



Assessing the potential impact of EU Cohesion Policy based on a structural macroeconomic model with semi-endogenous growth

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Why use structural general equilibrium models to assess impact of Cohesion policy?

- Take into account cross-economy spillovers of policies - General equilibrium effects
- Models can provide coherent and internally consistent framework to analyse channels through which policies have effect
- Account for international spillovers (global model)
- Provide dynamic profile – adjustment costs

But:

- Dependent on “efficient use” of funds: assuming no waste, no sub-optimal use (reality may be different)
- Model cannot give point estimates of impact
- Simulations can only indicate the channels through which cohesion spending may have an impact and indicate its potential effects

Structure of the presentation

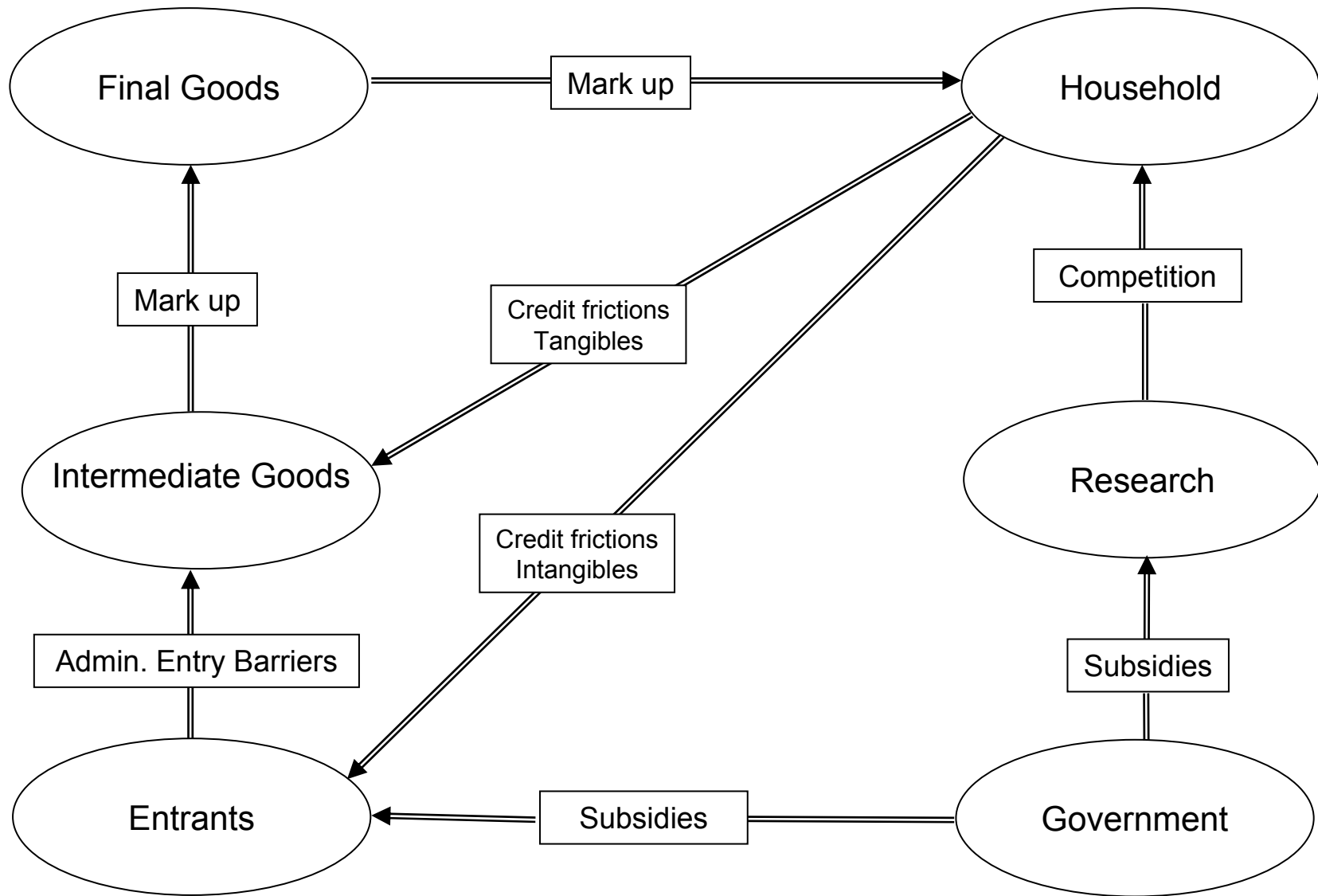
1. QUEST III model with endogenous growth
2. Impact assessment 2007-13
3. Sensitivity analysis
4. Cohesion Funds and the financial crisis
 - a. Frontloading spending – speed-up absorption
 - b. Co-financing and additionality
5. Options for 2014-2020: geographical concentration

QUEST III R&D model

- Core : QUEST III model: standard DSGE model
- Extensions:
 - semi-endogenous growth (technological change - increasing product variety a la Dixit & Stiglitz ; R&D producing sector);
 - human capital accumulation
- Global model (27 MS plus RoW)
- Economy populated by: Households , Final goods producing firms, Intermediate goods producing firms , R&D sector, Monetary and Fiscal authorities
- Disaggregation of labour force: low-, medium, high skilled (employment rate, skill efficiencies)

Technological change: increasing product variety
(Dixit&Stiglitz)

QUEST III RD Model



Infrastructure investment

Productivity enhancing effect of public capital K^G :

$$Y_t = A_t^{(1-\alpha)\left(\frac{1}{\theta}-1\right)} \left(K_t^P\right)^{1-\alpha} \left(L_{Y,t}\right)^\alpha \left(K_t^G\right)^{\alpha_G} - FC_Y$$

$$K_t^G = (1 - \delta_G) K_{t-1}^G + I_t^G$$

$$I_t^G = (s_t^{IGY} + \varepsilon_t^{IG}) Y_t$$

Investment in infrastructure I^G raises total factor productivity

But by how much depends on α^G :

default : $\alpha^G = 0.10$ (sensitivity analysis $\langle 0.05 - 0.15 \rangle$)

R&D sector

Innovation corresponds to the discovery of new designs.

- The R&D sector hires high-skilled labour $L_{A,t}$ and generates new designs ΔA_t according to a following knowledge production function:

$$\Delta A_t = \nu A_{t-1}^{*\omega} A_{t-1}^\phi L_{A,t}^\lambda$$

A^* : International R&D spillovers (Bottazzi & Peri, 2007):

ω and ϕ measure the foreign and domestic spillover effects from the aggregate international A^* and domestic A_{t-1} stock of knowledge

Critical: share of high-skilled $L^h : L_A \leq L^h$
(limited absorption capacity)

R&D promoting policies may drive up wages of high skilled => negative spillover to other sectors

Human capital accumulation

Labour-aggregate composed of three skill-types:

$$L_{Y,t} = \left(s_L^{\frac{1}{\phi}} (h_t^L L_t^L)^{\frac{\phi-1}{\phi}} + s_M^{\frac{1}{\phi}} (h_t^M L_t^M)^{\frac{\phi-1}{\phi}} + s_{H,Y}^{\frac{1}{\phi}} (h_t^H L_t^{HY})^{\frac{\phi-1}{\phi}} \right)^{\frac{\phi}{\phi-1}}.$$

s^s population share of group s

L^s employment rate of group s

h^s accumulated human capital group s

Accumulated human capital h^s is produced by participating in education:

$$h_t^s = h_s e^{\psi \Lambda_t^s}, \quad \psi > 0$$

where Λ^s is amount of time spent accumulating human capital

(years of schooling) ψ : Mincerian return to schooling

Additional training:

$$\Lambda_t^s = \Lambda^s + l_t^{s,TR}, \quad \text{where } l_t^{s,TR} = (1 - \chi_s) l_{t-1}^{s,TR} + \varepsilon_t^{s,TR}$$

Note: - slow dynamics (cohort effect)

- Short term reduction labour force (short run effect can be negative)

Simulations of Cohesion Policy

Detailed fiscal block:

$$B_t = (1 + r_t)B_{t-1} + G_t + IG_t + TR_t + BEN_t + S_t - T_t^C - T_t^L - T_t^P - COH_t$$

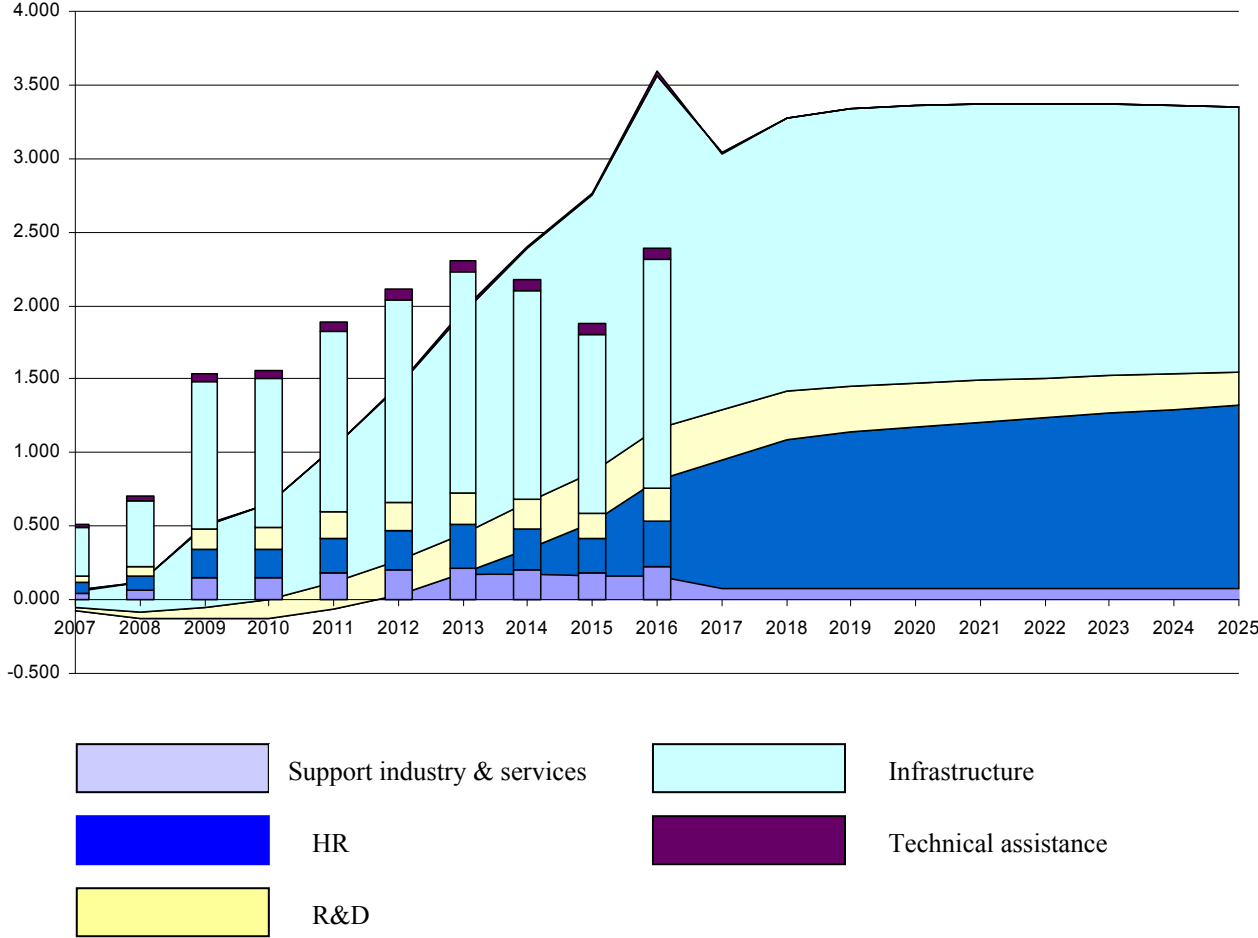
- 86 types of interventions linked to model variables (requires judgment!)

