Banks, Public Finances and the Financial Crisis

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Analysis of endogenous risk
due to interaction between
health of banks & health of public finances

Estimated DSGE model of Euro Area

Recent financial crisis:

highlights close links between health of banking system and health of public finances

Crisis originated in loan losses on US sub-prime mortgages;

spread rapidly to Euro Area (EA) and other parts of world:

worst global recession since 1930s

Countered by:

- **massive government support for banks**
- **fiscal stimulus**

Provided relief to banks & real economy

But: sharp rise in public debt (+20 ppt in EA)

undermines sustainability of public finances

Sovereign default: would destabilize real economy & banks

Pyrrhic victory ?

Contribution of this paper:

quantitative analysis of interaction between banking system and public finances

- **Effect of banking shocks on real economy and public finances**
- **Effect of government support for banks on real economy**
- **Effect of sovereign default on banks and real economy**

Based on estimated New Keynesian model of Euro Area with

● banks: take deposits, make loans

face bank capital requirement;

Losses (default) on loans & sovereign debt

● Rich fiscal set-up:

government spending,

distorting taxes, sovereign debt

● Estimation uses detailed macro, banking and fiscal data for EA (1995-2011)

THE KEY MECHANISM

BANK CAPITAL: KEY STATE VARIABLE FOR INTEREST RATES AND REAL ACTIVITY

BANK CAPITAL CHANNEL:

LOAN LOSS $\Rightarrow$ BK CAP $\downarrow$

$\Rightarrow$ LENDING RATE SPREAD $\uparrow$

$\Rightarrow$ LENDING $\downarrow$ $\Rightarrow$ Investment $\downarrow$, GDP $\downarrow$

- **Government support to banks**

Modeled as public transfer to banks, financed by higher taxes

BK CAP ↑ ⇒ LENDING RATE SPREAD ↓

⇒ LENDING ↑ ⇒ Investment ↑, GDP ↑

Results

- **Empirical support for key role of bank capital for real activity**

- **Government support to banks is effective tool for stabilizing real activity--provided gov't solvency maintained**

- **Bank state aid multiplier in same range as conventional fiscal multiplier**

- **Bank state aid has positive effect on consumption & investment; conventional stimulus crowds out C & I**

- **When banks hold gov't bonds: sovereign default destabilizes banks & real activity.**

Bank balance sheet = powerful transmission channel of sovereign default

EMPIRICAL ANALYSIS OF CRISIS in EA

- **Bank asset losses: explain**

1/4 of fall in EA GDP & C

3/4 of fall in EA investment, in 2007-9

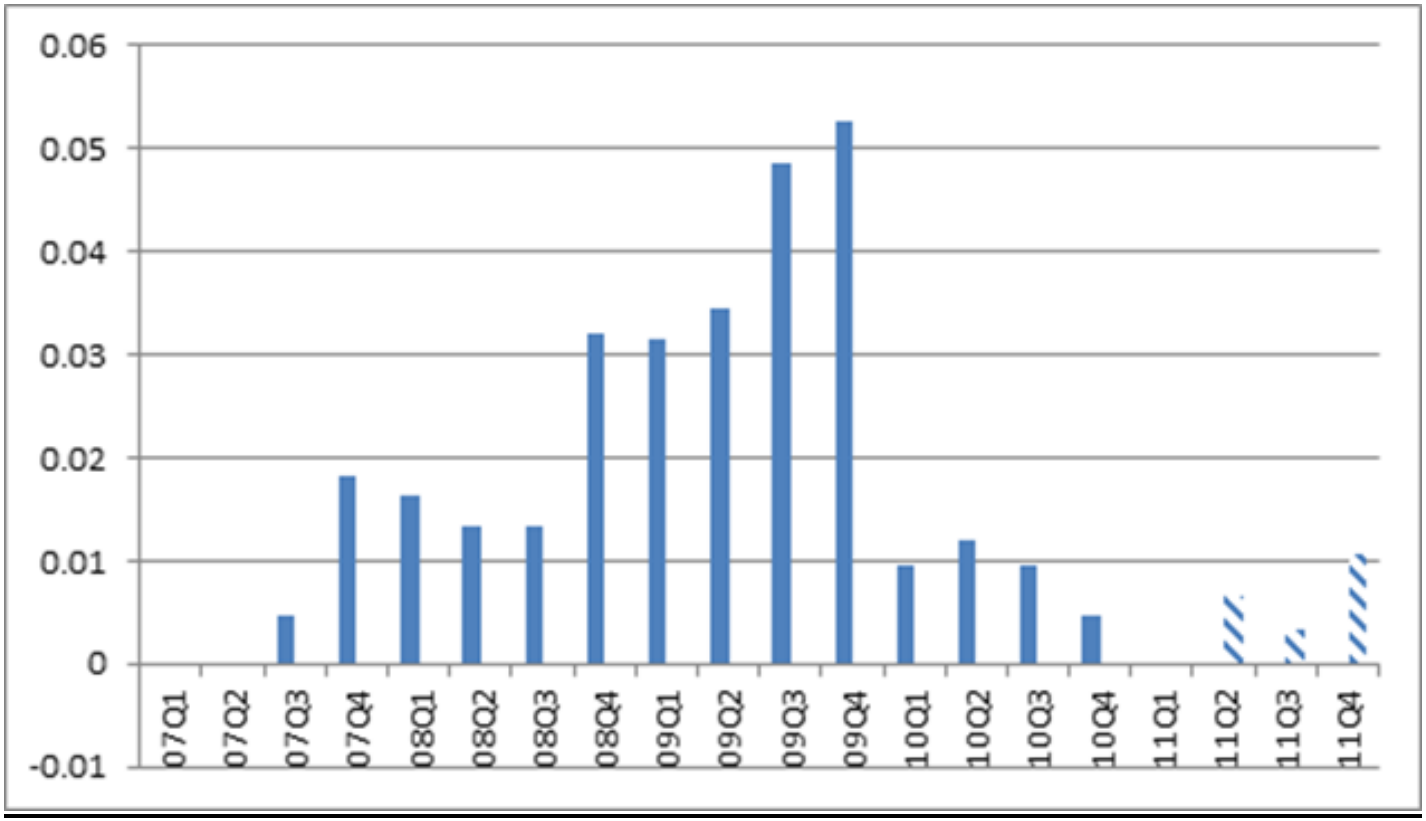
- **Bank state aid off-set effect of loan losses on GDP in 2009**

