# Public investment and EU funds in a small open economy integrated in the euro area

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# Introduction

- Small open economies within the European Union can be extensively influenced by the utilization of the EU funds.
  - Net position of Slovakia over period 2007-2015 was 1.8 % of GDP. Funds allocated for SK for period 2014-2020 amount to EUR 15.3 bn (estimated net position of 1.7 % of GDP).
- In some countries, we observe an EU-funds cycle that causes spikes in total investment as the programming period draws to its end, and a decline afterwards. Graphs
  - So far only 22 % of funds allocated for SK were spent, and 70 % is decided. Graphs
- As the share of EU-funded public investment and the public investment financed from domestic sources varies highly over time, we decided to explore the differences in the transmission of these two types of public investment shocks into the real economy.

# Methodology

- Following applications of QUEST and HERMIN models in the literature, we decided to also use a fully structural DSGE model for the simulation of different public investment scenarios.
- We used EAGLE model – multi-country DSGE model of euro area, with extended fiscal sector, calibrated for Slovak economy.
- We extended the model structure with EU funds mechanisms and updated the calibration of the model.

# Main features of the EAGLE model

- Four regions: Slovakia (SK), Germany (DE), Rest of EA (REA), Rest of the World (RW).
- SK, DE and REA form a monetary union of euro area (EA).
- Ricardian and non-Ricardian households.
- Intermediate monopolistically competitive firms (Calvo pricing with indexation) produce tradable and non-tradable goods.
- Final perfectly competitive firms combine domestic intermediate goods with imports and produce: final consumption, investment and export goods.
- Monetary policy captured via Taylor rule (one for EA and one for RW).

# EAGLE model with extended fiscal sector

- Standard government budget constraint (several types of tax revenues, transfers, dividends, seignorage, bonds).
- Fiscal rule – lump-sum taxes are raised endogenously to achieve stable public debt-to-GDP ratio in steady state.
- Differentiation between non-productive government consumption and productive government investment $\Rightarrow$ public capital as a production factor. Production Function
- Separate final firms to produce government consumption and investment with defined import content.
- Complementarity between government and private consumption in utility function of households. CES aggregate

# EU funds mechanism (1/3)

- We extended the government budget constraint with incoming EU funds ($EU_t^{IN}$) on the income side and outgoing contributions to the EU budget ($EU_t^{OUT}$) on the side of expenses.
- We assume that the total EU funds are collected from individual EA members proportionately to the size of their economy ($s^{CO}$):

$$EU_t^{OUT} = \frac{s^{CO_1} EU_t^{IN,CO_1} + s^{CO_2} EU_t^{IN,CO_2} + s^{CO_3} EU_t^{IN,CO_3}}{s^{CO_1} + s^{CO_2} + s^{CO_3}}, \tag{1}$$

  which results in the same per capita contributions.

# EU funds mechanism (2/3)

- Total government investment is redefined as a sum of incoming EU funds, co-financing from domestic sources ($G_{I_C,t}$) and autonomous government investment ($G_{I_A,t}$):

$$G_{I,t} = \frac{EU_t^{IN}}{P_{G_I,t}} + G_{I_C,t} + G_{I_A,t} \tag{2}$$

- Co-financing $G_{I_C,t}$ is given by co-financing parameter $\chi^{EU}$ as

$$G_{I_C,t} = \chi^{EU} \frac{EU_t^{IN}}{P_{G_I,t}}, \tag{3}$$

co-financing parameter is set to 0.25 in order to achieve a ratio of co-financig of 1:4 or 20 %.

# EU funds mechanism (3/3)

- We define a share of incoming EU funds and autonomous government investment on GDP:

$$EUY_t = \frac{EU_t^{IN}}{P_{Y,t} Y_t} \quad (4) \qquad AGIY_t = \frac{G_{I_A,t}}{P_{Y,t} Y_t} \quad (5)$$

- These shares are given exogenously via AR(1) processes:

$$EUY_t = (1 - \varrho^{EU})\overline{EUY} + \varrho^{EU} EUY_{t-1} + \varepsilon_t^{EU} \quad (6)$$

$$AGIY_t = (1 - \varrho^{G_{I_A}})\overline{AGIY} + \varrho^{G_{I_A}} AGIY_{t-1} + \varepsilon_t^{G_{I_A}} \quad (7)$$

# Calibration

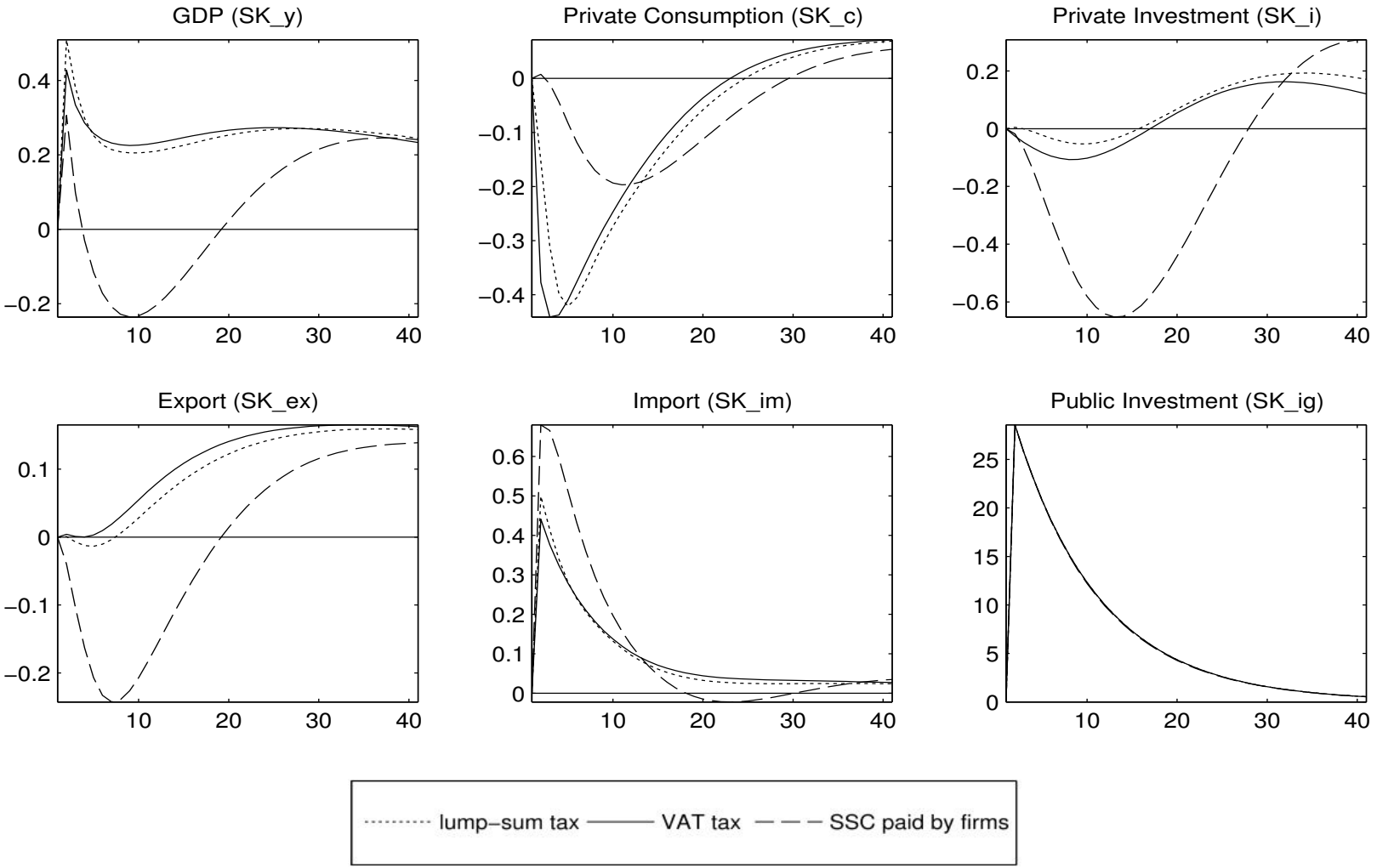
- Calibration of Senaj and Výškrabka (2015) a starting point.
- Set the import shares for the public consumption and investment goods.
- We increased the calibration of nominal rigidities in the domestic tradable and non-tradable sectors to 0.92.
- Reverted to logarithmic utility function.
- $\chi^{EU}$ calibrated to 0.25, which results in a ratio of EU funds and domestic funds in EU-funded public investment projects of 4:1.
- Persistence and volatility parameters of newly defined shocks were calibrated to 0.9 and 0.01 respectively.

