Probably Too Little, Certainly Too Late.
An Assessment of the Juncker Investment Plan

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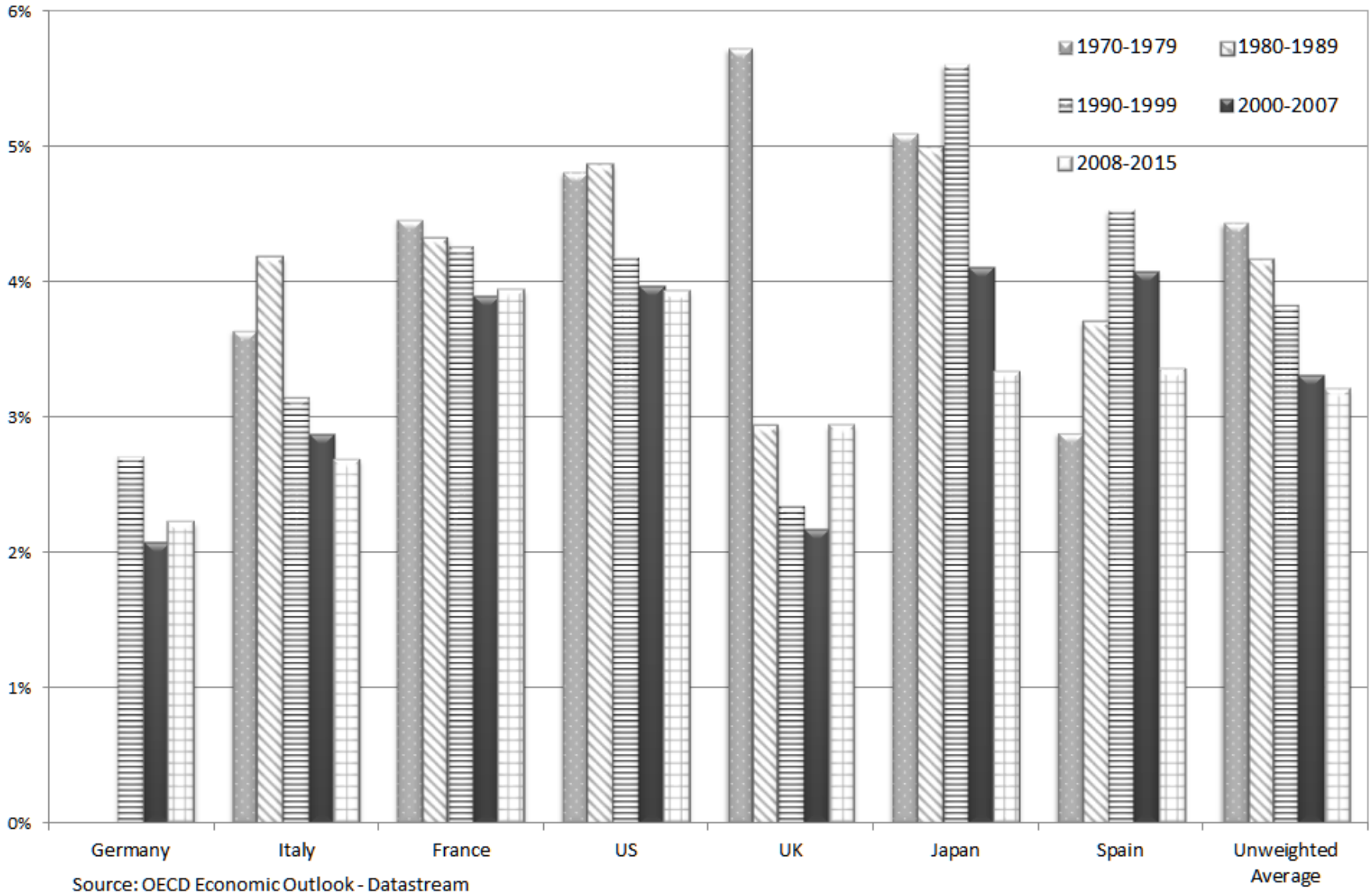
Outline

Investment at historically low levels

- Total investment in 2014 far below pre-crisis 2007 levels:
  - in EU, by 12.6%
  - in EMU, by 16%
- Private investment low
  - because uncertainty and lack of global demand
  - despite historically low interest rates
- Public investment victim of consolidation policies
- Infrastructure insufficient or in poor condition