- **Bank state aid & fiscal stimulus explain 1/2 of rise in public debt/GDP**

Table 2: Euro Area - Financial Crisis 2008-2010:

	Annual growth rates		
	2008	2009	2010
GDP	0.5	-4.2	1.8
Gov. Consumption	2.3	2.5	0.5
Consumption	0.7	-1.7	0.8
Non-residential investment	2.3	-20.0	4.3
Residential Investment	1.2	-9.3	-5.2
Employment	0.9	-1.9	-0.5

EA bank asset write-downs
(shares of trend quarterly GDP)



Note: values for 2011 (hashed bars) are model-based estimates

CUMULATED ASSET LOSSES OF EA BANKS:

8.7% of annual EA GDP

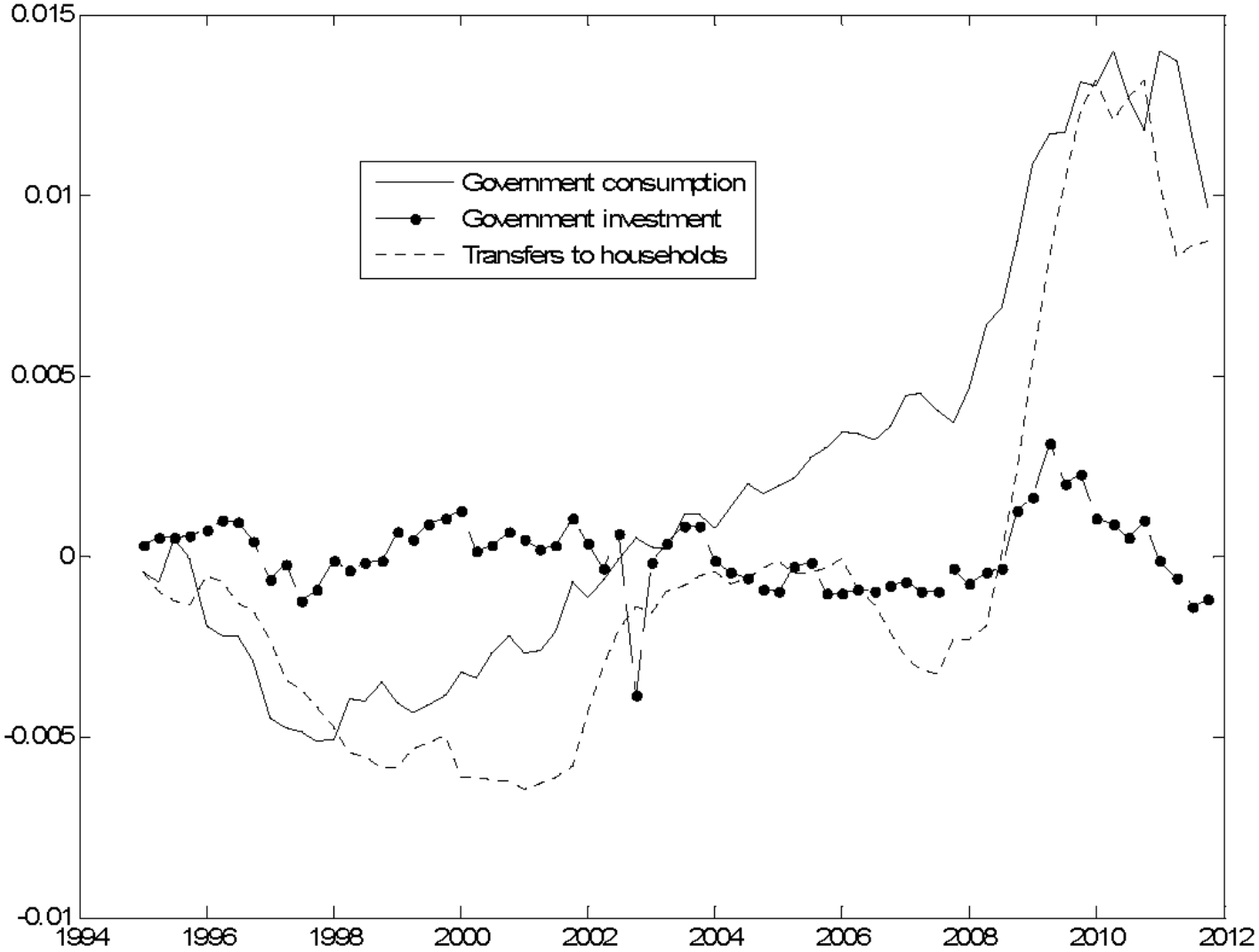
EA Gov't support for banks

(cumulative, % of annual GDP)

	Feb-09	May-09	Aug-09	Dec-09
Purchases of impaired bank assets	0.43	0.45	0.75	2.84
Recapitalizations	1.09	1.45	1.67	1.88
Total bank aid	1.52	1.90	2.42	4.72

