EUROPEAN COMMISSION
DIRECTORATE GENERAL ECONOMIC AND FINANCIAL AFFAIRS

Fiscal stimulus and exit strategies in the EU: a model-based analysis

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OUTLINE

- European Commission's QUEST model with credit constrained households
- Fiscal policy
- Multipliers temporary stimulus
- Impact of permanent fiscal consolidations

QUEST III model

- Standard DSGE model (Ratto *et al*, 2009)
- Extension : housing sector and credit-constrained consumers (Kiyotaki&Moore,1997, Iacoviello, 2005)
- Detailed fiscal policy
- Multi country disaggregation

Figure 1: Euro area:
Credit standards applied to the approval of loans to households

(net percentages of banks reporting tightening credit standards)

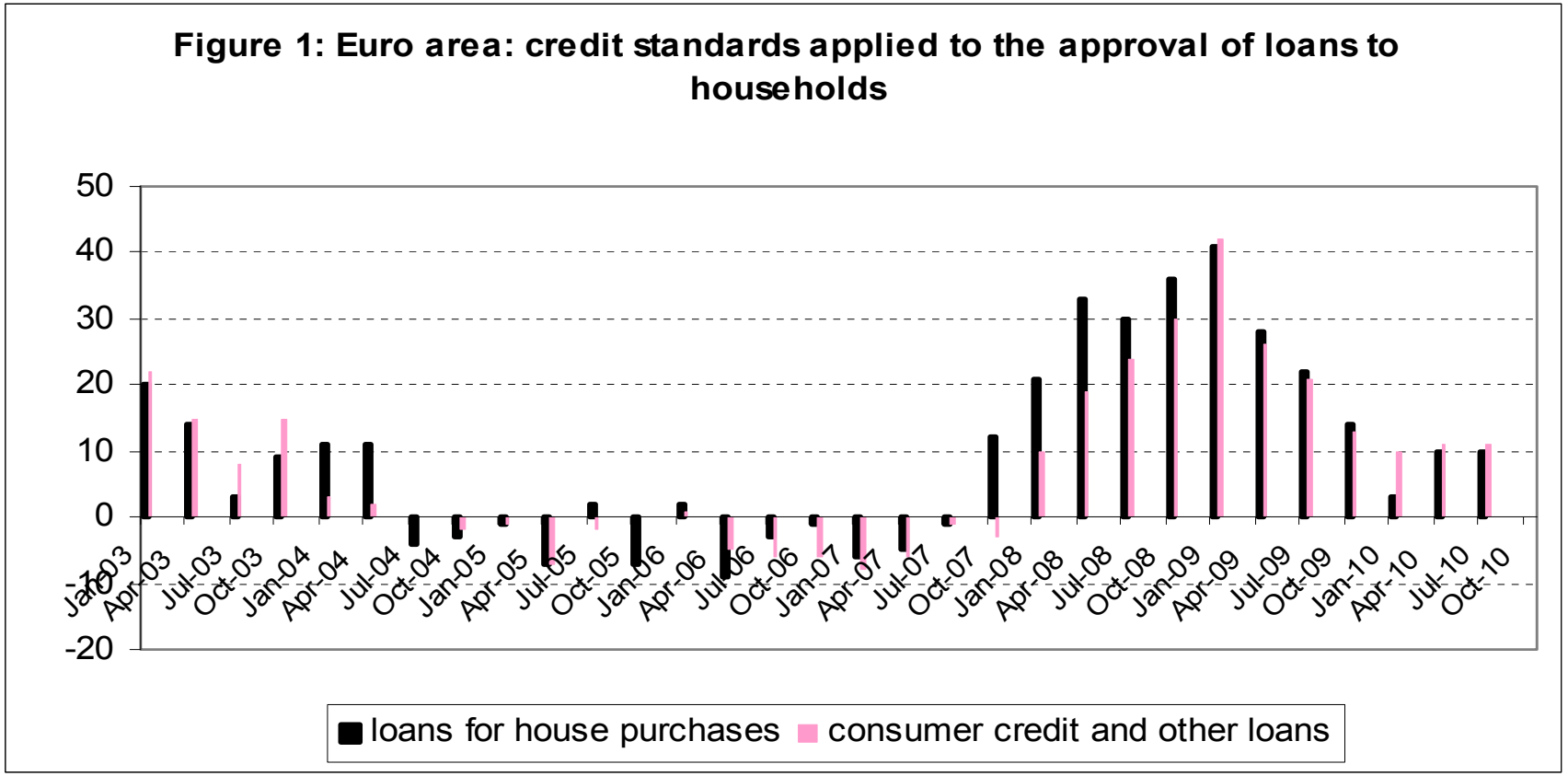
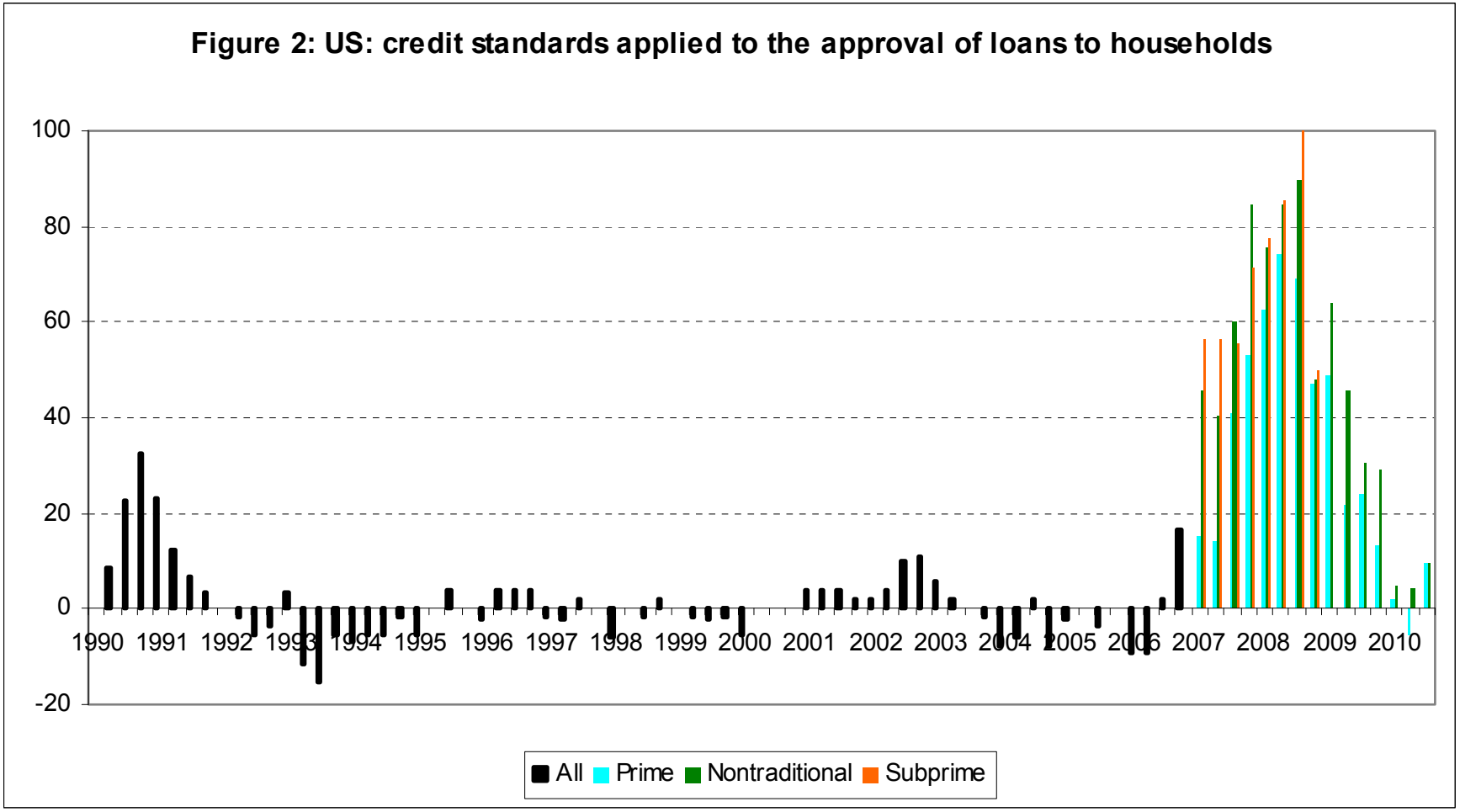


Figure 2: US:

Credit standards applied to the approval of loans to households

(net percentages of banks reporting tightening credit standards)



Households:

Disaggregation of the household sector into borrowers and lenders:

- **Non-constrained / Ricardian / lenders**: intertemporal optimising (utility separable in consumption, leisure and housing)
  - full access to financial markets
- **Credit-constrained / borrowers:** intertemporal optimising over consumption, leisure and housing
  - subject to borrowing constraint: collateral constraint endogenously linked to nominal value of asset (housing)
- **Liquidity-constrained** ("**hand-to-mouth**"):
  - Consume their current disposable income

Households 1: Non-constrained households - lenders

Period utility function separable in C, leisure and housing services H
Ricardian hh hold government bonds and bonds issued by domestic and foreign hh, real capital of T and NT sector

$$Max \quad V_0^r = \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^{r\,t} U(C_t^r, 1-L_t^r, H_t^r)$$

$$-\mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^r \beta^{r\,t} \left(\begin{array}{l} (1+t_t^c) p_t^C C_t^r + \sum_j p_t^{K,j} (1-itc_t) I_t^j + p_t^H (1+t_t^c) I_t^{H,r} + p_t^H (1+t_t^c) I_t^{HLC,r} + (B_t^{G,r} + B_t^r) \\ + rer_t B_t^{F,r} - (1+r_{t-1})(B_{t-1}^{G,r} + B_{t-1}^r) - (1+r_{t-1}^F)(1-risk(.)) rer_t B_{t-1}^{F,r} \\ - \sum_j ((1-t_t^k) i_{t-1}^{K,j} + t_t\, \delta^{k,j}) p_{t-1}^{K,j} K_{t-1}^j - (1-t_t^W)(w_t^P L_t^{P,r} + w_t^G L_t^{G,r}) + \frac{\gamma_W}{2} \frac{\Delta W_t^{\,2}}{W_{t-1}} - \\ ((1-t^k) i_{t-1}^H + \delta^H) p^H{}_t H_{t-1}^{LC,r} - p_t^L J_t^{Land} - \sum_{j=1} \mathrm{Pr}_t^j - \mathrm{Pr}_t^H + t_t^H p_{t-1}^H (H_{t-1}^r + H_{t-1}^{LC,r}) + T_t^{LS,r} \end{array} \right)$$

$$-\mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^r \beta^{r\,t} \left(\sum_j \xi_t^j (K_t^j - J_t^j - (1-\delta^{K,j}) K_{t-1}^j) \right) - \mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^r \zeta_t^r \beta^{r\,t} \left(H_t^r - J_t^{H,r} - (1-\delta^H) H_{t-1}^{H,r} \right)$$

$$-\mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^r \vartheta_t^r \beta^{r\,t} \left(H_t^{LC,r} - J_t^{HLC,r} - (1-\delta^H) H_{t-1}^{LC,r} \right) - \mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^r \xi_t^r \beta^{r\,t} \left(Land_t + J_t^{Land} - (1+g_t^L) Land_{t-1} \right)$$

Households 2: Credit-constrained households - borrowers

Intertemporally optimising (as "Ricardians") (i.e. not hand-to-mouth) but:

1. higher rate of time preference $\beta^c < \beta^r$ and
2. they face a collateral constraint on their borrowing : borrow B^c from domestic "Ricardian" households

$$Max \quad V_0^c = \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^{c\,t} U(C_t^c, 1 - L_t^c, H_t^c)$$

$$- \mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^c \beta^{c\,t} \left(\begin{array}{l} (1+t_t^c)\, p_t^C C_t^c + p_t^H (1+t_t^H) I_t^{H,c} - B_t^c + (1+r_{t-1}) B_{t-1}^c - \\ (1-t_t^W)(w_t^P L_t^{P,c} + w_t^G L_t^{G,c}) + \frac{\gamma_W}{2} \frac{\Delta W_t^{\,2}}{W_{t-1}} + t_t^H\, p_{t-1}^H H_{t-1}^C + T_t^{LS,c} \end{array} \right)$$

$$- \mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^c \zeta_t^c \beta^{c\,t} \left(H_t^c - J_t^{H,c} - (1-\delta^H) H_{t-1}^c \right)$$

$$- \mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^c \psi_t \beta^{c\,t} \left(B_t^c - (1-\chi)\, p_t^H H_t^c \right)$$

Consumption:

Ric:

$$\frac{\mathrm{E}_t(C^r_{t+1} - hC_t)}{C^r_t - hC_{t-1}} = \beta^r(1+r_t)$$

CC:

$$\frac{\mathrm{E}_t(C^c_{t+1} - hC_t)}{C^c_t - hC_{t-1}} = \beta^c \frac{(1+r_t)}{(1-\psi_t)}$$

Housing investment:

Shadow price of housing capital ς_t = PDV of ratio of the marginal utility of housing services H and consumption C

Ric:

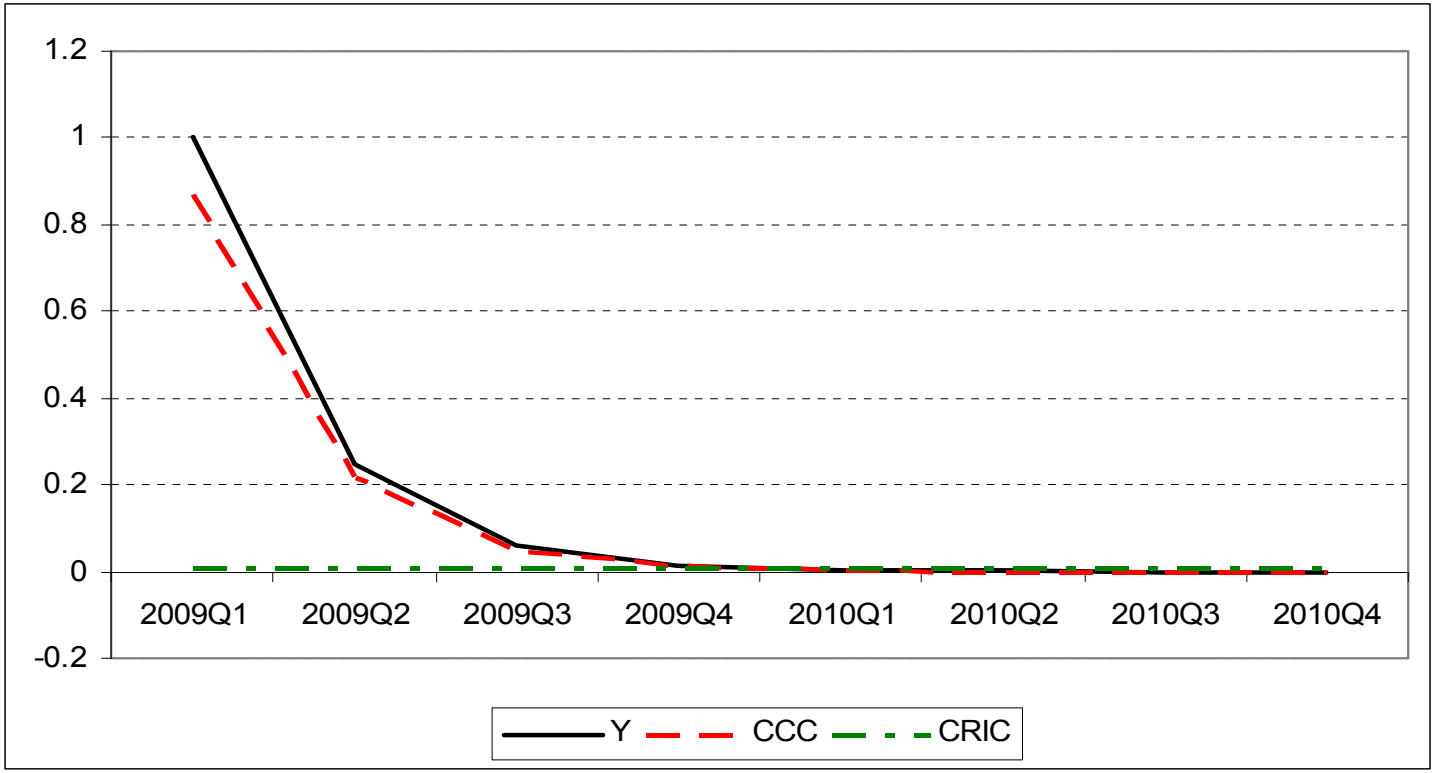
$$\frac{\zeta^r_t}{p^H_t(1+t^c_t)} = \omega^r \frac{(C^r_t - hC_{t-1})(1+t^c_t)p^C_t}{H^r_t(1+t^c_t)p^H_t} + \mathrm{E}_t\left(\frac{1}{(1+r_t+\pi^{GDP}_{t+1}-\pi^H_{t+1}-\Delta t^c_{t+1})} \frac{\zeta^r_{t+1}}{p^h_{t+1}(1+t^c_{t+1})}(1-\delta^H)\right)$$

CC:

$$\frac{\zeta^c_t}{p^H_t(1+t^c_t)} = \omega^c \frac{(C^c_t - hC_{t-1})(1+t^c_t)p^C_t}{H^c_t(1+t^c_t)p^H_t} + \psi_t(1-\chi) + \mathrm{E}_t\left(\frac{(1-\psi_t)}{(1+r_t+\pi^{GDP}_{t+1}-\pi^H_{t+1}-\Delta t^c_{t+1})} \frac{\zeta^c_{t+1}}{p^H_{t+1}(1+t^c_{t+1})}(1-\delta^H)\right)$$

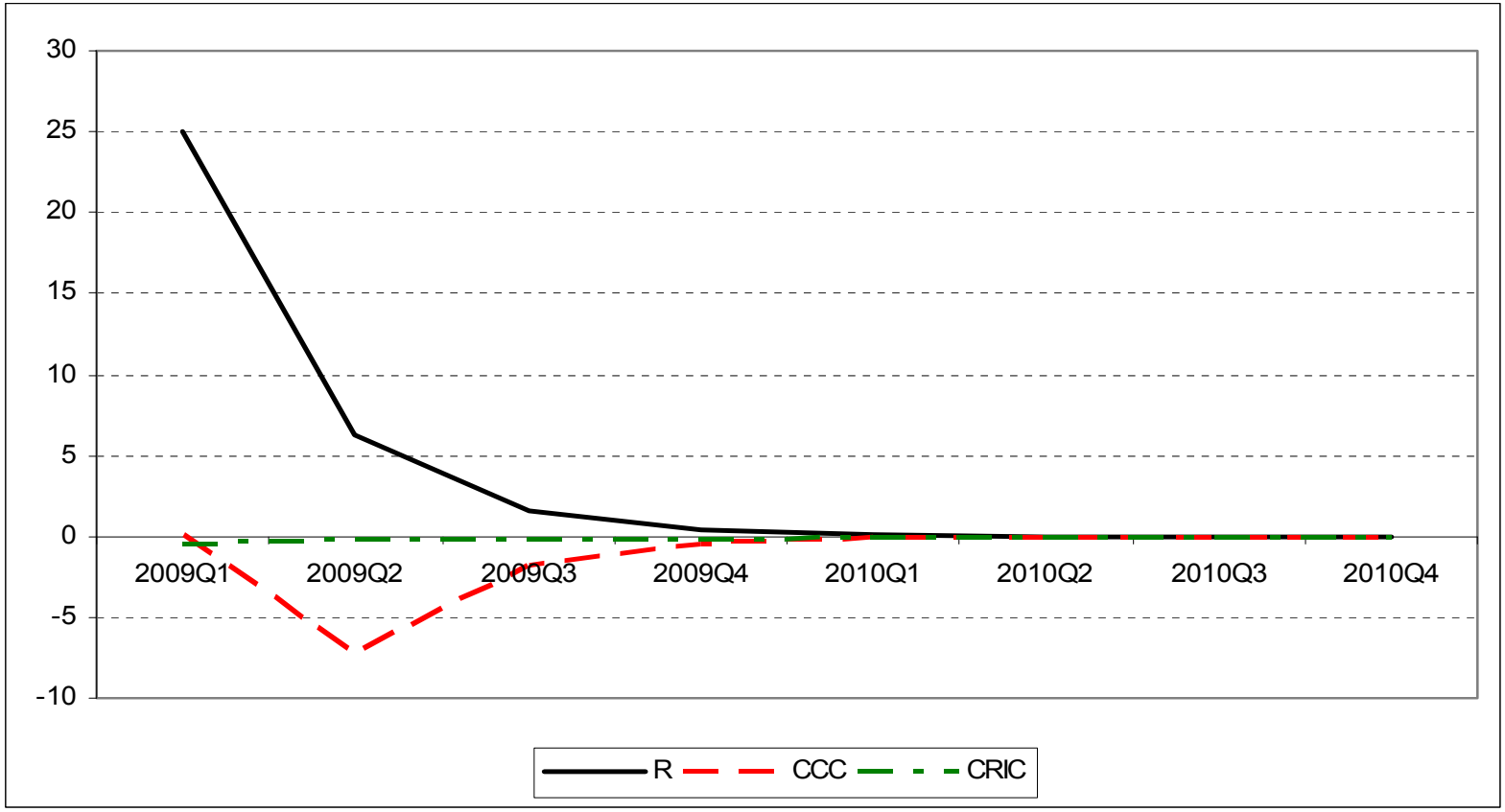
Note: Lagrange multiplier of the collateral constraint ***ψ*** - acts like premium on interest rate (fluctuates positively with tightness of constraint)

Figure 3: Response of consumption to changes in current income Y (absolute deviations)



Y disposable income
CCC consumption credit constrained hh
CRIC consumption “Ricardian” households

Figure 4: Response of consumption to changes in interest rates R (% deviations)



R	real interest rate
CCC	consumption credit constrained hh
CRIC	consumption “Ricardian” housholds

Households 3: Liquidity-constrained households

"Hand-to-mouth": Consume entire disposable income (no intertemporal optimisation)

$$(1+t_t^c)P_t^c C_t^l = (1-t_t^w)(W_t^P L_t^P + W_t^G L_t^G) + TR_t^l - T_t^{LS,l}$$

Wage setting

Trade union maximises a joint utility function (distributed equally – population weigths s^i)

Wage rule :

$$(24) \qquad \frac{s^c U^c_{1-L,t} + s^r U^r_{1-L,t} + s^l U^l_{1-L,t}}{s^c U^c_{c,t} + s^r U^r_{c,t} + s^l U^l_{c,t}} = \frac{(1-t_t^W)}{(1+t_t^C)} \frac{W_t}{P_t^C} \eta_t^W$$

Wage mark up:

$$(25)$$
$$\eta_t^W = 1 - 1/\theta - \gamma_W / \theta \left[\beta (\pi_{t+1}^W - (1 - sfw)\pi_t) - (\pi_t^W - (1 - sfw)\pi_{t-1}) \right] \qquad 0 \le sfw \le 1$$