IRF comparison

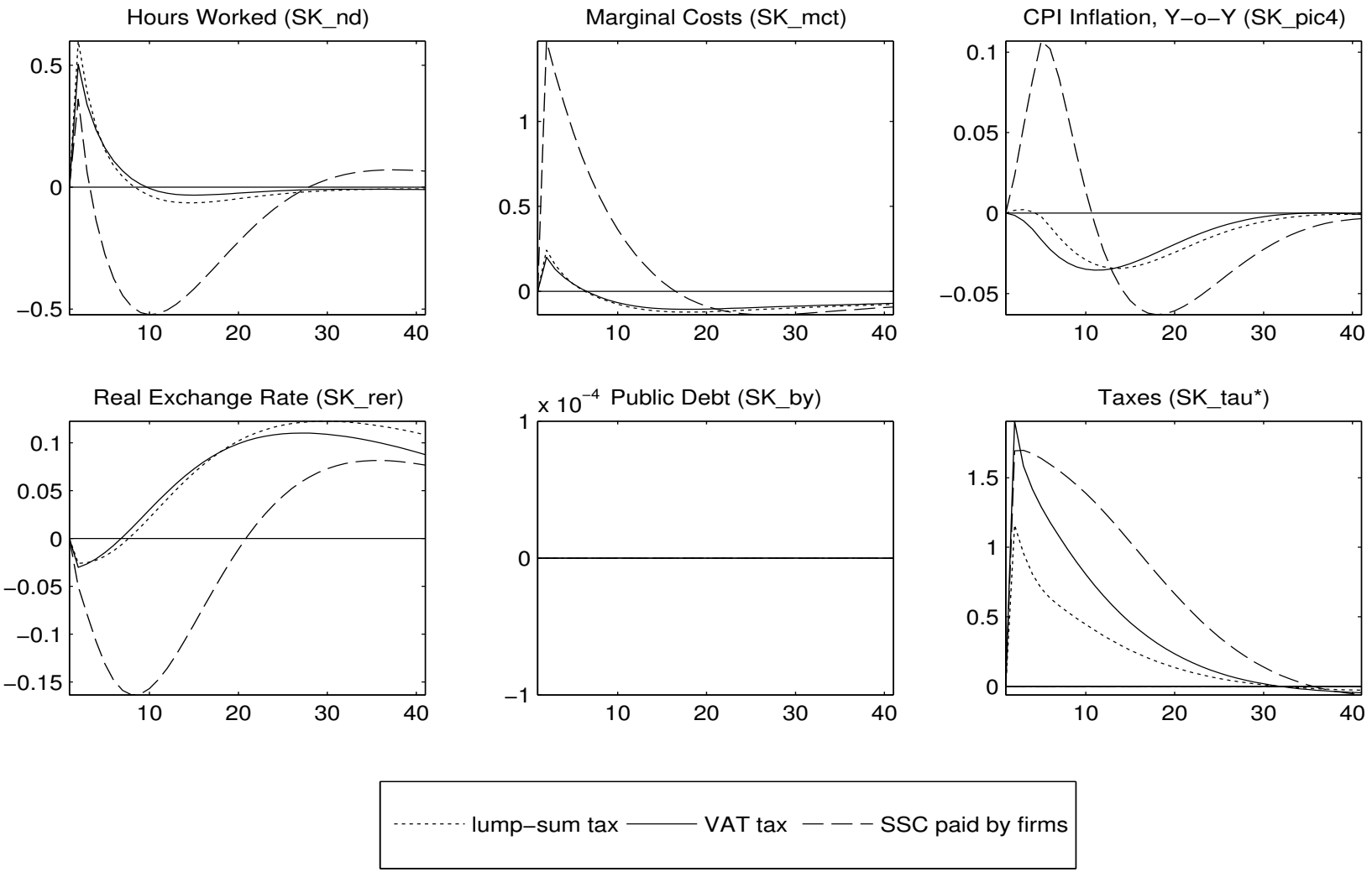
# Scenarios definition

- Alternatives by share of domestic funding:
  - Autonomous government intestment shock
    100 % funded from domestic sources,
  - EU funds shock
    20 % co-funded from domestic sources.
- Alternatives by sources of domestic funds:
  - Lump-sum taxes,
  - VAT tax,
  - Social security contributions (SSC) paid by firms.

# Autonomous government investment shock (1/3)



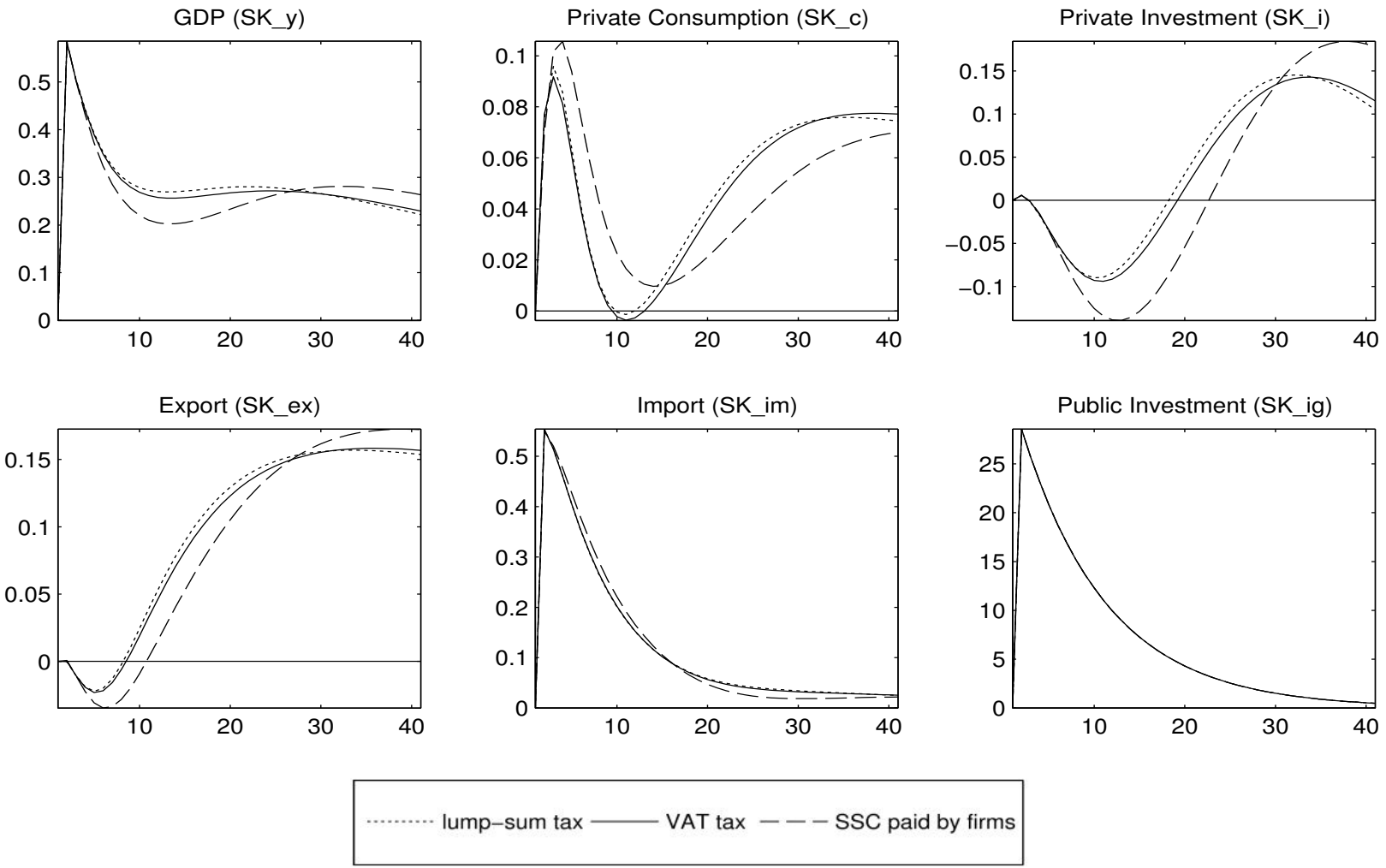
# Autonomous government investment shock (2/3)



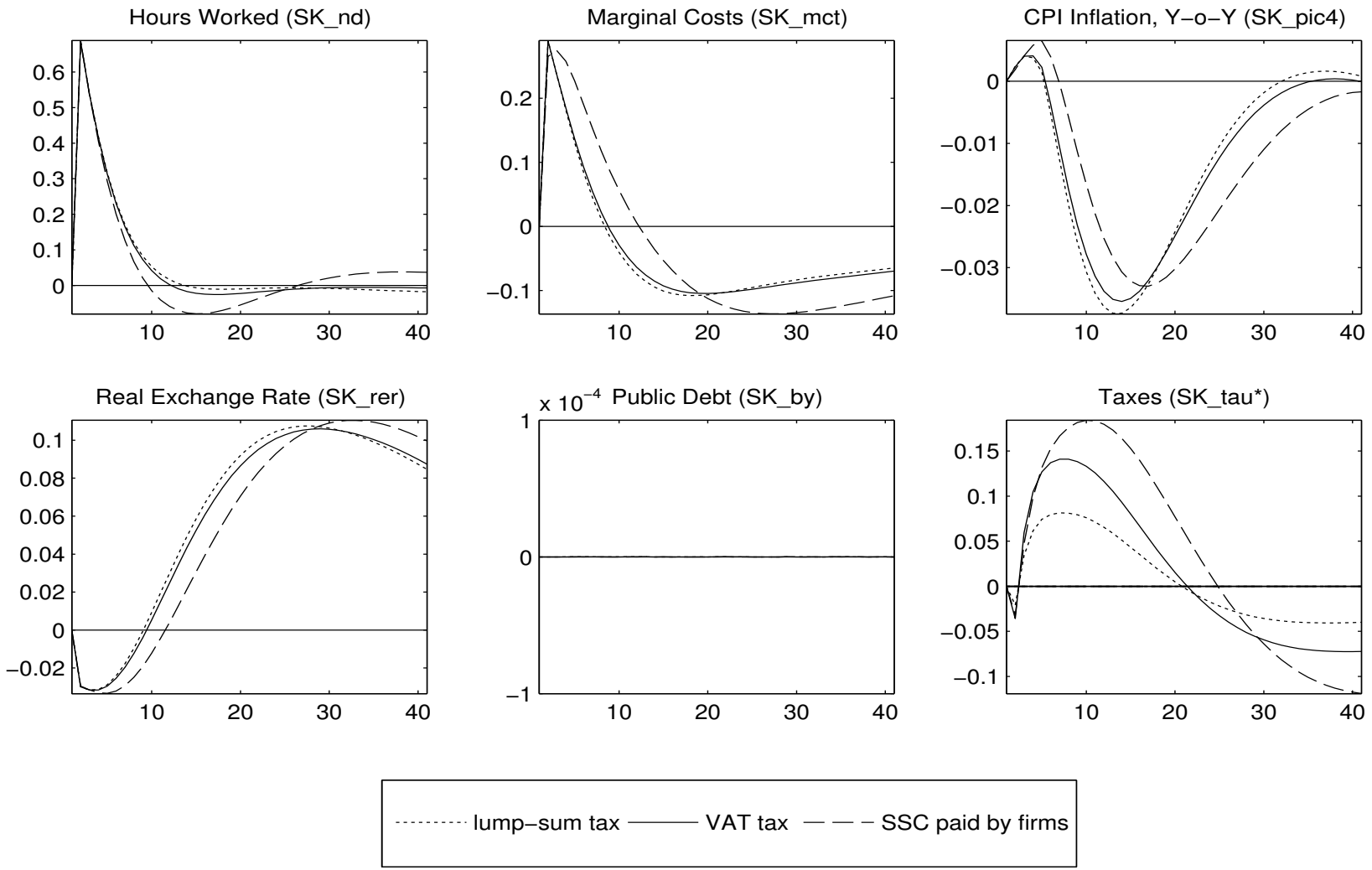
# Autonomous government investment shock (3/3)

- 1 % of GDP ex-ante shock $\Rightarrow$ cca 25% increase of public investment.
- Tax financing leads to a drop of private consumption and eases the inflationary pressures.
- Financing through SSC paid by firms is inflationary by itself and leads to a loss of aggregate demand and competitiveness in trade.
- Increasing the stock of public capital leads to lower marginal costs in the medium run, after the initial demand driven inflationary pressures subside.