Field	Variable to implement the shock
Infrastructure	Temporary increase in I^G , government investment (via ε_t^{IG})
Agriculture, Industry&Services	Temporary increase in other government expenditures (G_t) Reducing fixed costs of tangible capital costs faced by final goods firms (FC_Y and rp^K , permanent or temporary reductions)
RTD	Reducing the fixed costs or risk-premia faced by the users of R&D products, (FC_A and rp^A , permanent or temporary reductions)
Human resources	Raising human capital and government transfers expenditures - investment in high-skilled human capital (h_t^H via Λ_t^H) - educational investments in all skills (h_t^s via Λ_t^s)
Technical assistance	Temporary increase in government consumption (G_t)

- COH = Net Cohesion Receipts (i.e. adjusted for contribution to EU budget)
- Contributions to EU budget assumed proportional to MS's GDP and financed by increase in labour taxes

Figure 1 New Member States:

Cohesion spending (% of GDP) and GDP impact (% difference from baseline)



Economic Impact Cohesion Spending: summary

- Productivity enhancing effects
- Consumption increases:
 - Non-constrained consumers: anticipate higher permanent income
 - Liquidity-constrained : higher employment and wages
- Wages grow in long run in line with productivity
- Donor countries: higher contributions to the EU budget - increase in labour taxes - negative impact on employment growth.
- Recipient countries: higher growth boosts tax revenues.

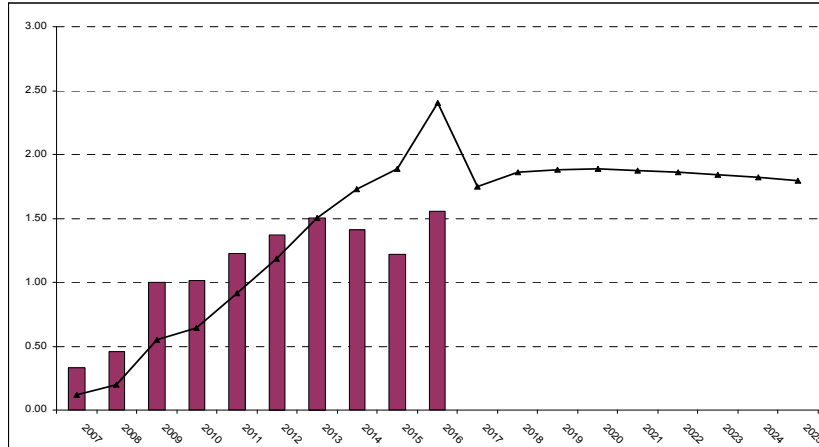
- Corporate investment is generally crowded out in the short run,
- In medium run productivity enhancing effects dominate (Inv. increases).

- Upward pressure on inflation as demand effects dominate in short run,
- But in medium run, as potential output increases, inflationary pressures subside.

- Imports are boosted by the increase in demand
- (Real) appreciation reduces exports growth.
- Trade balances deteriorate and current account deficits become larger.

Figure C.1. Simulated GDP impact NMS aggregate

Infrastructure

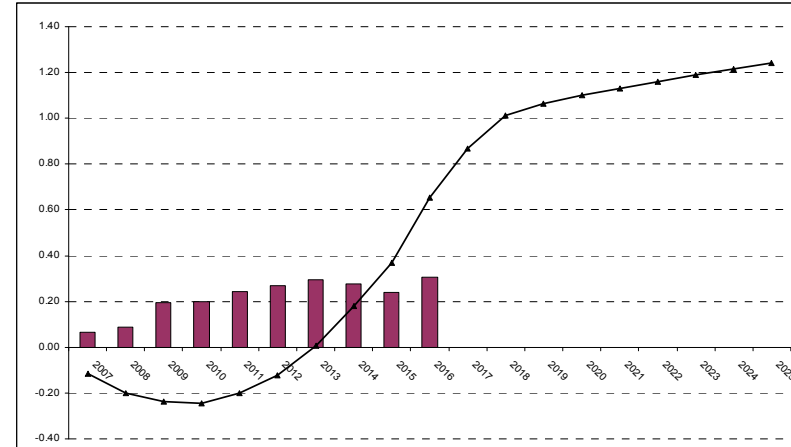


Transport, telecommunication, energy, environmental, social infrastructure

- Direct effect (IG enters GDP identity)
- Inflation
- (Real) appreciation
- Partly crowded-out by lower priv. investment
- Import leakage

However, in the medium term government investment raises productivity

Human capital investment



- Government spending (wage bill)
- Improvement skill efficiencies.

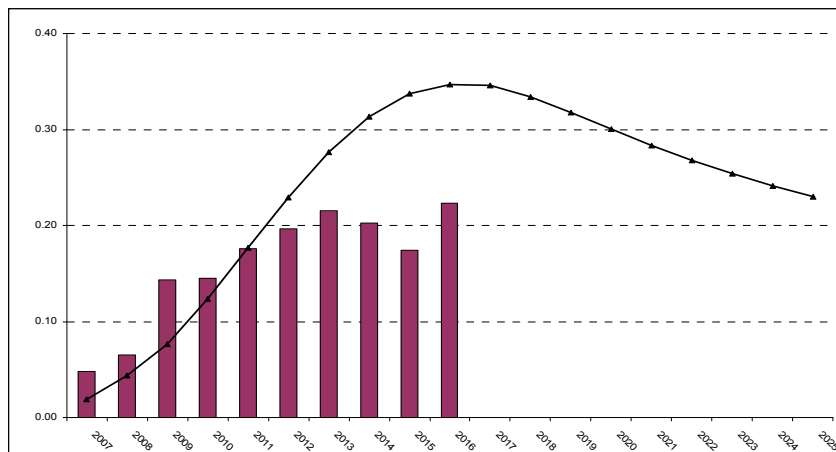
The effects on average skill efficiencies take time to build up (cohort effects)

Longer time spent in education/training – delayed entry into labour force

- Negative impact initially
- Large positive impact in medium run

Figure C.1. Simulated GDP impact NMS

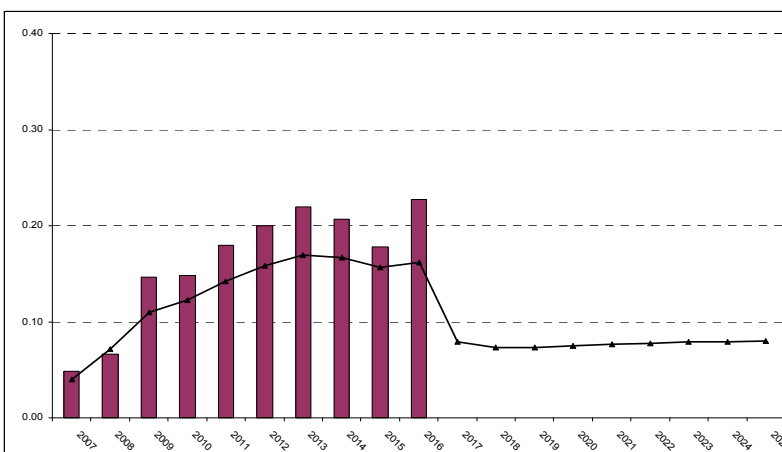
R&D



Reductions in intangible capital costs for the intermediate sector

- new start-ups enter the market (new products).
- high skilled workers reallocated in the model from production sector to R&D sector.
- Initially, this reallocation reduces final goods production and has a negative impact on growth,
- But over time the positive output effects dominate as productivity increases, and this also stimulates physical investment (endogenous growth)

Assistance industry and services



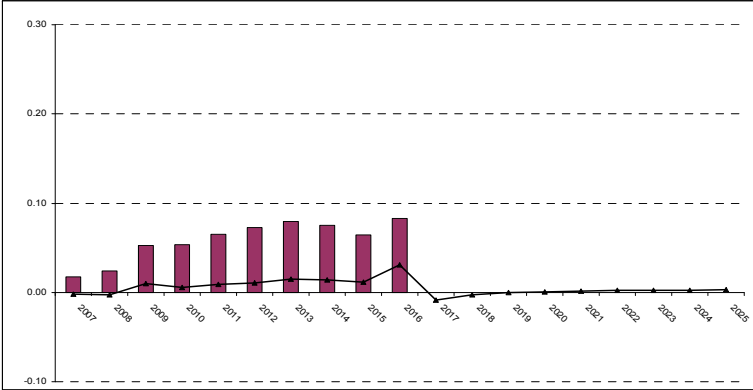
Reductions in fixed costs: lowering startup cost and increasing entry of new firms