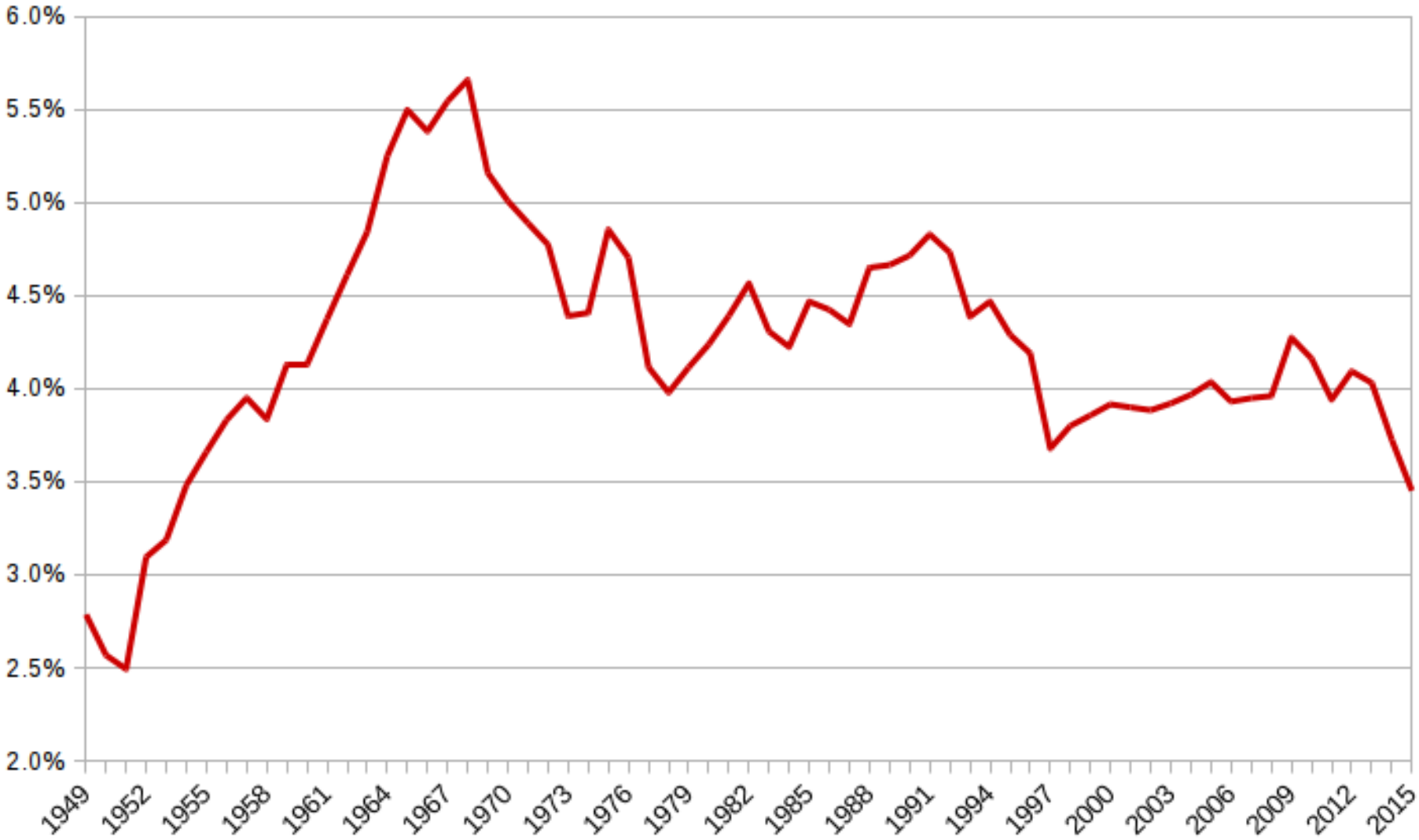
Public investment in selected OECD countries

