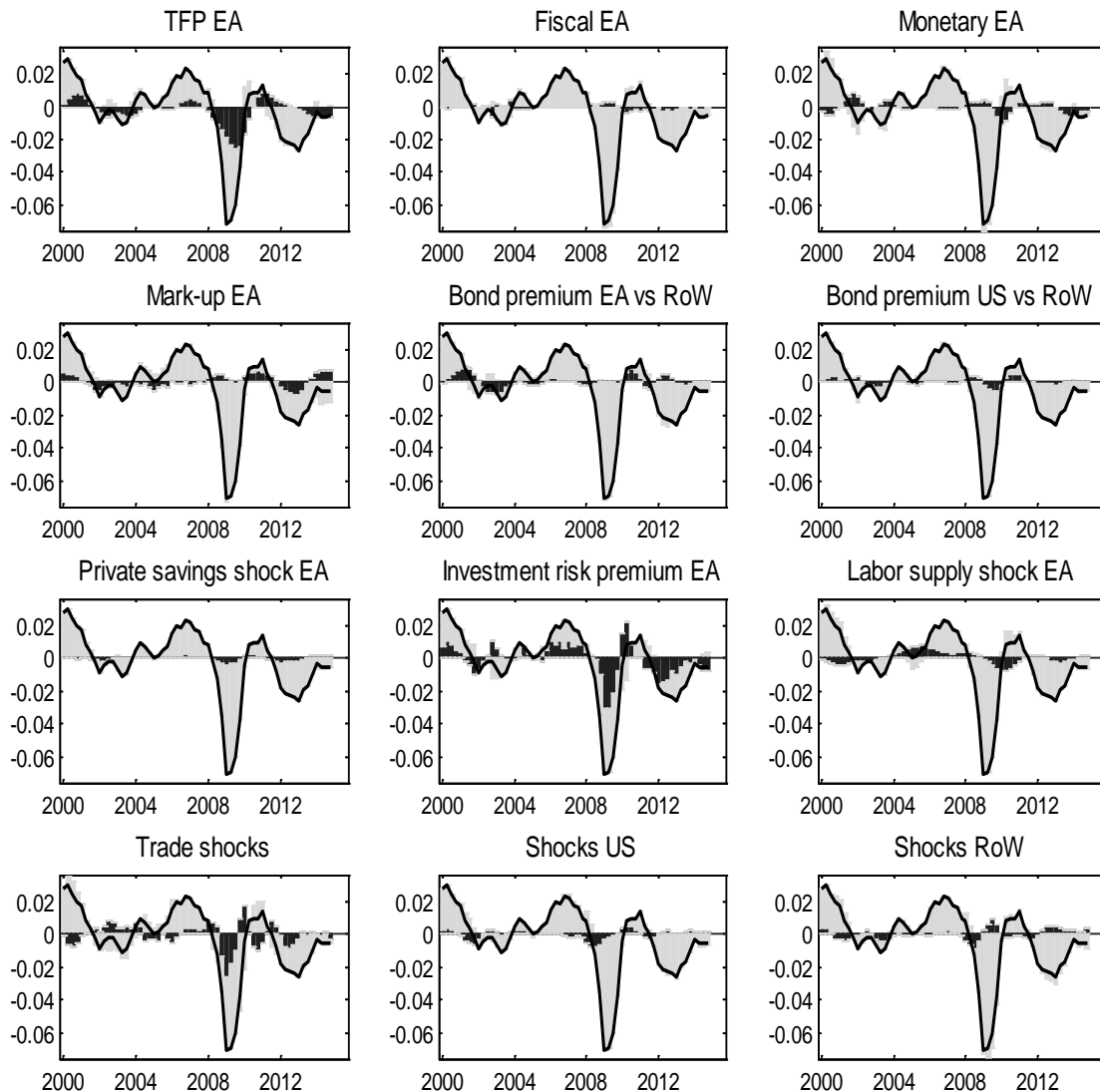


The firm maximizes the present value of dividends

$$V_t = \text{div}_t^i + E_t \rho_{t,t+1}^i (p_t / p_{t+1}) V_{t+1},$$

$\rho_{t,t+1}^i$ is a stochastic discount factor that can differ from the intertemporal marginal rate of substitution of the Ricardian household: $\rho_{t,t+1}^i = (1 + \varepsilon_t^i) \beta_{t,t+1}^r \lambda_{t+1}^r / \lambda_t^r$, by ε_t^i

Investment wedge (captures intermediation friction and/or bubbles)



Investment boom before crisis.