Fiscal policy

GBC:

$$B_t = (1 + i_t + rp_t^B) B_{t-1} + P_t^C C_t^G + W_t^G L_t^G$$
$$+ P_t^C I_t^G + itc_t P_t^I I_t + TR_t + TRCC_t$$
$$+ b^U W_t (POP_t^W - POP_t^{NPART} - L_t)$$
$$- t_t^w (W_t^P L_t^P + W_t^G L_t^G) - t_t^c (P_t^c C_t + P_t^H I_t^H)$$
$$- t_t^H P_{t-1}^H H_{t-1} - t_t^K i_t^K P_t^I K_{t-1} - T_t^{LS}$$

Tax rule:

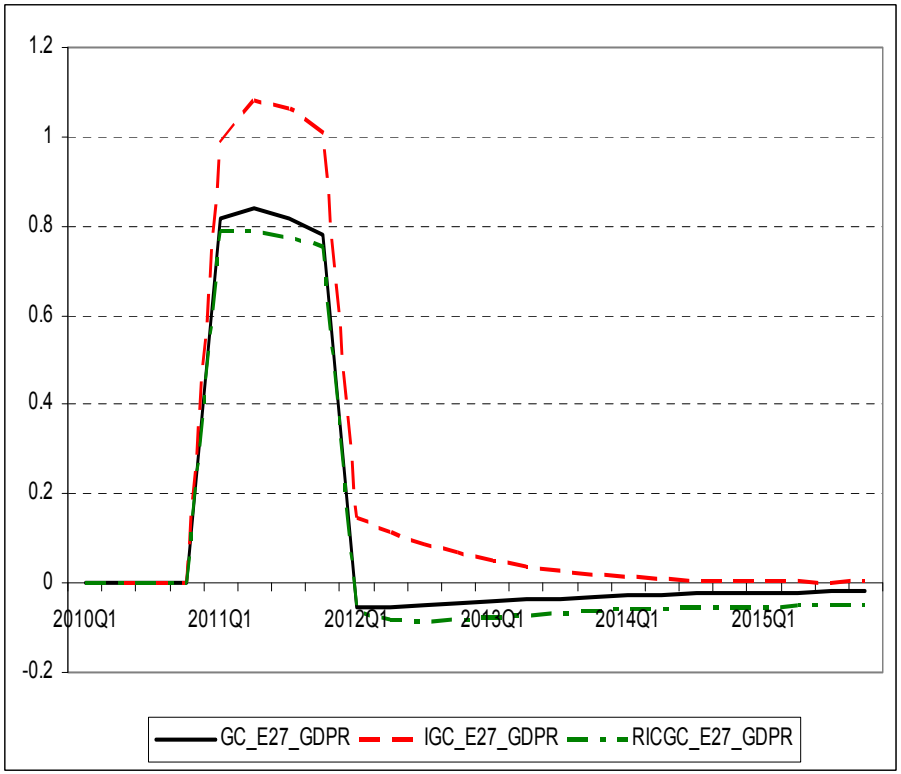
$$\Delta t_t^w = \tau^B \left(\frac{B_{t-1}}{GDP_{t-1} P_{t-1}} - b^T \right) + \tau^{\Delta B} \Delta \left(\frac{B_t}{GDP_t P_t} \right) + \tau^{DEF} \left(\frac{\Delta B_t}{GDP_t P_t} - def^T \right)$$

	EU	*US*
Nom. Rigidities:		
Avg. duration between price adjustments (Quarters)	5.5	5
Avg. wage contract length (Quarters)	4.5	4.5
Real Rigidities:		
Labour adjustment cost (% of total add. wage costs) (γ_L)	13	10
Labour supply elasticity ($1/\kappa$)	1/5	1/3
Semi-wage elasticity w.r.t. employment rate (κ/γ_w)	0.33	0.20
Capital adjustment cost (γ_K)	20	20
Investment adjustment cost (γ_I)	75	75
Consumption:		
Share of liquidity-constrained consumers s^l	0.3	0.3
Share of credit-constrained consumers s^c	0.3(CC) / 0 (RIC)	0.3(CC) / 0 (RIC)
Share of non-constrained consumers s^r	0.4(CC) / 0.7(RIC)	0.4(CC) / 0.7(RIC)
Downpayment rate χ	0.25	0.25
Habit persistence h	0.7	0.7
Monetary policy:		
Lagged interest rate τ_{lag}^{INOM}	0.85	0.85
Consumer price inflation τ_{π}^{INOM}	1.5	1.5
Output gap τ_{Y}^{INOM}	0.05	0.05
National accounts decomposition:		
Consumption	0.59	0.64
Investment tradedables	0.06	0.05
Investment non-tradables	0.07	0.06
Investment residential	0.06	0.06
Government consumption	0.18	0.15
Government investment	0.04	0.04
Exports	0.18	0.15
Imports	0.18	0.15
Transfers to households	0.16	0.13

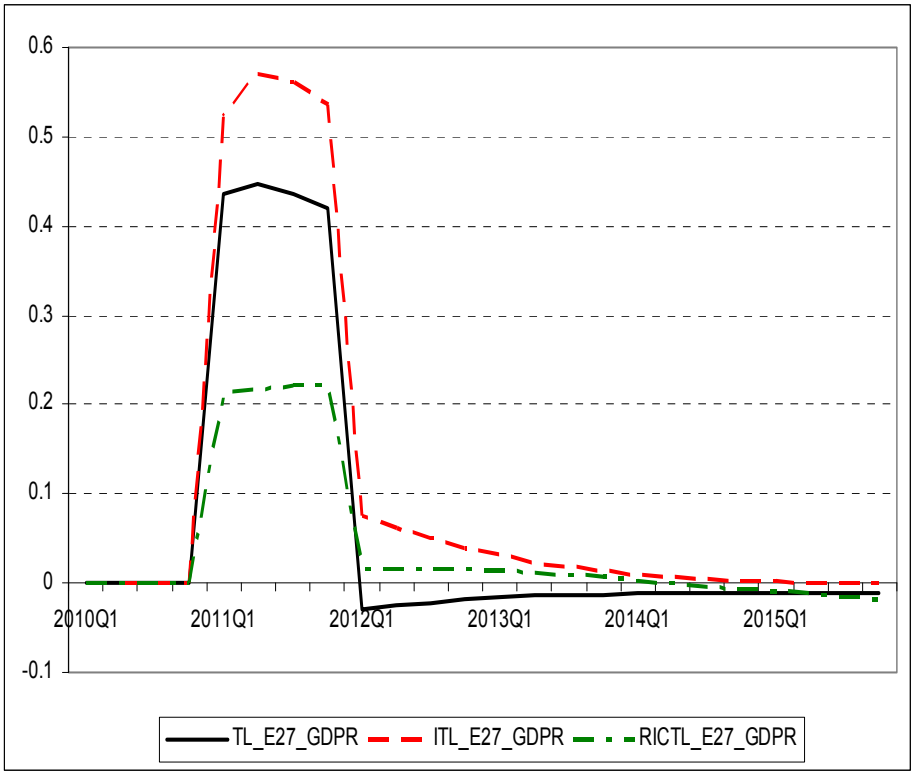
Higher fiscal multipliers :

Effects of credit-constraints and zero interest rate floor

Gov.purchases



Labour tax



: no credit-constrained households, normal monetary policy

: with credit-constrained households, normal monetary policy

: with credit-constrained households and zero interest rate floor (ZLB)

Fiscal multipliers QUEST (one year fiscal stimulus)

	EU alone			Global stimulus		
	Without credit constraints	With credit constraints	With credit constraints and zero interest rate floor	Without credit constraints	With credit constraints	With credit constraints and zero interest rate floor
investment subsidies	1.52	1.59	2.04	2.00	2.11	2.63
government investment	0.89	0.91	1.08	1.04	1.08	1.24
government purchases	0.78	0.81	1.03	0.94	1.00	1.21
government wages	1.11	1.26	1.39	1.15	1.34	1.46
general transfers	0.20	0.41	0.53	0.24	0.51	0.62
transfers targetted to credit-constrained hh.	-	0.67	0.86	-	0.82	1.01
transfers targetted to liquidity-constrained hh.	0.66	0.69	0.89	0.81	0.86	1.05
labour tax	0.22	0.44	0.55	0.26	0.53	0.64
consumption tax	0.40	0.48	0.65	0.49	0.59	0.76
property tax	0.01	0.12	0.18	0.01	0.16	0.21
corporate income tax	0.02	0.03	0.04	0.03	0.04	0.05

GDP % difference from baseline in year 1 after a shock to fiscal instrument of 1% of (baseline) GDP

1. Credit constraints and fiscal multipliers

Presence of collateral constrained households raises fiscal multipliers because of two factors:

- Higher MPC out of current net income.
- Higher sensitivity to changes in real interest rates (interest rate exerts an income effect on spending of collateral constrained households – exceeds interest elasticity of spending of Ricardian households

2. Zero interest rate floor and multipliers

With interest rates at zero lower bound fiscal multipliers are larger :

- Upward pressure on inflation reduces real interest rates when nominal interest rates are kept unchanged (i.e. additional monetary channel)
- This channel is amplified when credit constrained households are present (higher interest sensitivity).

Costs of withdrawal of stimulus / rapid introduction consolidation measures

1. As long as credit conditions remain tight, and more households face a binding collateral constraint on their borrowing, the larger the costs of a withdrawal of fiscal stimulus.
2. As long as interest rates remain low, monetary policy is less likely to support a fiscal tightening by reducing interest rates.

An early consolidation risks a much sharper contraction in output than when the exit is delayed till credit and monetary conditions have returned to normal

II: Macroeconomic impact of consolidations
Standardised scenarios

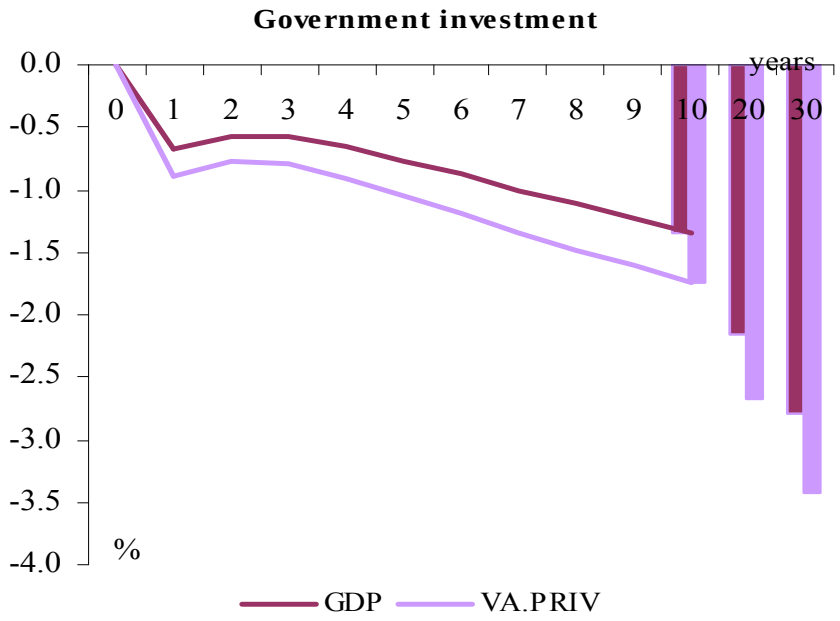
- Permanent consolidations 1% of GDP
- In each scenario this is achieved by an adjustment in the respective instrument that equals ex-ante 1% of (baseline) GDP.
- Tax rule labour income tax turned on after 15 years targetting LR reduction in debt-to-GDP ratio: -25%p
- Lower sovereign risk premium (75 bp lower in the long run).

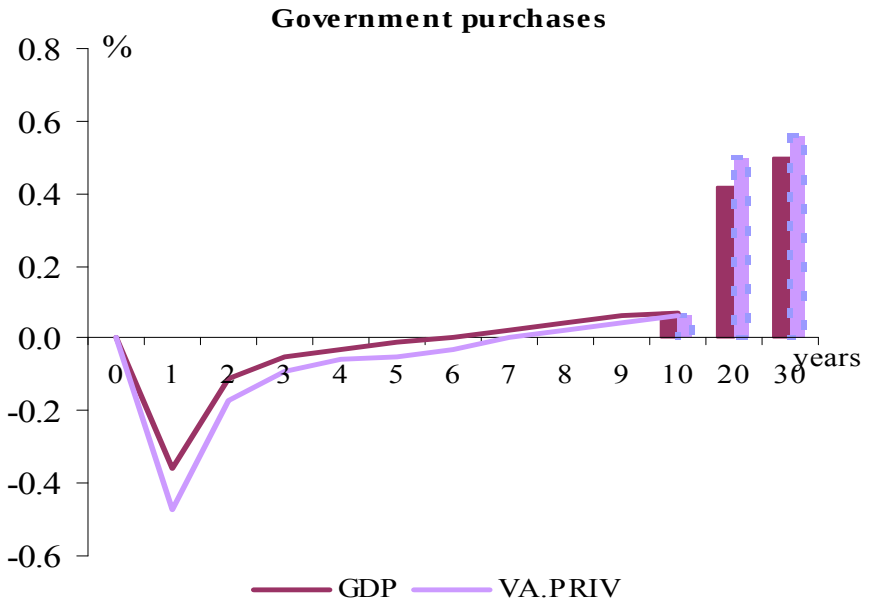
Macro-economic effects:

Gradual decumulation of government debt:

- => lower interest payments create space for reductions in labour taxes
- => This raises employment and boosts GDP in the medium and long run.

GDP effect of permanent consolidation 1% of GDP





<u>Government investment</u>: productive spending
permanent reduction leads to the significant GDP losses

<u>Government purchases</u>: unproductive spending
reduction has only a short-term negative GDP effect
when compensated by cuts in labour taxes in the medium/long run.

GDP

Market clearing condition:

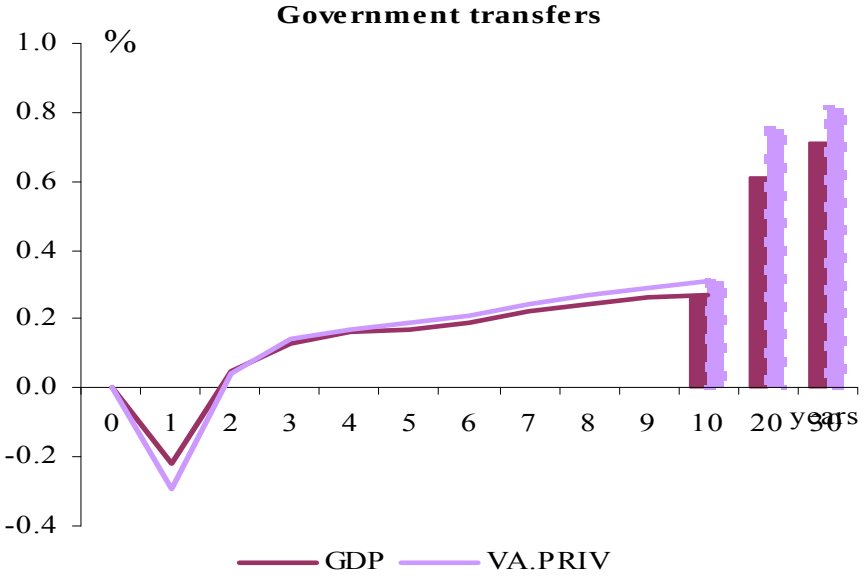
$$Y_t = C_t + J_t^{inp} + J_t^{Constr} + C_t^G + I_t^G + X_t - M_t$$

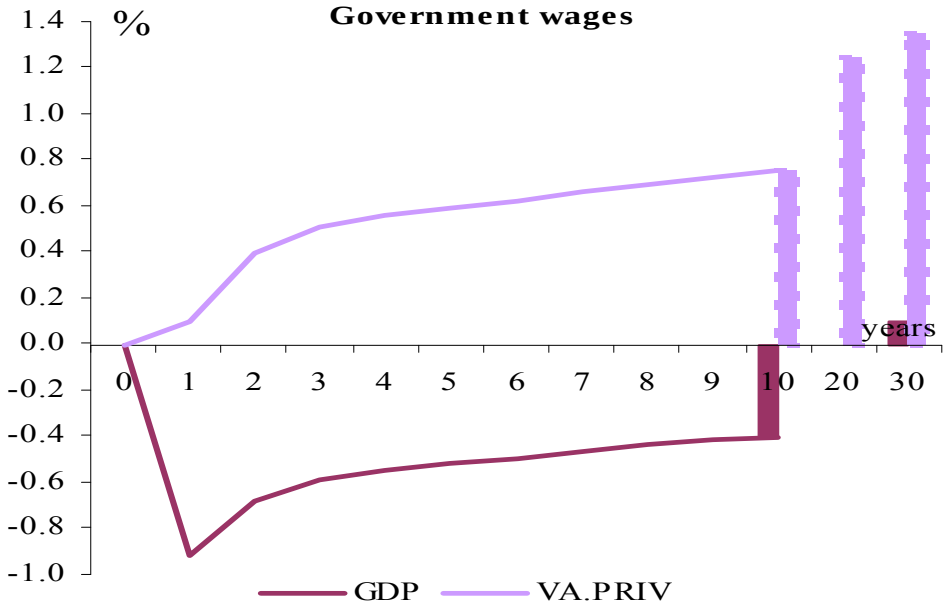
Total GDP:

$$GDP_t = Y_t + w_t^G L_t^G + p_t^{rent} H_t$$

- Private sector value added Y_t
- Output general government valued at costs (gov. wage bill) $w_t^G L_t^G$
- Output housing services (product of imputed rent times the housing stock) $p_t^H = \frac{U_{H,t}^s}{U_{C,t}^s} p_t^C$

GDP effect of permanent consolidation 1% of GDP





Transfers : unproductive - only serve distributional purposes.

Reducing transfers - and lowering distortionary labour taxes in medium/long run – leads to positive output effects

However, distributional consequences: 'rule of thumb' households hit more

Lowering government wages: large direct impact on GDP (definition NA).

Downward pressure on wages private sector (spillover)

Reduction in incomes leads to a fall in consumption (constrained households !)

Lower wages private sector boost competitiveness, raises employment.

Gradually increase value-added private sector – higher GDP

Consolidations through tax increases

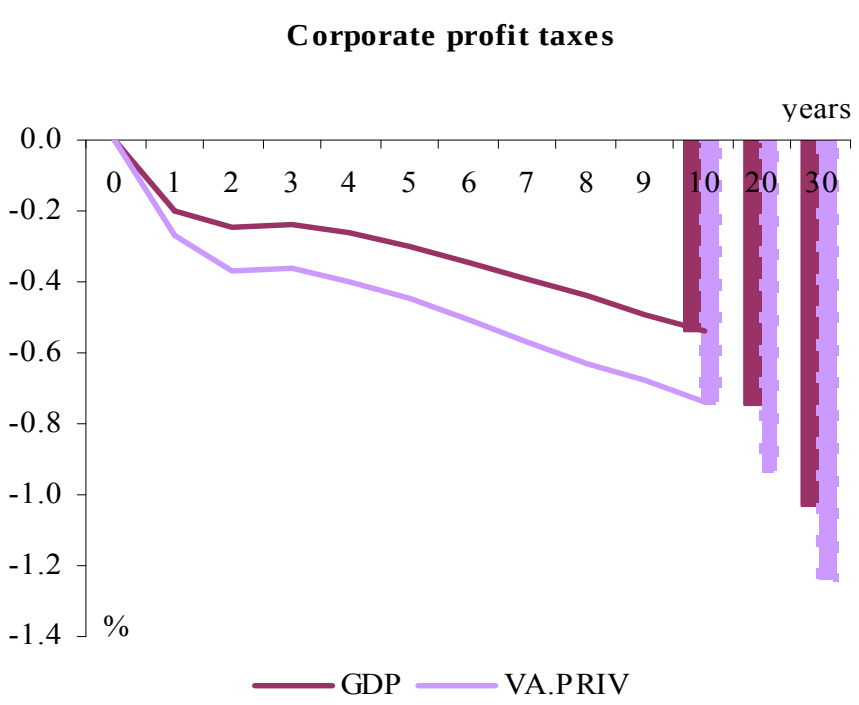
- Raising taxes has generally negative short and long term output effects

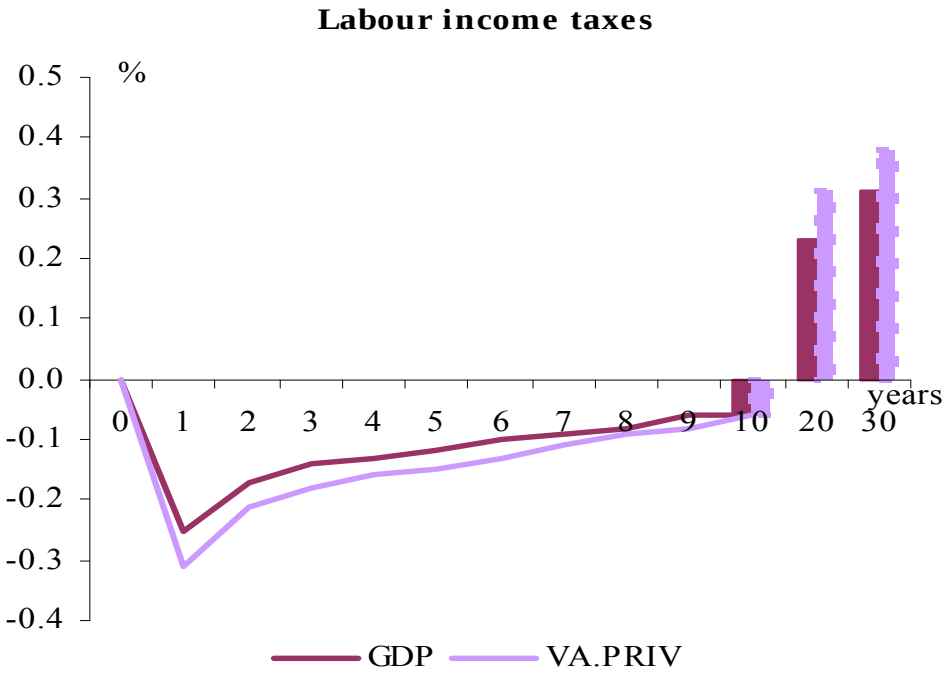
- But in these scenarios tax increases are compensated in the long run by reductions in labour taxes as the debt burden declines.