% of GDP



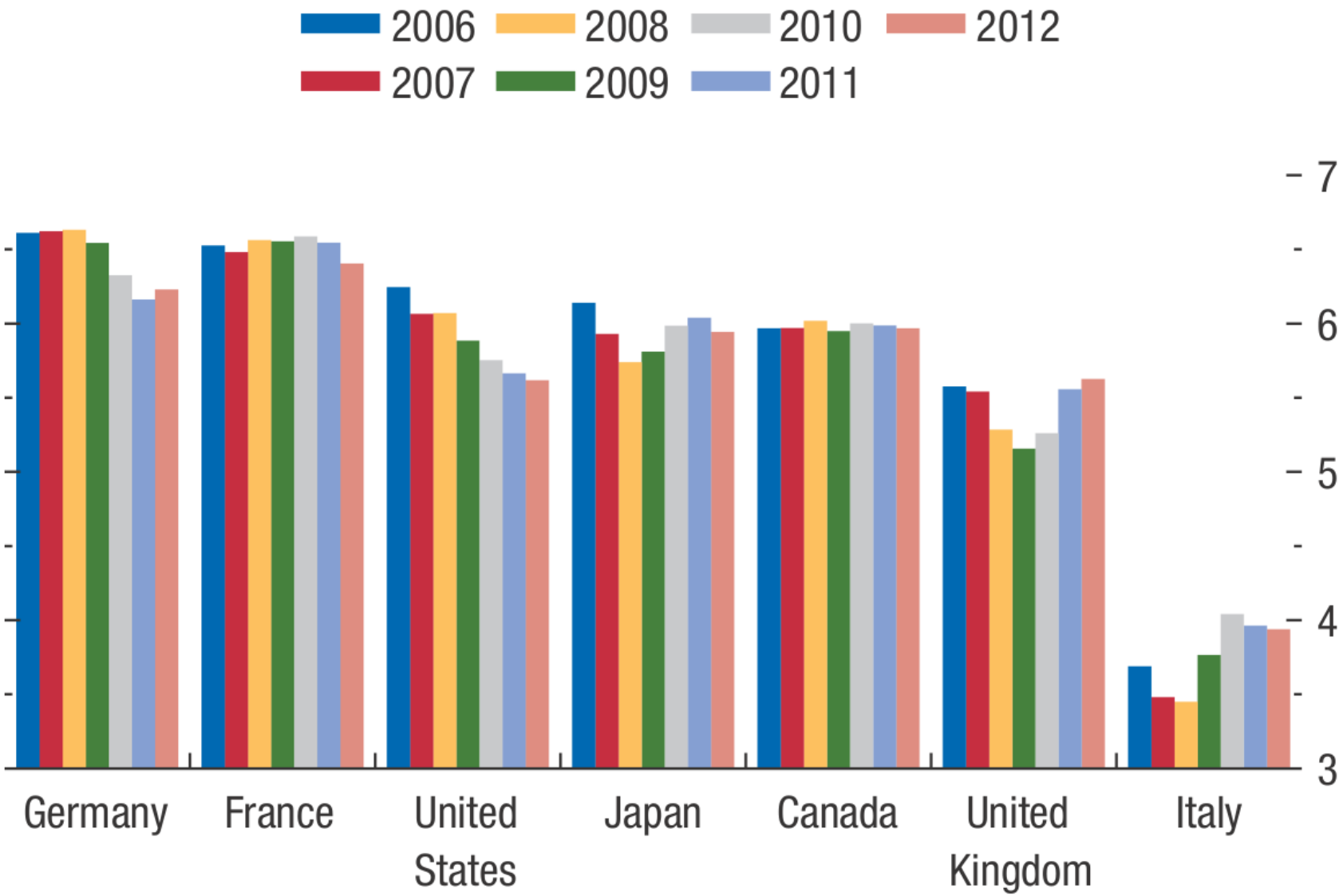
Public investment in France

% of GDP



Source: INSEE

Infrastructure quality in selected OECD countries



Source: IMF (2014)

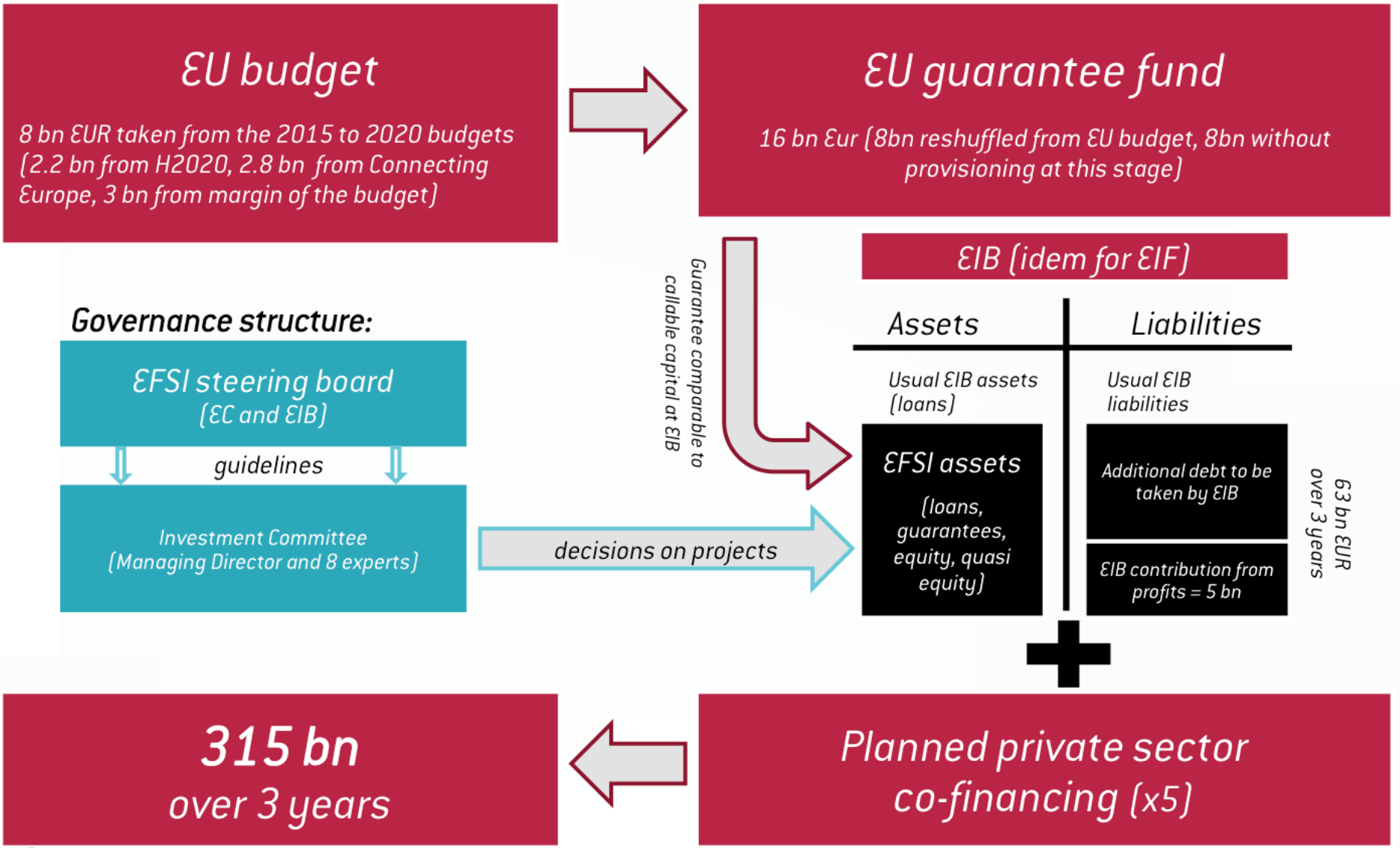
Time for a public investment push?