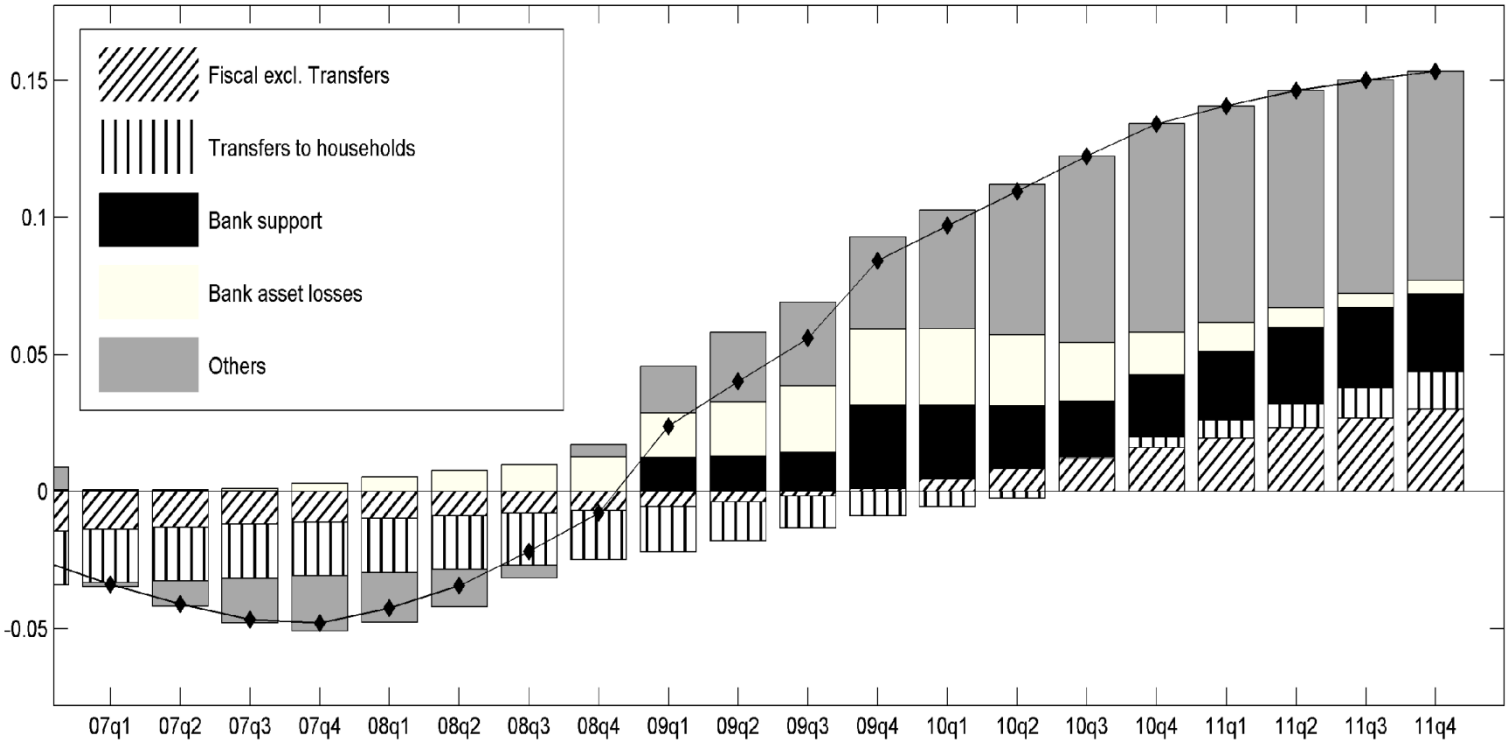
Source: European Commission

Non-systematic (discretionary) components of fiscal variables (shares of trend of quarterly GDP)



CUMULATED 'CONVENTIONAL' FISCAL IMPULSE 2008-11: 9.8% OF ANNUAL GDP

Debt to GDP ratio (demeaned)



RELATED LITERATURE

Before crisis: standard quantitative macro models abstracted from financial intermediaries

► Since crisis: much works that builds banks into DSGE models

Gerali, Neri, Sessa & Signoretti (2010); de Walque, Pierrard & Rouabah (2010);

Curdia & Woodford (2010); Meh & Moran (2010); Brunnermeier & Sannikov (2010),

Kollmann, Enders & Mueller (2011), Ratto, Roeger & in't Veld (2011); Dewachter & Wouters (2012) etc.

Mostly abstract from government; no analysis of gov't support for banks; sovereign default

This paper also offers novel specification of banking sector:

● previous models assume that banks only accumulate capital through retained earnings;

focus on lending to firms.

● our model: banks can issue equity, make mortgage loans to HOUSEHOLDS

We show that loan losses have persistent negative effect on real activity, even when banks can issue equity & lend to households

- **Paper also related to:**

assessments of fiscal stimulus during crisis

E.g. Coenen et al. (AEJ-Macro, 2012)

That literature abstracts from banks

- **Model here is <u>estimated</u>**

Related banking/fiscal macro literatures mainly rely on calibrated models

The Model

Open economy with two workers (patient and impatient), entrepreneur & government

- **Workers provide labor services, own house**

►**Patient worker holds: bank deposits and government debt**

►**Impatient worker borrows from the bank, using her housing capital as collateral.**

- **Entrepreneur owns corporate sector:**

►**Bank**

►**Goods producing & distribution firms**

- **Bank: intermediary between patient & impatient worker**

holds government bonds and foreign bonds

Bank capital constraint—a fraction of her assets has to be financed using bank capital

Consider open economy to capture external asset losses: ≈50% of EA bank losses in crisis were external

Related literature: models with patient savers & impatient borrowers,
BUT direct lending (no bank)

Iacoviello (2005), Iacoviello & Neri (2010)

Goods production & distribution

(standard New Keynesian specification)

►Differentiated intermediate goods produced from K & L; monopolistic competition, price stickiness

►Final good = aggregate of differentiated intermediates, used for private and public consumption and investment, exports

- **Government**

Spends:

goods & services

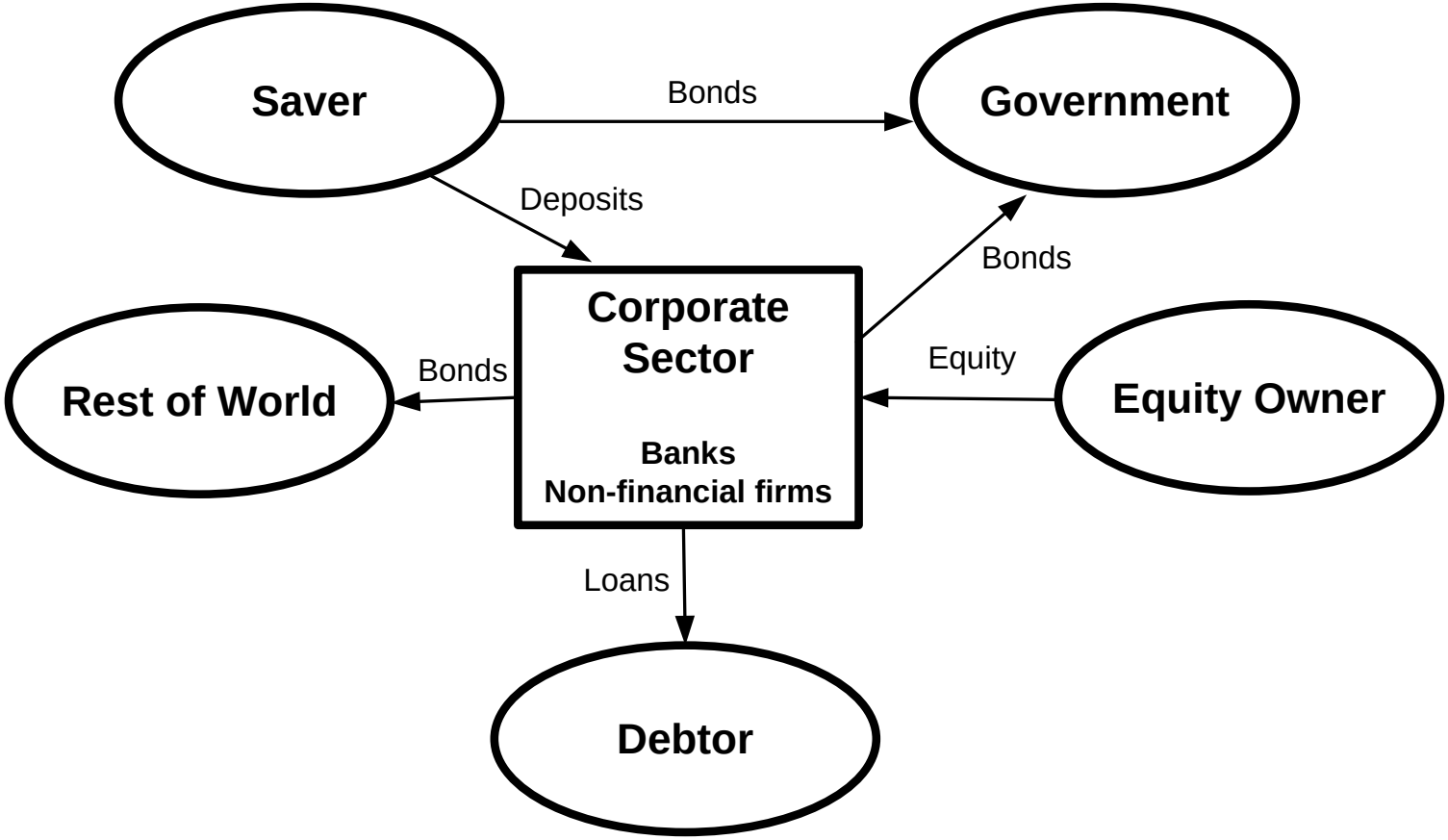
transfers to household

bank support

Distorting taxes (on consumption, labor income, profits)

Issues debt

Financial flows



Bank decision problem

Bank assets (end of period t):

$$A_{t+1} \equiv L_{t+1} + B^{B}_{t+1} + e_t F_{t+1}$$

L_{t+1}: mortgage loans

B^{B}_{t+1}: Government bonds

F_{t+1}: loans to rest of world

e_t : exchange rate

Deposits: D_{t+1}

Bank capital requirement:

Fraction γ of assets has to be funded with equity

'Excess bank capital': $x_t \equiv \{A_{t+1} - D_{t+1}\} - \gamma A_{t+1}$

Bank bears real cost

$$\Phi_t^x = \frac{1}{2}\phi^x \cdot (x_t)^2, \phi^x > 0$$

if bank capital differs from target

Period t bank budget constraint:

$$D_t R_t + L_{t+1} + B^B_{t+1} + e_t F_{t+1} + \Phi^x_t + d^B_t =$$

$$D_{t+1} + L_t R^L_t - \Delta^L_t + B^B_t R_t - \Delta^{G,B}_t + e_t F_t R^F_t - \Delta^F_t + S^B_t,$$

Δ^L_t: **default on mortgage loan**

$\Delta^{G,B}_t$: **default on bank-held sovereign bonds**

Δ^F_t: **default on external bonds**

S^B_t: **government support to the bank (subsidy)**

d^B_t : **bank dividend**

R^D_t, R^L_t, R^F_t : **gross rates of return (deposits, mortgage loans, foreign loans)**

Bank maximizes present value of dividend flow, using entrepreneur's IMRS as discount factor, $\rho_{t,t+s}$

Bank FOCs:

Deposits: $$R^D_{t+1} E_t \rho_{t,t+1} = 1 + \phi^x \cdot x_t,$$

Loans: $$R^L_{t+1} E_t \rho_{t,t+1} = 1 + (1-\gamma) \cdot \phi^x \cdot x_t$$

$$\Rightarrow \quad R^L_{t+1} - R^D_{t+1} \cong -\gamma \cdot \phi^x \cdot x_t, \quad \phi^x > 0$$

Lending rate spread: DECREASING in excess capital

$\phi^x \cdot x_t$: **marginal cost of excess capital**

$-\phi^x \cdot x_t$: **marginal cost of excess leverage**

If loans and deposits rise by 1$, then bank capital is unaffected, but required capital rises by γ\$. Thus, excess capital falls by γ\$ this raises bank's cost by $-\gamma\phi^x x_t$

Hence $R^L_{t+1} - R^D_{t+1} = -\gamma\phi^x_t x_t > 0$

Entrepreneurs' Euler eqn w.r.t. physical K:

$$R_{t+1}^{K} E_t \rho_{t,t+1} = 1; \;\; R_{t+1}^{K}$$: marginal return on K

$$R_{t+1}^{D} E_t \rho_{t,t+1} = 1 + \phi^{x} \cdot x_t$$

$$\Rightarrow \qquad R_{t+1}^{K} - R_{t+1}^{D} = -\phi^{x} \cdot x_t$$

Assume bank raises deposits by 1$, to increase dividend & entrepreneur uses higher dividend to raise physical capital stock.