Lower capital costs for tangible capital: increasing investment and capital accumulation

Government consumption: unproductive government spending (i.e. only growth boosting effect in the short run)

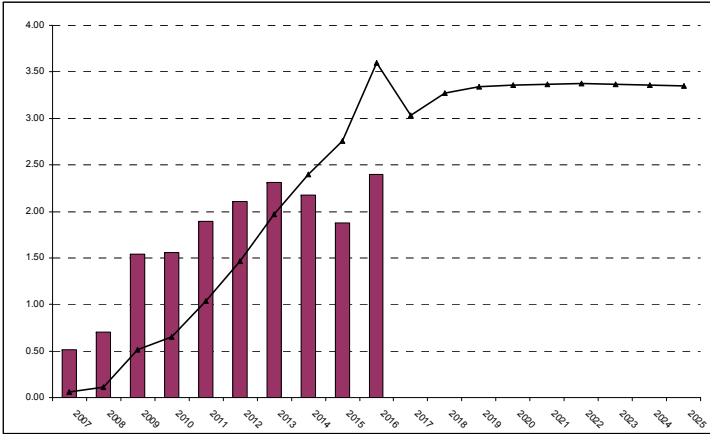
Figure C.1. Simulated GDP impact NMS

Technical assistance



Monitoring, evaluations :
not productive spending (in model)

Total:



SUMMARY TABLE GDP IMPACT

Field of intervention	Short run	Long run
Infrastructure investment	+	++
Human capital investment	- / 0	+++
R&D promoting policies	- / 0 / +	++
Assistance ind. & services	+	(+)
Technical assist (monitoring, evaluation)	0	0

Sensitivity analysis 1: infrastructure investment

$$Y_t = A_t^{(1-\alpha)(\frac{1}{\theta}-1)} (K_t^P)^{1-\alpha} (L_{Y,t})^\alpha (K_t^G)^{\alpha_G} - FC_Y$$

Critical parameter α^G : How productive is public capital ?

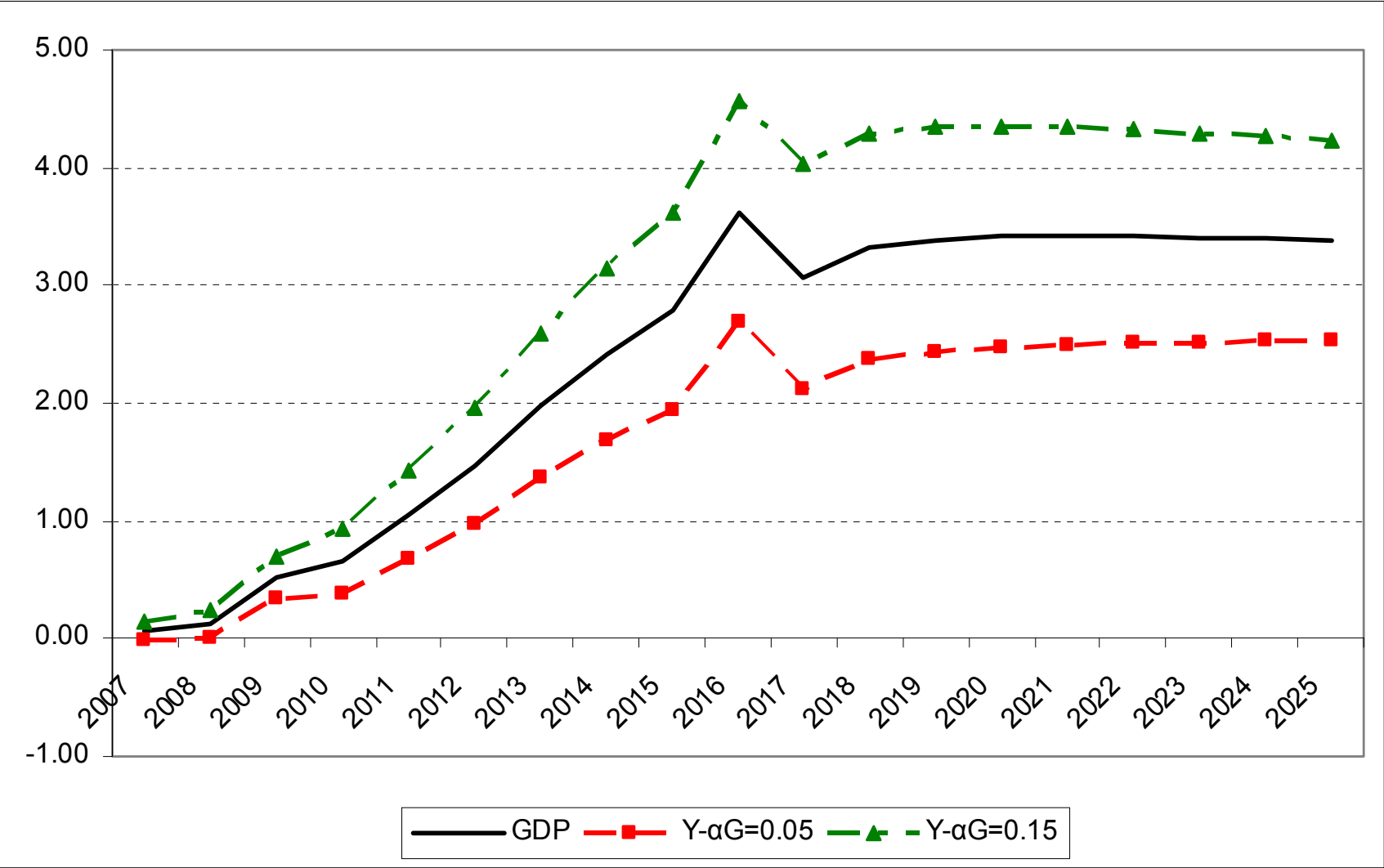
- Wide range of estimates found in the literature. E.g.
Aschauer (1989): 0.24; De la Fuente (2009): 0.08; Holtz-Eakin(1992): 0 ;
Evans-Karras (1994): <0; Kamps (2004): 0
- Econometric problems relating to common trends, missing variables, simultaneity bias and reverse causation hamper a proper identification of this elasticity from macro-economic timeseries.
- Not all transport infrastructure (e.g. regeneration natural environment, restoration cultural heritage)

Assumption adopted in the model : output elasticity of public capital α^G is set such that the marginal product of public capital is identical to that of private capital ($\alpha^G = 0.10$) (identical rate of return on private and public capital, Gramlich (1994))

=> **Sensitivity analysis : $\alpha^G = 0.05$ - $\alpha^G = 0.15$**

Sensitivity analysis 1: GDP effects for alternative output elasticities of public investment

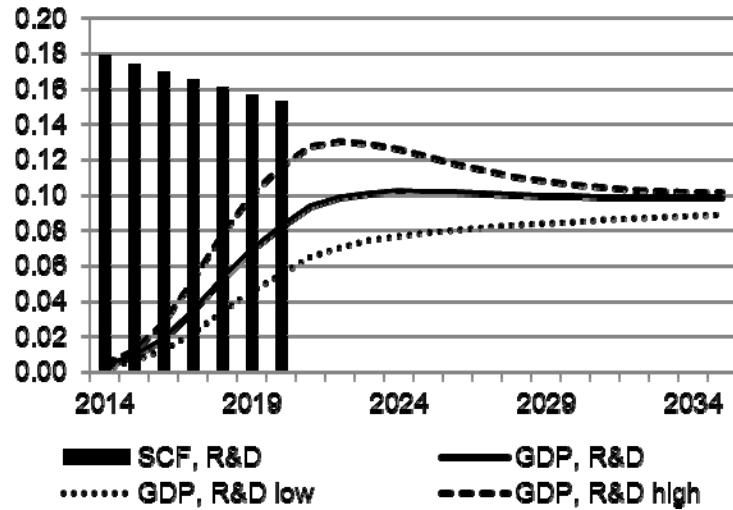
NMS aggregate, 2007-13



Sensitivity analysis 2 : R&D and Human capital investment

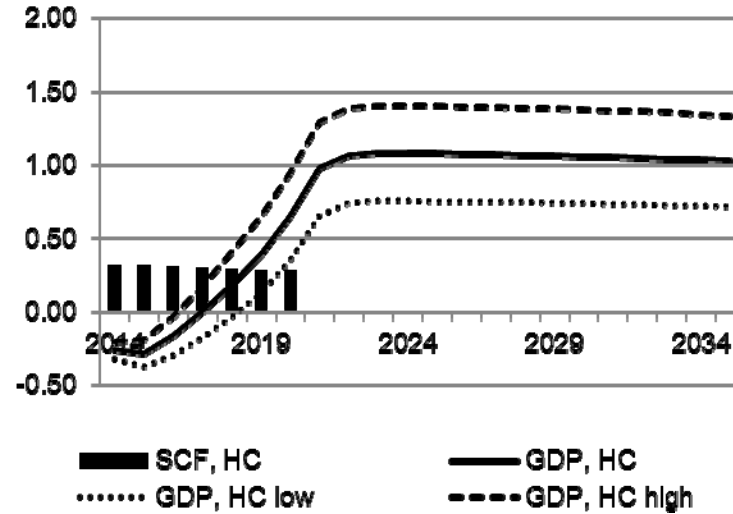
2014-2020 programme period

R&D



Sensitivity to R&D workforce productivity ($\lambda \approx 0.6$)
 Range λ : <-20% ; +20%>

Human capital investment



Sensitivity to Mincerian return to schooling ($\psi = 0.07$)
 Range ψ : < 0.05 ; 0.09 >

Cohesion Policy and the financial crisis

1. Long **delays** in spending due to implementation lags.

- Delays in submitting programmes and decision lags mean funding is spread over many more years.
- Spending in the first three years (2007-9) has been extremely low.
- These delays may be inevitable due to the strict conditions which projects are subject to, but it means potential benefits of this funding are not reaped to the full.

=> Speeding-up absorption / frontloading spending would yield larger GDP gains.