# EU funds shock (1/3)



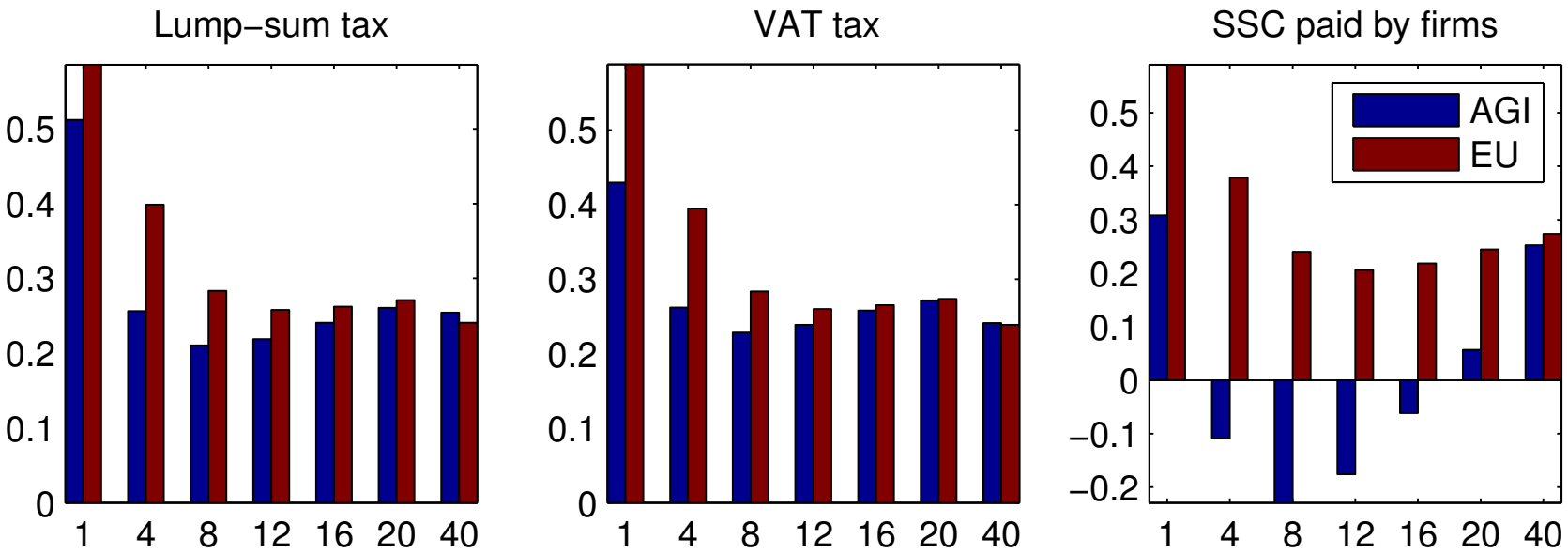
# EU funds shock (2/3)



# EU funds shock (3/3)

- The same 1 % of GDP ex-ante shock ⇒ cca 25% increase of public investment, but only 20 % is financed from domestic sources.
- More similar results than in previous shock, mostly driven by growth of public investment, effects of taxes are marginal for most of the variables.
- Differentiated response of private consumption, lump-sum taxes and VAT are the worst for households.
- From the point of view of GDP, the SSC increase is still the least preferred alternative.

# EU funds vs. domestically funded public investment (1/3)



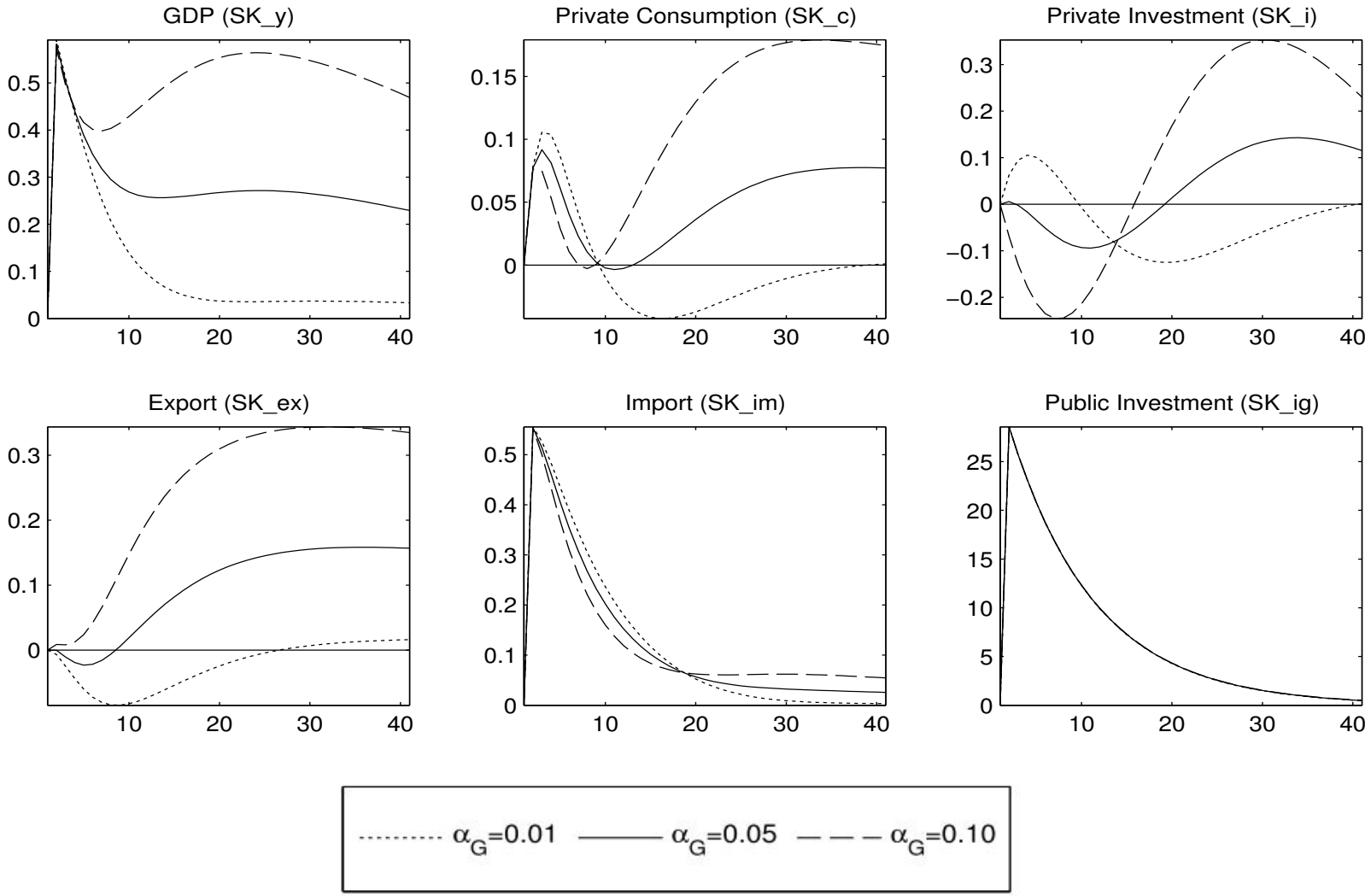
# EU funds vs. domestically funded public investment (2/3)

- **Lump-sum tax.** The main difference between the two shocks in terms of GDP is the larger initial increase in case of EU funds shock. This is given by the fact that the shock is not accompanied by such a large tax hike as in the case of public investment funded wholly from domestic sources. Response to both shocks converges in the medium run.
- **VAT tax.** Similar to the lump-sum tax case. However, the distortionary effects of the VAT tax on the decision making of households cause smaller GDP increase after the autonomous public investment shock and larger gap between the two shocks overall.

# EU funds vs. domestically funded public investment (3/3)

- **SSC paid by firms.** The transmission mechanism is now different. In this scenario the higher rise in SSC paid by firms leads to higher marginal costs for the firms when public investment is financed wholly from domestic sources. This translates directly into higher domestic inflation and lower consumption and exports due to real appreciation. The EU funds shock generates substantial positive effects in the GDP over the whole simulation horizon.