At optimum, R_{t+1}^{K} **equals the funding cost:** R_{t+1}^{D} **plus marginal cost of leverage** $-\phi^{x} \cdot x_t$

Negative shock to (excess) bank capital

RAISES the lending rate spread $R^L_{t+1} - R^D_{t+1}$

& 'physical investment spread' $R^K_{t+1} - R^D_{t+1}$

$\Rightarrow$ **investment** $\downarrow$, **consumption** $\downarrow$, **GDP** $\downarrow$

Without operative bank capital requirement,

$\phi^x = 0$, **bank spreads are CONSTANT**

$\Rightarrow$ **shock to (excess) bank capital has little effect on real activity**

Fiscal policy

Gov't consumption (G_t), investment (I_t^G) and transfers to workers (S_t^W) given by policy rules:

$$G_t = (1-\rho^{CG})\bar{G} + \rho^{CG} G_{t-1} - \tau_B^G (B_t / GDP_{t-1} - \bar{B}) - \tau_\delta^G (def_{t-1}^B / GDP_{t-1} - \bar{\delta}^B) + \varepsilon_t^G$$

$$I_t^G = (1-\rho^{IG})\bar{i}^G + \rho^{IG} I_{t-1}^G - \tau_B^{IG} (B_t / GDP_{t-1} - \bar{B}) - \tau_\delta^{IG} (def_{t-1}^B / GDP_{t-1} - \bar{\delta}^B) + \varepsilon_t^{IG}$$

$$S_t^W = (1-\rho^S)\bar{S} + \rho^S S_{t-1}^W - \tau_B^S (B_t / GDP_{t-1} - \bar{B}) - \tau_\delta^S (def_{t-1}^B / GDP_{t-1} - \bar{\delta}^B) + \varepsilon_t^S$$

$$T_t + B_{t+1} = R_{t+1}^D B_t - (\Delta_t^{G,p} + \Delta_t^{G,b}) + G_t + I_t^G + S_t^B$$

T_t: **tax revenues (net of subsidy to workers)**

$\Delta_t^{G,p}, \Delta_t^{G,B}$: **default (towards patient worker & bank)**

S_t^B: **support to bank (i.i.d. process)**

Monetary policy: Taylor rule

Model Solution and Estimation

Linear approximation around steady state

Calibrate ‘big ratios’:

- **SS sovereign debt/annual GDP: 70%**
- **23% of government bonds bank-held in steady state**
- **SS household debt/annual GDP: 45%**
- **SS bank loans/GDP: 45%**
- **steady state bank capital ratio: 10%**

Estimate remaining parameters:

Bayesian approach, quarterly EA data, 1995q1-2011q4

Observables: macro aggregates, deflators, banking variables, fiscal variables,

gov't bank support, loan losses

Posterior parameter estimates are in standard range (see Table 1)

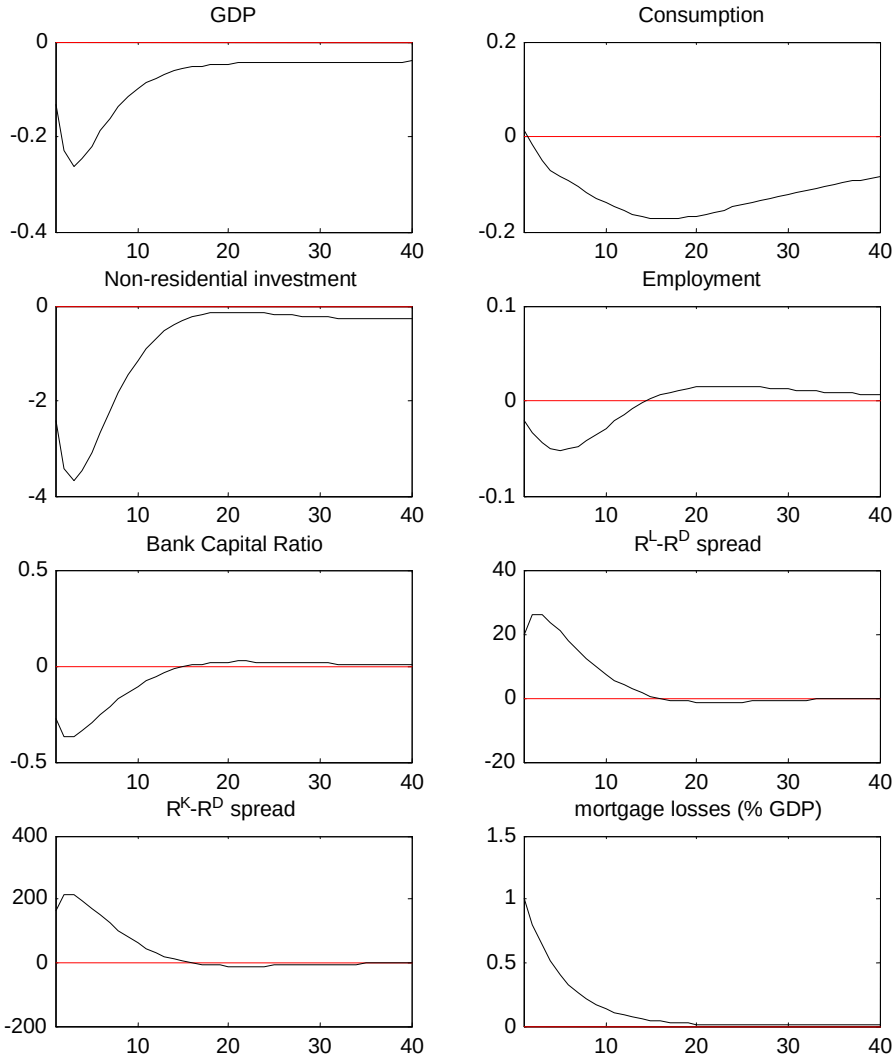
Curvature parameter of bank's cost to deviating from target capital ratio:

$\phi^x = 0.65 \Rightarrow$

1 percentage point rise in bank capital ratio LOWERS

loan rate spread by 40 basis points p.a.