- Combines two positive effects:
  - demand in the short run
  - supply in the longer run
- Crowding-in of private investment (via complementarities)
- Historically low interest rates
- Multipliers likely high, hence may be a free lunch (IMF, 2014; OECD, 2016)

The Juncker plan

- Official name: European Fund for Strategic Investment (EFSI)
- Public-private partnership financing scheme
- Objective: trigger €315bn of new investment in Europe over 3 years
- Fields:
  - infrastructure
  - research & development
  - environmental projects
  - support to SMEs (through partnerships with intermediary banks)

The Working of the Juncker Plan



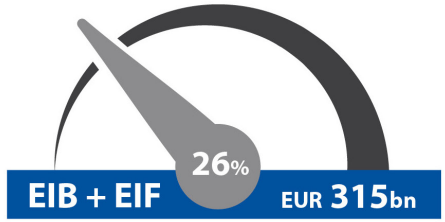
Source: Claeys (2015)

State of play as of April 2016

Of which EUR 5.8 bn signed

Approved EFSI financing*

Total investment related to EFSI approvals

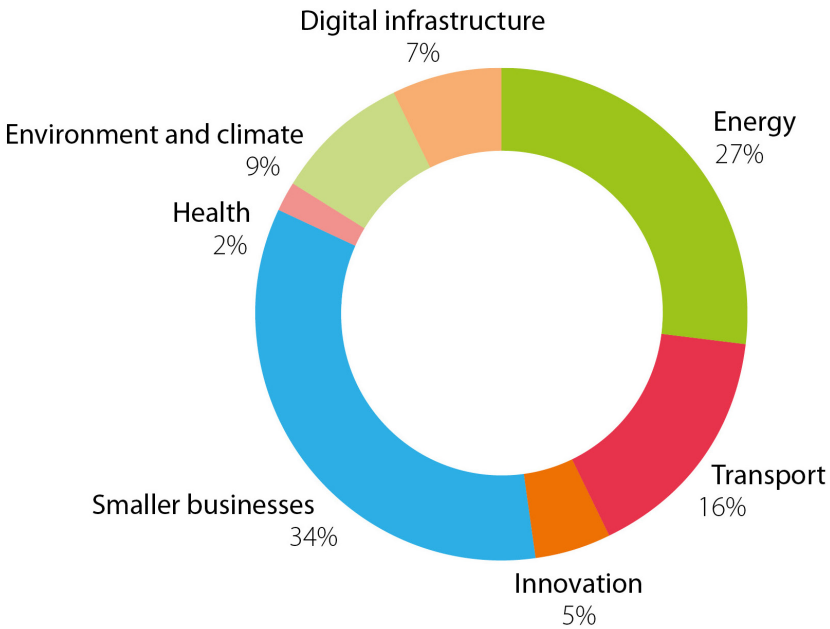


EUR 11.2 bn

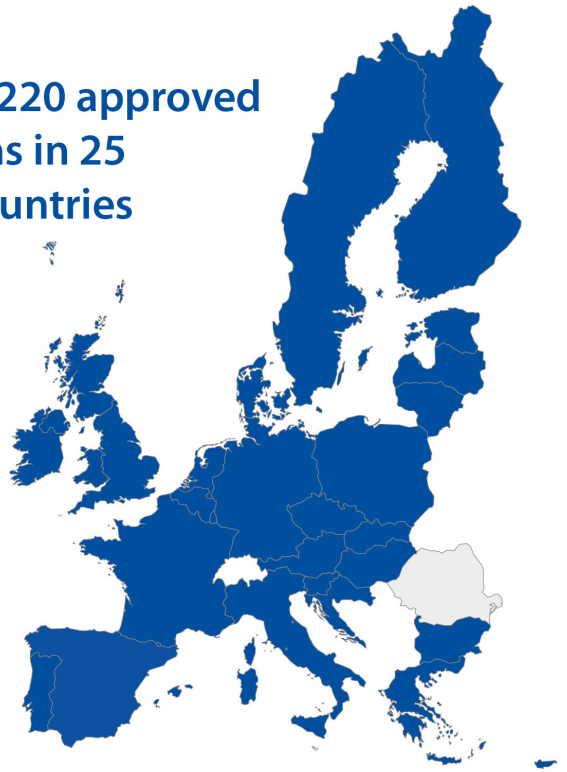
EUR 82.1 bn

* EIB approved: EUR 7.8bn
EIF approved: EUR 3.4bn

EFSI financing by sector



More than 220 approved transactions in 25 of 28 EU countries



Source: EIB

Paper objectives

- Assess macro impact of Juncker plan through a DSGE model
- Both in "normal" times and in a liquidity trap
- Comparison with Obama 2009 plan