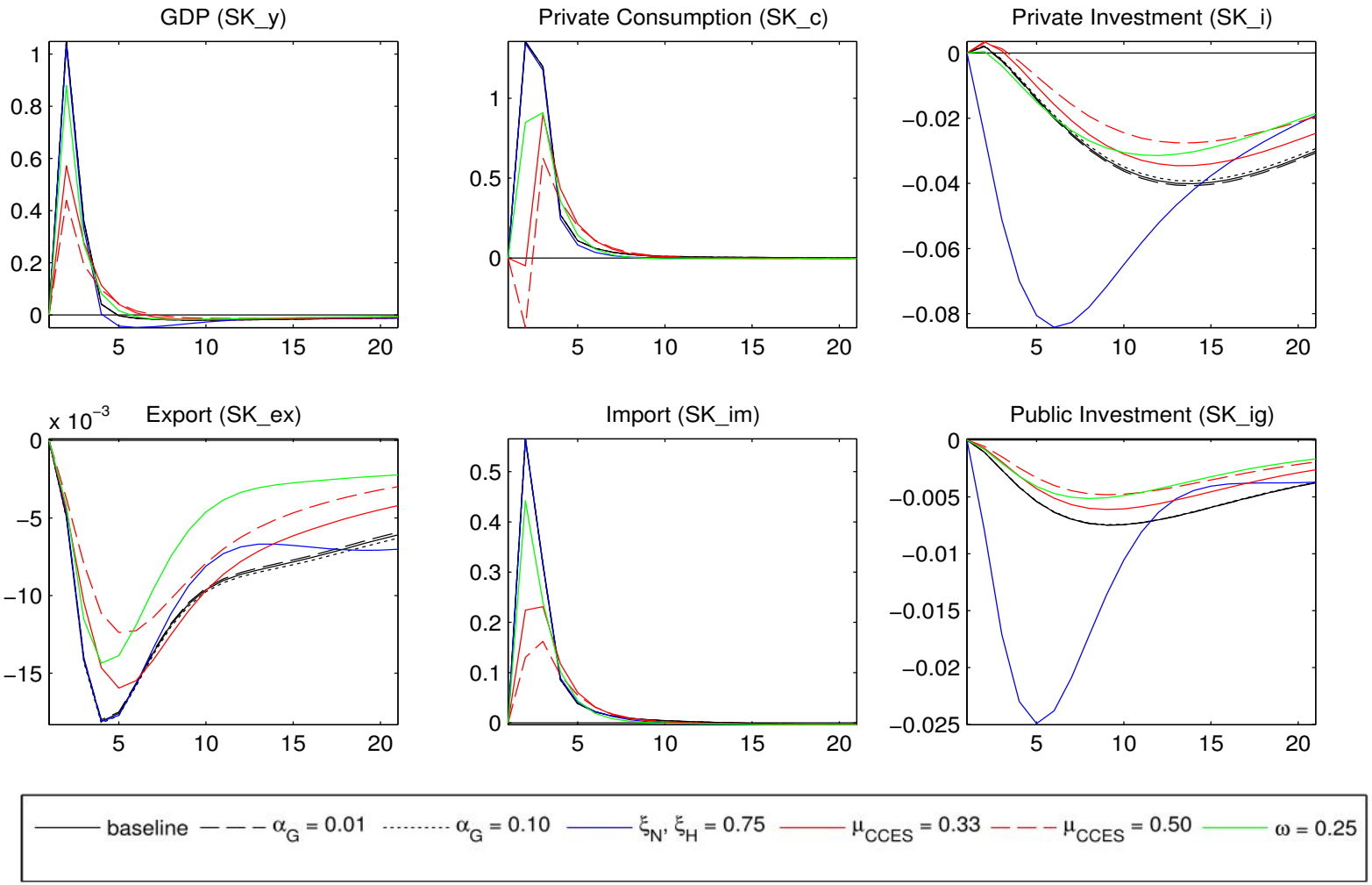
# Sensitivity analysis: Productivity of public capital $\alpha_G$



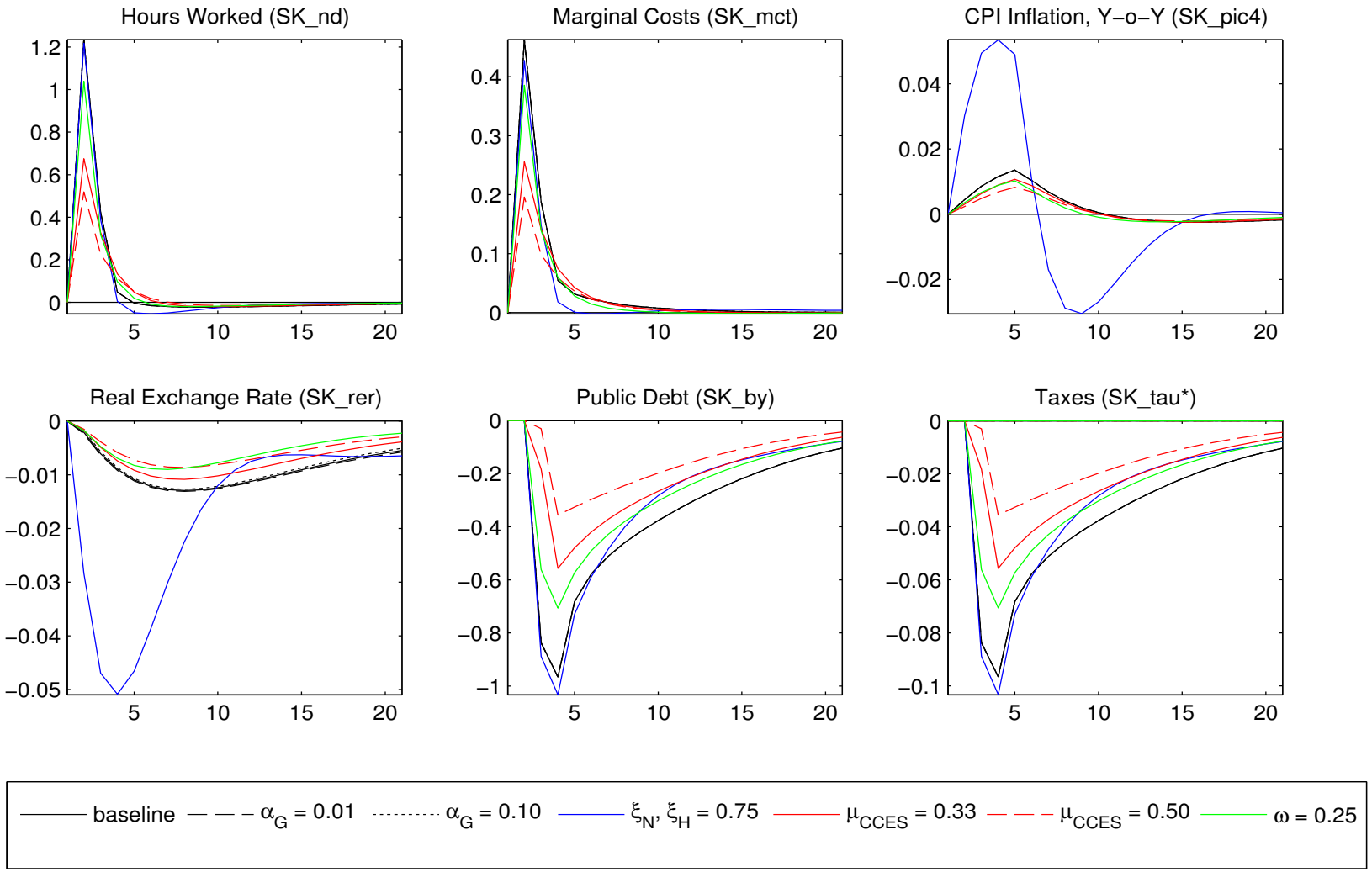
# Scenario (1/3)

- EU funds shock leads to the same (1% share of nominal GDP) $\Uparrow$ of total public investment with no persistance
- $\Downarrow$ of autonomous public investment (gov. substitutes domestic sources with EU funds)
- $\Uparrow$ government spending instead (0.8% share of nominal GDP)

# Scenario (2/3)


GDP (SK_y)
Private Consumption (SK_c)
Private Investment (SK_i)
x 10^-3
Export (SK_ex)
Import (SK_im)
Public Investment (SK_ig)
baseline
α_G = 0.01
α_G = 0.10
ξ_N, ξ_H = 0.75
μ_CCES = 0.33
μ_CCES = 0.50
ω = 0.25

# Scenario (3/3)


Hours Worked (SK_nd)
Marginal Costs (SK_mct)
CPI Inflation, Y−o−Y (SK_pic4)
Real Exchange Rate (SK_rer)
Public Debt (SK_by)
Taxes (SK_tau*)
baseline
$\alpha_G$ = 0.01
$\alpha_G$ = 0.10
$\xi_N$, $\xi_H$ = 0.75
$\mu_{CCES}$ = 0.33
$\mu_{CCES}$ = 0.50
$\omega$ = 0.25

# Conclusion

- By extending EAGLE model, we have analyzed and compared the transmission of autonomous government investment shock and EU funds shock into the home economy.
- Since, the tax hikes needed for domestic (co-)financing of the public investment depress the domestic aggregate demand, the impacts of EU-funded investment on GDP are generally stronger.
- SSC increase is the least preferred financing option due to large pro-inflationary effects leading to loss of demand and competitiveness.