- **Dynamic effects of innovation to bank loan loss (1% of quarterly GDP)**

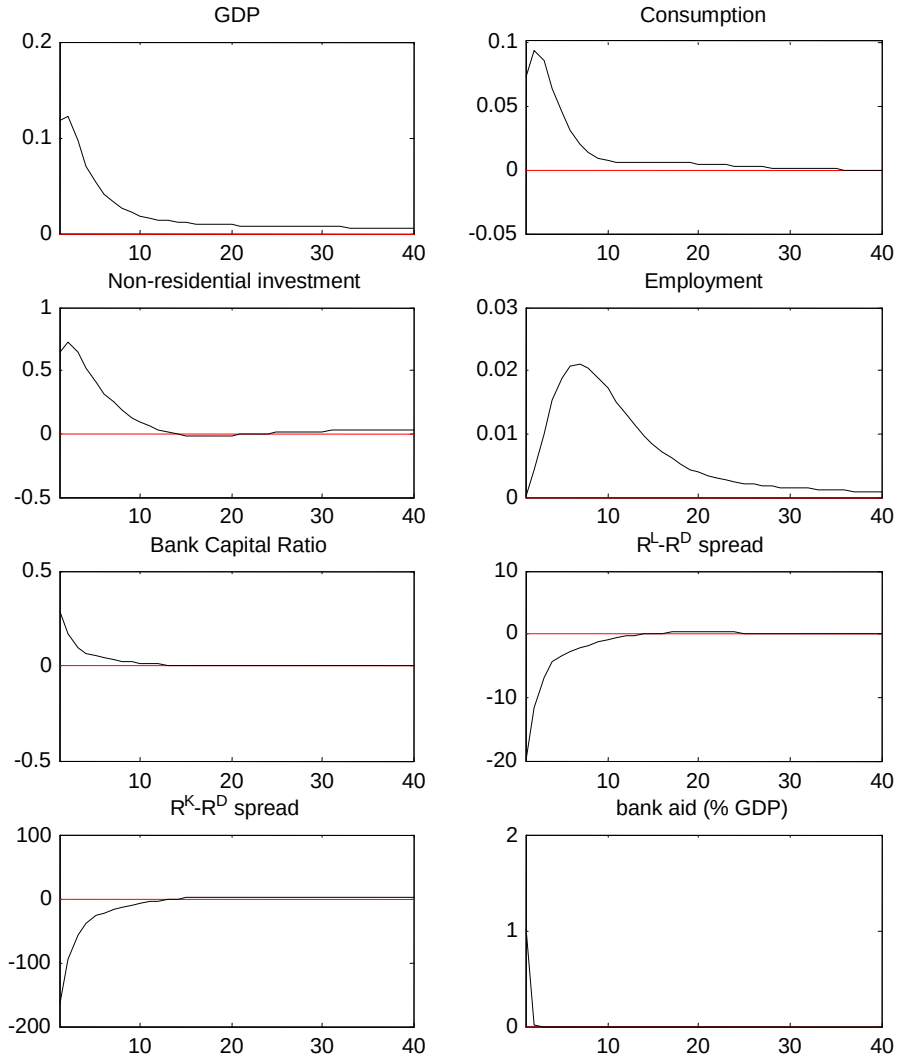


Responses-- GDP, C, I, Employment: % deviations from steady state

Capital ratio: percentage points; spreads: basis points per annum

Cumulated loss: 1.25% of annual GDP (1/7 of actual losses)

- **One-time government support for bank (1% of quarterly GDP)**

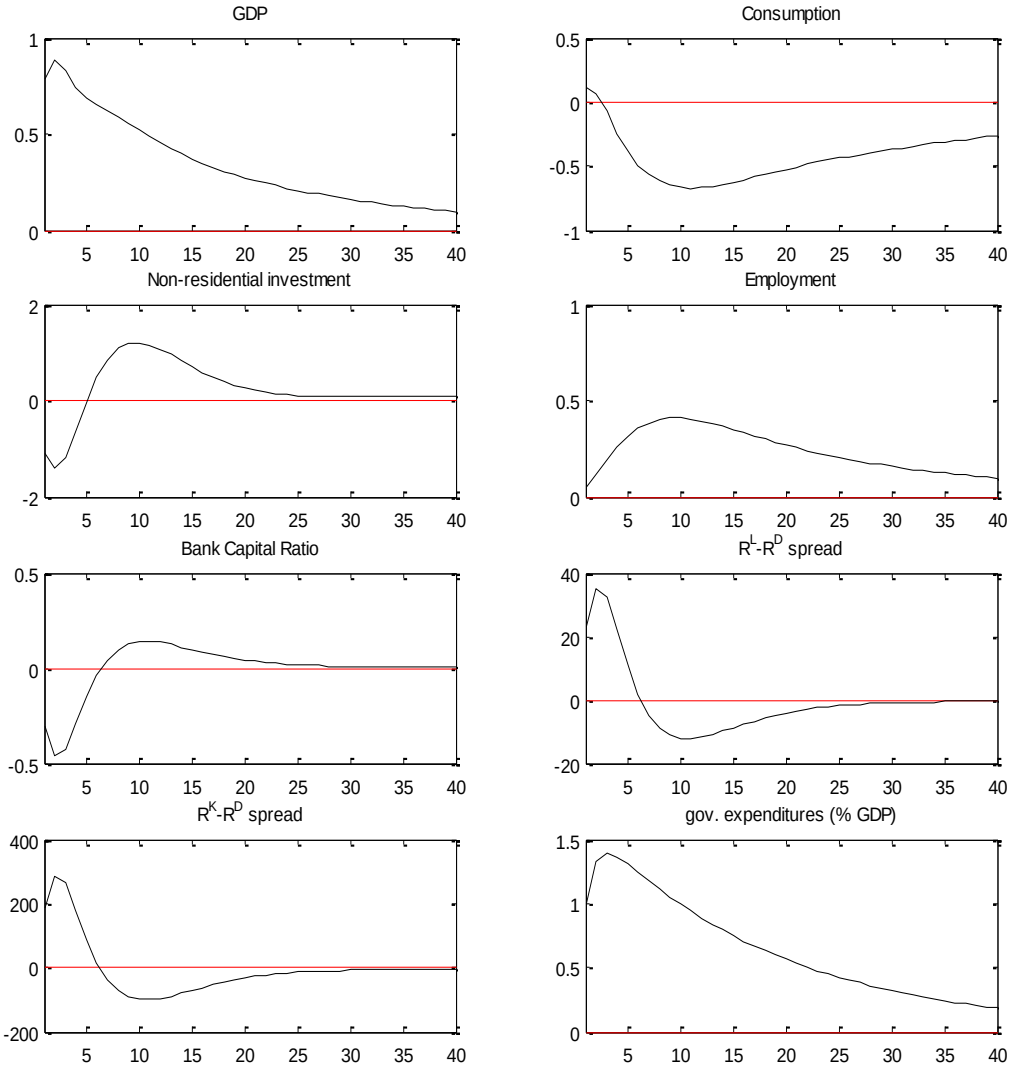


[1/20 of actual support; GDP multiplier: 0.44 in year 1]