Main results

- Even under very favorable hypothesis, impact of Juncker plan moderate
- Had it been implemented earlier, could have been effective against ZLB ("certainly too late")
- Had it been bigger (of the Obama plan size), would have been effective against ZLB even today ("probably too little")
- Time-to-build and private leverage play critical roles

Outline

Structure

- Closed-economy model of Euro area
- Medium-scale DSGE with New Keynesian core
- Two types of households (Ricardian/Keynesian or patient/impatient): consume, supply labor
- Productive sector with 3 factors: labor, private capital, public capital
- Monetary authority: Taylor rule
- Fiscal authority:
  - Several taxes, adjusted through fiscal rule
  - Discretionary public investment decision
  - Co-financing of projects by private sector: households contribute out of their savings

Households

- Two categories:

  patient/savers/Ricardian with discount factor β^S
  impatient/borrowers/Keynesian with discount factor $\beta^B < \beta^S$

- Households maximize:

$$\max \mathbb{E}_0 \sum_{t=0}^{\infty} \beta(i)^t \mu_t \left[\frac{(C_t(i) - h\, C_{t-1})^{1-\sigma}}{1-\sigma} - \chi \frac{L_t(i)^{1+\epsilon}}{1+\epsilon} \right]$$

  - external habit formation
  - preference for leisure
  - liquidity constraint on real debt:

$$\frac{B_t(i)}{P_t} \leq D > 0 \tag{1}$$

  - time rate preference shock μ_t: used to bring the economy at ZLB

Patient Households (Savers) (1/2)

- Have access to financial markets:
  - can hold bonds issued by the government
  - can lend to firms investing in private capital
- Own the (intermediate good) firms, hence profits Π_t are part of their income
- Budget constraint in real terms:

$$(1-\tau_t^w)w_t(i)L_t(i) + (1-\tau_t^k)r_t^k K_{t-1}^S(i) + \frac{B_t^S(i)}{P_t} + \Pi_t = (1+i_{t-1})\frac{B_{t-1}^S(i)}{P_t} + (1+\tau_t^c)C_t^S(i) + I_t^S(i) + I_t^{GS} + \psi(u_t(i))\,\bar{K}_{t-1}^S(i) + \frac{\gamma^w}{2}\pi_t^w(i)^2 w_t(i)$$

Patient Households (Savers) (2/2)

Non standard elements

- Households are wage-setters, with Rotemberg-type adjustment cost:

$$\frac{\gamma^w}{2}\pi_t^w(i)^2 w_t$$

- Households invest $I_t^S(i)$ in private capital $\bar{K}_t^S(i)$, and decide the utilization intensity $u_t(i)$ (with convex adjustment cost). Thus:

$$K_t^S(i) = u_t(i)\bar{K}_t^S(i)$$

- Patient households can also invest in the public capital stock: I_t^{GS}
  - not the result of optimization
  - but follows an *ad hoc* behavioral rule (proportional to public contribution)
  - investment in public capital does not yield any direct private return

Impatient Households (Borrowers)

- Impatient households have access to the financial markets in order to contract a debt or save...
- ...but cannot invest in private or public capital
- Because these agents are less patients than savers, they borrow up to their credit constraint, so that $\frac{B_t^B(i)}{P_t} = D$.
- As a consequence, the budget constraint simplifies to:

$$(1-\tau_t^w)w_t(i)L_t(i) = (1+\tau_t^c)C_t^B(i) + \left(\frac{1+i_{t-1}}{1+\pi_t} - 1\right)D$$

- Same wage demand schedule as savers

Production

- The perfectly competitive final good sector produces for consumption, private investment and public investment.
- Inputs come from a monopolistically competitive intermediate sector. The intermediate sector drives the demand for labor, taking real wages as given.

The characterization of **Final Goods** is standard

$$\max_{y_t(j)} P_t Y_t - \int_0^1 p_t(j) y_t(j) \, \mathrm{d}j$$

$$\text{s.t. } Y_t = \left(\int_0^1 y_t(j)^{\frac{\theta_t^p - 1}{\theta_t^p}} \, \mathrm{d}j \right)^{\frac{\theta_t^p}{\theta_t^p - 1}}$$

$$\Rightarrow y_t(j) = \left(\frac{p_t(j)}{P_t} \right)^{-\theta_t^p} Y_t$$

Intermediate Goods

- Technology (Leeper et al, 2010):

$$y_t(j) = z_t\, K_{t-1}(j)^{\alpha} L_t(j)^{1-\alpha} \left(K_{t-1}^G\right)^{\nu}$$