$\Rightarrow$ Scenarios show the *dynamic adjustment* to *partial tax shifts* from labour taxes

Short term effects tax changes depend on adjustment costs in capital and labour

GDP effect of permanent consolidation 1% of GDP

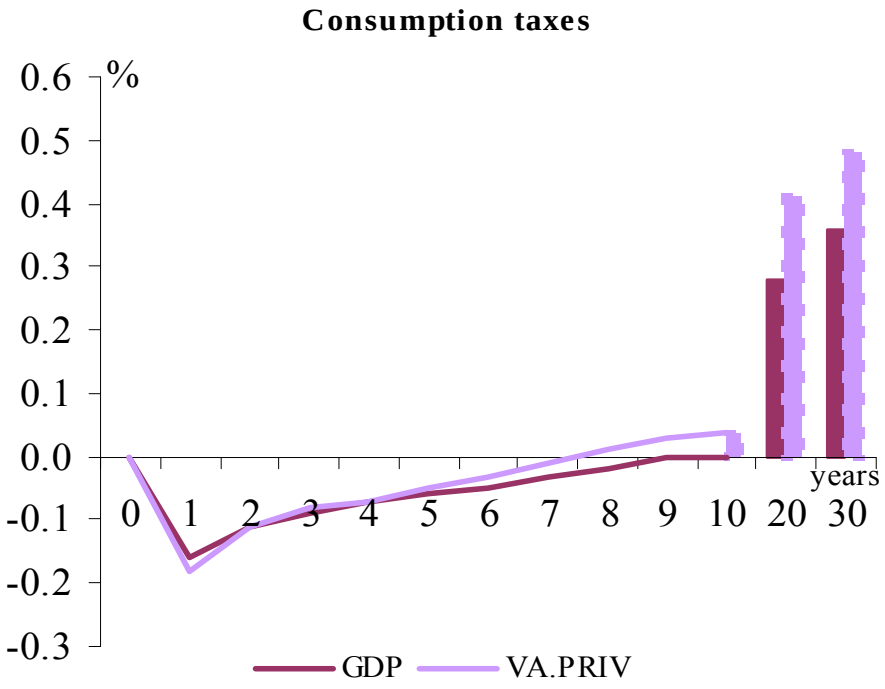


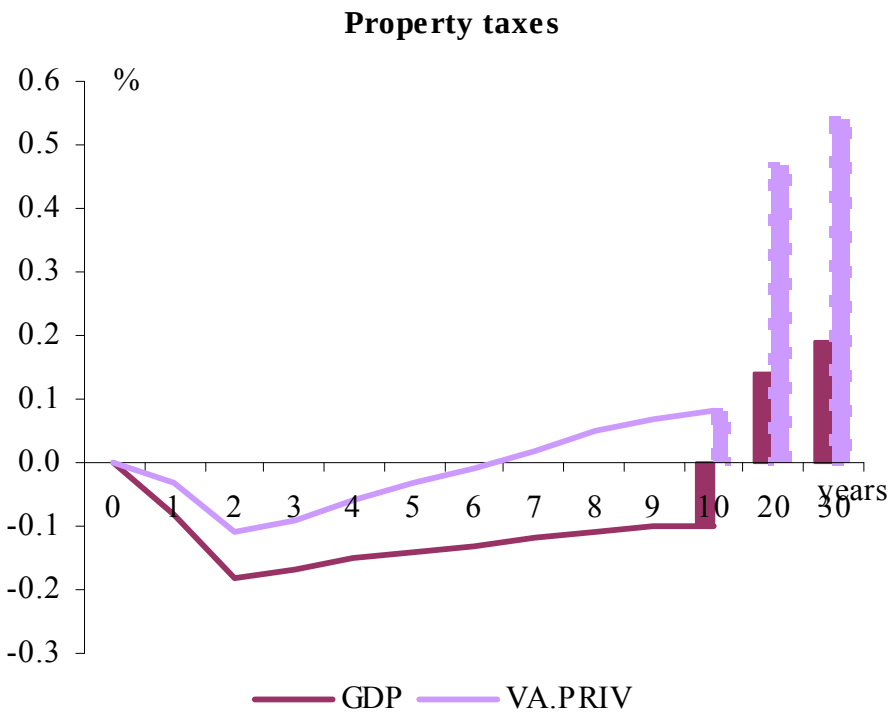


Corporate profit tax: investment ↓ capital stock ↓

Labour taxes increase: employment ↓ initial GDP loss,
but in long run labour taxes can be reduced, and GDP eventually turns positive.

GDP effect of permanent consolidation 1% of GDP





Taxes on consumption and taxes on housing property:
smaller short term impacts(-0.2%) and GDP gradually recovers.

Taxes on housing property:
Impact on GDP (decline housing stock), smaller impact on value added

GDP impact of consolidations

Expenditure-based consolidations :

- Highest costs from consolidations based on investment spending
- Lowest for reductions in general transfers and gov. purchases (‘unproductive’)
- But distributional consequences

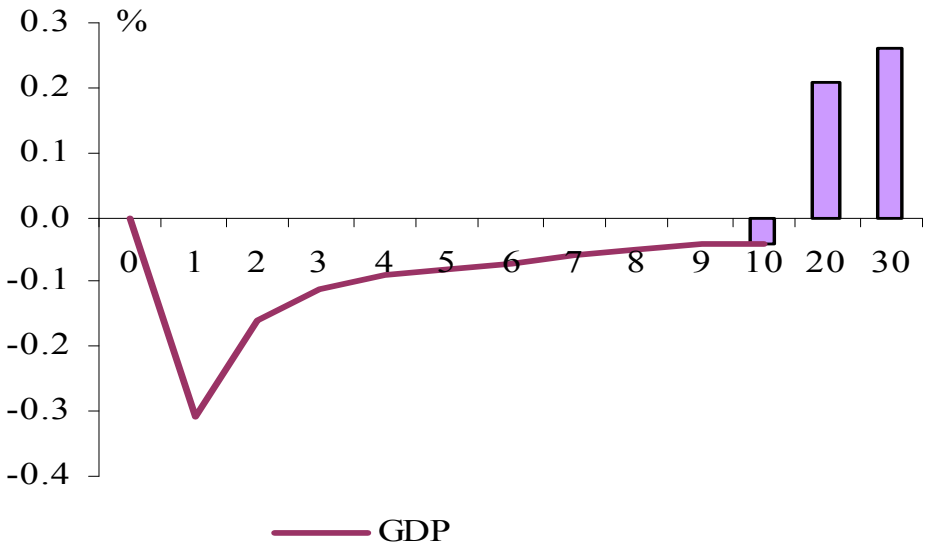
Revenue-based consolidations:

- Negative GDP impacts
- Highest costs: corporate taxes and labour taxes
- Indirect tax: smaller negative output effects (and do not harm competitiveness)

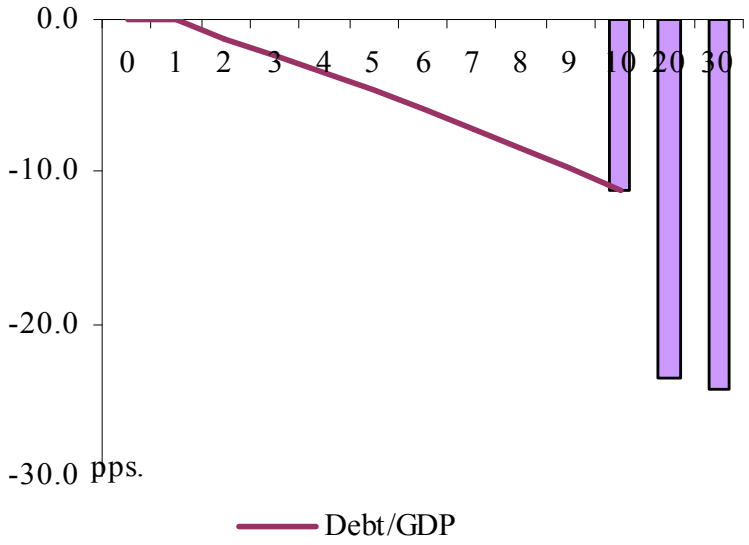
“Across-the-board” consolidation 1% of GDP:

Adjustment in spending and taxes roughly proportional to their share in government budget:

Graph I.2.5a: **GDP**



Graph I.2.5d: **Debt to GDP ratio**

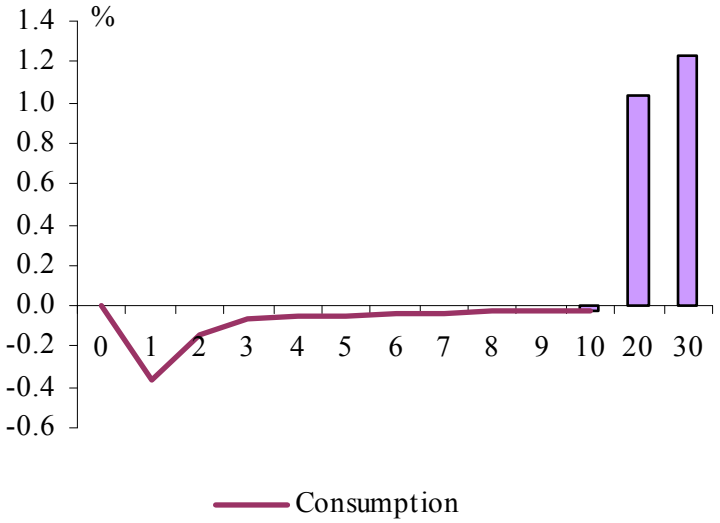


Deficit reduction 1% of GDP			
gov transfers	-0.15	labour tax	0.2
gov wages	-0.1	cons tax	0.2
gov employ	-0.1	corp tax	0.05
gov purchases	-0.1	prop tax	0.05
gov investment	-0.05		

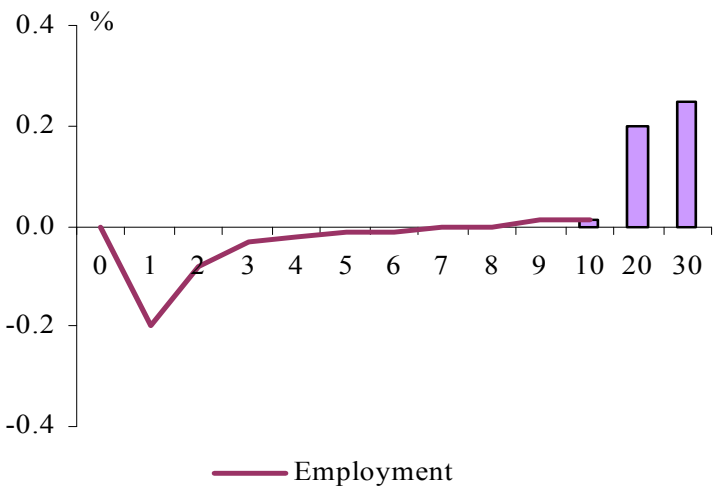
“Across-the-board” consolidation 1% of GDP(2):

Adjustment in spending and taxes roughly proportional to their share in government budget:

Graph I.2.5b: **Consumption**



Graph I.2.5c: **Employment**



Deficit reduction 1% of GDP			
gov transfers	-0.15	labour tax	0.2
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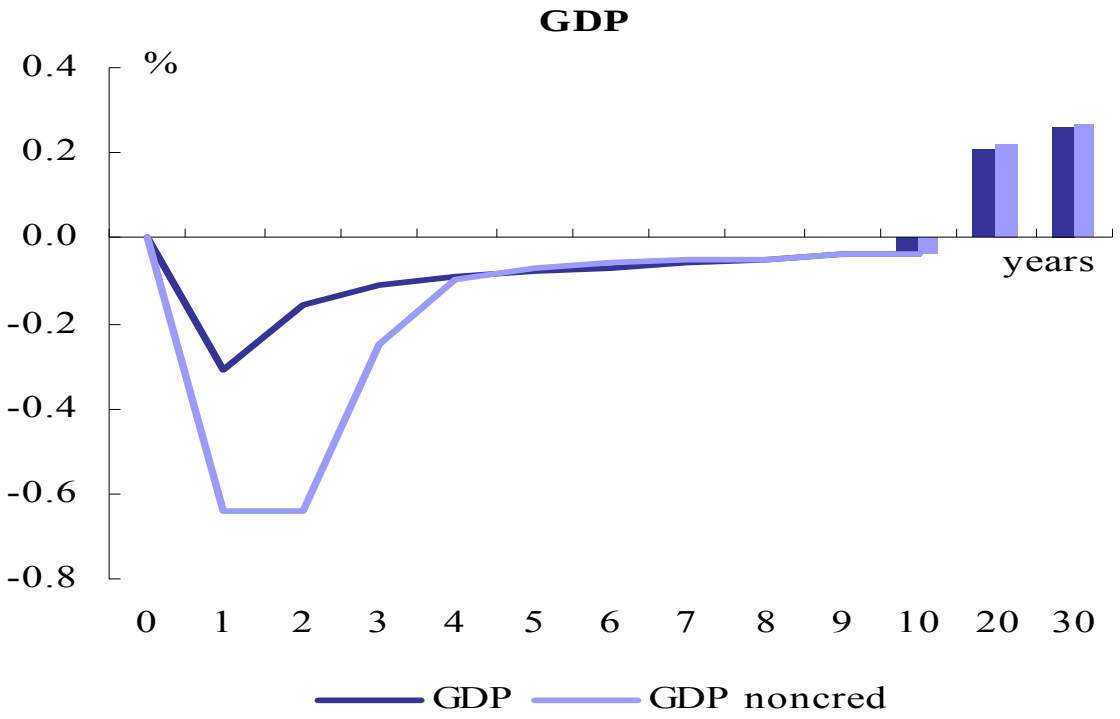
gov employ	-0.1	corp tax	0.05
gov purchases	-0.1	prop tax	0.05
gov investment	-0.05		

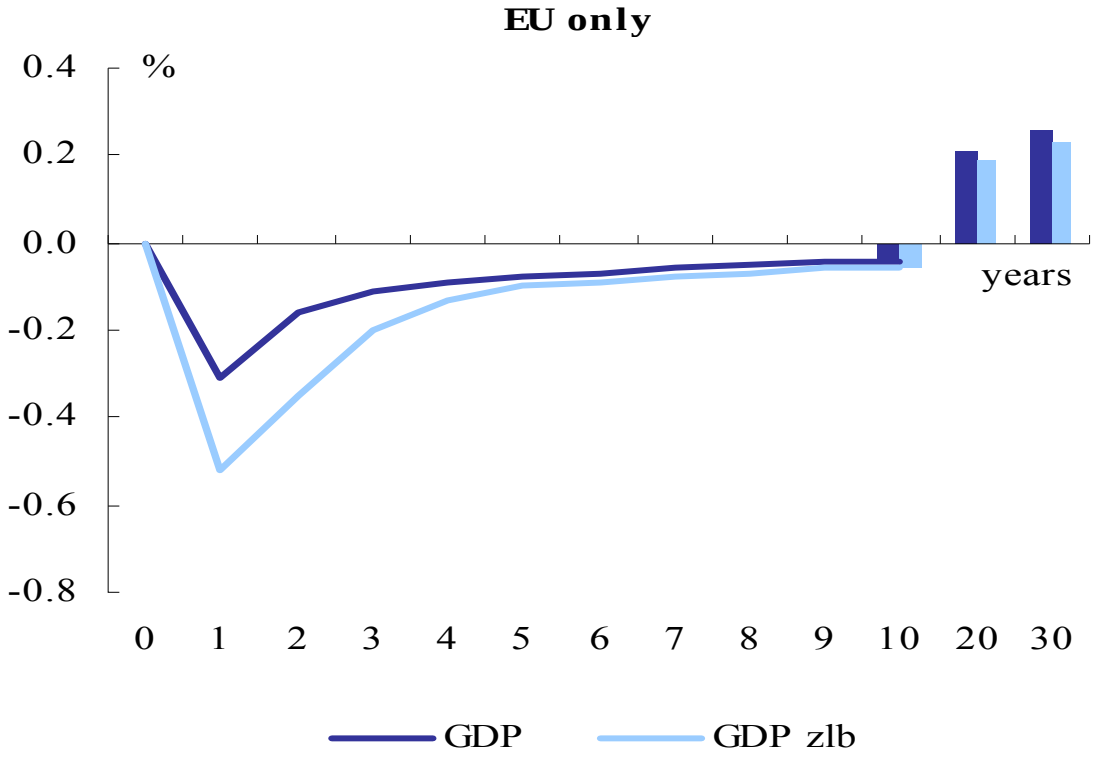
Consolidation : Larger impact in case of lack of credibility (perceived as temporary):



If consolidation perceived as <u>temporary</u> (first two years): Larger impact multipliers

=> Consolidations that are not perceived as permanent but expected to be reversed at a later stage may have significantly larger output and employment costs.

Consolidation : Larger impact at zero interest rate floor:

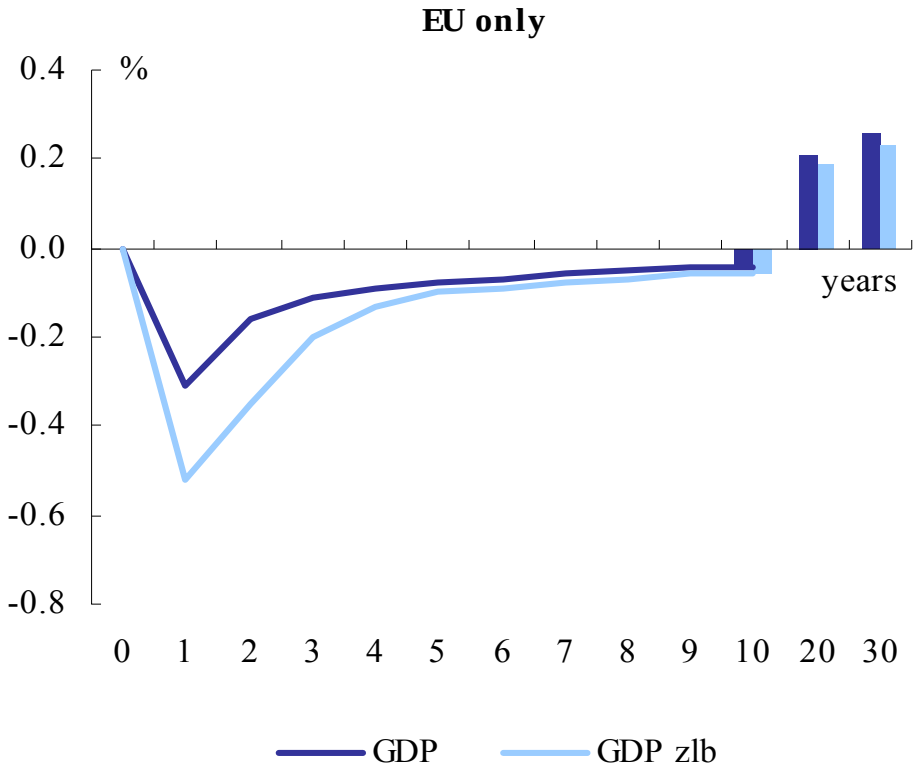


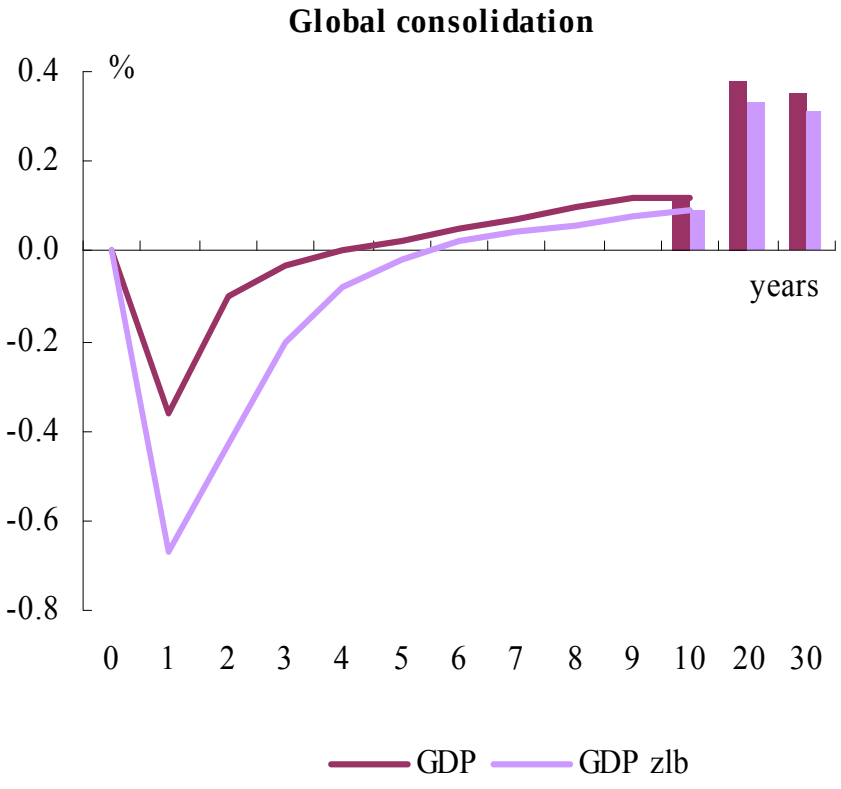
When ZLB is binding:

central banks cannot support consolidation by reducing interest rates

Larger GDP effects

Consolidation : Larger impact in case of global synchronisation

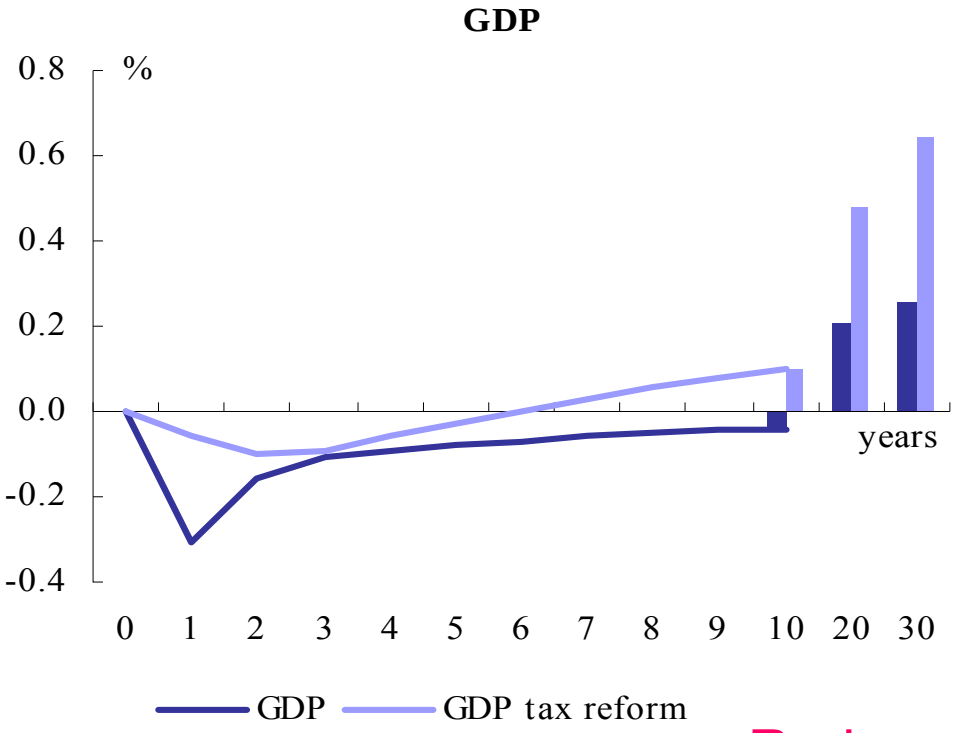




Spillovers:
When global fiscal retrenchments: Larger GDP effects

Consolidation combined with tax reform:

shift from labour and corporate tax towards consumption tax



Deficit reduction 1% of GDP			
gov transfers	-0.3	labour tax	-0.3
gov wages	-0.1	cons tax	0.5
gov employ	-0.1	corp tax	-0.3
gov purchases	-0.1	prop tax	0.5
gov investment			