# Next steps

- More nuanced setting of the steady state
  - EU funds share over GDP in steady state is now equal across the EA regions (1 %), regions receive the same amount as they contribute ⇒ differentiate net contributors and net receivers

THANK YOU

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# Appendix - backup slides

# Production function of intermediate firms

$$Y_t = z_t \cdot K_{G,t}^{\alpha_G} \cdot K_t^{\alpha} \cdot N_t^{1-\alpha} - \psi$$

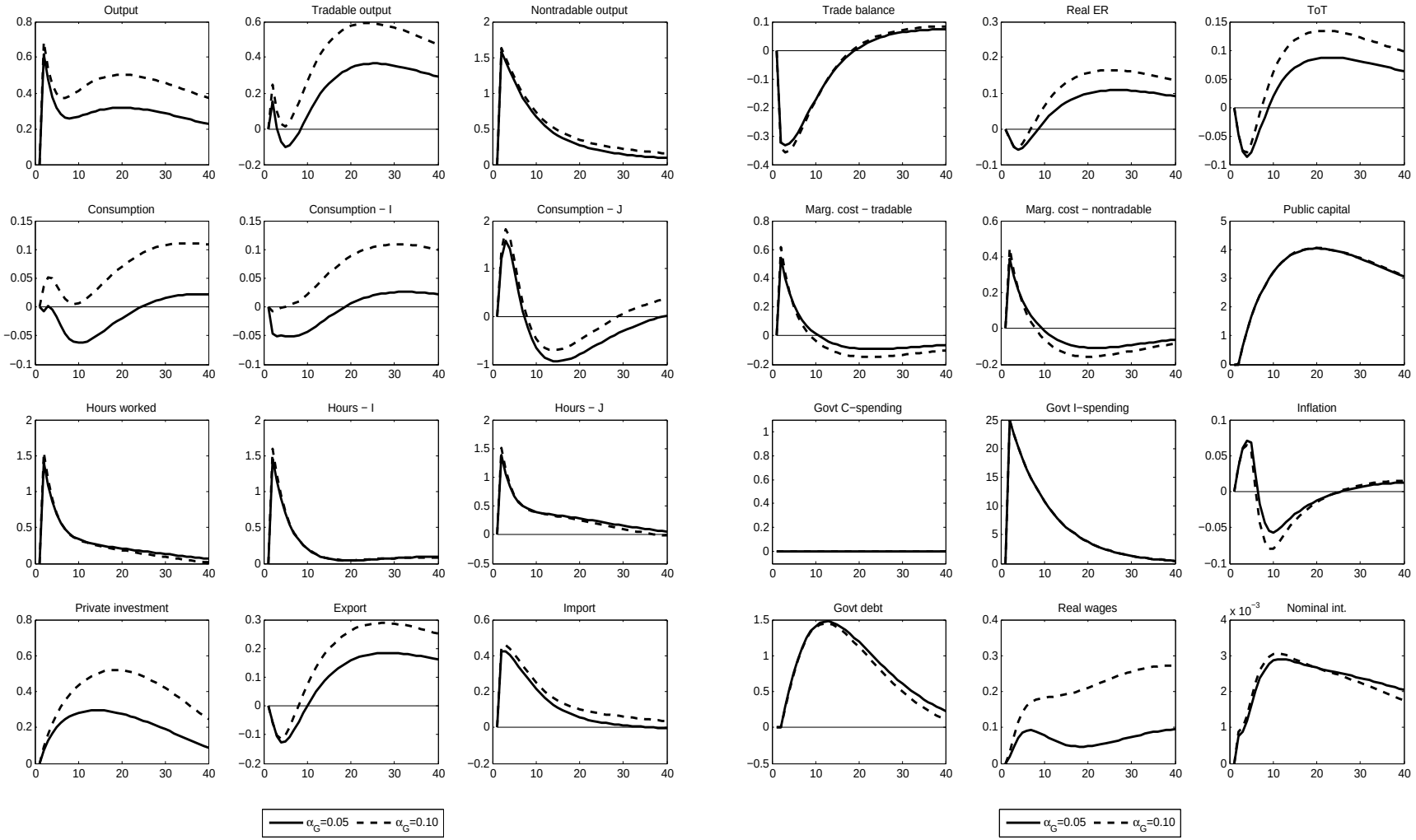
$$K_{G,t+1} = (1 - \delta_G) \cdot K_{G,t} + G_{I,t}$$

Government capital acts similarly to technological progress. Its increase would lower the marginal costs in the intermediate sector:

$$MC = \frac{1}{z_t \cdot K_{G,t}^{\alpha_G} \cdot \alpha^{\alpha} \cdot (1-\alpha)^{1-\alpha}} \cdot \left(R_t^K\right)^{\alpha} \cdot \left((1 + \tau_t^{W_f}) W_t\right)^{1-\alpha}$$

Sensitivity to $\alpha_G$ Return

# Sensitivity to the calibration of $\alpha_G$ - Gov. Inv. shock




Return

# CES aggregate of public and private consumption

$$\mathcal{U} = f(\widetilde{C}_t, \cdot)$$

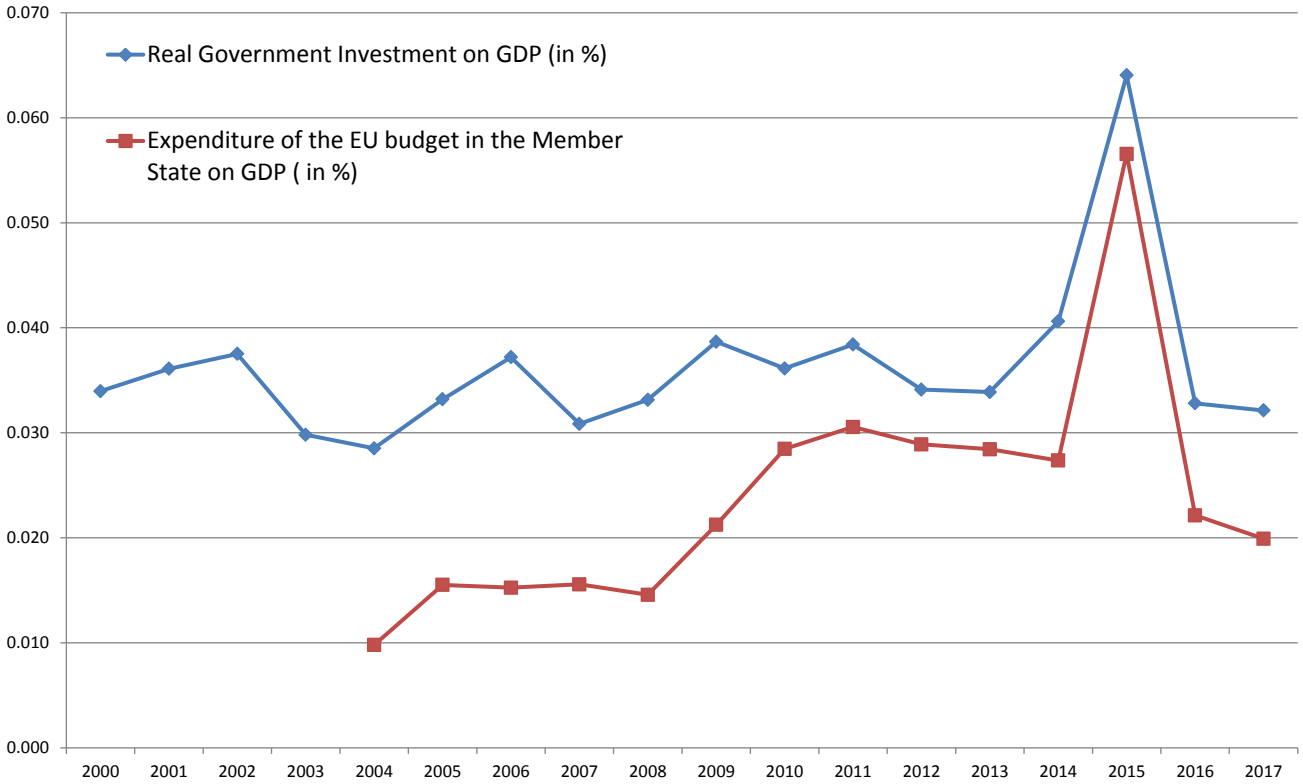
$$\widetilde{C}_t = \left[ \nu_{CCES}^{\frac{1}{\mu_{CCES}}} \left(C_t\right)^{\frac{\mu_{CCES}-1}{\mu_{CCES}}} + \left(1-\nu_{CCES}\right)^{\frac{1}{\mu_{CCES}}} \left(G_{C,t}\right)^{\frac{\mu_{CCES}-1}{\mu_{CCES}}} \right]^{\frac{\mu_{CCES}}{\mu_{CCES}-1}}$$

Allows complementarity b/w public and private consumption in the utility function of HH. Changes in public consumption affect the optimal private consumption directly, as opposed to the utility function with separable public consumption.