- K_t^G is aggregate public capital, ν its productivity
- Rotemberg nominal price rigidities. Price adjustment cost: $\frac{\gamma^p}{2}\pi_t(j)^2 Y_t$
- Cost minimization. Choice of $K_{t-1}(j)$ and $L_t(j)$ (given $y_s(t)$):

$$C(y_t(j)) = \min_{K_{t-1}(j), L_t(j)} w_t L_t(j) + r_t^k K_{t-1}(j)$$

$$\text{s.t. } y_t(j) \leq F(K_{t-1}(j), L_t(j), K_{t-1}^G)$$

- Profit maximization. Joint choice of $p_s(j)$ and $y_s(j)$:

$$\max_{p_s(j)} \mathbb{E}_t \sum_{s=t}^{\infty} \left(\beta^S\right)^{s-t} \frac{\lambda_s^S}{\lambda_t^S} \left[\frac{p_s(j)}{P_s} y_s(j) - C(y_s(j)) - \frac{\gamma^p}{2}\pi_s(j)^2 Y_s\right]$$

$$\text{s.t. } y_s(j) = \left(\frac{p_s(j)}{P_s}\right)^{-\theta_t^p} Y_s$$

Government

- Budget constraint:

$$T_t + \frac{B_t^G}{P_t} = G_t + I_t^G + \frac{1 + i_{t-1}}{1 + \pi_t} \frac{B_{t-1}^G}{P_{t-1}}$$

$$T_t = \tau_t^c \left((1-n) C_t^S + n\, C_t^B \right) + \tau_t^w w_t L_t + \tau_t^k r_t^k (1-n) K_{t-1}^S$$

- Fiscal rule (mimics the Stability and Growth Pact)

$$\Delta_t - r_t \frac{B_{t-1}^G}{P_{t-1}} = \Phi \left(\frac{B_{t-1}^G}{P_{t-1}} - b^{G*} \right) - \varepsilon_t^G$$

$$\Delta_t = \tau_t^c \left((1-n) C^{S*} + n\, C^{B*} \right) + \tau_t^w w^* L^* + \tau_t^k r^{k*} (1-n) K^{S*} - G_t - I^{G*}$$

- The different tax rates are (exogenously) proportional to total tax revenues

Public Investment: Time to Build and Leverage

- "Time-to-build". Choice of A_t yields a flow of expenditures for N periods: $A_t \sum_{s=0}^{N-1} \phi_s$
- Public investment comes from the government (A) and from patient households (A^S)
- At time t, total expenditure is the quota of all past decisions coming due:

$$I_t^G = \sum_{s=0}^{N-1} \phi_s A_{t-s} \qquad I_t^{GS} = \sum_{s=0}^{N-1} \phi_s A_{t-s}^S$$

- The law of motion of capital:

$$K_t^G = (1-\delta^G) K_{t-1}^G + A_{t-(N-1)} + (1-n) A_{t-(N-1)}^S$$

with $1-n$ fraction of patient households.

- Hypothesis on **leverage** triggered by government investment:

$$(1-n) A_t^S = (\xi - 1)(A_t - A^*)$$

where $\xi \geq 1$ is the private leverage factor.

Monetary policy

The monetary authority follows a classical Taylor Rule, subject to a ZLB constraint:

$$1 + i_t = \max\left((1 + i_{t-1})^{\rho^i}\left(\frac{1+\pi_t}{1+\pi^*}\right)^{(1-\rho^i)\phi_\pi}\left(\frac{Y_t}{Y_{t-1}}\right)^{(1-\rho^i)\phi_Y}(1+\varepsilon_t^i);\ 1\right)$$

where $\rho^i \in [0, 1)$ is the interest rate smoothing parameter, $\phi_\pi > 0$ (resp. $\phi_Y \geq 0$) captures the central bank reaction to inflation (resp. growth)

Model Closure: Market Clearing

- The equilibrium on the final good market is given by

$$Y_t = (1-n)C_t^S + nC_t^B + (1-n)(I_t^S + I_t^{GS}) + G + I_t^G$$
$$+ \int_0^1 \frac{\gamma^p}{2}\pi_t(j)^2 Y_t \mathrm{d}j + \int_0^{1-n} \left[\frac{\gamma^w}{2}\pi_t^w(i)^2 w_t(i) + \psi(u_t(i))\bar{K}_{t-1}^S(i)\right] \mathrm{d}i$$

- Market clearing on markets for debt, private capital and labor, implies:

$$B_t^G + n\,D + \int_0^{1-n} B_t^S(i)\mathrm{d}i = 0$$

$$(1-n)K_t^S = \int_0^1 K_t(j)\mathrm{d}j$$

$$L_t = \int_0^1 L_t(j)\mathrm{d}j$$

Outline

Doubts about plan effectiveness

- EIB/EU contributions are not new money
- Very optimistic private leverage effect
- Incitative impact not certain: some projects may have been launched without EFSI support
- Quality of projects in terms of productivity contribution?

We ignore these concerns and focus on the most favorable case.

Output elasticity of public capital

$$Y_t = z_t \, K_{t-1}^{\alpha} L_t^{\beta} \left(K_{t-1}^{G} \right)^{\nu}$$

- Aschauer (1989b): $\nu = 0.24$ (core infrastructure in the US)
- Eberts (1986): $\nu = 0.03$ (at metropolitan level in the US)
- IMF (2014): $\nu = 0.17$ (core infrastructure of national govt.)
- Our benchmark value: $\nu = 0.1$

Calibrated parameters (1/2)

Share of borrowers	n	0.34
Private leverage factor of public investment	ξ	5
Preferences		
Discount rate of savers	β^S	0.995
Discount rate of borrowers	β^B	0.99
Disutility of labor	χ	1
Persistence of time rate preference	ρ^μ	0.75
Production		
Private capital depreciation rate	δ^k	0.025
Public capital depreciation rate	δ^G	0.0125
Private capital share in production	α	0.36
Public capital influence in production	ν	0.1
Private capital utilization rate (steady state)	u^*	0.85