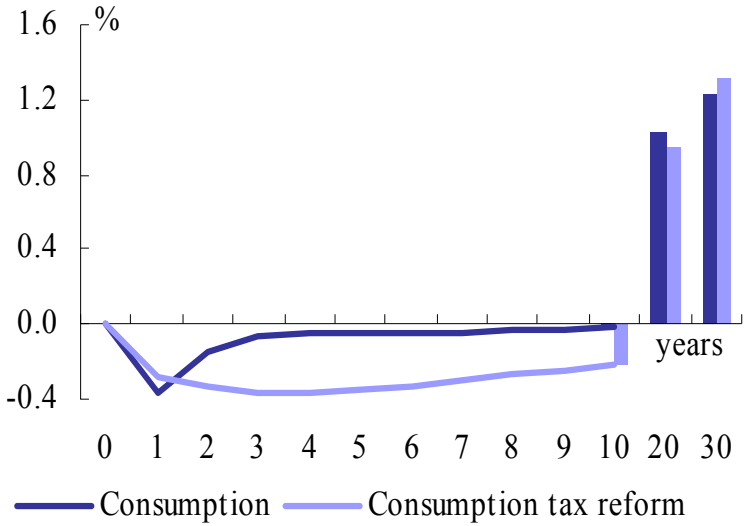
- Reduce spending
- Increase VAT + property tax
- Reduce labour + corporate tax

=> Short run: Lower output loss

=> Long run: Larger gains

Consolidation combined with tax reform (2):
shift from labour and corporate tax towards consumption tax

Graph I.2.8b: **Consumption**



Graph I.2.8c: **Employment**

Deficit reduction 1% of GDP			
gov transfers	-0.3	labour tax	-0.3
gov wages	-0.1	cons tax	0.5
gov employ	-0.1	corp tax	-0.3
gov purchases	-0.1	prop tax	0.5
gov investment			

Reduce spending
Increase VAT + property tax
Reduce labour + corporate tax
=> Short run: Lower output loss
=> Long run: Larger gains

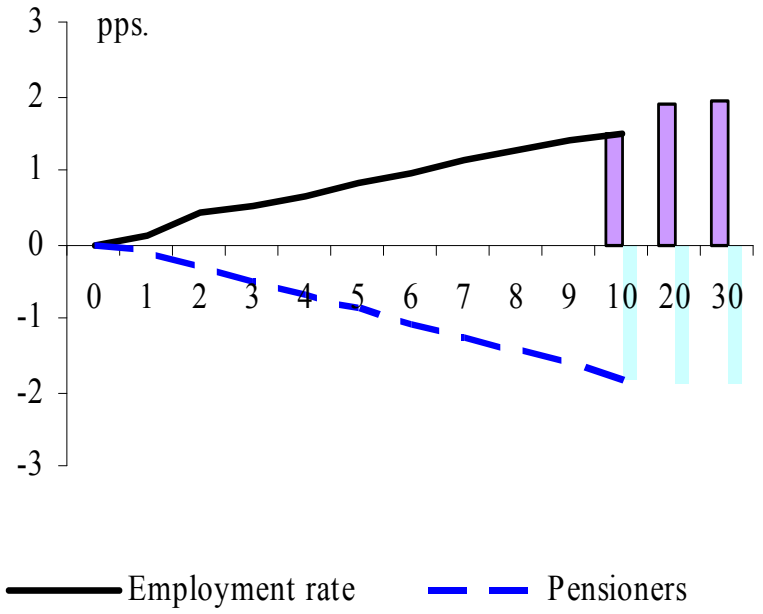
Pension reform:
raise age of retirement by 2 year

10% reduction in number of pensioners, phased in over 10 years)

TRANSFERS =
No. of pensioners *
pension replacement rate *
av. wage
+ OTHER_TRANSFERS

TOTAL POPULATION =
NON-PARTICIPATION +
PENSIONERS +
LABOUR FORCE
(employed +unemployed)

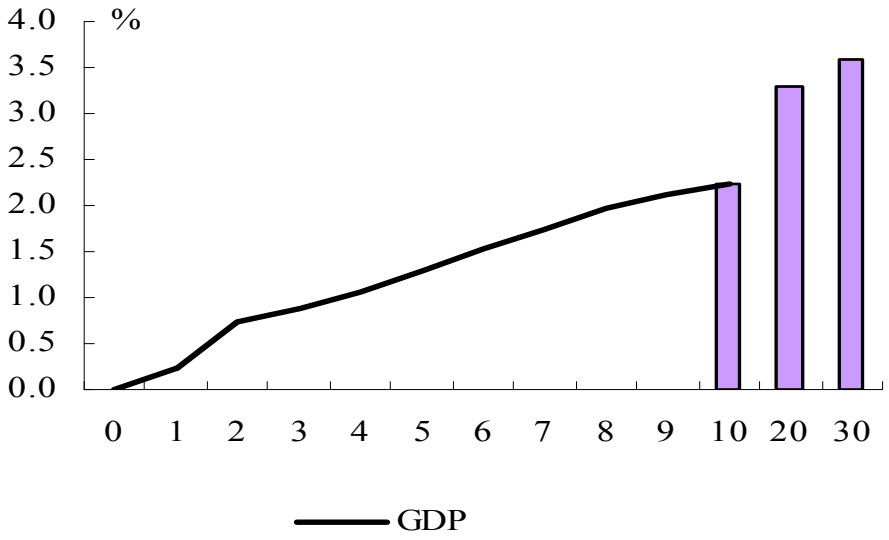
Graph 1: **Employment and pensioners rate**



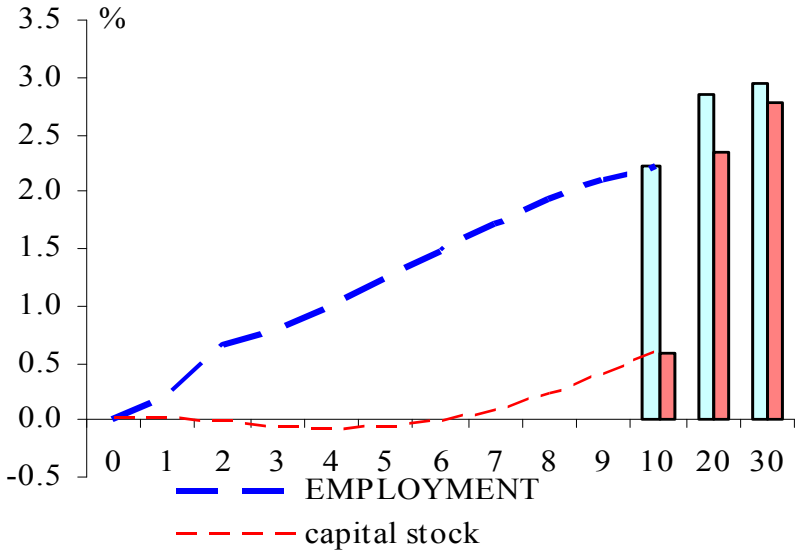
Pension reform: raise age of retirement by 2 year

10% reduction in number of pensioners, phased in over 10 years)

Graph 2: **GDP**



Graph X: **Capital and employment**



<u>Raising retirement age :</u>

Pensioners ↓ => pension payments ↓ => gov. budget bal. ↑

Labour force ↑ => real wages ↓ => employment ↑

=> capital accumulation ↑

=> potential output ↑

Raising retirement age:
Pensioners -10% , gradually over 10 years

Table 1:

Macro-economic impact raising retirement age

	After 10 years	After 40 years
GDP	2.2	3.6
Employment	2.1	3.0
Pensioners	-9.6	-10.0
Consumption	2.1	5.6
Investment	4.2	2.9
Transfers	-6.1	-7.2
Real wages	-0.4	-0.3
Gov balance (% of GDP)	3.3	1.1
Gov debt (% of GDP)	-14.8	-37.1

Note: reduction in number of pensioners of 10%, phased in over 10 years

Concluding remarks

1. Short term costs : lower GDP and employment
2. Costs higher at zero interest rate floor
3. Long term gains: higher output
4. Credibility is important.

   Part of wider agenda that deals convincingly with long run sustainability of public finances, external imbalances and promoting long run growth potential.

5. Composition matters:

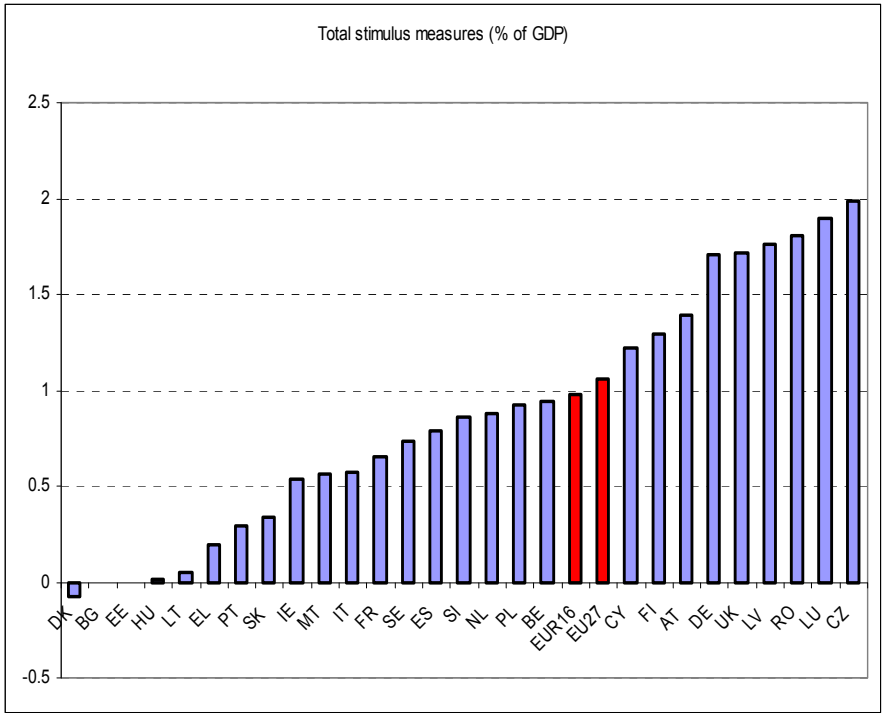
   Focus on ‘unproductive’ spending, or least distortionary taxes

6. Pension reform can tackle source of problem: increase in retirement age can reduce transfer payments, raise tax revenue, and increase labour force (higher potential output).

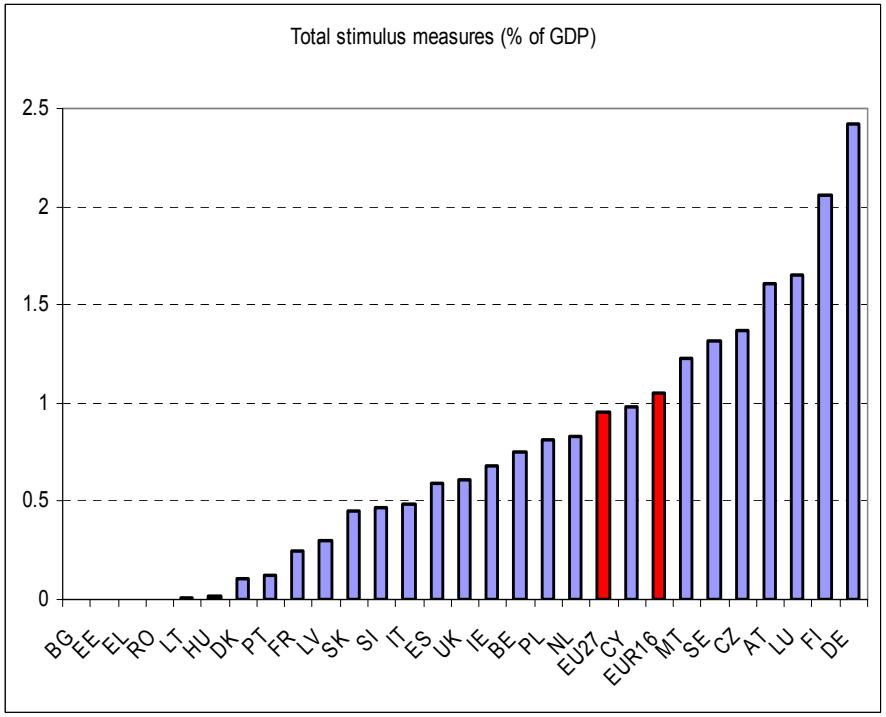
Extra slides

Fiscal stimulus measures

2009

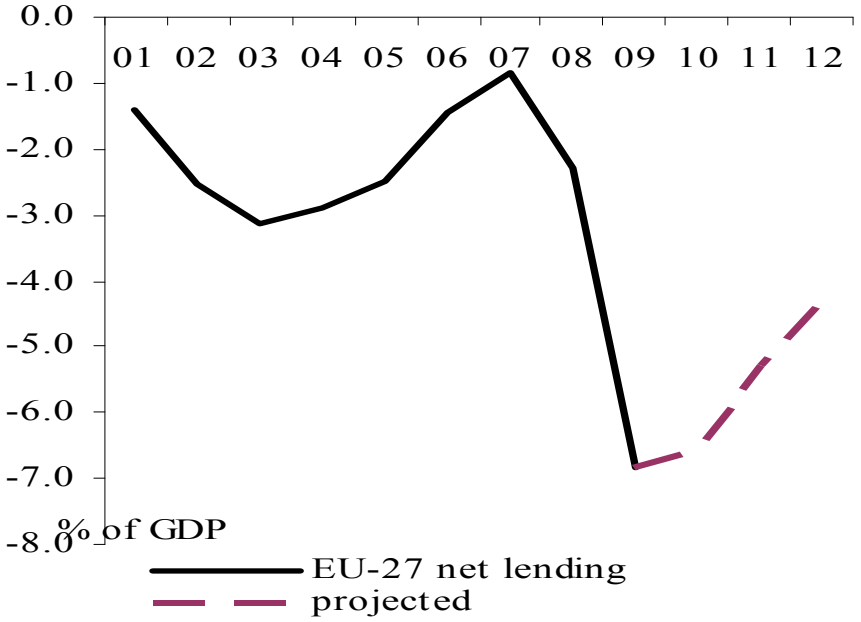


2010

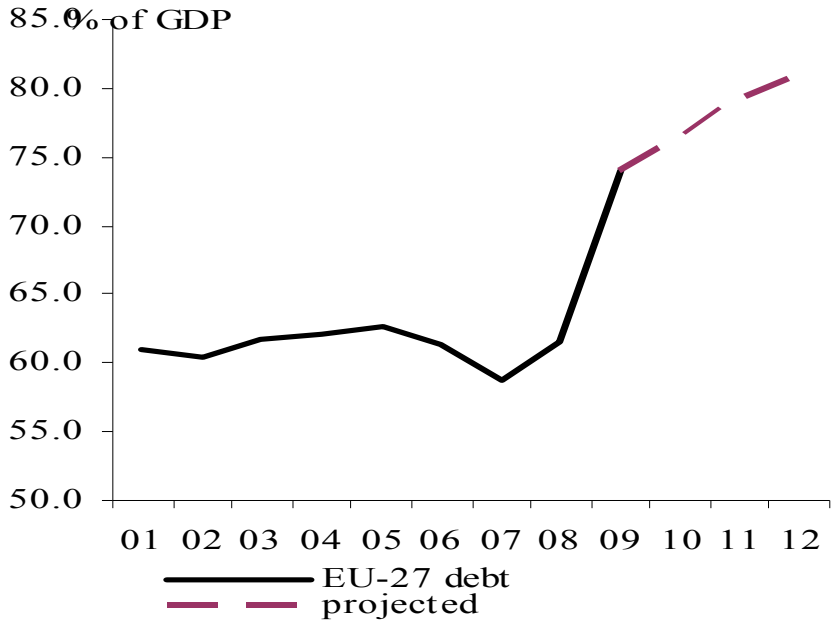


Deteriorating fiscal positions in EU

Net lending (+) net borrowing(-), as % of GDP



Gross debt (as % of GDP)

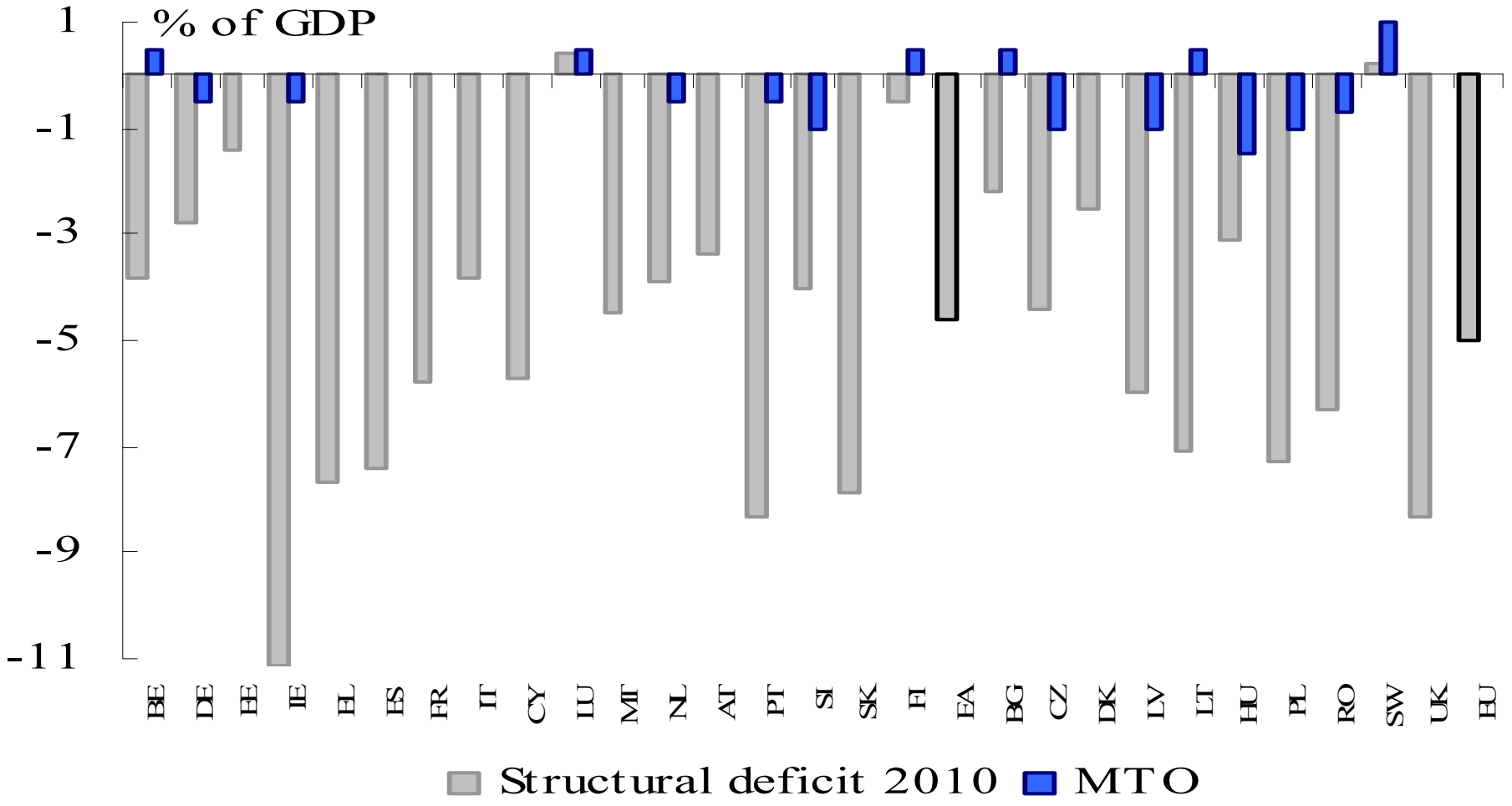


Contributing factors:

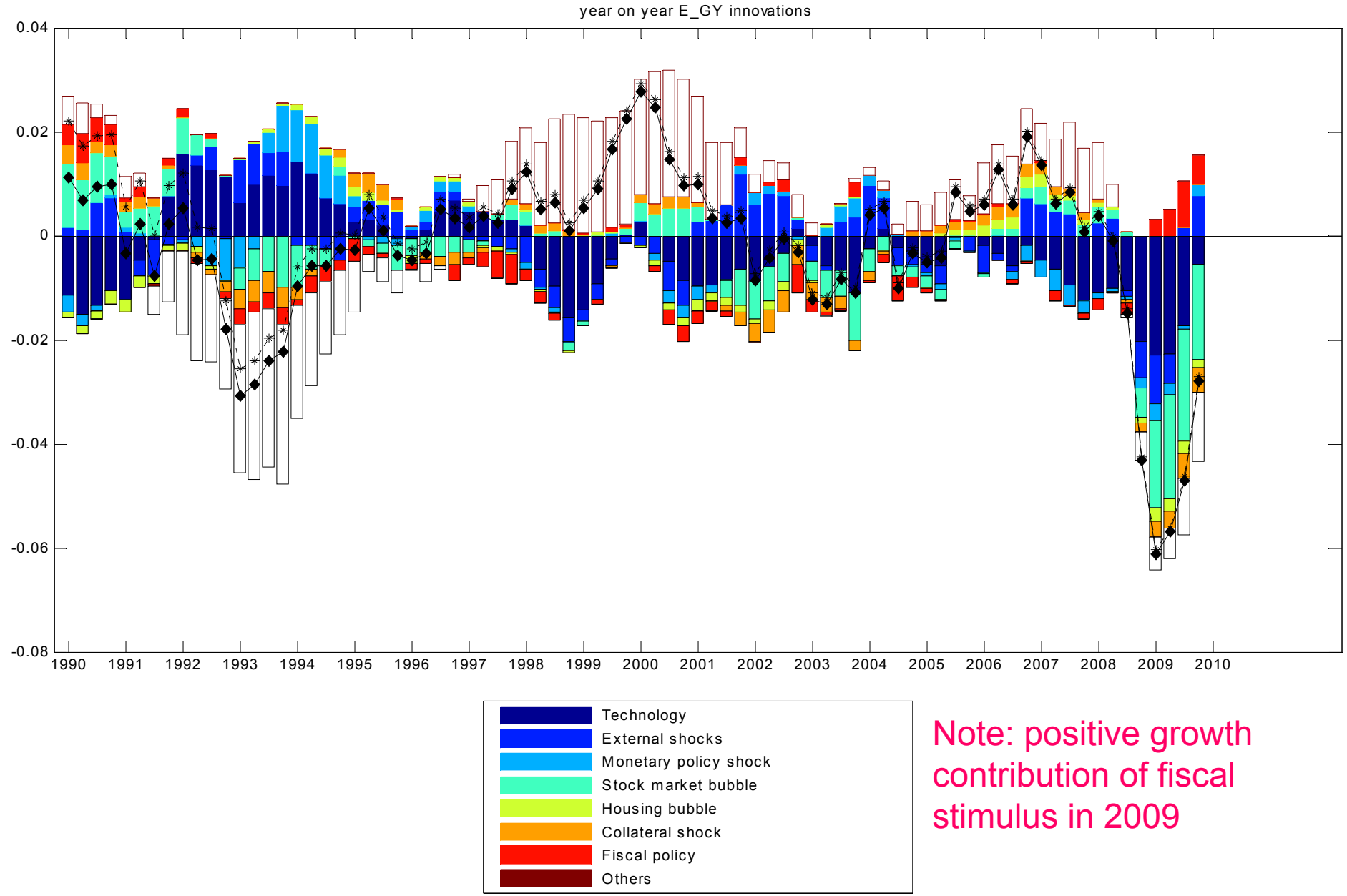
- Cyclical factors (automatic stabilisers)
- Revenue losses from lower asset prices and fin. profits
- Fiscal stimulus measures