2. The conditions of **co-financing and additionality** have been called into question

- The EU only pays up to 85 percent of each funded programme, and governments have to add to this from their own budgets.
- Several MS have had little room for manoeuvre to co-fund additional projects
- Changes in the regulations allow for acceleration/advance payments from EU funds to ensure the availability of financial resources during the crisis (MS will have to pay back required co-financing at a later stage)

=> Co-financing condition initially lowers multiplier but delivers overall larger GDP effects

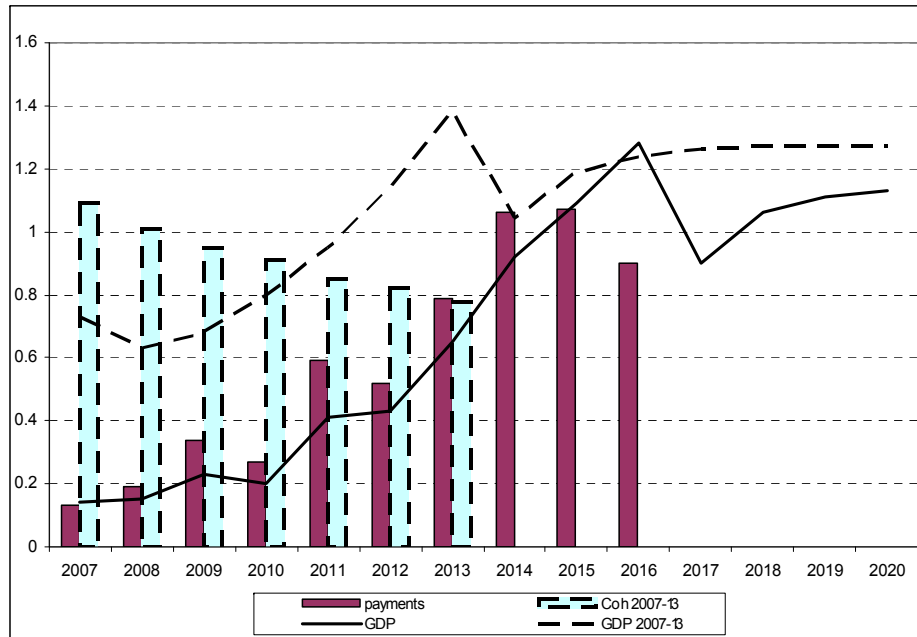
1. Delays in spending / Slow absorption

Long **delays** in spending due to implementation lags.

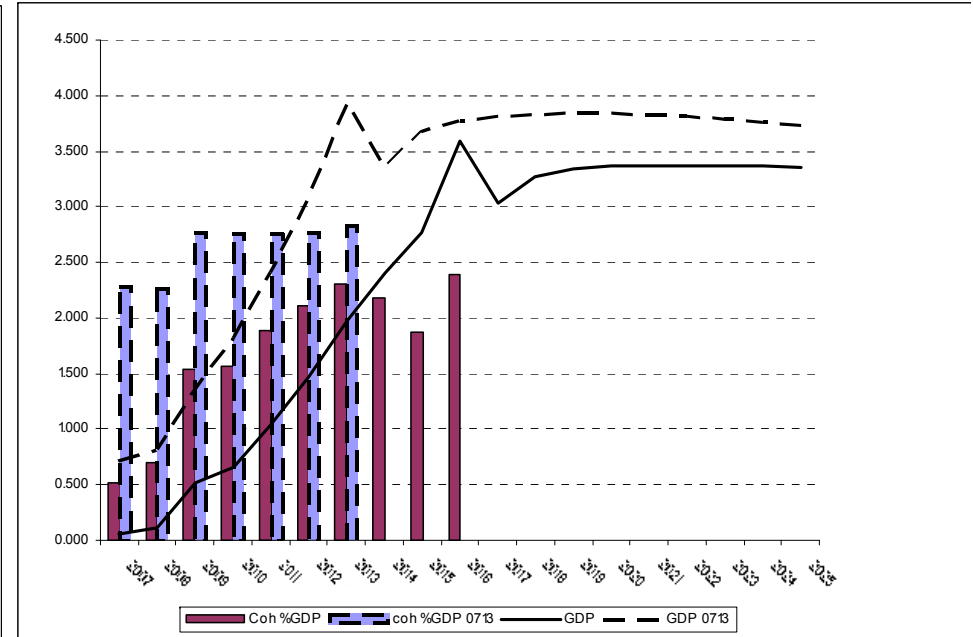
- Delays in submitting programmes and decision lags mean funding is spread over many more years.
- Spending in the first years of programme period has been extremely low.
- These delays may be inevitable due to the strict conditions which projects are subject to, but it means potential benefits of this funding are not reaped to the full.
- What is impact of slow absorption of funding?

Figure 5: GDP impact slow vs fast absorption (2007-13)

Greece



NMS



Bars represent (net) cohesion payments (% of GDP) :

red = projected payment profile (slow absorption) ; blue = "decided" amounts (faster absorption)

Lines represent GDP impact (% difference)

_____ (solid line) = GDP impact slow absorption (projected payment profile),

----- (dashed line) = GDP impact faster absorption (decided amounts)

1. Delays in spending / Slow absorption

- Cost of delaying productive expenditure is significant.
- If such implementation delays could be avoided and a faster "absorption" of the funds could be achieved, this would not only raise GDP in the short run but also **raise potential output by more** in the medium term.
- The long delays in payments are partly due to the strict conditions which these projects are subject to, designed to **avoid** funding being lost on **unproductive** projects.
- Wasteful spending should obviously be avoided, but this simulation indicates there are also significant costs in delaying available funding for productive investments

⇒ **European Investment Pact:**

EUR 60 bn unallocated funds from SF could be reprogrammed towards growth enhancing investment

2. Additionality and co-financing conditions

Additionality: Structural Funds are additional to domestically-financed expenditure and are not used as a substitute for it.

Co-financing: EU provides only matching funds to individual projects - EU funds are matched to a certain extent by domestic expenditure.

How to define proper benchmark for simulations?

In practice this principle of additionality is hard to verify and rarely binding.

- M.S. not required to create new budgetary expenditure to co-finance cohesion policy support.
- Existing national resources can be 'earmarked' to co-finance SF transfers.

Total spending increases only by the amount of SF transfers.

$$TOTEXP_t = COH_t + \max(EXP_0, c \cdot COH_t) = COH_t + EXP_0$$

As spending on infrastructure and education typically exceeds the co-financing requirements, this exercise takes domestically-financed expenditure in the counterfactual situation (without structural and cohesion funds) as the benchmark and only examines the impact of the fiscal transfer received from the EU cohesion funds.

2. Co-financing and additionality

- Financial crisis has forced many sharp retrenchments
- Public expenditure has been slashed.

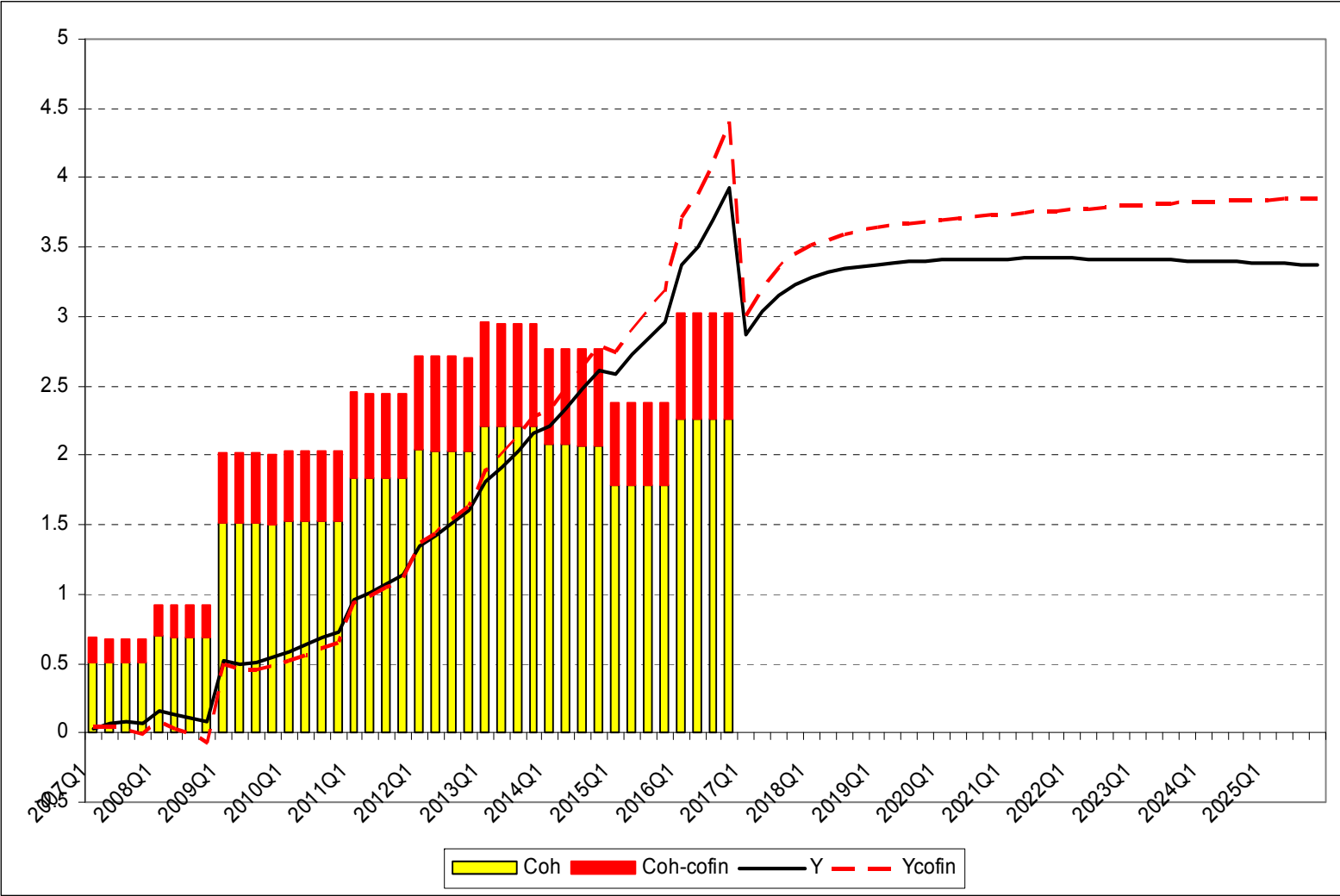
The conditions seemed unnecessary restrictive in these circumstances :

- increase in borrowing costs,
- raise debt servicing costs further.