Return

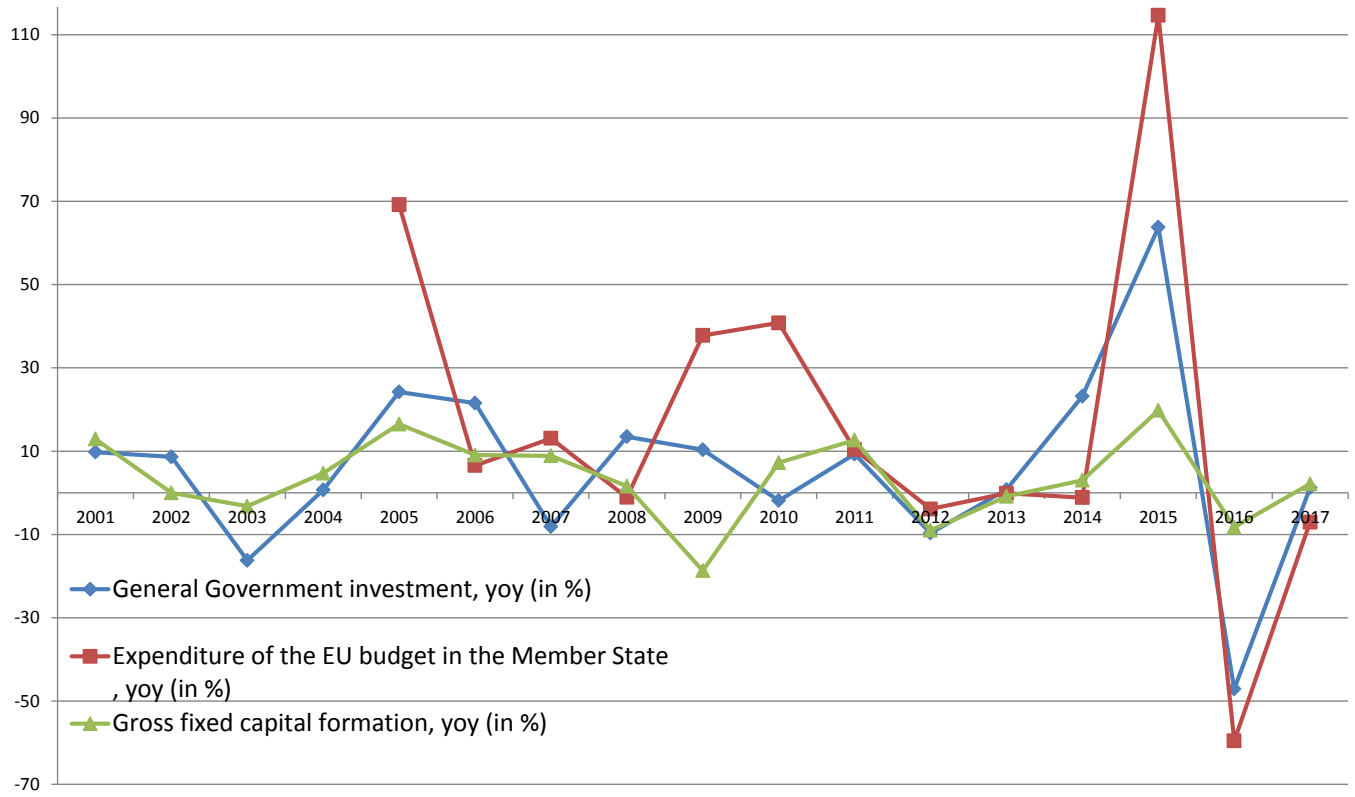
# EU-funds cycle in public investment (1/2)

Spike of drawn EU-funds at the end of (prolonged) programming period of 2007-2013



# EU-funds cycle in public investment (2/2)

The spike is clearly visible even in the total investment in 2015 (and dip in 2016)

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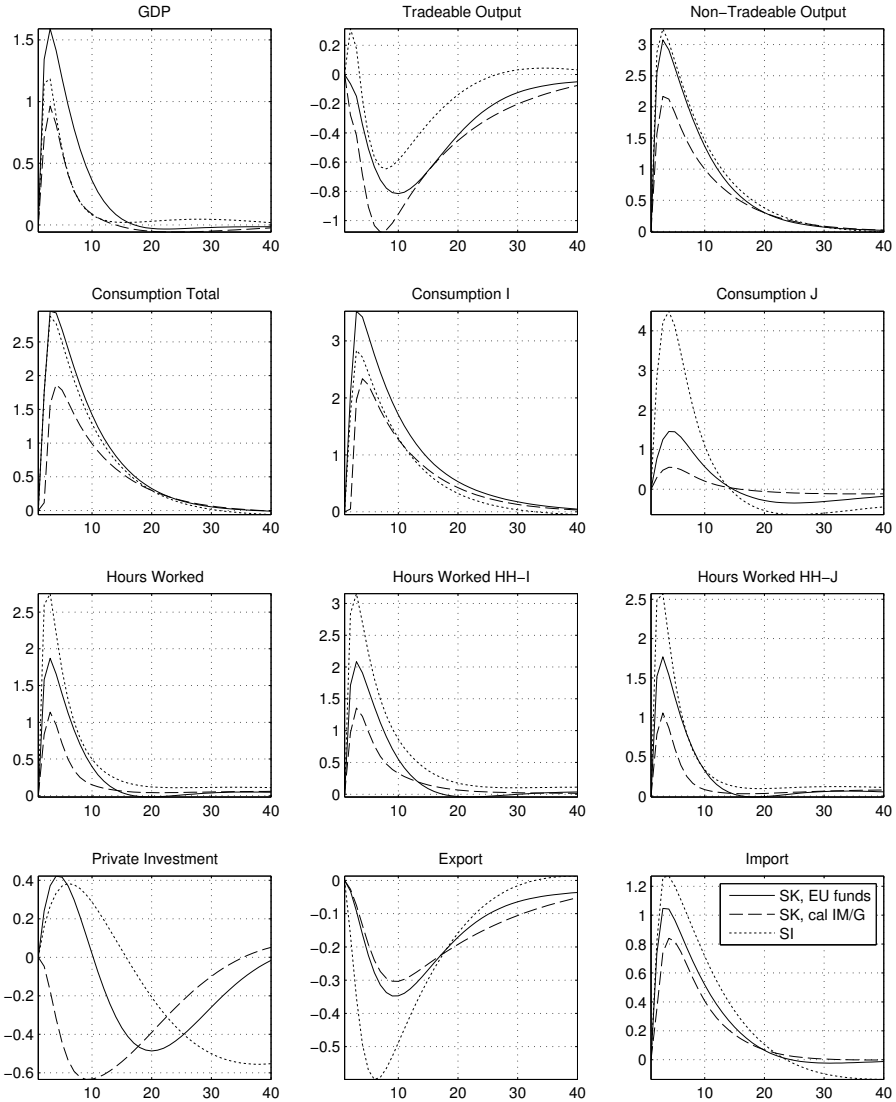
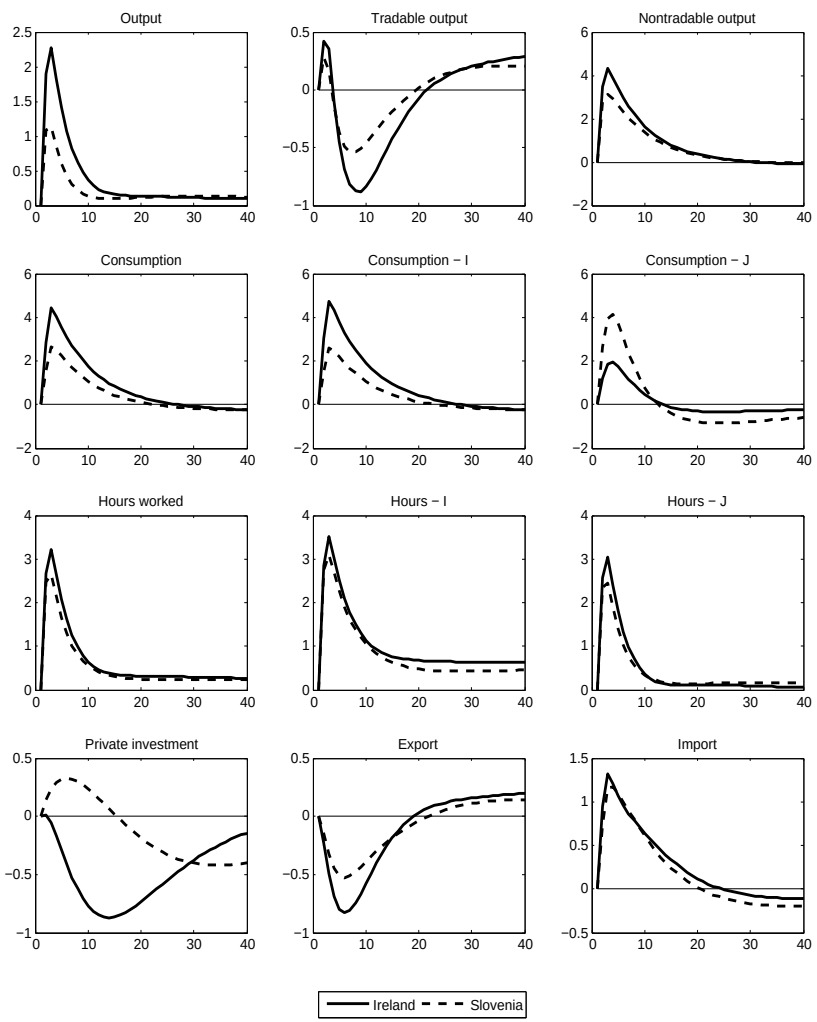
# IRF comparison - Government Consumption (1/2)