Required consolidation efforts in EU :

Graph I.2.2: **Structural deficits and MTOs**

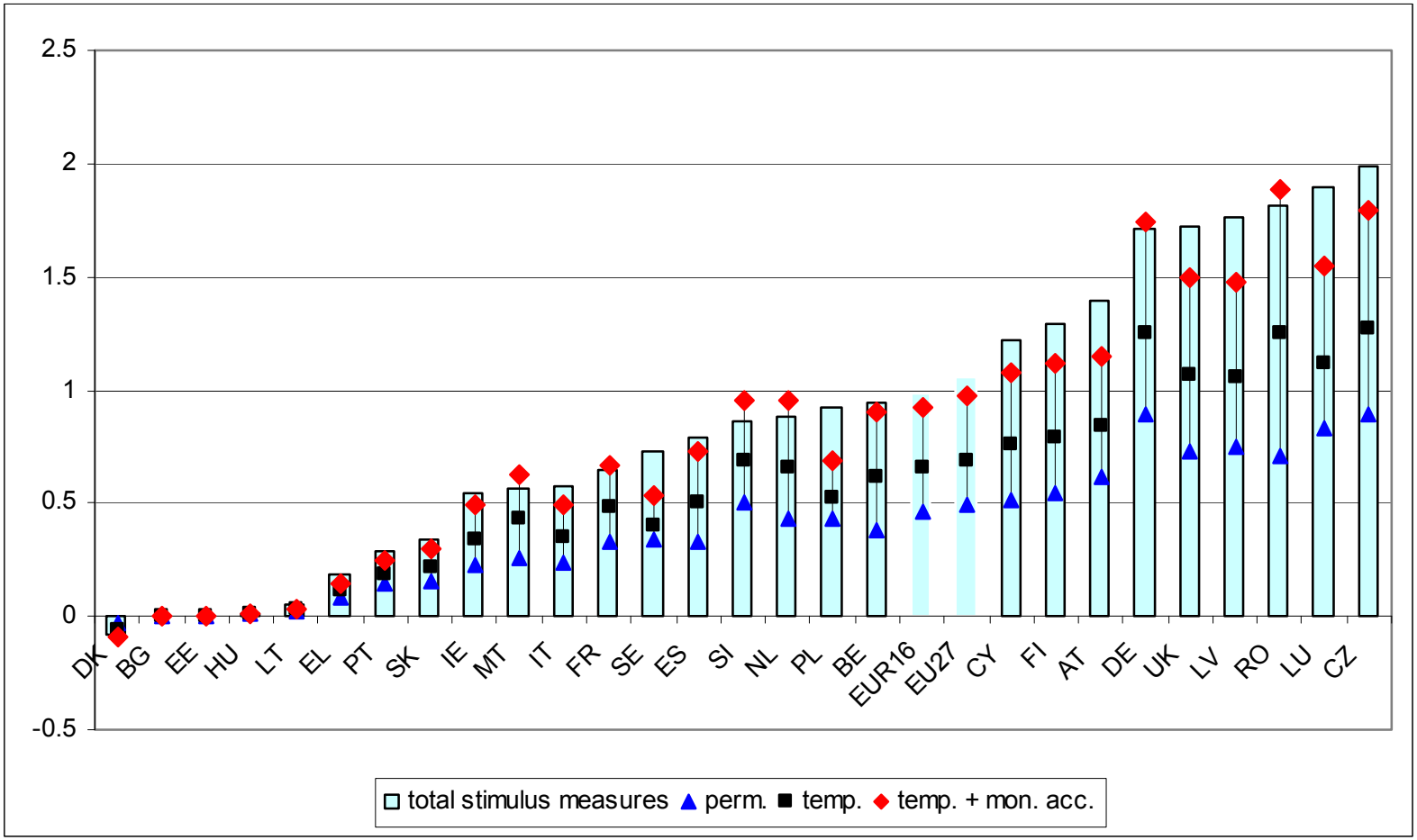


Euro area: growth decomposition 1990Q1-2009Q4

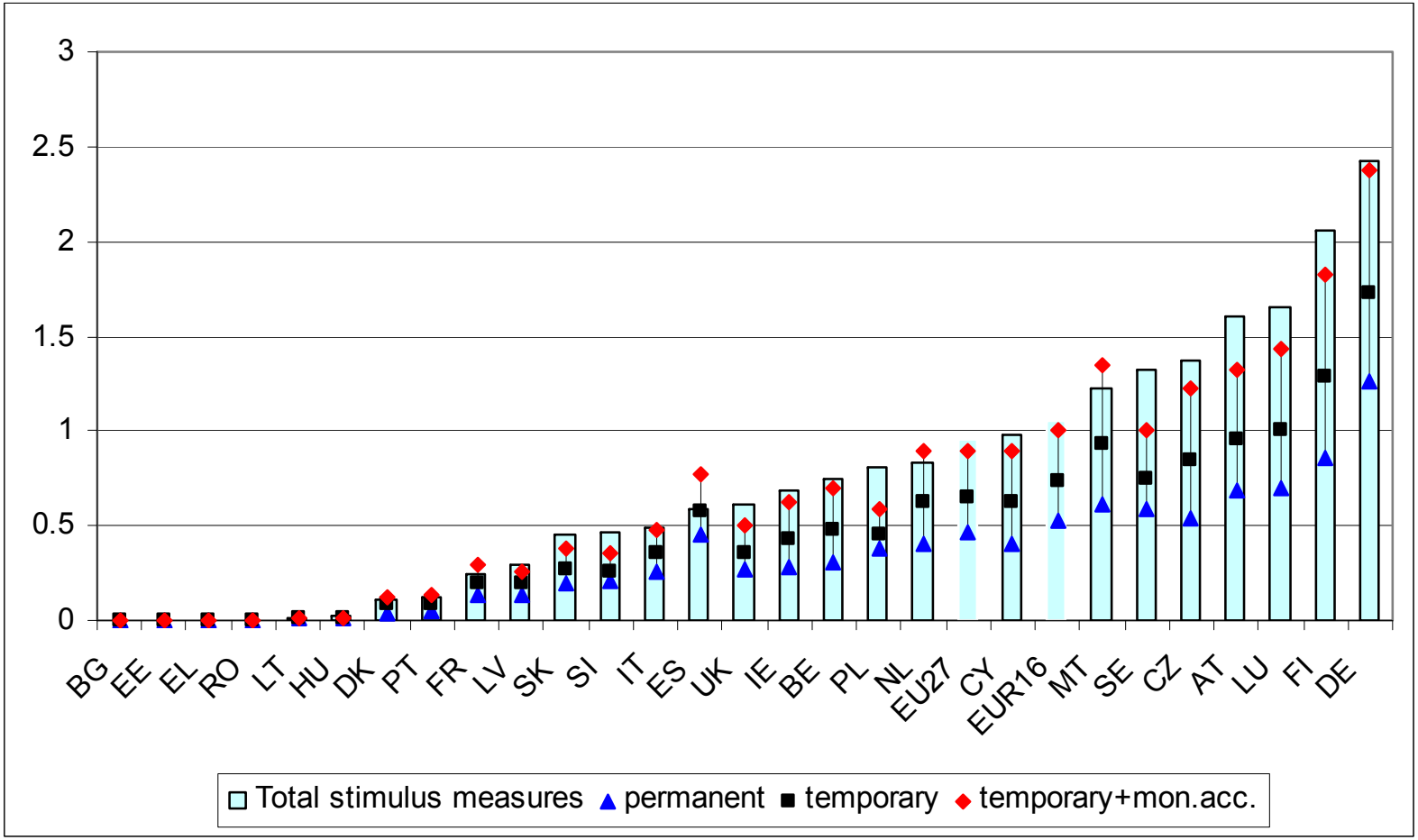


Note: positive growth contribution of fiscal stimulus in 2009

EU27: Fiscal measures 2009

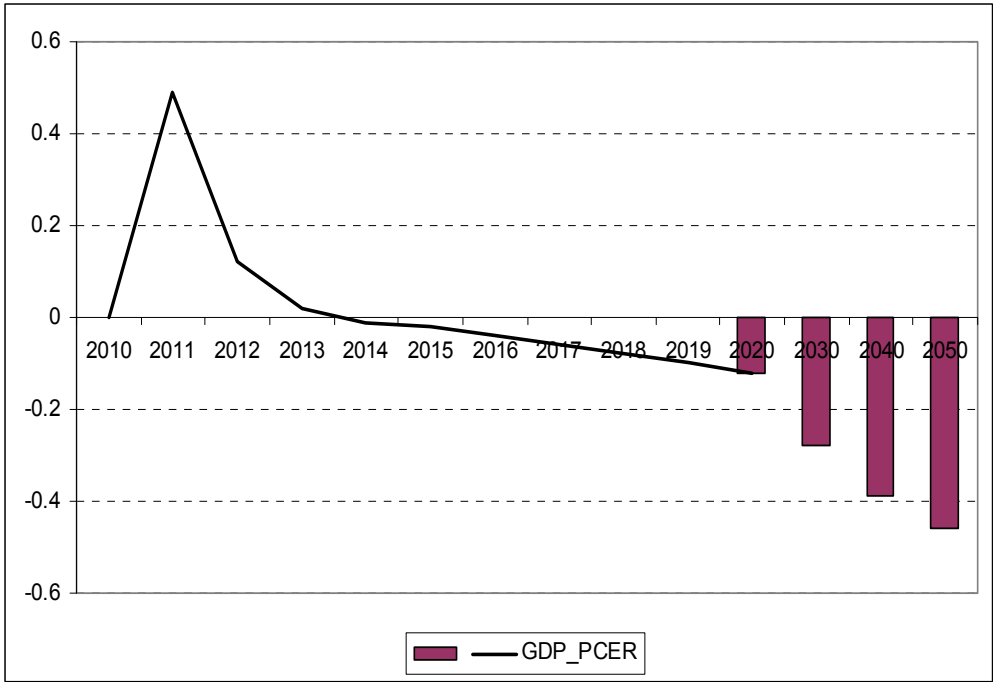


EU 27: Fiscal measures 2010

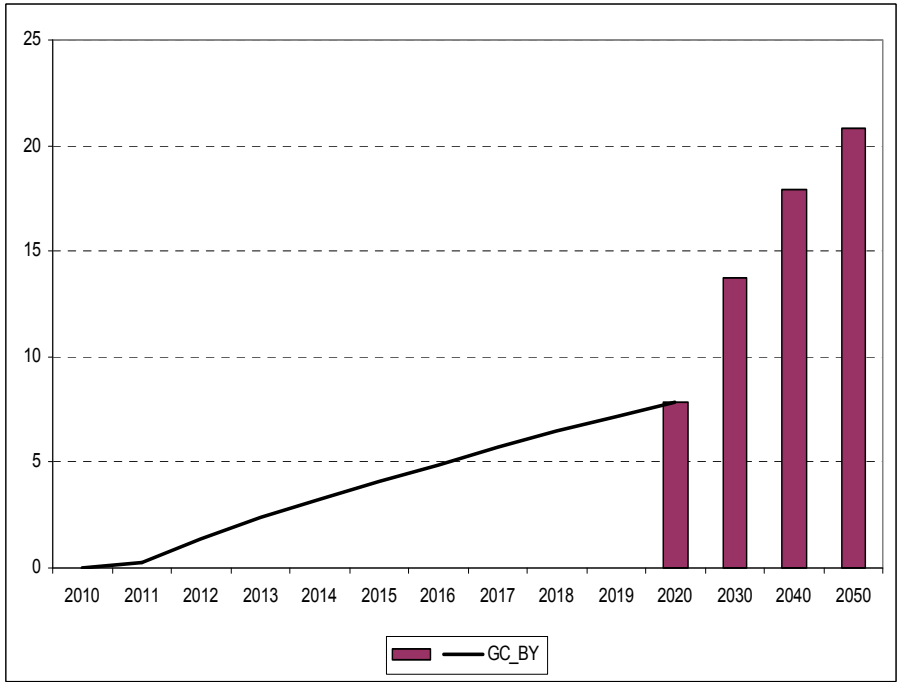


Permanent fiscal expansion:

GDP



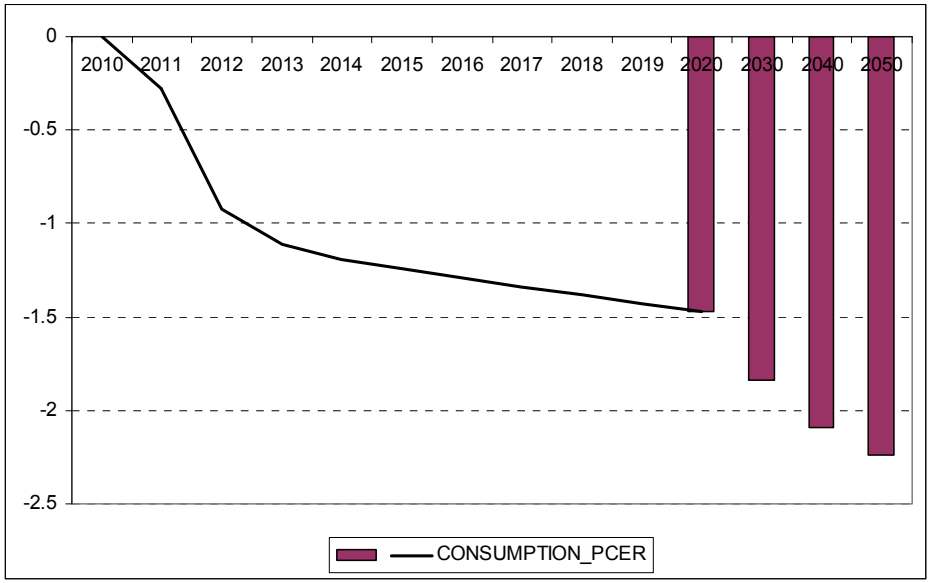
Debt/GDP



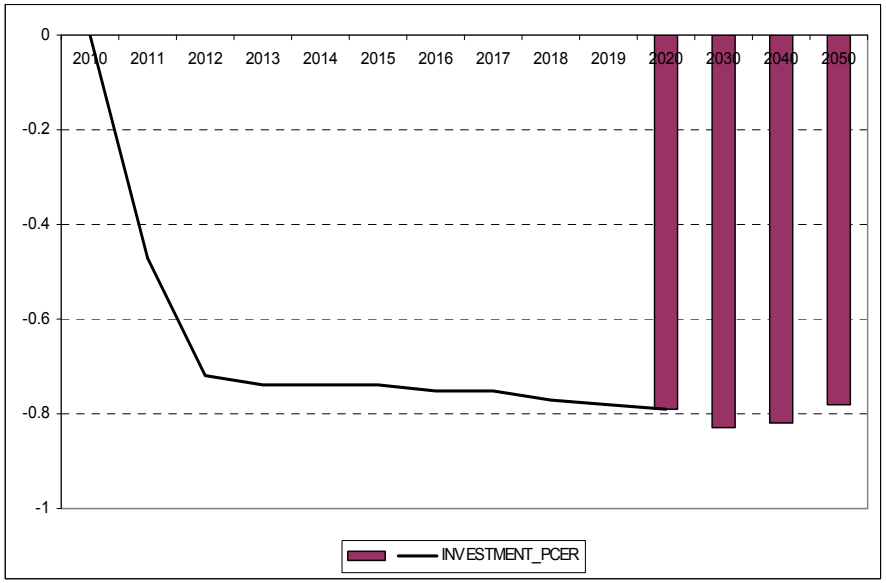
1. **Permanent increase in debt leads to long run contraction in output**
2. **Perception that deficits become permanent also reduces short-run multiplier**

Permanent fiscal expansion:

Consumption

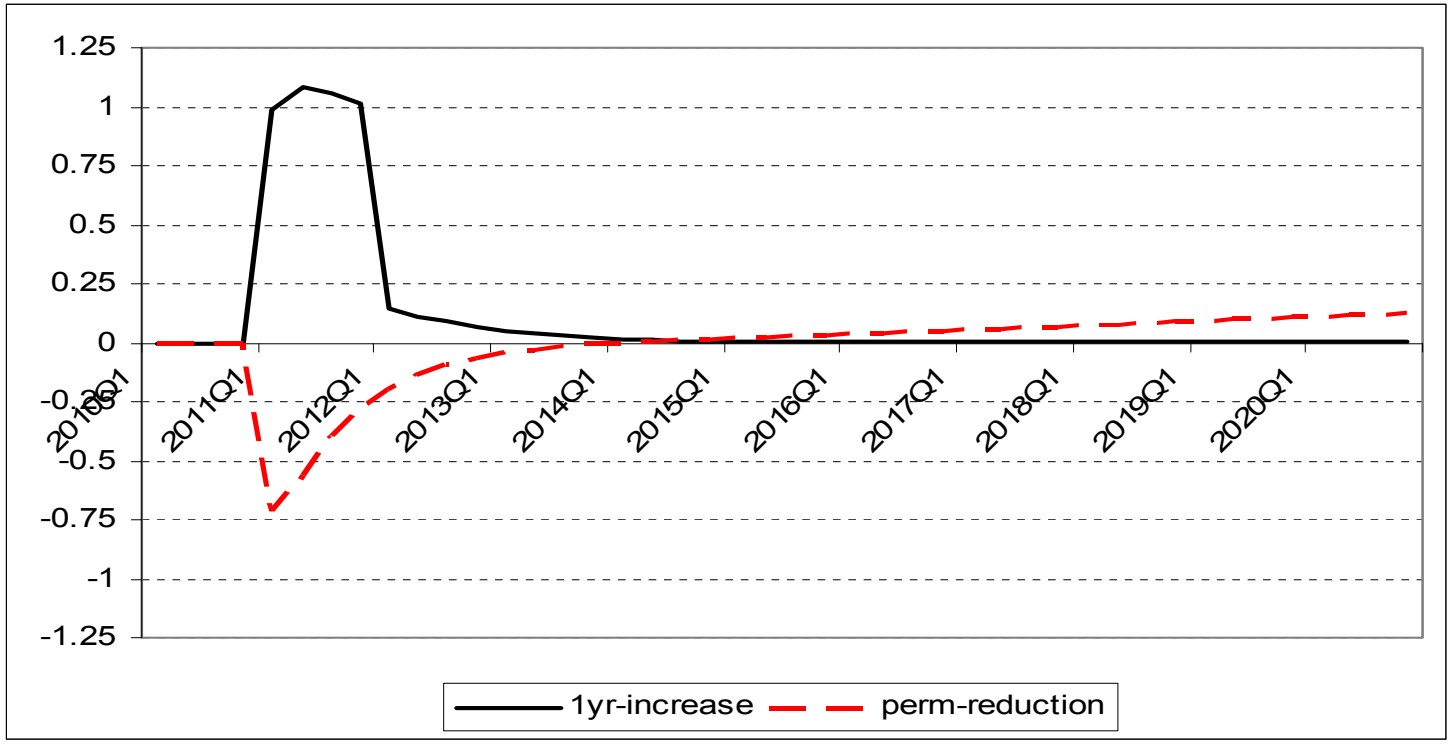


Investment



Anticipation of permanently higher tax liabilities

Asymmetry multipliers:
Temporary stimulus vs. Permanent consolidation



Note: temporary increase vs. permanent reduction gov. purchases 1% of GDP

1. **Impact multiplier permanent consolidation much smaller than that of temporary shocks**
2. **Long run effects of permanent consolidations positive**

Production: tradables and non-tradable sector

Output *O* : CES production function

$$O_t^j = \left\{ (1 - s_{\text{int}})^{\frac{1}{\sigma in}} . Y^{j\,(\frac{\sigma in - 1}{\sigma in})} + s_{\text{int}}{}^{\frac{1}{\sigma in}} . INT^{j\,(\frac{\sigma in - 1}{\sigma in})} \right\}^{\frac{\sigma in}{\sigma in - 1}}$$

Value Added: *Y* = f(capital *K*, production workers *L-LO*, public capital K^G)

$$Y_t^j = (ucap_t^j K_t^j)^{1-\alpha} (L_t^j - LO_t^j)^{\alpha} U_t^{Y\,\alpha} \left(K_t^G\right)^{\alpha_G}$$

Intermediates:

$$INT_t^j = \left\{ s_T{}^{1/\sigma tnt} \left[\left\{ sdom^{\frac{1}{\sigma}} INTD^{\left(\frac{\sigma-1}{\sigma}\right)} + (1 - sdom)^{\frac{1}{\sigma}} INTF^{\left(\frac{\sigma-1}{\sigma}\right)} \right\}^{(\frac{\sigma}{\sigma-1})} \right]^{(\frac{\sigma tnt - 1}{\sigma tnt})} + (1 - s_T)^{1/\sigma tnt} INTNT^{(\frac{\sigma tnt - 1}{\sigma tnt})} \right\}^{(\frac{\sigma tnt}{\sigma tnt - 1})}$$

Aggregation:

$$(26a) \quad C_t = s^r C_t^r + s^c C_t^c + s^l C_t^l$$

$$(26b) \quad L_t = s^r L_t^r + s^c L_t^c + s^l L_t^l \quad \text{with} \quad L_t^r = L_t^c = L_t^l .$$

Liquidity constrained households do not own financial assets:

$$B_t^l = B_t^{lF} = K_t^l = 0$$

Credit constrained households only engage in debt contracts with Ricardian households:

$$(27) \quad B_t^c = \frac{s^r}{s^c} B_t^r .$$

Fiscal policy: expenditure (1)

Government investment	Public capital accumulation K^G	- Demand effect: : GDP expenditure - Productivity effect: $Y_t^j = U_t^{Y\alpha}(L_t^j - LO_t^j)^{\alpha}(ucap_t^j K_t^j)^{1-\alpha}\left(K_t^G\right)^{\alpha_G}$
Government consumption:	. Purchases goods and services: . Government wages	- Demand effect: GDP expenditure - Disposable income $Y_t^{disp} = (1-t_t^w)(W_t^P L_t^P + W_t^G L_t^G) + ...$
Investment subsidies		- Budget constraint investors $..... + \sum_j p_t^{K,j}(1-itc_t)I_t^j + ...$