2009:

- Inv-risk increases
- Permanent level shift of TFP
- Negative trade shocks.

2010:

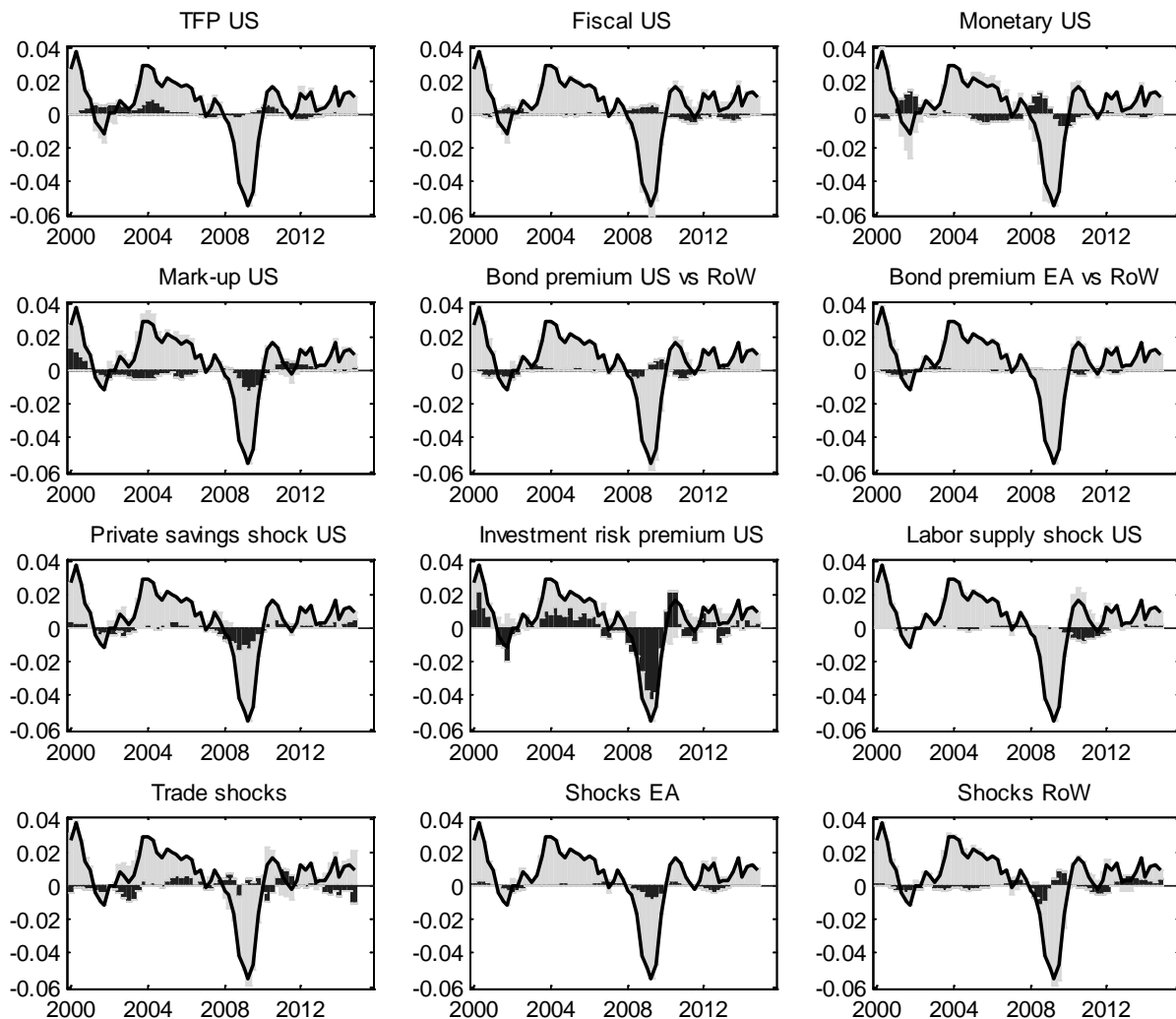
- Recovery, fall in risk premia

After 2011:

- Rise in risk premium (sov debt crisis)

LESS IMPORTANT:

- Price and wage markups
- Household saving
- ROW/US growth
- Euro risk premium
- Fiscal policy stabilising in 2009 and negative afterwards



Inv risk premium explains pre-crisis boom
 2008-2009:
 Investment risk premium.
 BUT: more short-lived in the US than in the EA.
 Saving
 Price mark up increase

Monetary policy shocks slightly stabilizing.

EA & US Lending spreads and estimated investment risk premia