However, these conditions are seen as a **guarantee** that the EU funds are not 'misspent' on sub-optimal projects.

Suspending the co-financing rule might reduce incentives for Member States to come up with proposals for productive projects and instead lead to wasteful spending on less productive projects.

Figure 4 NMS: Effect of co-financing condition of cohesion expenditure



2. Co-financing and additionality

Alternative scenario: an additional 25 % of all projects financed from each country's own resources.

Short run:

- This part is not received as a transfer from abroad, but is domestic public expenditure => economic agents now anticipate higher future tax liabilities.
- This leads to more crowding out of private spending and reduces multiplier.
- The increase in government spending also leads to increase in debt – higher sovereign risk premium – higher interest payments – reduces additional GDP impact from higher spending.

=> As a result, GDP is slightly lower in the short run.

Long run:

- Total spending is one-third higher in this scenario.
- As most of the interventions are productive investments, the supply-side effects are considerably larger under co-financing condition.
- Higher output also raises tax revenues and improves government finances in the medium run, making the burden of higher spending easier to bear.

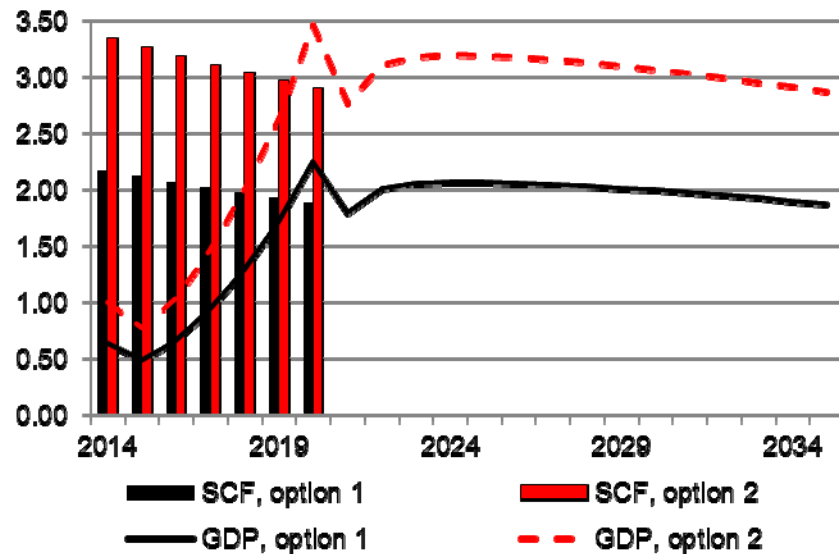
=> The long run output effect is more than 10 percent larger under co-financing.

Note though that this is less than the differences in total spending, which is one-third higher in this scenario, i.e. the overall multiplier is lower.

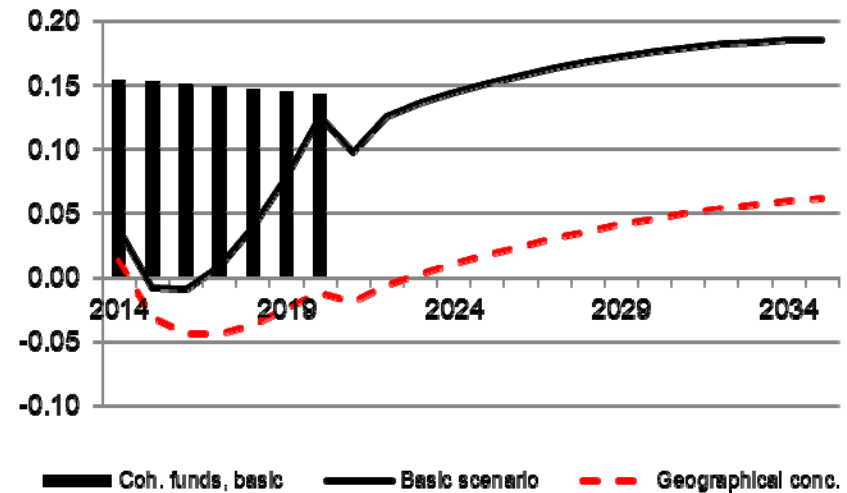
Geographical concentration (2014-20):

- Reduce current allocation for richer regions (zero funding OMS)
- Refocus towards lagging MS

New MS



Old MS



Bars represent cohesion receipts (% of GDP) :

Black bars = projected payment profile (NMS and OMS);

Red bars = geographic concentration : "reallocated" towards lagging MS (NMS)

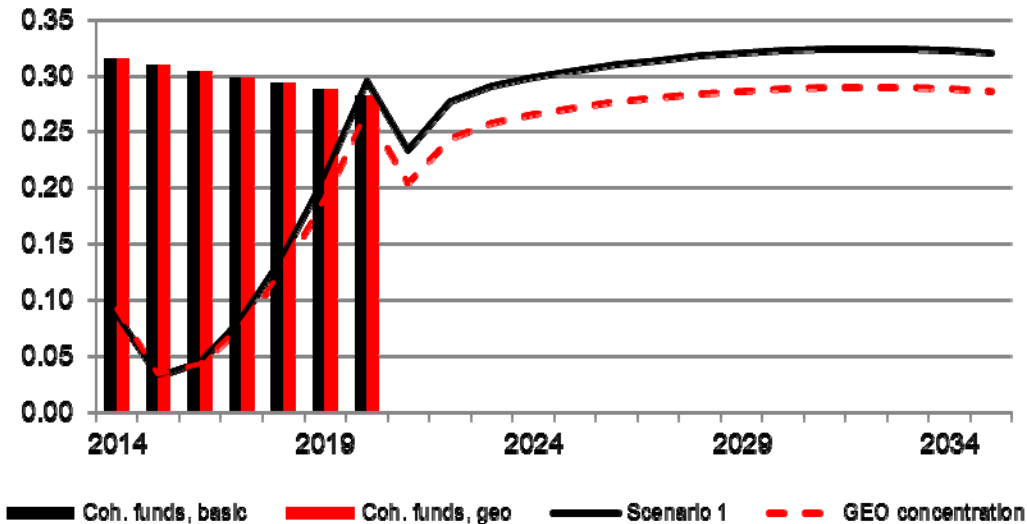
Lines represent GDP impact (% difference)

_____ (solid line) = GDP impact projected payment profile (NMS and OMS); ,

----- (dashed line) = GDP impact geographic concentration (NMS)

Geographical concentration (2014-20)

EU27 aggregate



_____ (solid line) = GDP impact option 1
- - - - (dashed line) = GDP impact geographic concentration

- Overall EU27 GDP results can be slightly lower under geographical concentration due to absorption problems in NMS (given limited number of high-skilled workers (scientists) more R&D spending pushes up wages for high-skilled workers also in non-R&D final goods sector)
- But obviously EU27 GDP should not be the main concern.

Conclusions

- Microfounded DSGE model with semi-endogenous growth
- In the short run:
 - spending could lead to crowding out of productive private investment and could give rise to real **appreciations** which lower export growth
 - R&D promoting policies could drive up **wages** of researchers and crowd out high skilled employment in other sectors.
 - little benefit one can expect in the short run from **training** and other human capital investments.
- In the medium term:
 - the **productivity enhancing** effects of infrastructure investment, R&D promoting policies, and human capital investments become gradually stronger
 - endogenous growth effects : positive benefits become stronger in the medium and long run

Conclusions (2)

- Implementation delays should be avoided (faster "absorption" of the funds),
 - while avoiding funding being wasted on unproductive projects.
- The conditions of co-financing and additionality are shown to have no detrimental effect on GDP.
 - Initially lower effects from crowding out
 - But the gains from more productive spending soon outweigh the costs of financing a share of the programme for their own budget, and long run GDP effects are larger.



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See also QUEST model page on ECFIN website:

http://ec.europa.eu/economy_finance/research/macroeconomic_models_en.htm

- Extra slides

Areas of intervention: summarised into 5 headings (% of total)

	support industry&services	Human resources	Infrastructure	RTD	technical assistance
BG	8.36	20.89	62.50	4.67	3.58
CY	14.99	20.45	50.95	10.03	3.58
CZ	8.39	15.56	61.09	11.58	3.38
DE	23.12	22.43	31.07	20.83	2.56
EE	8.04	10.87	62.31	16.75	2.04
ES	12.10	21.54	50.47	14.74	1.15
GR	6.83	21.53	63.52	5.69	2.42
HU	13.18	15.12	61.92	5.91	3.87
IT	16.54	18.22	54.80	8.60	1.83
LT	8.06	13.45	62.23	13.26	3.00
LV	4.13	11.49	67.81	14.07	2.51
MT	14.40	12.82	65.96	5.30	1.52
PL	7.81	13.67	63.00	11.94	3.58
PT	10.47	32.22	40.78	13.60	2.93
RO	8.95	18.62	65.19	3.65	3.59
SI	9.01	15.82	54.42	18.65	2.09
SK	5.43	11.75	70.05	9.32	3.44

Empirical evaluations EU Cohesion policy:

- Boldrin and Canova (2001) : no evidence of any form of systematic catching-up with the rest of regional income distribution.
- Cappelen *et al.* (2003): EU regional policy has become more effective in generating growth and contribute to greater equality in productivity and income in Europe.
However, growth in poorer regions is hampered by an unfavourable industrial structure (dominated by agriculture) and lack of R&D.
=> fiscal transfers should be accompanied by policies that facilitate structural change and increase R&D capabilities in poorer regions.
- Ederveen *et al.* (2002, 2006): Structural Funds are – on average - ineffective. However, can be effective when 'right' institutions (conditioning variables like openness, institutional quality, corruption and indicators of good governance)
- Checherita, Nickel and Rother (2009): Trade-off: Fiscal transfers contribute to reducing disparities in income but they also impede output growth, i.e. there is a negative impact of net transfers on growth in receiving regions and a negative impact of net taxes on growth in donor regions
=> “immiserising convergence” : output growth rates in receiving poor regions declining by less than in paying rich regions.