Fiscal policy: expenditure (2)

Government transfers	Pensions	Disposable income: $Y_t^{disp} = ... + POP_t^{PENS}\, pensrr_t\, W_t^i + ...$
	General transfers	Disposable income: $Y_t^{disp} = ... + TR_t^l + ...$
	Targetted transfers	Disposable income constrained households: $Y_t^{disp} = ... + TR_t^l + ...$
	Unemployment benefits	- Disposable income: $Y_t^{disp} = ... + (1 - L_t)benrr_t\, W_t^i + ...$ - Labour supply effect

Fiscal policy: revenue (1)

Consumption tax	$t_t^C (P_t^C C_t + P_t^H I_t^H)$
Labour income tax	$t_t^W (W_t^P L_t^P + W_t^G L_t^G)$
Corporate profit tax	$t_t^K (P_t^Y Y_t - W_t^P L_t^P - \delta P_t^I K_t)$
House property tax	$t_t^H P_t^H H_t$
Lump sum taxes	t_t^{LS}

Fiscal policy: closure

Interest payments

$$[inom_t + riskp(B_t / Y_t - \overline{B/Y})]B_{t-1}$$

Debt stabilisation rule

Labour income tax stabilises Debt/GDP ratio:

$$\Delta t_t^w = \tau^B\left(\frac{B_{t-1}}{GDP_{t-1}P_{t-1}} - b^T\right) + \tau^{\Delta B}\Delta\left(\frac{B_t}{GDP_tP_t}\right) + \tau^{DEF}\left(\frac{\Delta B_t}{GDP_tP_t} - def^T\right)$$

Impulse responses to gov. spending and tax shocks

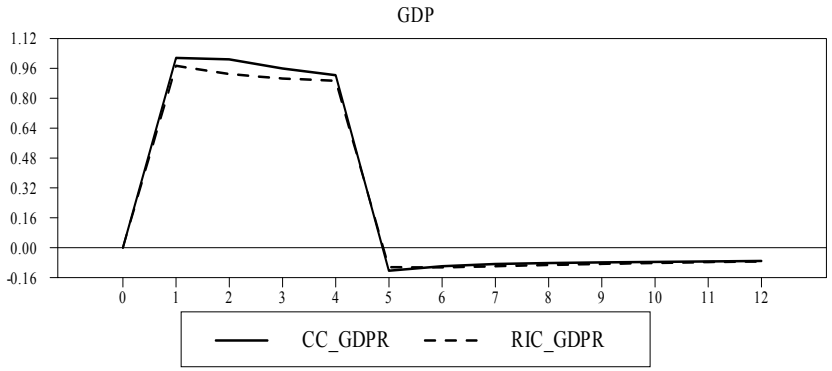
Models: / Household shares:	RIC_ - - - - - - -	CC_ ———
Liquidity constrained hh (LC)	0.3	0.3
Ricardian households (NLC)	0.7	0.4
Credit constrained hh (CC)	-	0.3

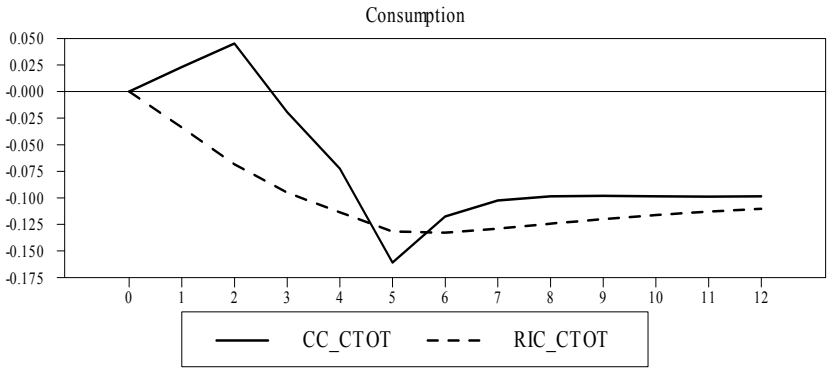
- Two region version of model: EU and RoW
- Standardised fiscal shocks: 1% of GDP (1 year)
- Global shocks

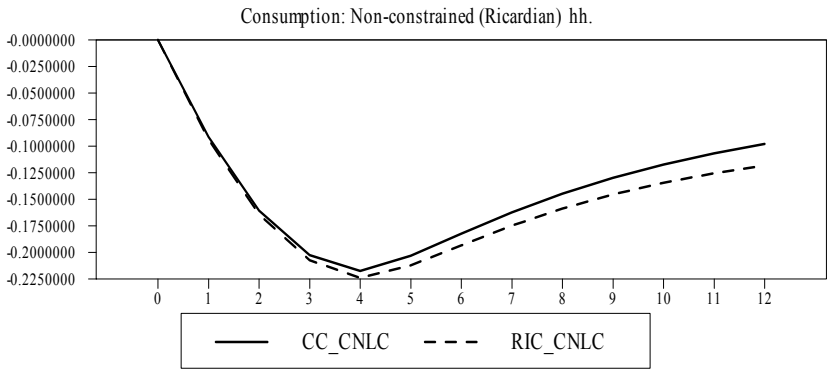
Figure 5 Temporary increase government consumption:

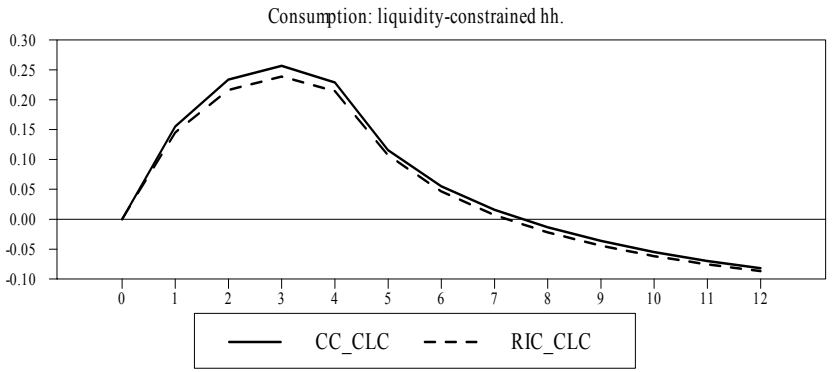
RIC_ : without credit-constrained hh - - - - - -

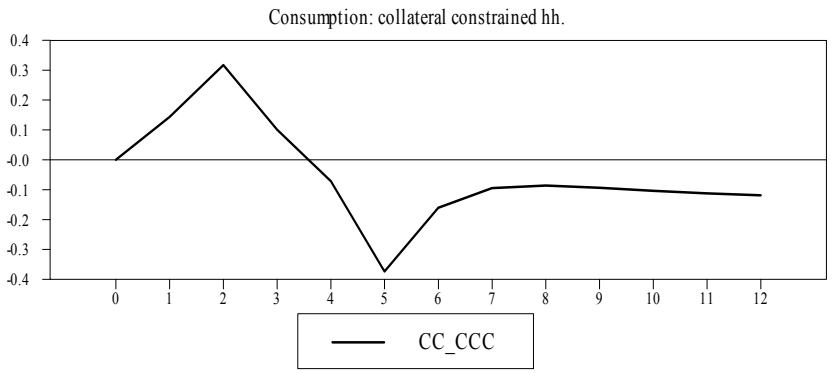
CC_ : with credit-constrained hh ——————











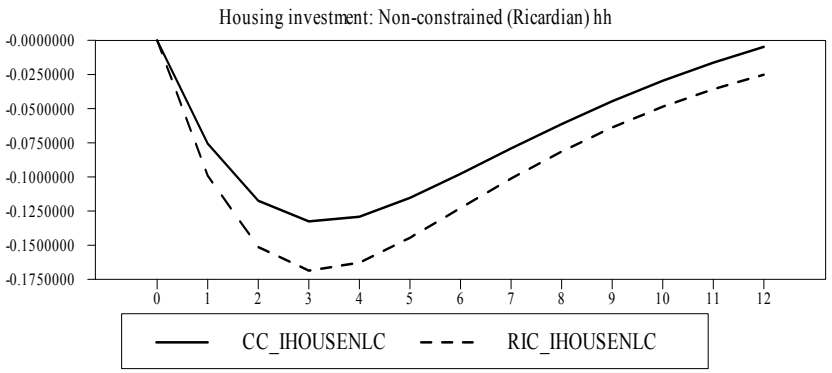
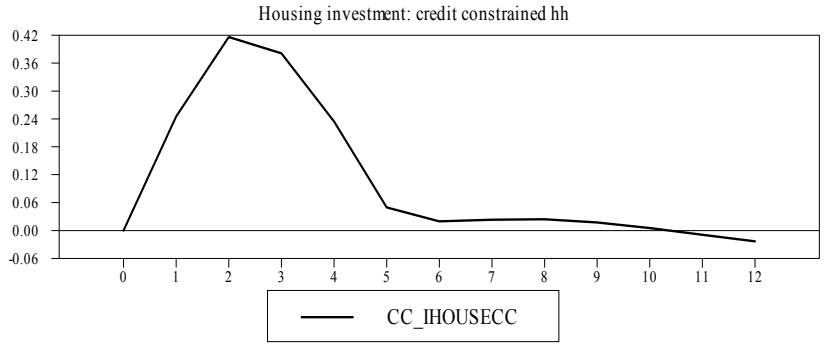
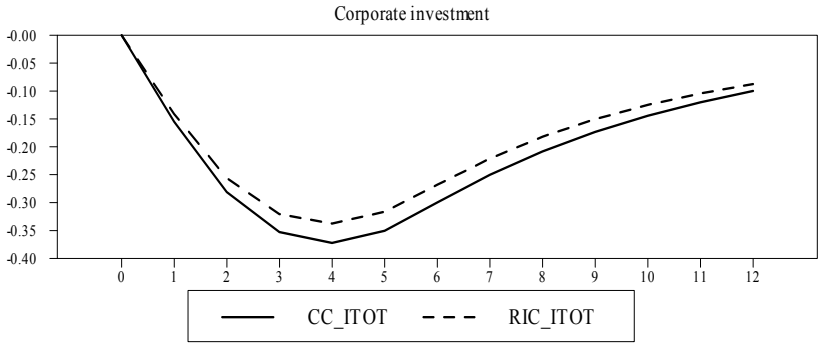


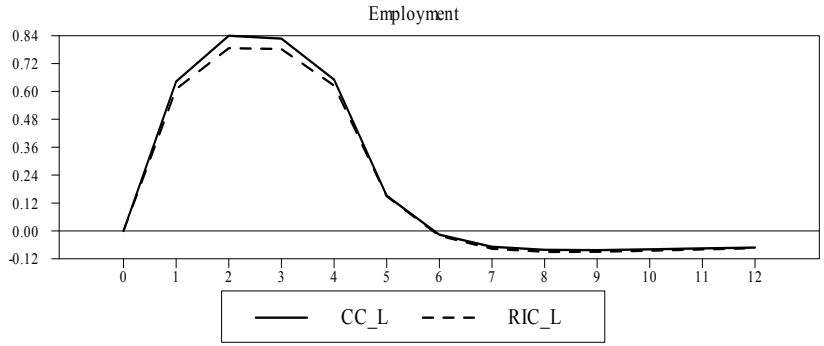
Figure 5.b Temporary increase government consumption :

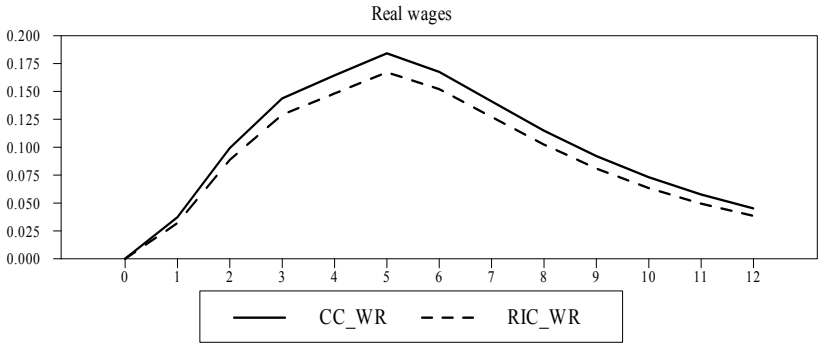
RIC_ : without credit-constrained hh - - - - - -

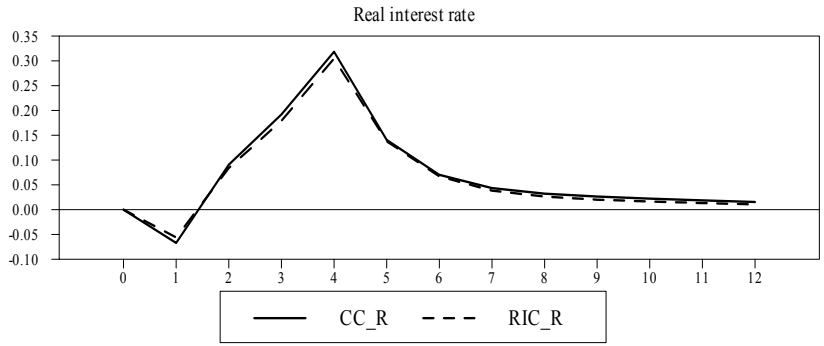
CC_ : with credit-constrained hh ——————











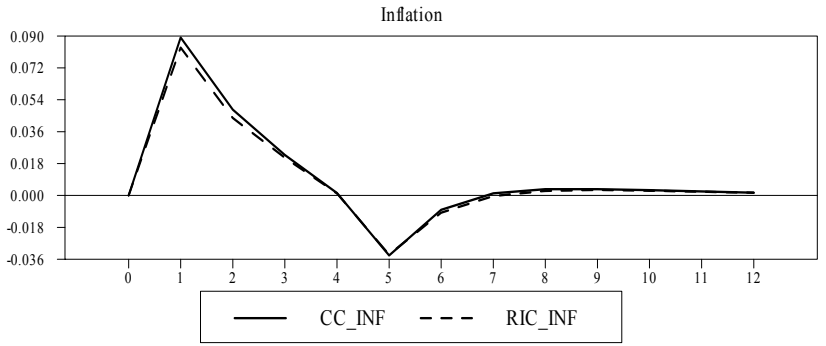
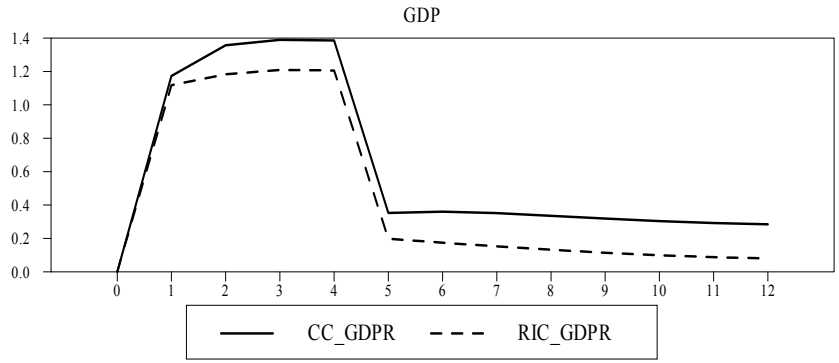
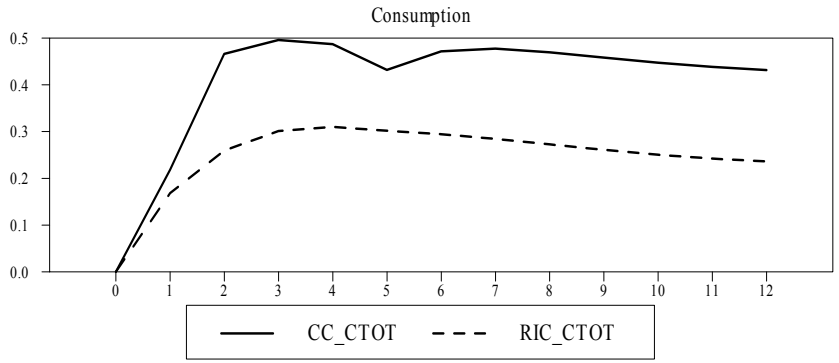


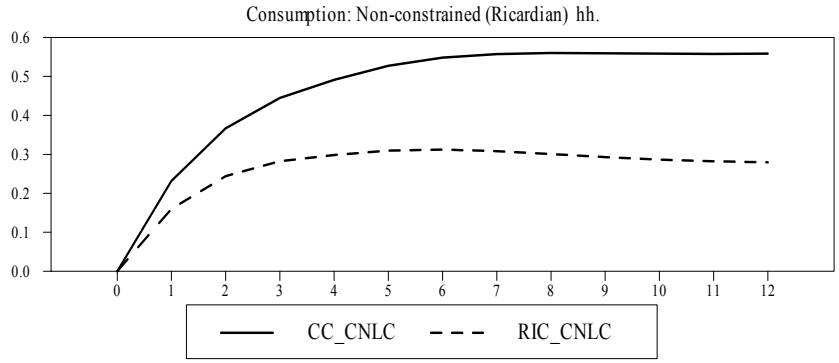
Figure 6 Temp. increase gov. cons. + mon. accommodation:

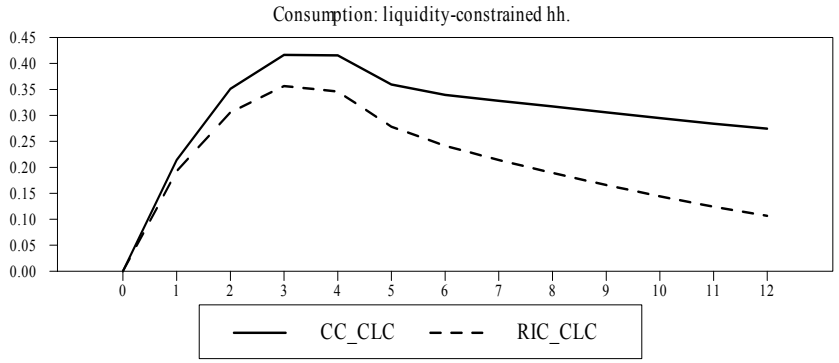
RIC_ : without credit-constrained hh - - - - - -

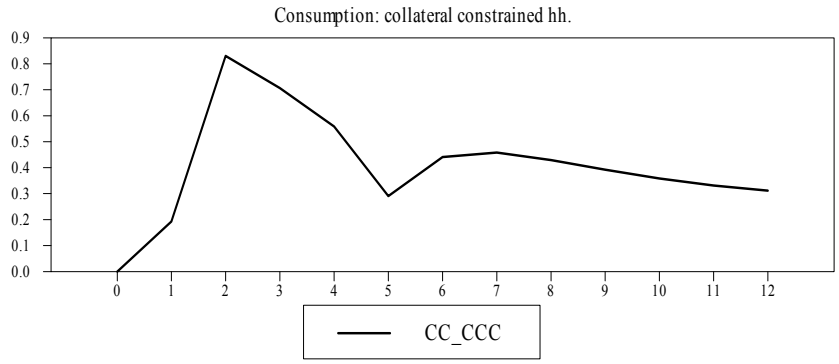
CC_ : with credit-constrained hh ——————











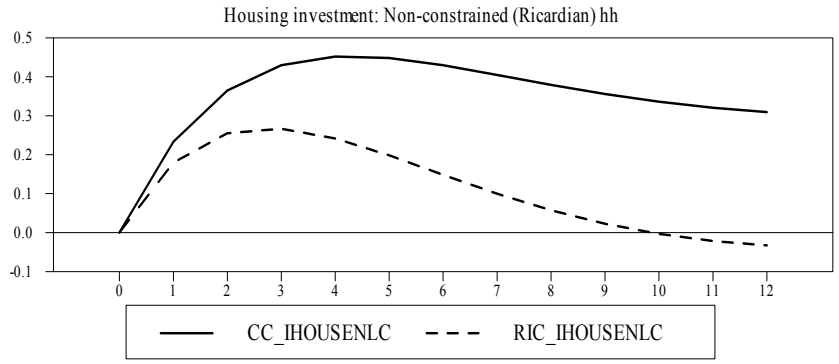
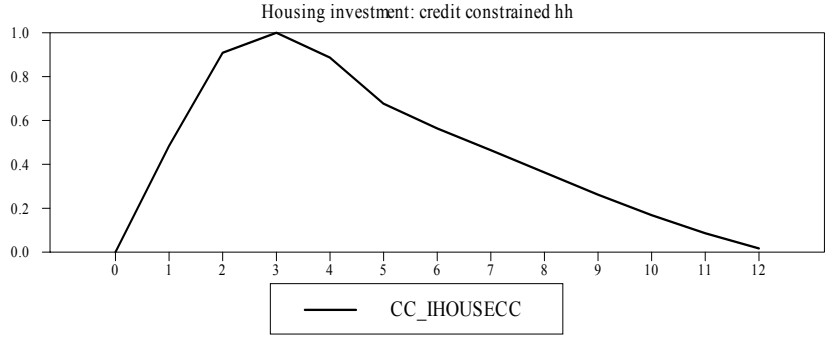
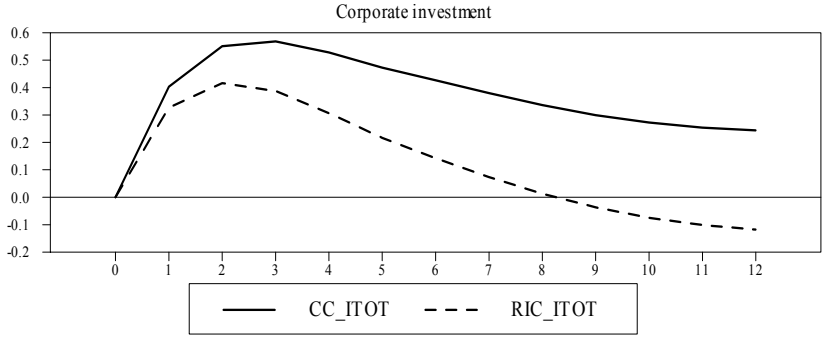


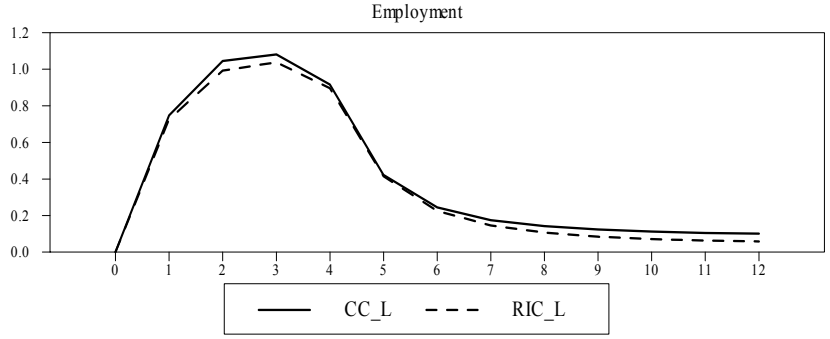
Figure 6.b Temp. increase gov. cons. + mon. accommodation :