Responses-- GDP, C, I, Employment: % deviations from steady state

Capital ratio: percentage points; spreads: basis points per annum

- **Innovation to government consumption rule (1% of quarterly GDP)**

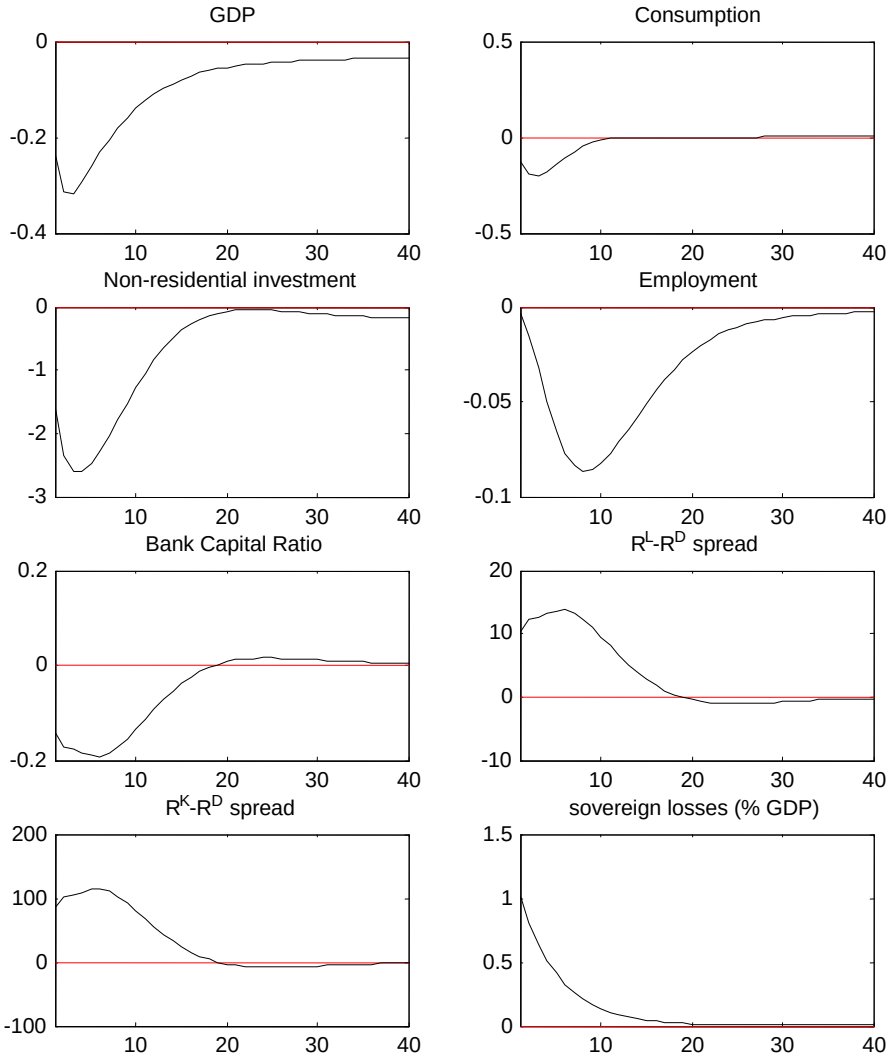


Cumulative rise in G: 5.1 of annual GDP.

GDP multiplier: 0.64 in year 1. G crowed out consumption and investment

- **Innovation to default on *bank-held* sovereign debt (1% of quarterly GDP)**

[Same time-profile of loss as for private mortgage default]



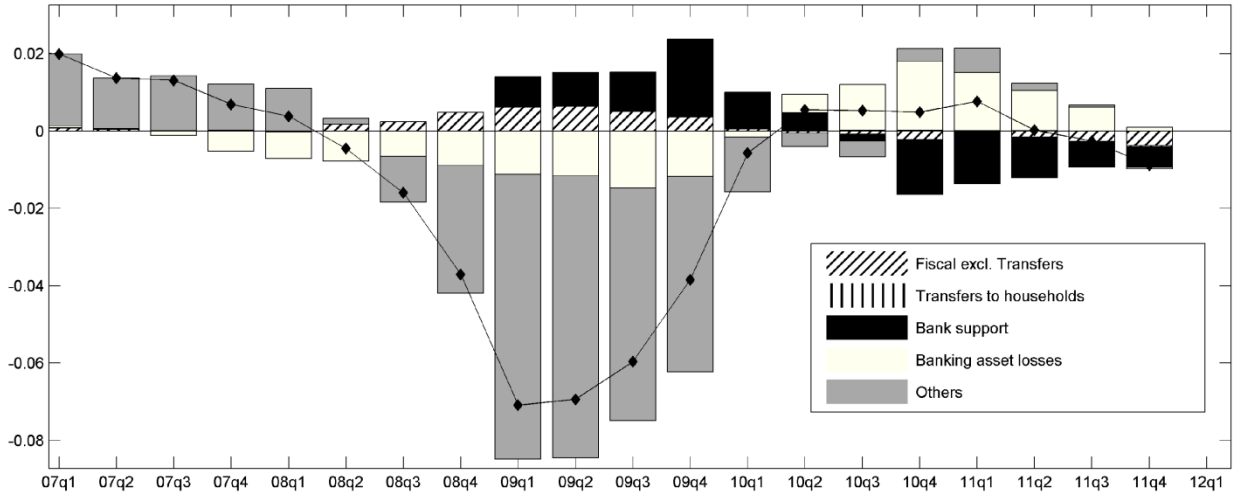
Responses-- GDP, C, I, Employment: % deviations from steady state