Absorption Problems (Herve and Holzmann, 1998)

1. **Waste** of transfers (projects with zero or negative economic return)
 2. **Administrative costs**-extra resources for programming and monitoring, cannot be used for increasing the productive capacity of the economy.
 3. **Rent-seeking** activities: incentive to invest resources in unproductive activities to catch a rent in the form of share of the transfers. Competition for resources absorbs resources that can no longer be used productively.
 4. **Diversion** of funds to **consumption**: increase in future consumption possibilities will lead to a higher consumption on impact (consumption-smoothing) to the detriment of investment
 5. **Timing** related problems (time lags before returns to investment materialise, opportunity costs are high and private investment decisions may be delayed),
 6. **Information disadvantage** of the disbursing authority (leading to support of sub-optimal investment projects),
 7. **Public choice** considerations (leading to intentional support of suboptimal projects).
 8. Changes in relative prices could lead to **Dutch disease** type phenomena (rising factor demand non-tradable sector leading to decline in tradable sector),
 9. **Immiserising growth** phenomena (industrial restructuring in favour of protected subsectors, with harmful consequences for long run growth)
 10. Worsening of negative effects of **market failures** (polarisation effects of transfers due to increasing returns to scale and labour market distortions).
- ⇒ Transfers may be detrimental to economic growth and real convergence (most likely cause: **rent seeking, protectionism** and **market rigidities**)
- ⇒ Absorption problems are likely to **increase** with the amount of transfers.

QUEST III model

Dynamic Stochastic General Equilibrium (DSGE) model:

- Microfounded: decisions based on dynamic optimisation subject to technological, budgetary and institutional constraints
- Heterogenous households: non-constrained ("savers"), credit-constrained ("borrowers") and liquidity-constrained ("backward-looking")
- Representative agent or overlapping generations framework
- Nominal and real rigidities
- Adjustment costs
- Global model (flexible regional aggregation)
- Modular approach: different versions, e.g.
 - housing/ construction / household debt (crisis);
 - R&D, skill disaggr. (structural reforms);
 - oil/energy, sectoral disaggr. (climate change/ energy policies)
- Calibrated and estimated variants (Bayesian methodology)

Dynamic Stochastic General Equilibrium (DSGE) models :

- DSGE models are derived from **micro principles** in a consistent manner - fully coherent, internally consistent framework
- Decisions are based on **intertemporal optimisation**, subject to **technological, budget and institutional constraints**
- Consistent modelling of **intertemporal budget constraints** for **households** and **government** plus the **current account**
- DSGE models include nominal rigidities that give rise to **imperfections** in labour and product markets
- Explicit modelling of **structural rigidities** (mark ups, entry barriers, financing restrictions (credit constrained households+firms))
- Role for **active monetary + fiscal policy (New-Keynesian)**
- Explicit modelling **capital flows** (important channel of adjustment)
- DSGE models allow for an analysis of **transition** to new steady state (short term adjustment costs, short term distributional consequences)
- Adjustment costs in labour and capital determine **dynamic adjustment**
- **Anticipatory effects** of (announced) future policies

QUEST III R&D model

Knowledge investment is key to economic growth.

Disaggregation of investment into tangibles and intangibles

- Physical capital:
 - rivalrous
 - constant returns to scale
- Knowledge capital : design for production of new good
 - non-rivalrous (Romer, 1990) (and knowledge spillovers)
 - sunk cost for firm – increasing returns to scale

What policies can induce firms to increase intangible investment ?

Romer (1990), Jones (1995), Aghion and Howitt (1998)

Households

- Non-constrained households ("Ricardian")
- Liquidity-constrained households
- Habit persistence

Non-liquidity constrained households

- buy new patents of designs produced by the R&D sector
- rent their total stock of design to intermediate goods producers
- pay income tax on the period return of intangibles
- receive subsidies after their investment in R&D products.

Final good firms

- Final output is produced using a labour aggregate, L_Y and A_t varieties of intermediate inputs ($x_{i,t}$) with an elasticity of substitution θ .

$$Y_t = A_t^{(1-\alpha)\left(\frac{1}{\theta}-1\right)} \left(K_t^P\right)^{1-\alpha} \left(L_{Y,t}\right)^\alpha \left(K_t^G\right)^{\alpha_G} - FC_Y, \quad \text{where } \sum_{i=1}^{A_t} x_{i,t} = K_t^P$$

Intermediate good firms

- The intermediate sector consists of monopolistically competitive firms
- enter the market by licencing a design from domestic households
- make an initial payment (FC_A) to overcome administrative entry barriers
- (tangible) capital inputs are also rented from the household sector
- firms which have acquired a design can transform each unit of capital into a single unit of an intermediate input
- entry occurs until the PDV of profits (where the discount factor contains the risk premium for intangible capital) is equal to the price of the patent (intangible) and a fixed entry cost

R&D promoting policies

R&D sector sells new patents of designs to households who rent them out to intermediate goods producers at rental rate i^A .

Households pay income tax at rate t^K on the period return of intangibles and they receive tax subsidies at rate τ^A

$$i_t^A \approx \frac{(1-\tau^A)(i_t - \pi_{t+1}^A + \delta^A) - t_t^K \delta^A}{(1-t_t^K)} + rp_t^A$$

i^A : households require a rate of return on intangible capital which is equal to the nominal interest rate minus the rate of change of the value of intangible assets and also covers the cost of economic depreciation plus a risk premium.

Government policies to promote R&D:

- tax incentives in the form of tax credits/depreciation allowances or
- lowering the tax on the return from patents.

Figure. Simulated GDP impacts New Member States

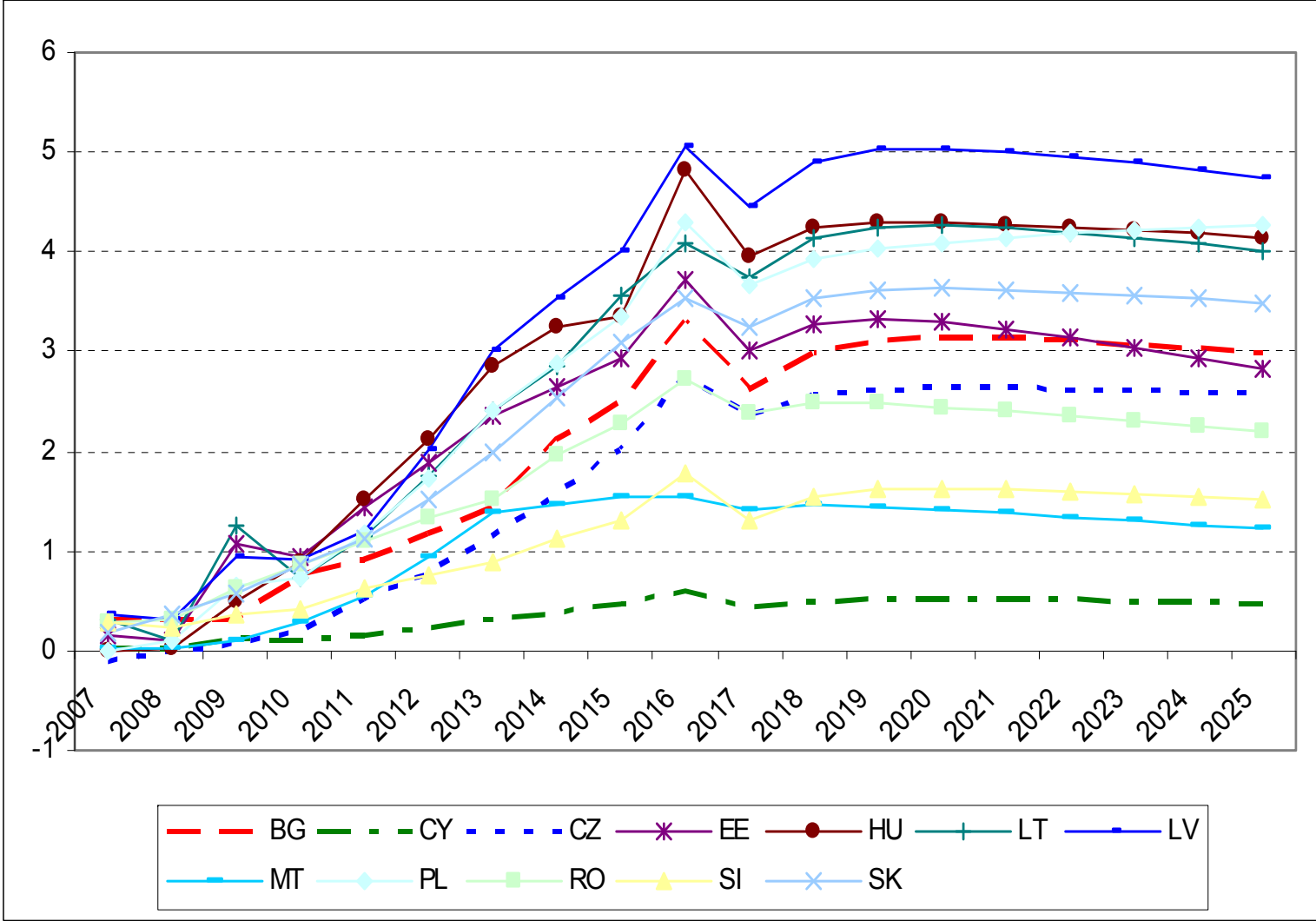
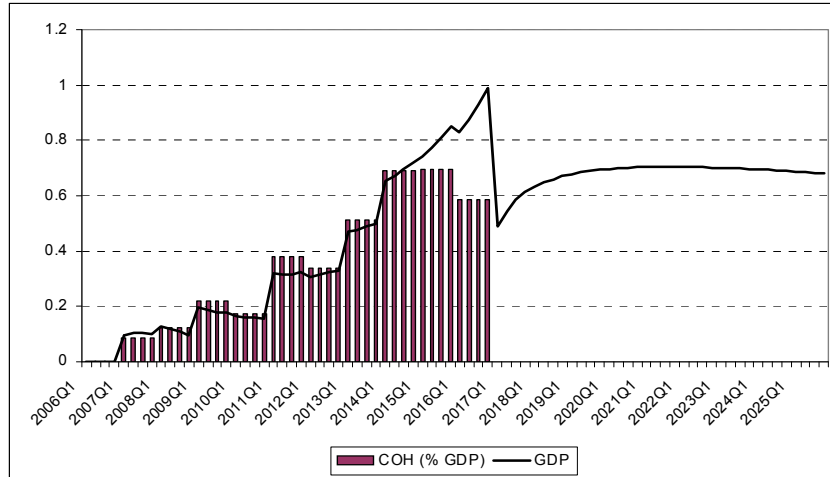