Calibrated parameters (2/2)

Price and wage stickiness		
Market power (goods, at steady state)	θ^{p*}	6
Market power (labor, at steady state)	θ^{w*}	6.2
Monetary policy		
Inflation (steady state)	π^*	0
Fiscal policy		
Speed of fiscal consolidation	Φ	$\frac{1}{80}$
Debt target	b^{G*}	$2.4\,Y^*$
Consumption tax (steady state)	τ^{c*}	0.2
Capital income tax (steady state)	τ^{k*}	0.184
Time to build of public investment	N	12
Time profile of public investment	ϕ_s	$\frac{1}{N}$
Government consumption (steady state)	G^*	$0.25\,Y^*$
Public investment (steady state)	A^*	$0.02\,Y^*$
Debt constraint of borrowers	D	$0.125\,Y^*$

Estimated parameters

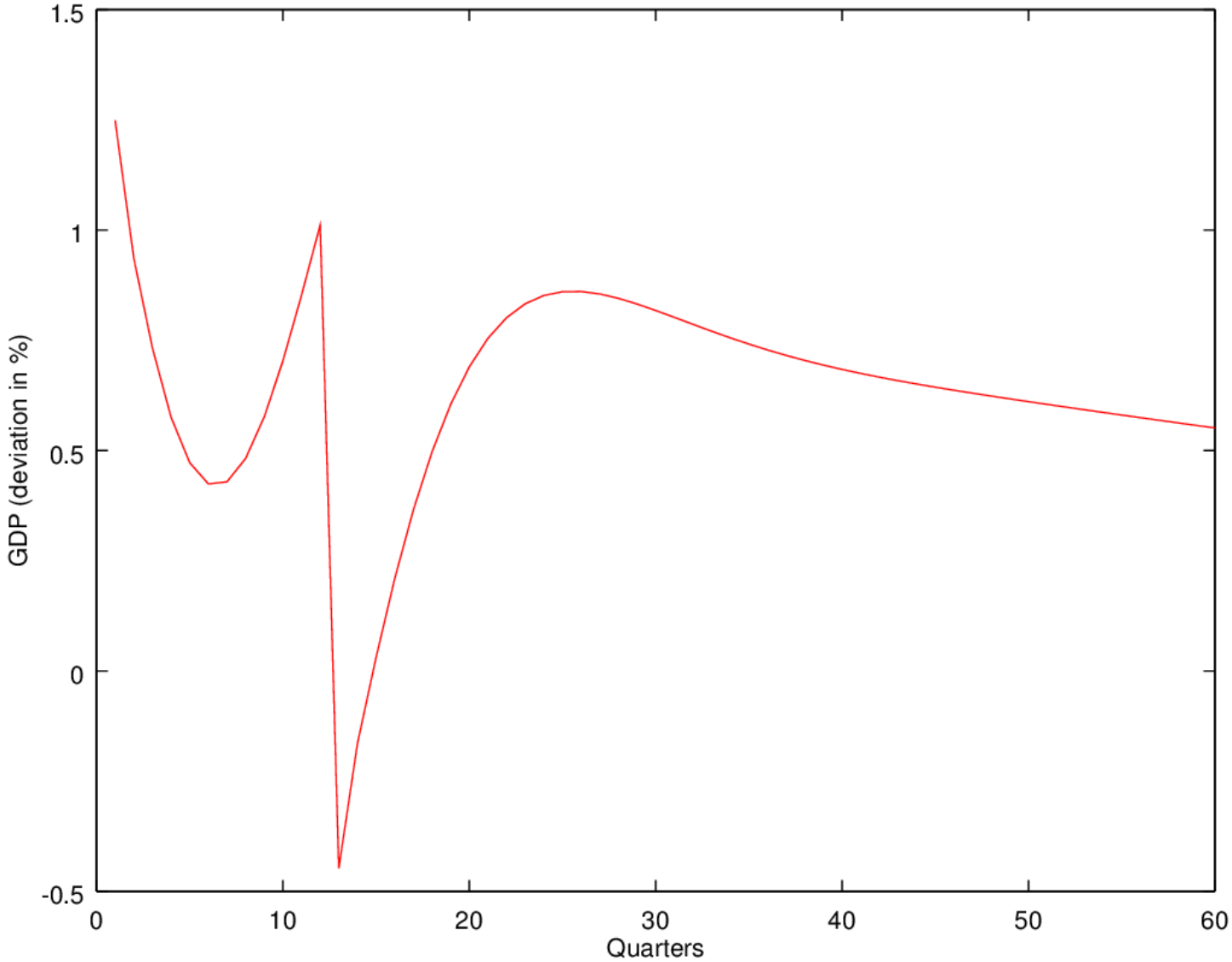
Parameter	Symbol	Prior Type	Prior Mean	Prior St. Dev	Posterior mode
Preferences					
Frisch elasticity of labor	ε	Γ	2	0.25	1.9200
Relative risk aversion	σ	Γ	1.75	0.5	1.8951
Habit formation in consumption	h	β	0.5	0.2	0.8715
Production					
Adjustment cost on private investment	γ^I	N	5	0.25	5.1858
Elasticity of capacity utilization rate	σ_u	N	5	0.1	4.9879
Persistence of investment shock	ρ^κ	β	0.5	0.2	0.9042
Persistence of productivity shock	ρ^z	β	0.5	0.2	0.8476
Price and wage stickiness					
Adjustment cost on wages	γ^w	Γ	110	100	353.5216
Adjustment cost on prices	γ^P	Γ	300	100	83.5008
Persistence of price markup shock	ρ^p	β	0.5	0.2	0.8972
Persistence of wage markup shock	ρ^w	β	0.5	0.2	0.1187
Monetary policy					
Persistence of interest rate	ρ^i	β	0.8	0.1	0.8065
Sensitivity to inflation	ϕ_π	Γ	1.7	0.1	1.7292
Sensitivity to GDP	ϕ_Y	N	0.125	0.05	0.1766