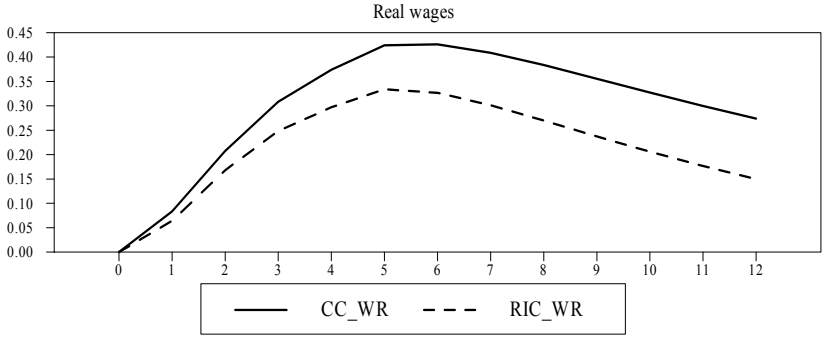
RIC_ : without credit-constrained hh - - - - - -

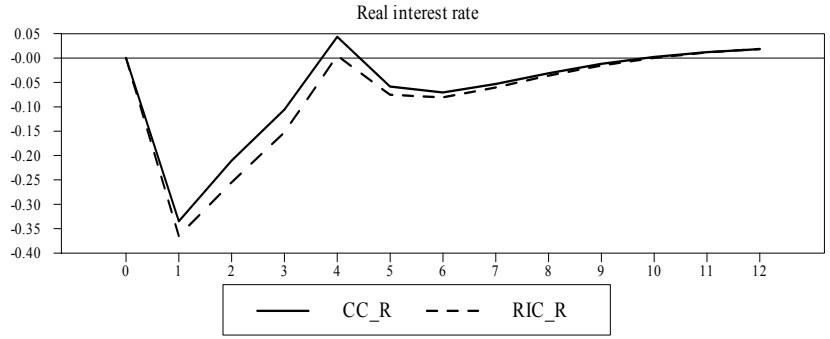
CC_ : with credit-constrained hh ——————











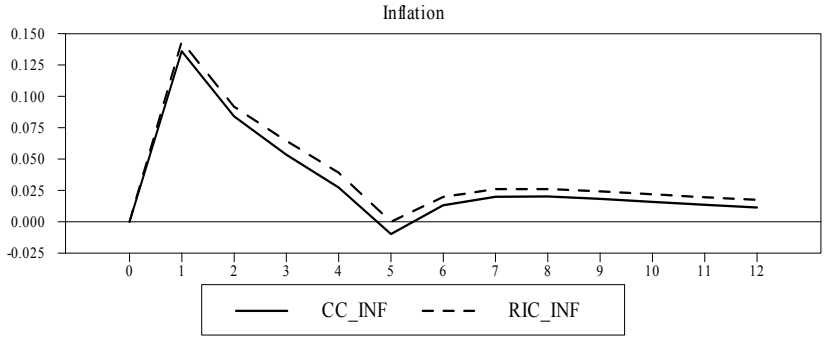
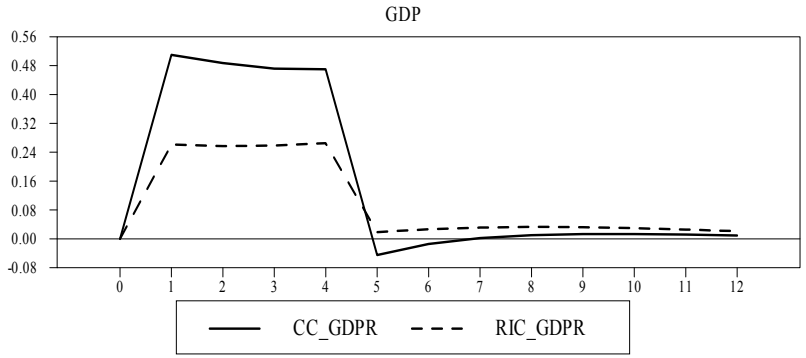
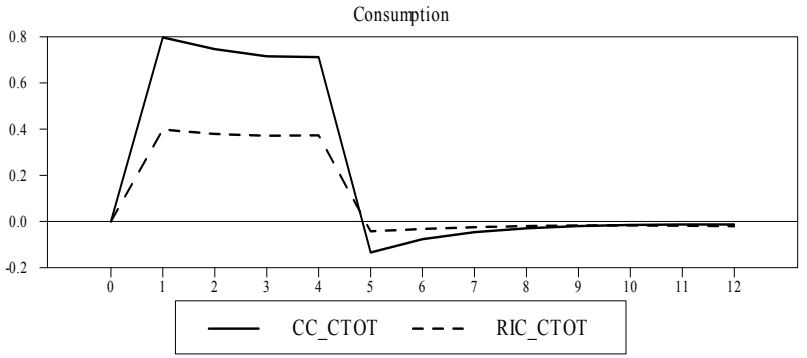


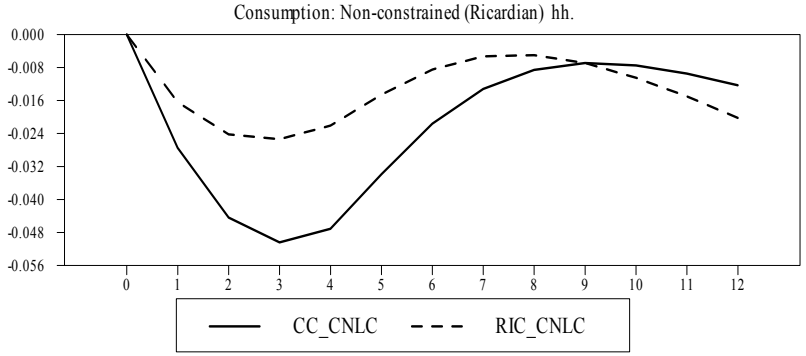
Figure 7 Temporary reduction labour taxes :

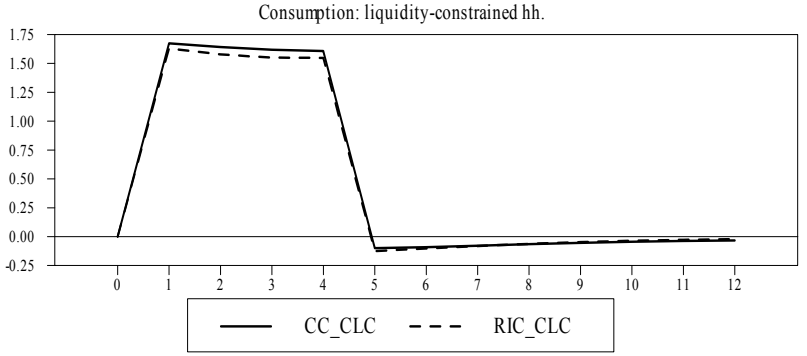
RIC_ : without credit-constrained hh - - - - - -

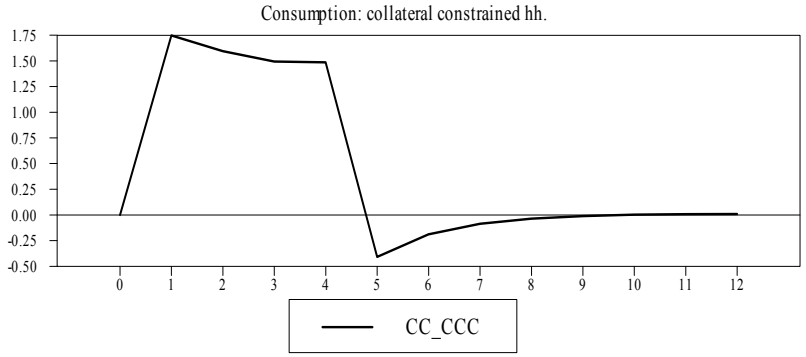
CC_ : with credit-constrained hh ——————











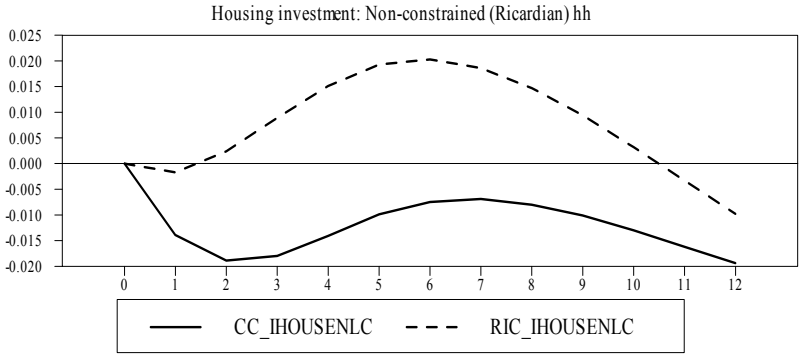
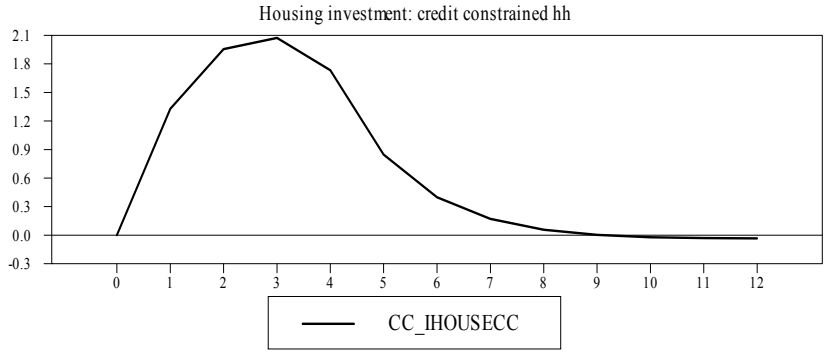
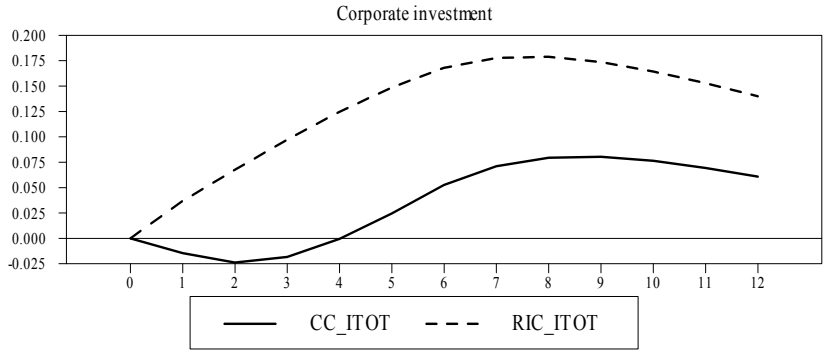


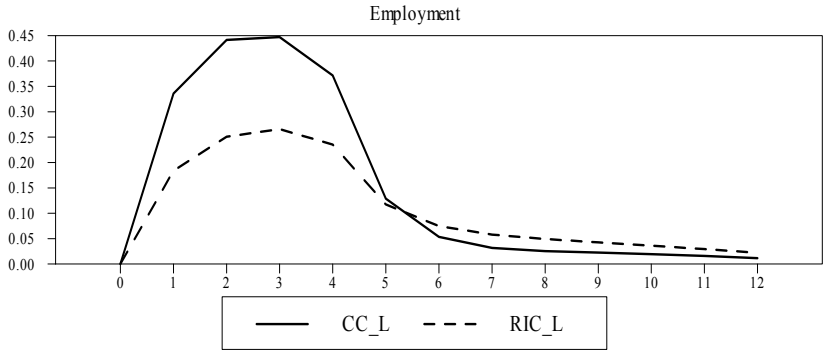
Figure 7.b Temporary reduction labour taxes:

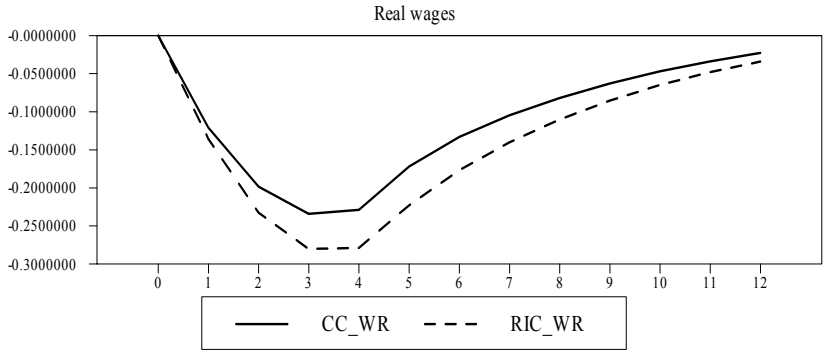
RIC_ : without credit-constrained hh - - - - - -

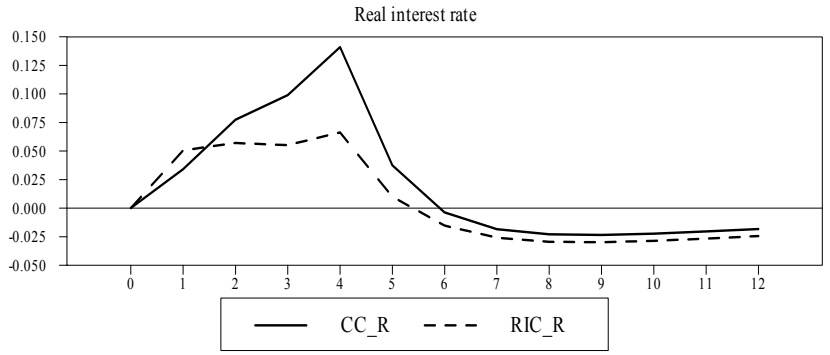
CC_ : with credit-constrained hh ——————











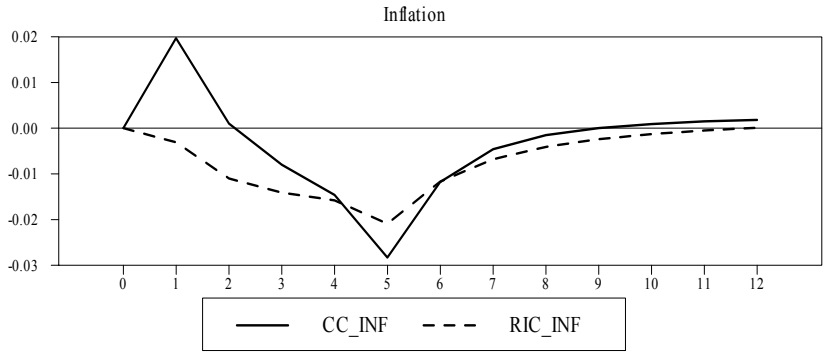


Figure 8 Temp. reduction lab. taxes + Monetary accommodation :

RIC_ : without credit-constrained hh - - - - - -

CC_ : with credit-constrained hh ——————

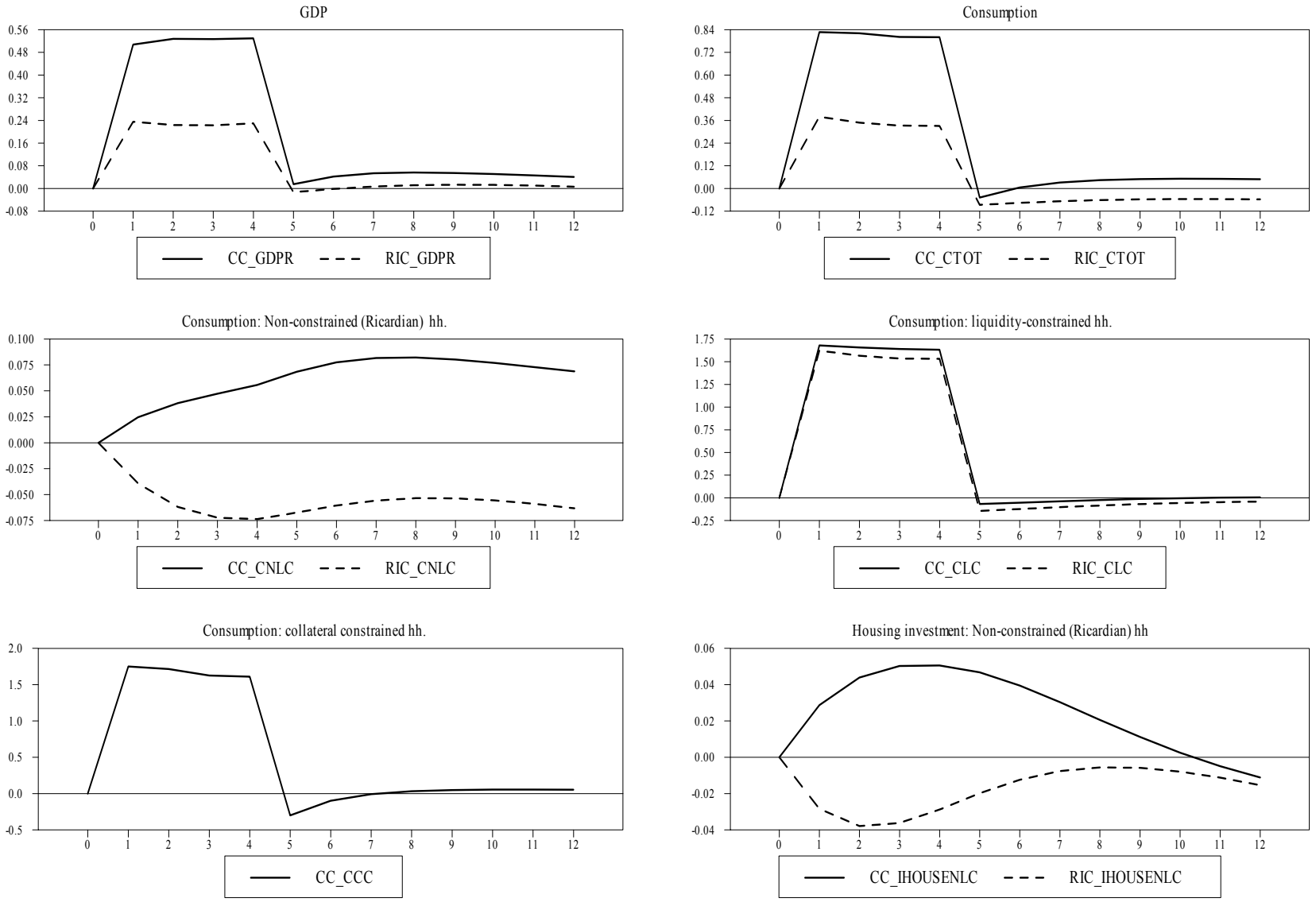
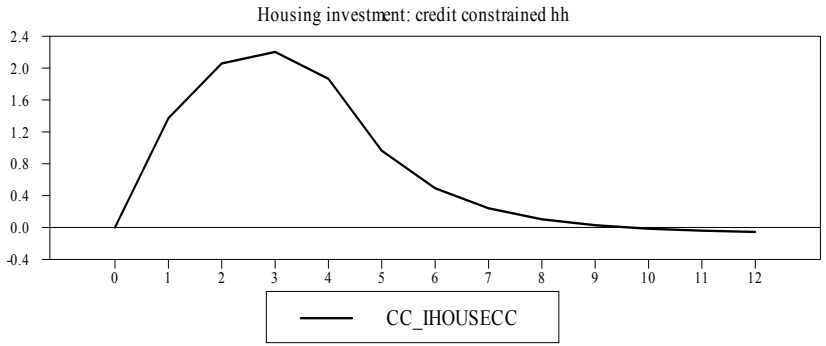
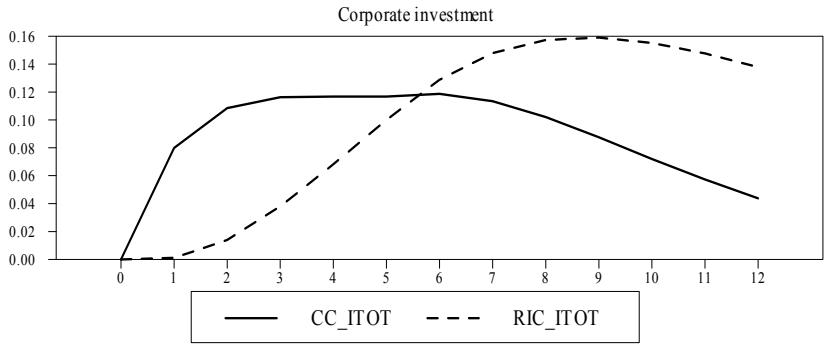


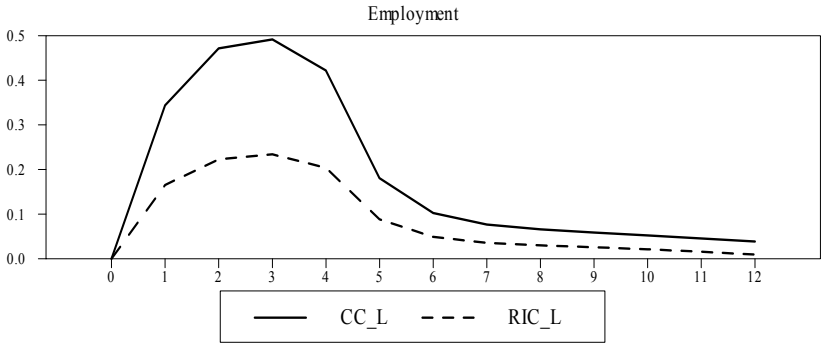
Figure 8.b Temp. reduction lab. taxes + Monetary accommodation:

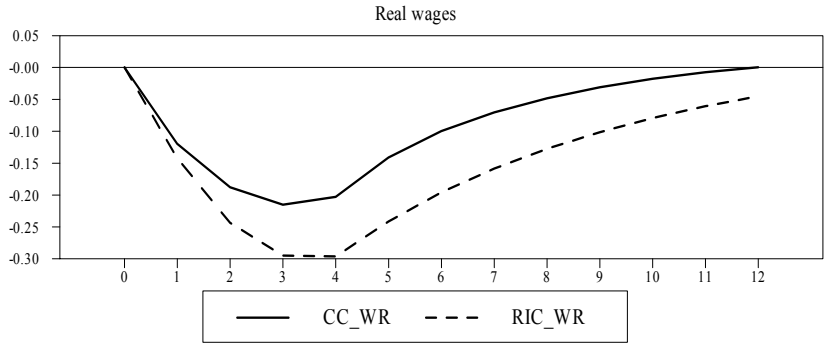
RIC_ : without credit-constrained hh - - - - - -