Table 6: Aggregate New Member States:

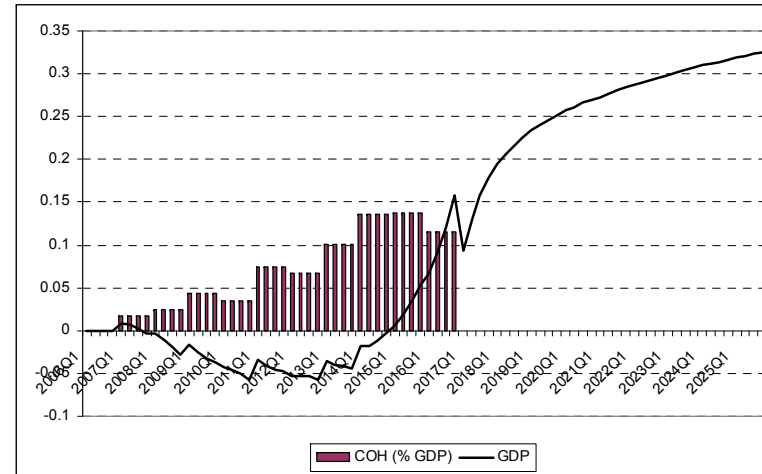
Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
GDP	0.07	0.12	0.52	0.66	1.05	1.47	1.98	2.41	2.78	3.63	3.07	3.32	3.39	3.41	3.42	3.42	3.41	3.40	3.38
Employment	0.08	0.13	0.33	0.29	0.38	0.51	0.65	0.72	0.81	1.04	0.39	0.43	0.56	0.65	0.71	0.76	0.80	0.83	0.86
. Low skilled	0.18	0.39	0.70	0.79	0.99	1.21	1.44	1.58	1.68	1.80	1.13	1.07	1.19	1.33	1.46	1.59	1.69	1.78	1.85
. Medium skilled	0.06	0.09	0.28	0.23	0.32	0.43	0.57	0.63	0.73	0.98	0.33	0.38	0.51	0.59	0.64	0.68	0.72	0.74	0.77
. High skilled	0.23	0.22	0.30	0.15	0.17	0.23	0.29	0.26	0.28	0.54	-0.11	0.05	0.20	0.24	0.26	0.27	0.29	0.30	0.31
Consumption	1.24	1.90	2.08	2.23	2.47	2.75	3.10	3.49	3.91	4.34	4.73	5.02	5.10	5.12	5.11	5.09	5.07	5.04	5.00
. Liq. Constr.	0.44	0.85	1.29	1.56	1.92	2.32	2.76	3.18	3.58	4.09	3.88	4.09	4.30	4.49	4.63	4.73	4.81	4.85	4.88
. Non-constr.	1.54	2.29	2.36	2.48	2.67	2.91	3.22	3.61	4.04	4.43	5.04	5.36	5.39	5.34	5.29	5.23	5.17	5.10	5.04
Investment	-0.05	-0.21	-0.38	-0.45	-0.44	-0.33	-0.14	0.14	0.50	0.93	1.43	1.80	2.02	2.15	2.25	2.32	2.38	2.43	2.47
Exports	-0.36	-0.50	-0.52	-0.45	-0.34	-0.18	0.03	0.29	0.54	0.84	1.12	1.22	1.25	1.25	1.26	1.26	1.25	1.25	1.25
Imports	2.16	3.21	3.96	3.85	3.85	3.71	3.45	2.89	2.23	2.01	-0.34	-0.54	-0.45	-0.42	-0.41	-0.40	-0.40	-0.40	-0.40
Real.wages	0.08	0.21	0.26	0.48	0.67	0.90	1.16	1.47	1.76	1.84	2.31	2.31	2.26	2.21	2.17	2.12	2.07	2.02	1.98
Patents	0.19	0.76	1.46	2.19	2.86	3.44	3.88	4.16	4.30	4.31	4.26	4.23	4.22	4.22	4.23	4.24	4.25	4.26	4.27
Price.level.GDP	0.34	0.84	1.37	1.67	1.97	2.20	2.34	2.30	2.13	1.91	0.95	0.51	0.21	-0.07	-0.33	-0.58	-0.81	-1.03	-1.24
Consumer.price.level	0.09	0.49	0.98	1.31	1.66	1.97	2.21	2.30	2.26	2.16	1.46	1.06	0.76	0.48	0.21	-0.04	-0.28	-0.50	-0.71
terms of trade	0.90	1.21	1.31	1.20	1.03	0.77	0.42	-0.01	-0.47	-1.00	-1.57	-1.76	-1.81	-1.82	-1.83	-1.83	-1.83	-1.82	-1.82
Dollar.exch.rate	-0.74	-0.61	-0.27	0.18	0.66	1.17	1.69	2.16	2.53	2.83	2.90	2.61	2.31	2.03	1.76	1.51	1.27	1.04	0.82
Euro.exch.rate	-0.66	-0.54	-0.23	0.17	0.57	1.01	1.46	1.88	2.19	2.44	2.50	2.22	1.94	1.68	1.43	1.19	0.97	0.75	0.55
Nom int rate	0.04	0.31	0.50	0.53	0.57	0.57	0.54	0.42	0.28	0.20	-0.31	-0.37	-0.35	-0.33	-0.32	-0.30	-0.29	-0.28	-0.27
Inflation	0.53	0.49	0.48	0.26	0.28	0.20	0.09	-0.10	-0.17	-0.42	-0.92	-0.32	-0.29	-0.27	-0.26	-0.24	-0.23	-0.22	-0.20
Gov Debt %GDP	-0.22	-0.60	-1.04	-1.23	-1.49	-1.76	-2.07	-2.33	-2.60	-3.07	-2.76	-2.90	-3.03	-3.10	-3.11	-3.06	-2.97	-2.83	-2.67
gov balance %GDP	0.20	0.15	0.11	0.05	0.07	0.11	0.17	0.24	0.32	0.38	0.28	0.34	0.31	0.25	0.19	0.14	0.09	0.04	0.00
Coh %GDP	0.51	0.70	1.54	1.56	1.89	2.11	2.31	2.17	1.87	2.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Net coh % GDP	0.51	0.70	1.54	1.56	1.89	2.11	2.31	2.17	1.87	2.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Trade bal %GDP	-0.92	-1.39	-1.73	-1.68	-1.71	-1.68	-1.62	-1.41	-1.17	-1.17	-0.09	-0.03	-0.10	-0.12	-0.13	-0.12	-0.12	-0.12	-0.11