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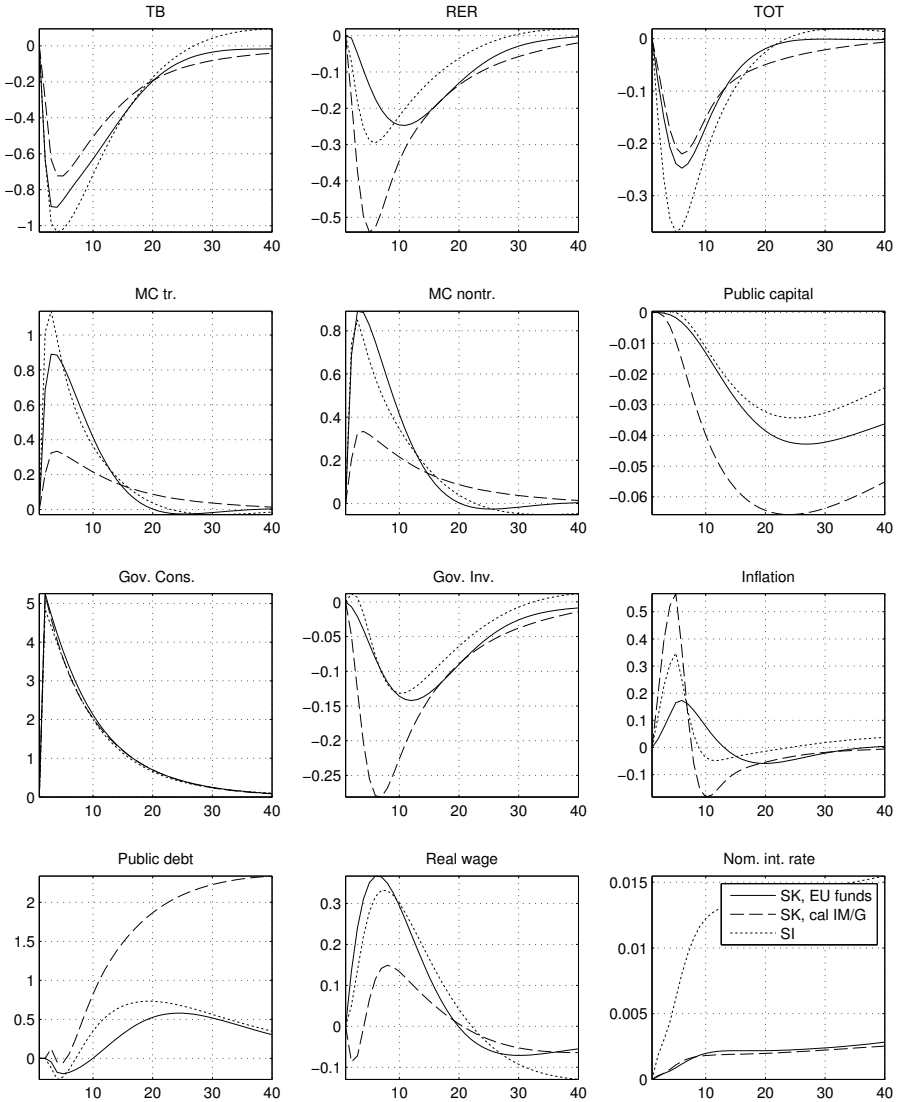
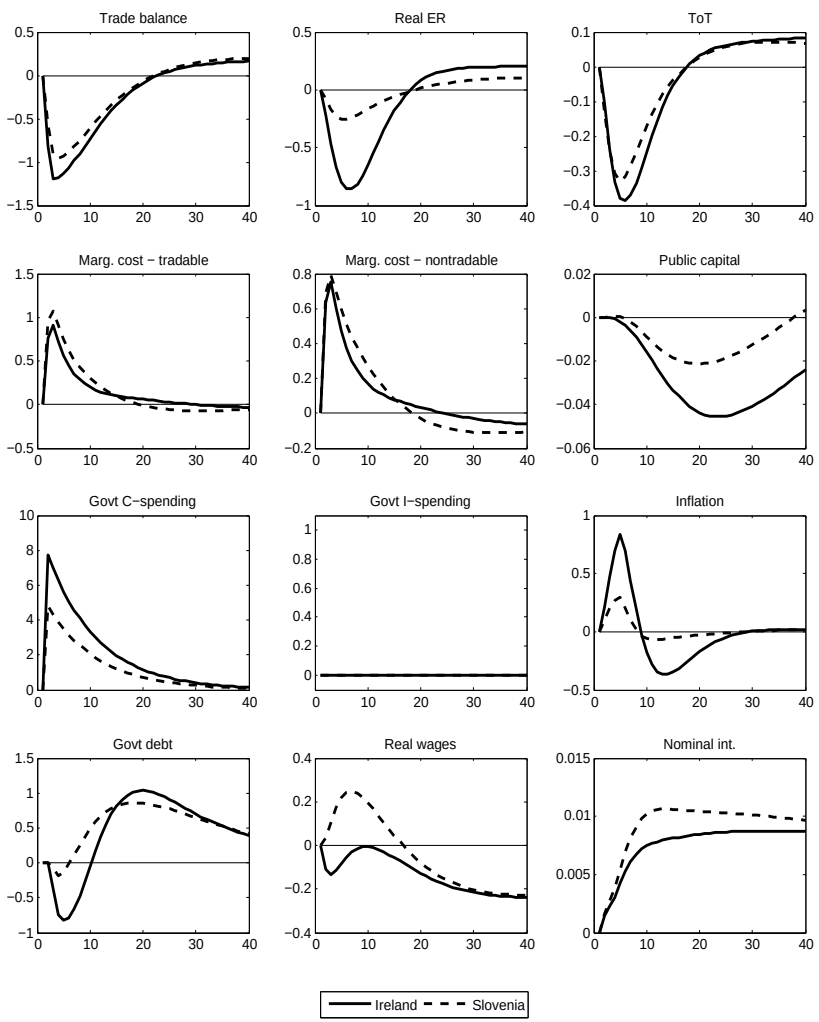
# IRF comparison - Government Consumption (2/2)

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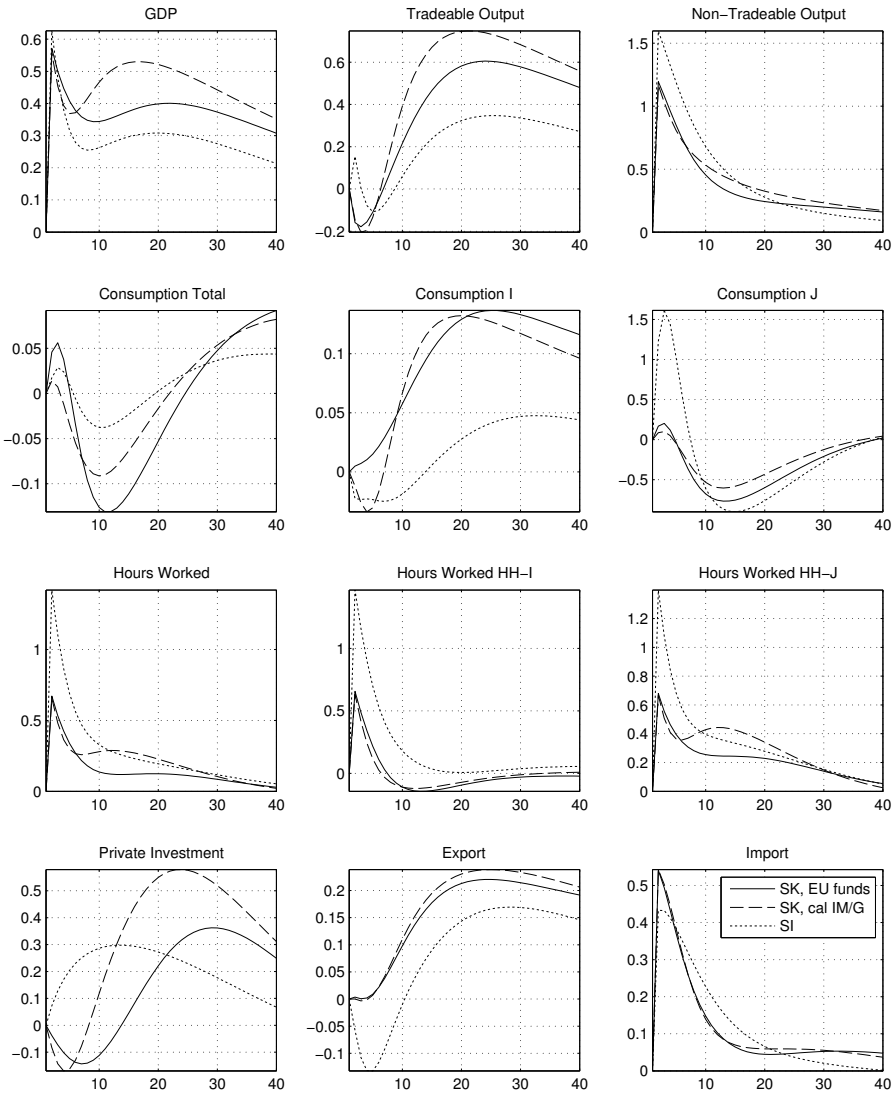
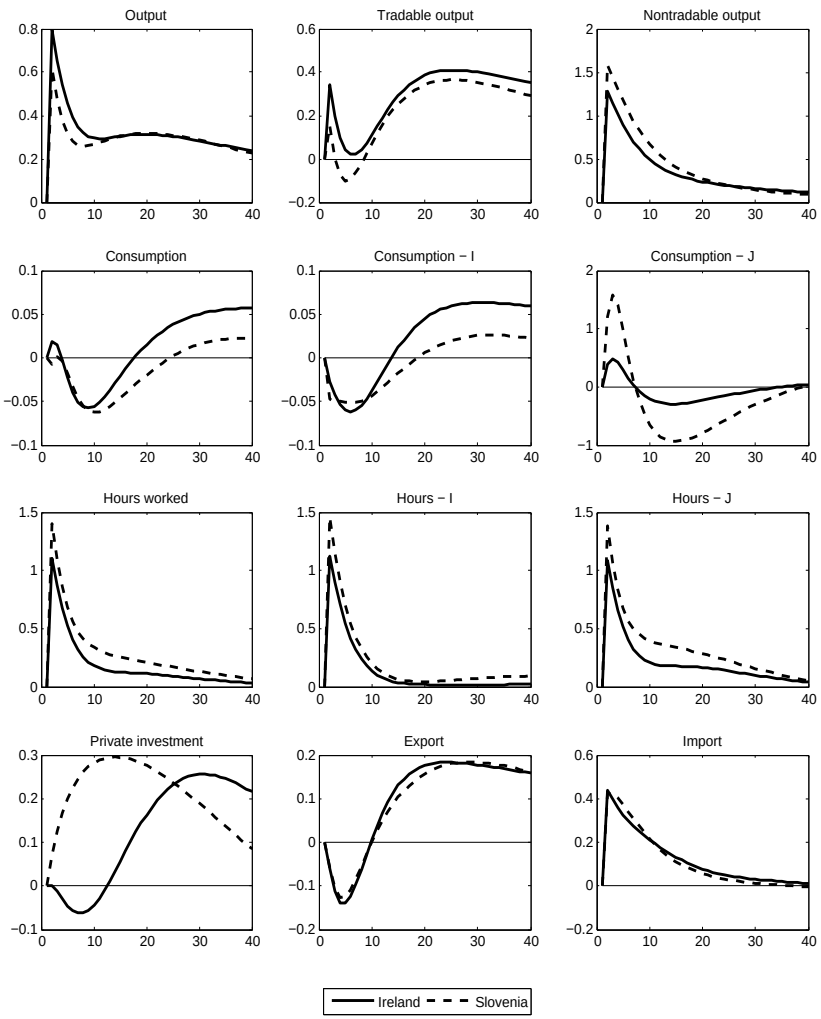
# IRF comparison - Government Investment (1/2)