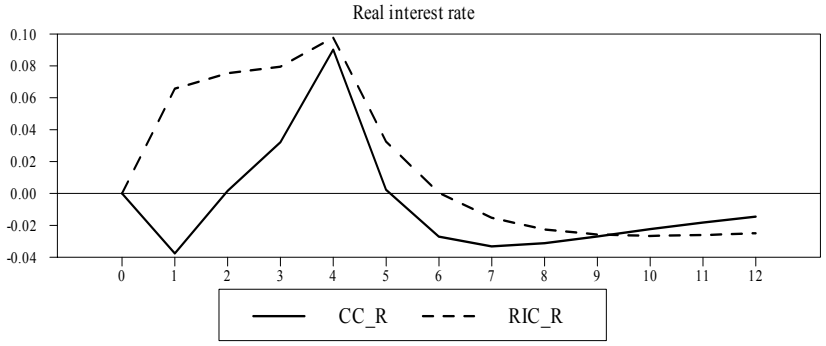
CC_ : with credit-constrained hh ——————

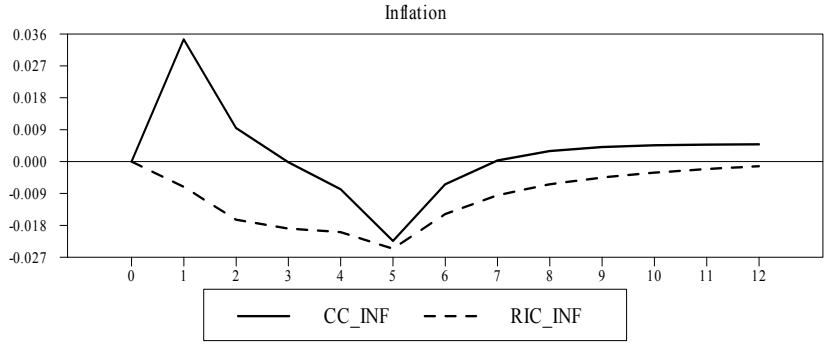












Effects higher government debt

Ricardian equivalence (Barro,1974): effects composition, but not level of output

Departures from Ricardian equivalence:

- No infinitely-lived households .
  - But even in OLG framework effect on interest rate is negligible
- Distortionary taxes (consumption taxes, tax on labour income, tax on corporate profits)

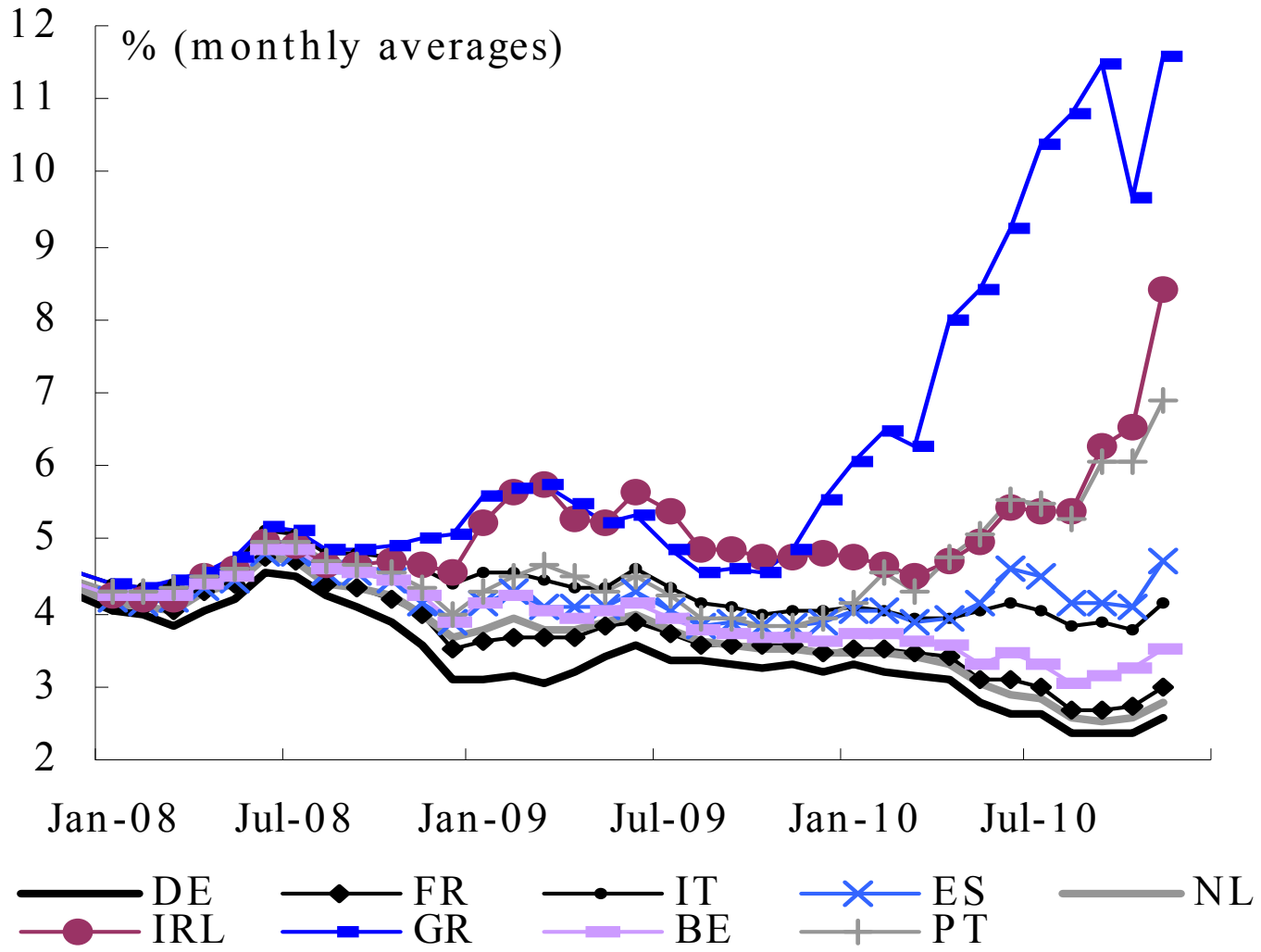
Effect on government interest rates:

- Laubach(2009): 1%p debt/GDP => 1-6bp gov interest rates
- Krishnamurthy and Vissing-Jorgensen (2007) show that an increase in Treasury debt held by public leads to decline in yield spread of AAA corporate debt over Treasuries.

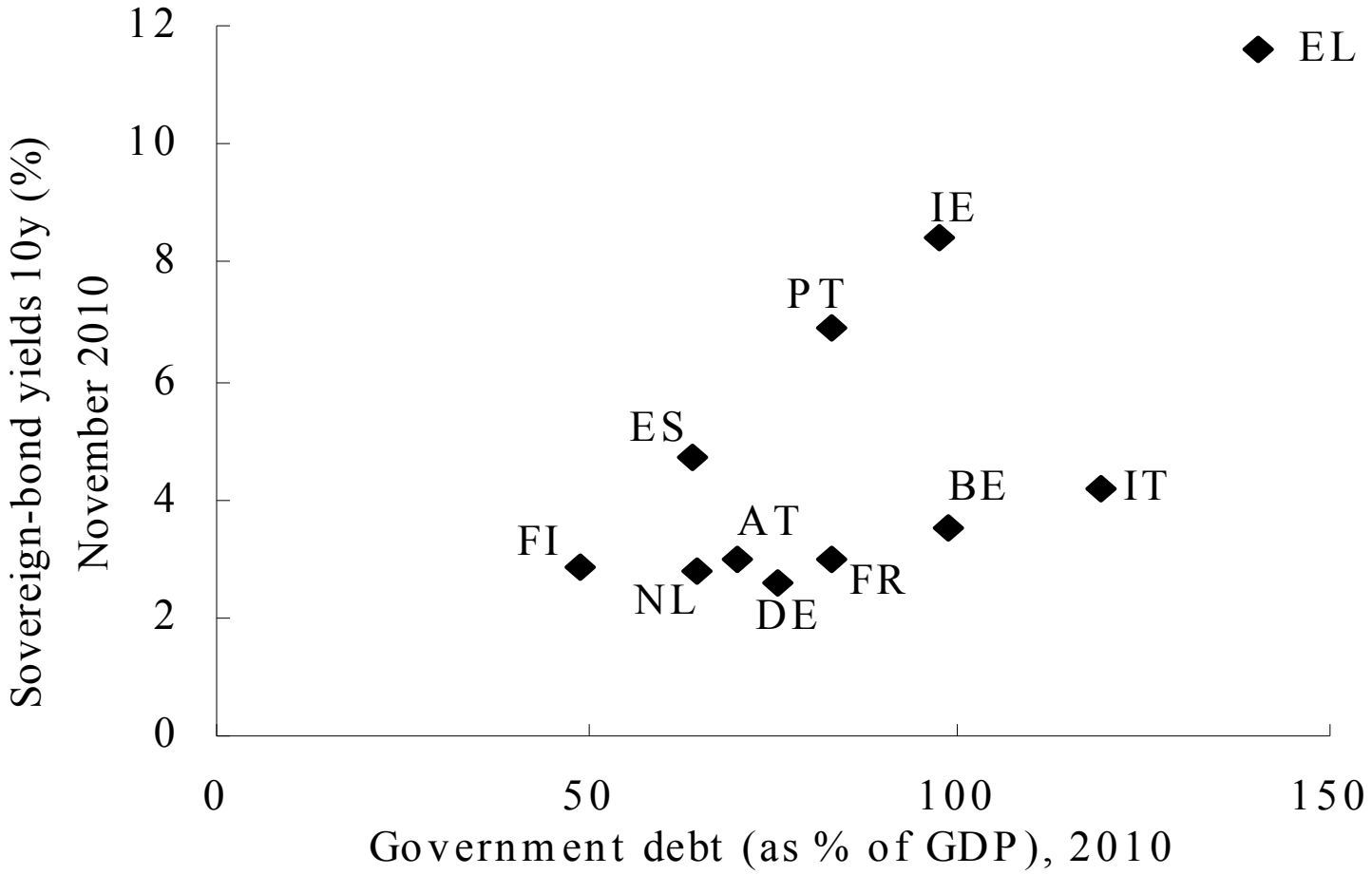
QUEST: sovereign risk premium

debt/GDP ratio +1%p -> gov bond rates +3bp

Graph I.2.3: **10y government-bond yields, selected Member States**

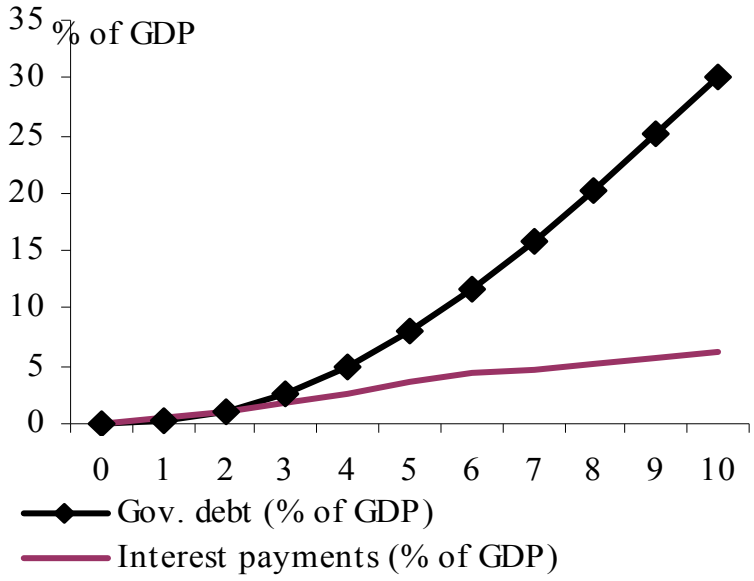


Graph I.2.4: **Sovereign-bond yields and debt ratios**

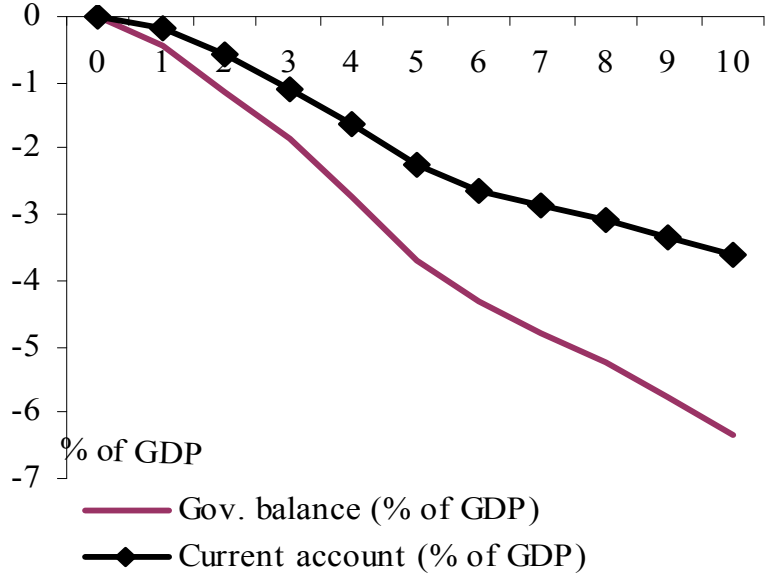


The effects of sovereign risk premia:
QUEST model simulations

Graph 1: **Impact sovereign risk premium**



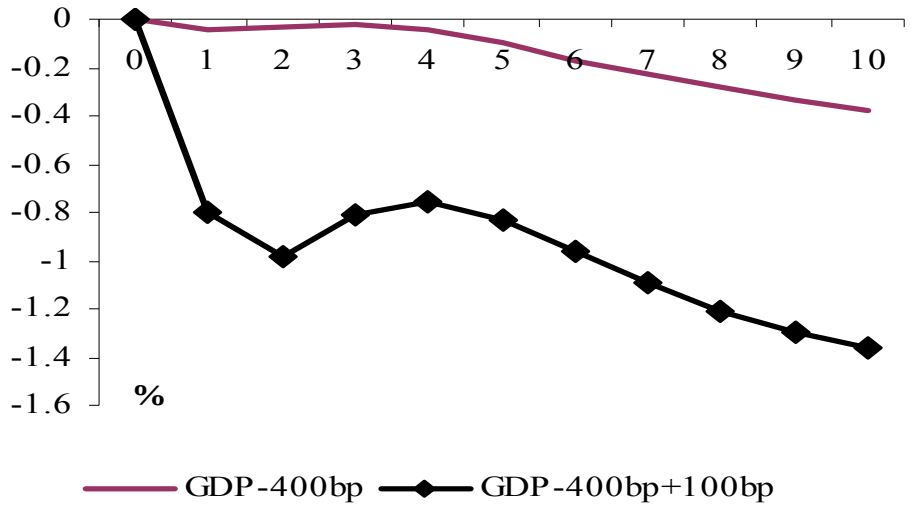
Graph 2: **Impact sovereign risk premium (2)**



400 bp sovereign risk premium,
Assuming 80% debt/GDP ratio in baseline, 70% held abroad, average debt maturity 5 years. No corrective action

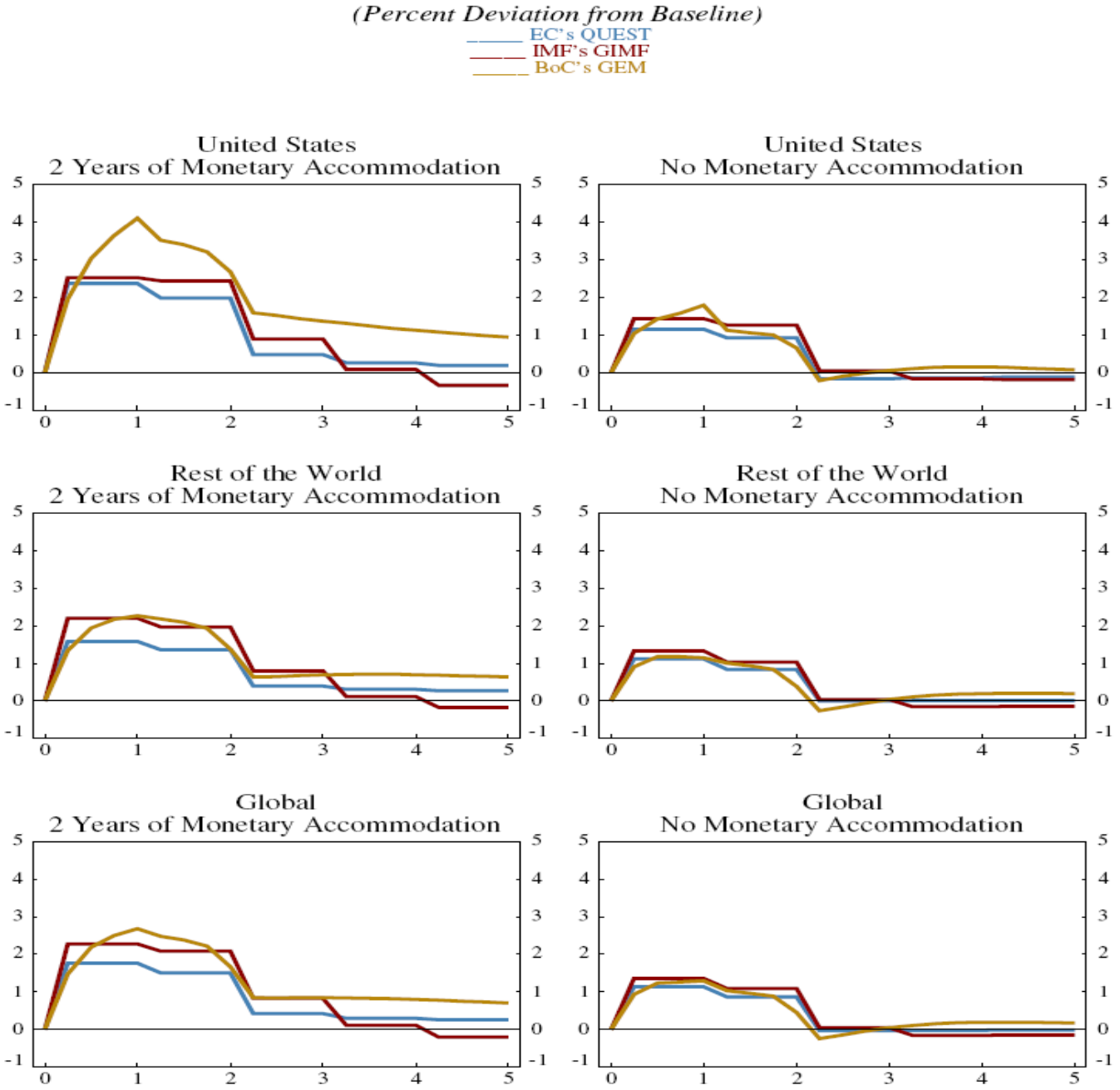
Debt stabilisation rule:
increase in labour taxes => Consumption ↓ Employment ↓ GDP ↓ (-0.4%)

Graph 3a: **Impact of risk premia**



Expectations of future defaults may lead to a *general* reassessment of risks
a general economy-wide increase in risk premia 100bp:
- Sharper fall in consumption and investment
- GDP declines by 0.8 % in the first year and is 1.4% lower after a decade

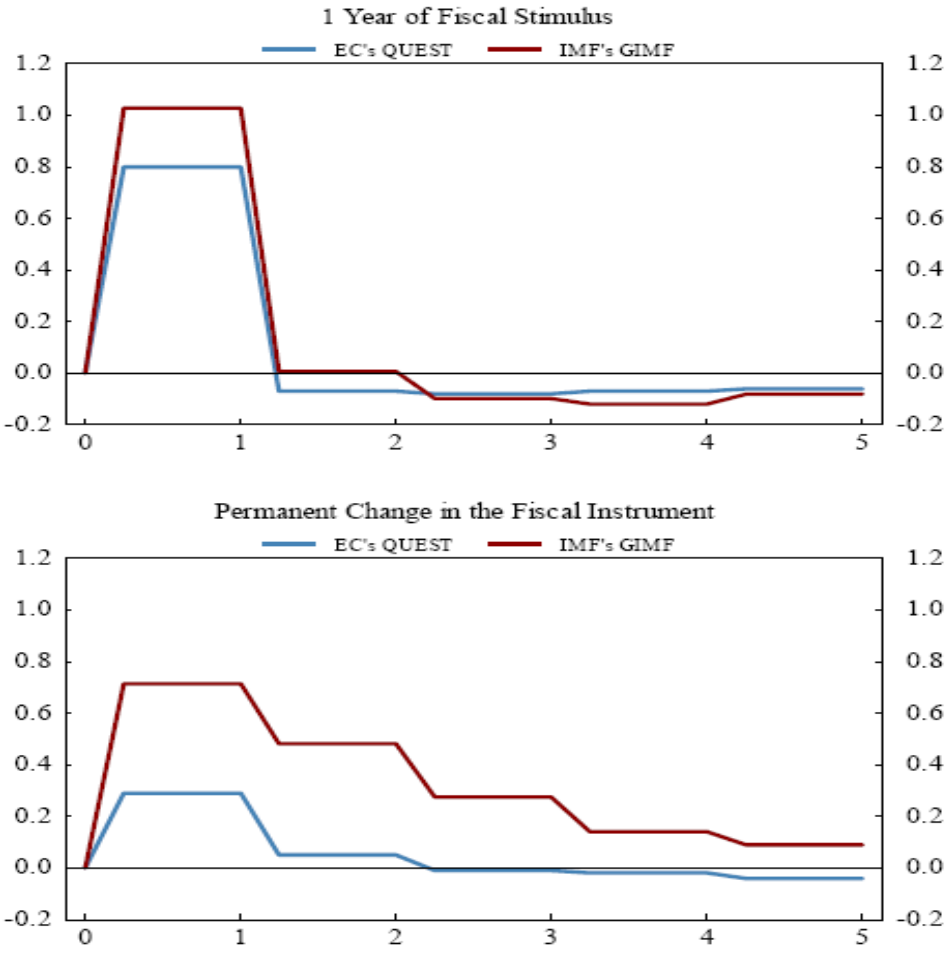
Figure 92: G20 Fiscal Stimulus Packages: Effect on GDP



Source: Coenen et al. (2010)

Figure 90. United States: Effect of 1 Year Fiscal Stimulus and Permanent Change in the Fiscal Instrument on GDP (Instrument: Government Consumption)

No Monetary Accommodation
(In percent)



Housing

- Production new houses : CES technology of new land J^{Land} and non-tradable goods $J^{inp,H}$:

$$J_t^H = \left(s_L^{\frac{1}{\sigma L}} J_t^{Land\,\frac{(\sigma L-1)}{\sigma L}} + (1-s_L)^{\frac{1}{\sigma L}} J_t^{inp,H\,\frac{(\sigma L-1)}{\sigma L}} \right)$$

- Price of land :(quasi) Hotelling rule

$$p_t^{Land} = \mathrm{E}_t \left(\frac{1}{(1+r_t)} p_{t+1}^{Land} (1+g_L) \right)$$

The growth rate of the price of land must guarantee a rate of return which can be earned by other assets, i.e. the growth rate of the price of land must be equal to *r-g*

- Price housing investment:

$$p_t^H = \frac{U_{H,t}^s}{U_{C,t}^s / p_t^C} + \mathrm{E}_t \left(d_t^s P_{t+1}^H (1-\delta^H) \right)$$

Labour tax multiplier and monetary accommodation

Labour tax multiplier not much different when interest rates at lower zero bound :

Why? No increase in inflationary pressure - no reduction in real interest rates

This in contrast to Eggertson (2009) who argues labour tax multiplier is negative at LZB (only considers shift in aggregate supply AS curve)

If AD curve (upward sloping at LZB) also shifts to right GDP effect is ambiguous