Figure C.1. Simulated GDP impact Greece

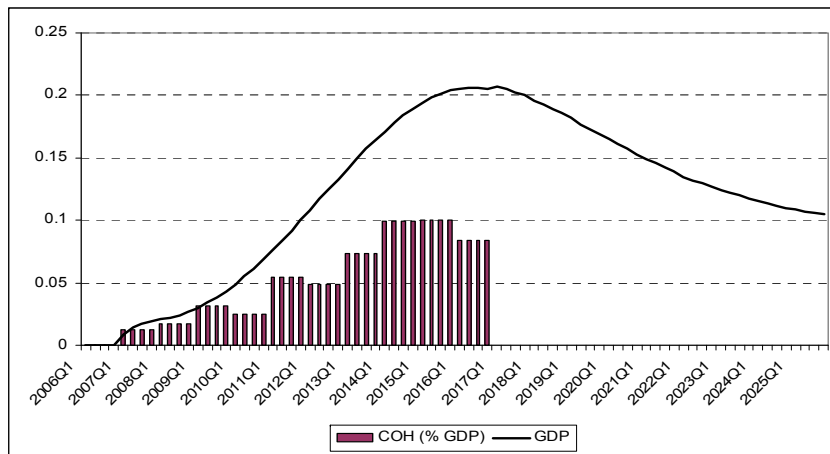
Infrastructure



Human capital investment



R&D



Assistance industry and services

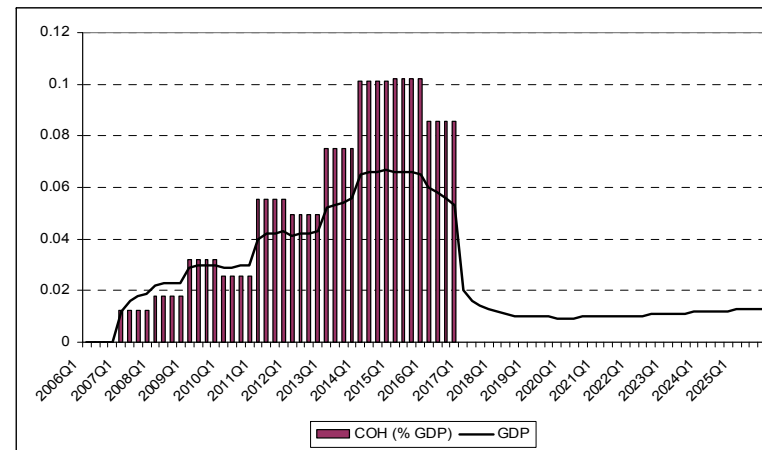
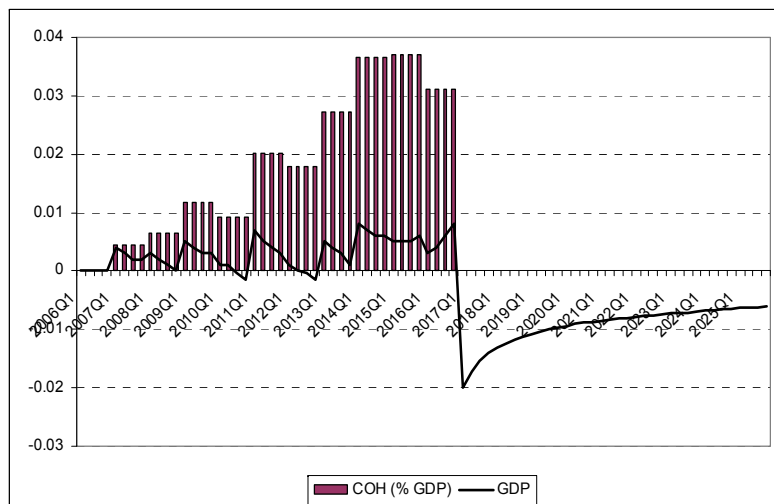
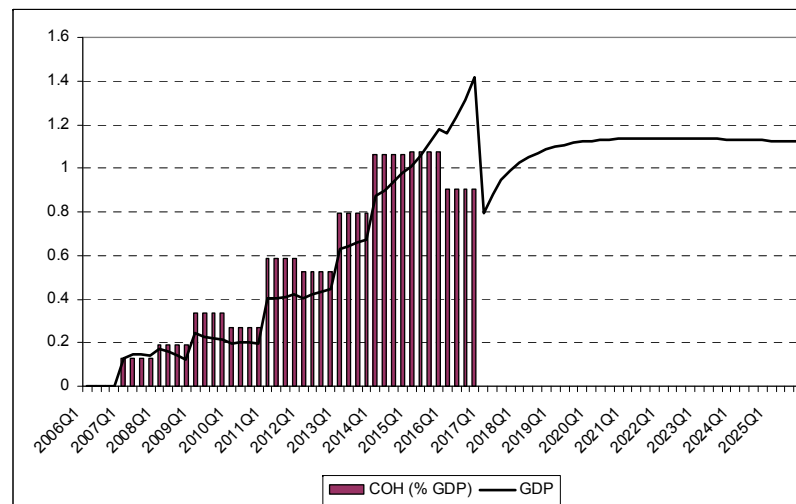


Figure C.1. Simulated GDP impacts Greece

Technical assistance



Total



Field of intervention

Short run

Long run

Infrastructure investment

+

++

Human capital investment

- / 0

+++

R&D promoting policies

- / 0 / +

++

Assistance ind. & services

+

(+)

Technical assist (monitoring, evaluation)

0

0

Sensitivity analysis (1)

α^G = output elasticity of public capital (infrastructure)

Large literature on infrastructure investment and economic growth (since Aschauer 1989, 1990)

Extremely wide range of estimates found in the literature

Econometric problems relating to common trends, missing variables, simultaneity bias and reverse causation hamper a proper identification of this elasticity from macro-economic timeseries.

Gramlich (1994) makes a case for an identical rate of return on private and public capital.

Assumption adopted in the model : output elasticity of public capital is set such that the marginal product of public capital is identical to that of private capital ($\alpha^G=0.10$)

=> **Sensitivity analysis 1 : $\alpha^G = 0.15$**

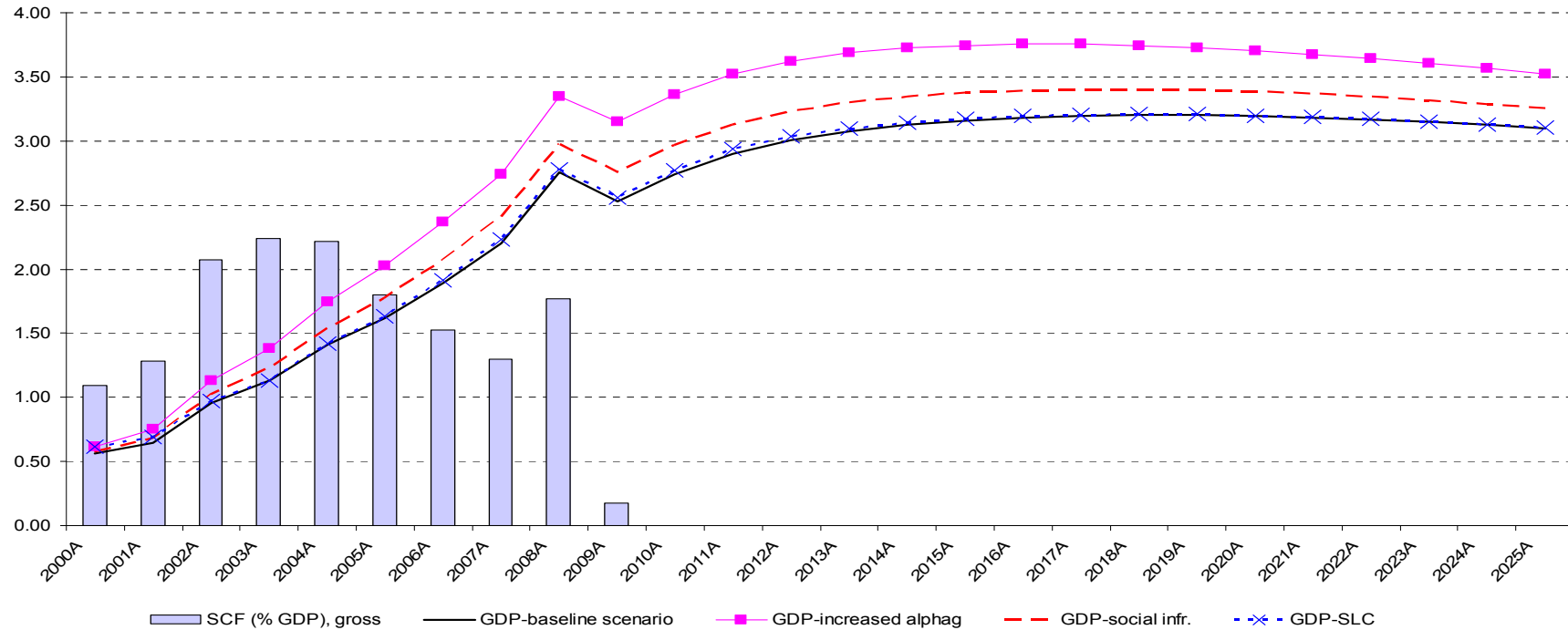
Sensitivity analysis (2)

s/c = the share of liquidity constrained consumers

- The share of liquidity-constrained households is generally an important parameter as it determines the degree of so-called non-Ricardian behaviour in the model for non-productive government spending shocks.
- The lower the share of liquidity-constrained households, the higher the degree of crowding out of government spending shocks due to an offsetting response of non-constrained households who raise their precautionary savings in anticipation of higher future tax liabilities.
- The share of liquidity constrained households in the euro area is typically estimated to lie in the range between 0.2 and 0.4 (e.g. Ratto *et al.*, 2009, Coenen *et al.*, 2008).
- The assumption in the model version used here, that this share is equal to the share of low skilled workers.
- This implies substantial differences across countries. Labour force data on skill groups shows a large dispersion in the share of low skilled workers across countries and our model assumption implies a similar dispersion in the share of liquidity constrained households.

⇒ **sensitivity analysis 2 : share liq constr hh = 0.5**

Figure 6.1 Portugal: sensitivity analysis:
 SF received (% of GDP) and GDP impact (% diff.)



- Higher output elasticity public capital (0.10 => 0.15)
- Reclassification "social infrastructure" as productive
- Higher share liquidity-constrained hh (0.4 => 0.5)

Summary conclusions sensitivity analysis

Higher output elasticity $\alpha^G = 0.15$:

As infrastructure spending amounts for a large share of overall spending (between 30-40 per cent) this has a significant impact on the results (eg. Portugal long term GDP effect from 3.1 per cent to 3.7 per cent)

Share liq-constr hh = 0.5 :

The impact of this assumption is not particularly large.

1. Cohesion spending is financed by fiscal transfers from the EU budget. This spending does not give rise to proportionally higher tax liabilities in the future but is a pure fiscal transfer from donor countries to recipient countries.
2. Consumption by non-constrained households is also positively affected as most spending is productive and leads to a rise in permanent incomes

Matching fields of interventions and model variables (p.1)

Category Cd	Category	TYPE	MODEL VAR
01	R&TD activities in research centres	RTD	RPREMA
02	R&TD infrastructure and centres of competence in a specific technology	RTD	FCA
03	Technology transfer and improvement of cooperation networks ...	RTD	FCA
04	Assistance to R&TD, particularly in SMEs (including access to R&TD services in research centres)	RTD	FCA
05	Advanced support services for firms and groups of firms	AIS	FCY
06	Assistance to SMEs for the promotion of environmentally-friendly products and production processes (...)	AIS	FCY
07	Investment in firms directly linked to research and innovation (...)	RTD	RPREMA
08	Other investment in firms	AIS	FCY
09	Other measures to stimulate research and innovation and entrepreneurship in SMEs	RTD	RPREMA
10	Telephone infrastructures (including broadband networks)	INFR	IG
11	Information and communication technologies (...)	INFR	IG
12	Information and communication technologies (TEN-ICT)	INFR	IG
13	Services and applications for citizens (e-health, e-government, e-learning, e-inclusion, etc.)	AIS	FCY
14	Services and applications for SMEs (e-commerce, education and training, networking, etc.)	AIS	FCY
15	Other measures for improving access to and efficient use of ICT by SMEs	AIS	FCY
16	Railways	INFR	IG
17	Railways (TEN-T)	INFR	IG
18	Mobile rail assets	INFR	IG
19	Mobile rail assets (TEN-T)	INFR	IG
20	Motorways	INFR	IG
21	Motorways (TEN-T)	INFR	IG
22	National roads	INFR	IG
23	Regional/local roads	INFR	IG
24	Cycle tracks	INFR	IG
25	Urban transport	INFR	IG
26	Multimodal transport	INFR	IG
27	Multimodal transport (TEN-T)	INFR	IG
28	Intelligent transport systems	INFR	IG
29	Airports	INFR	IG
30	Ports	INFR	IG