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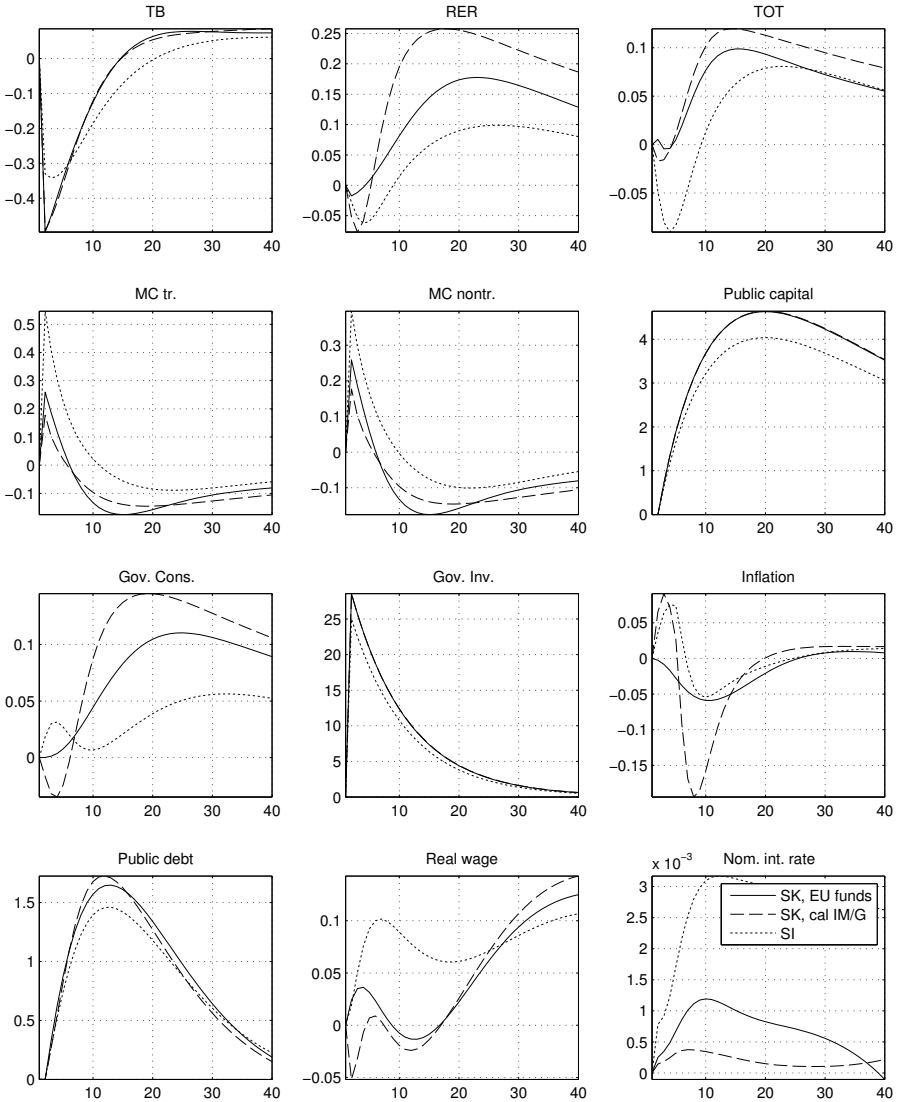
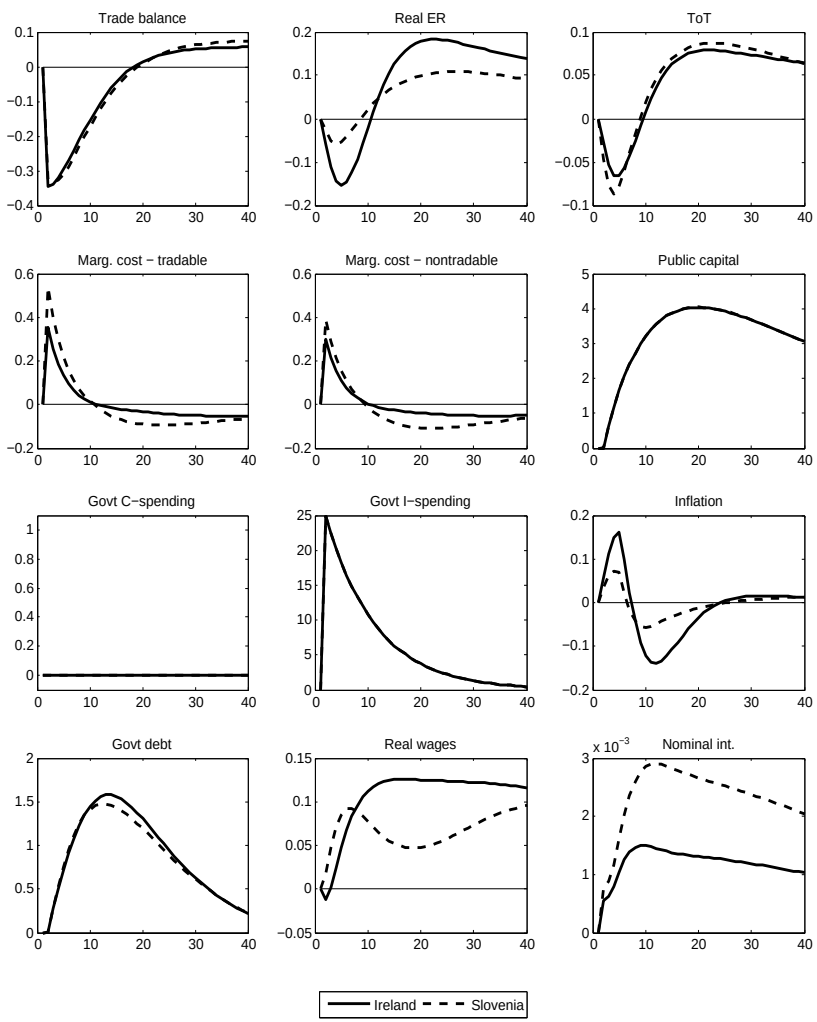
# IRF comparison - Government Investment (2/2)

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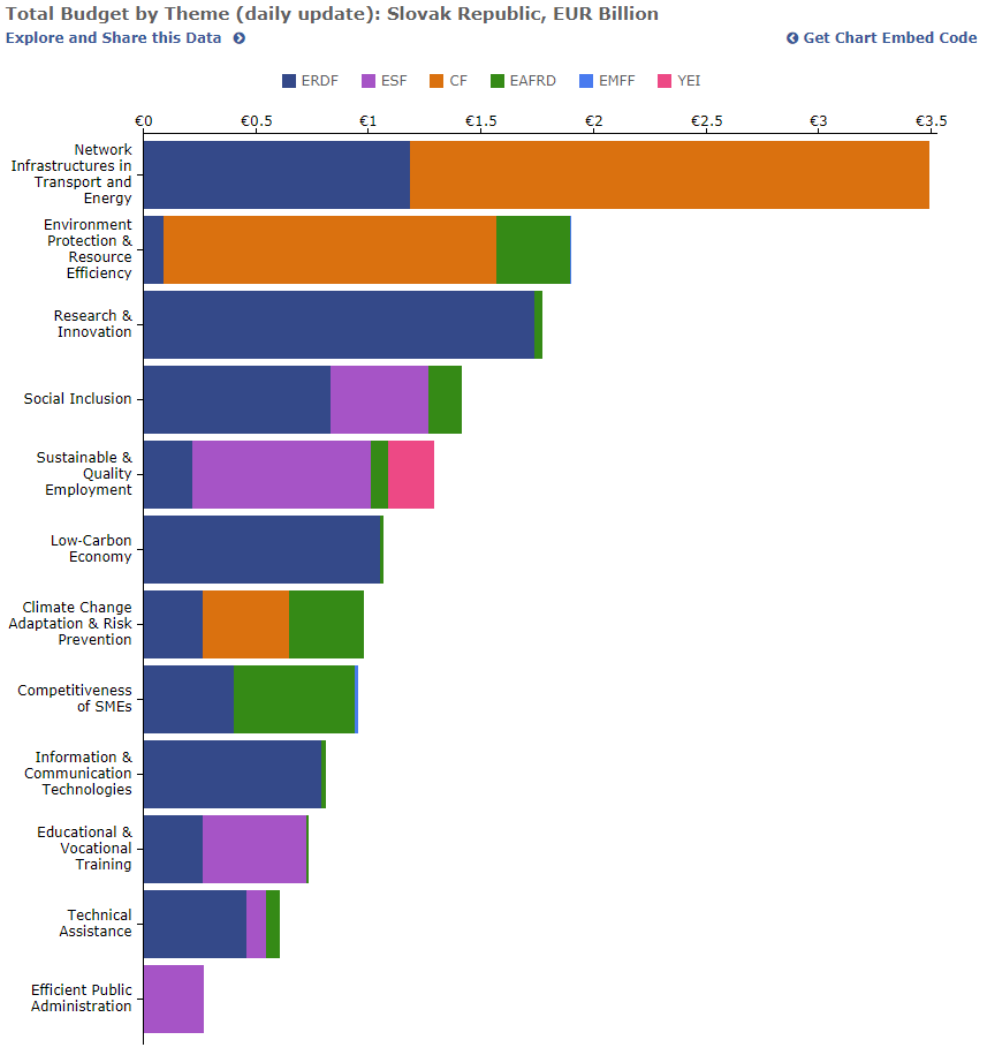
# EU Funds allocation for SK

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