Capital ratio: percentage points; spreads: basis points per annum

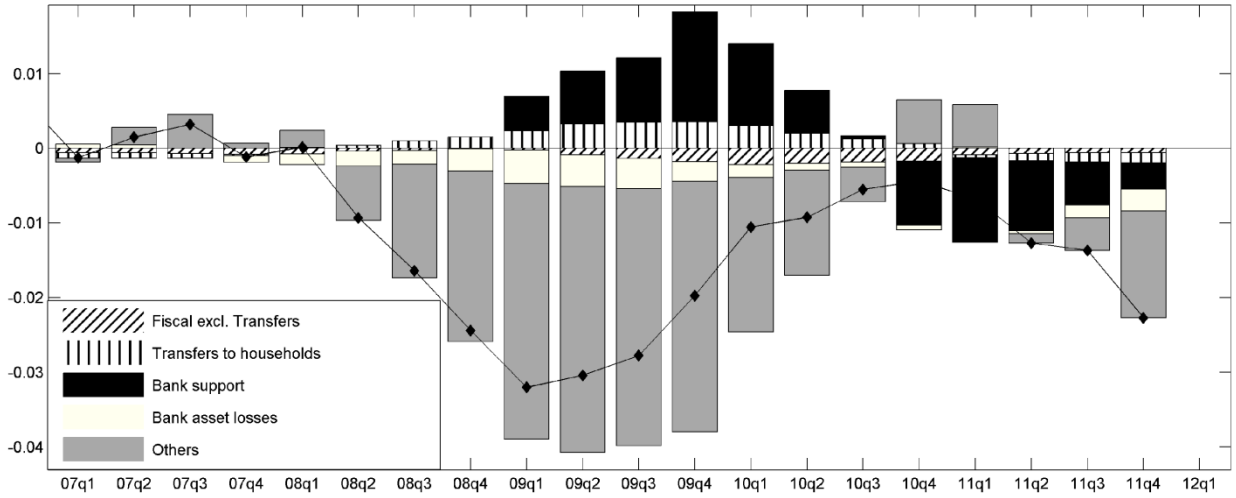
NB DEFAULT ON HOUSEHOLD-HELD SOVEREIGN DEBT HARDLY AFFECTS REAL ACTIVITY (APPROX. RICARDIAN EQUIV.)

Figure 2. Historical decompositions of Euro Area variables

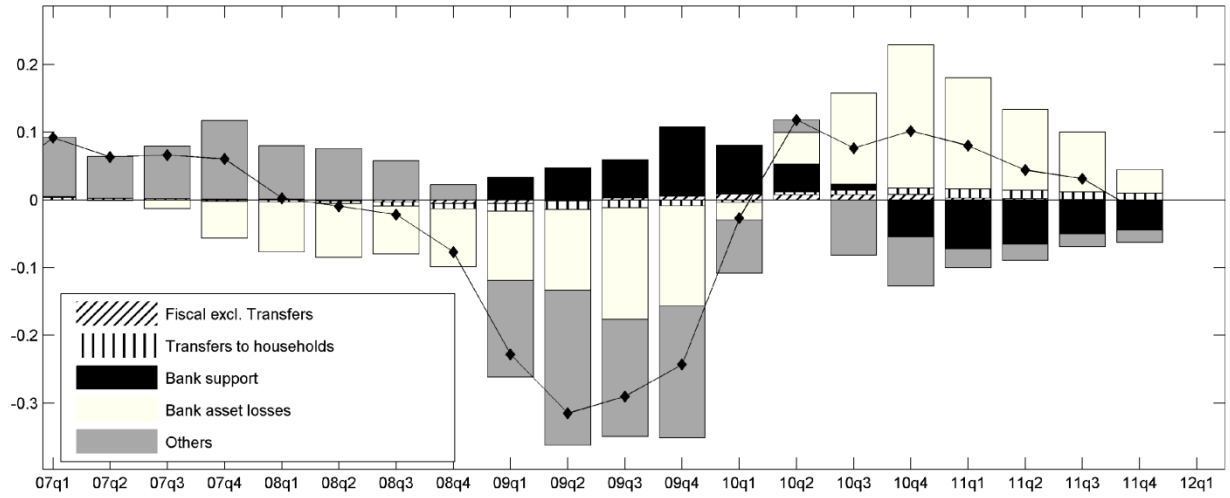
(a) YoY GDP growth (demeaned)



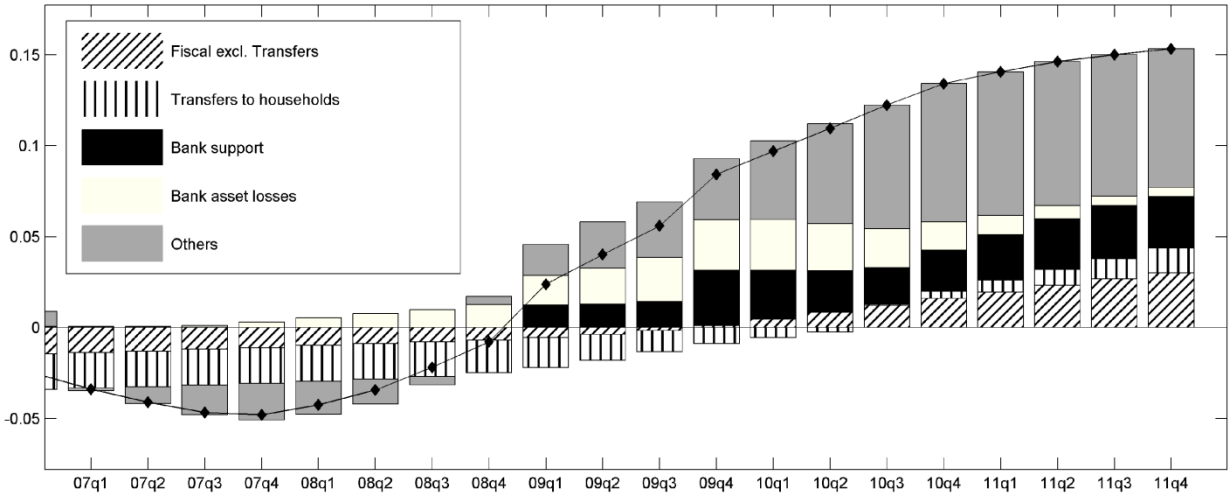
(b) YoY Consumption growth (demeaned)



(c) YoY private non-residential investment growth (demeaned)



(d) Debt to GDP ratio (demeaned)



CONCLUSION

- **Analyzed impact of EA bank losses, government support for banks & conventional fiscal stimulus measures during crisis**
- **Developed and estimated a tractable macro model with banking & fiscal sector**
- **Transmission channel of shocks to EA real economy is consistent with key features of crisis, especially strong investment decline**

● Bank losses explain 1/4 of fall in EA GDP & consumption in 2007-09 and

more than 3/4 of fall in investment

● Private loan losses and losses on bank-held sovereign debt have similar transmission mechanisms into the real economy and strongly affect non residential investment.

● Government support for banks was effective tool for stabilizing output, consumption & investment