The Juncker plan in the model

- Positive temporary shock on public investment allowances
- Magnitude: 0.5% of annual GDP (one-period shock during quarter of plan launching)
- Because of time-to-build, new investment spread over 3 years
- Magnified by private leverage of 5
- New public capital operational 3 years after plan launching

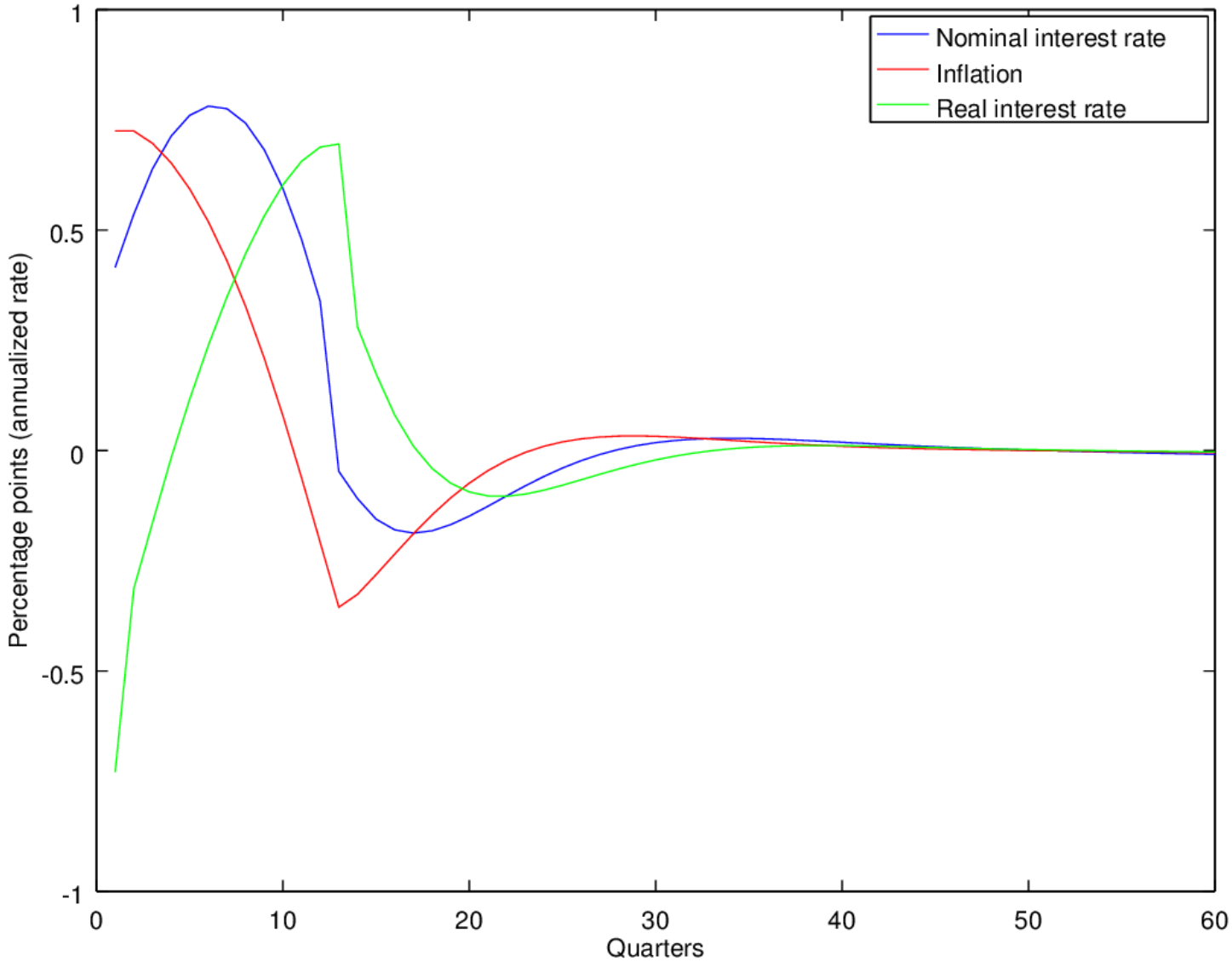
Impact of Juncker plan on output

Baseline scenario, deviation from steady state



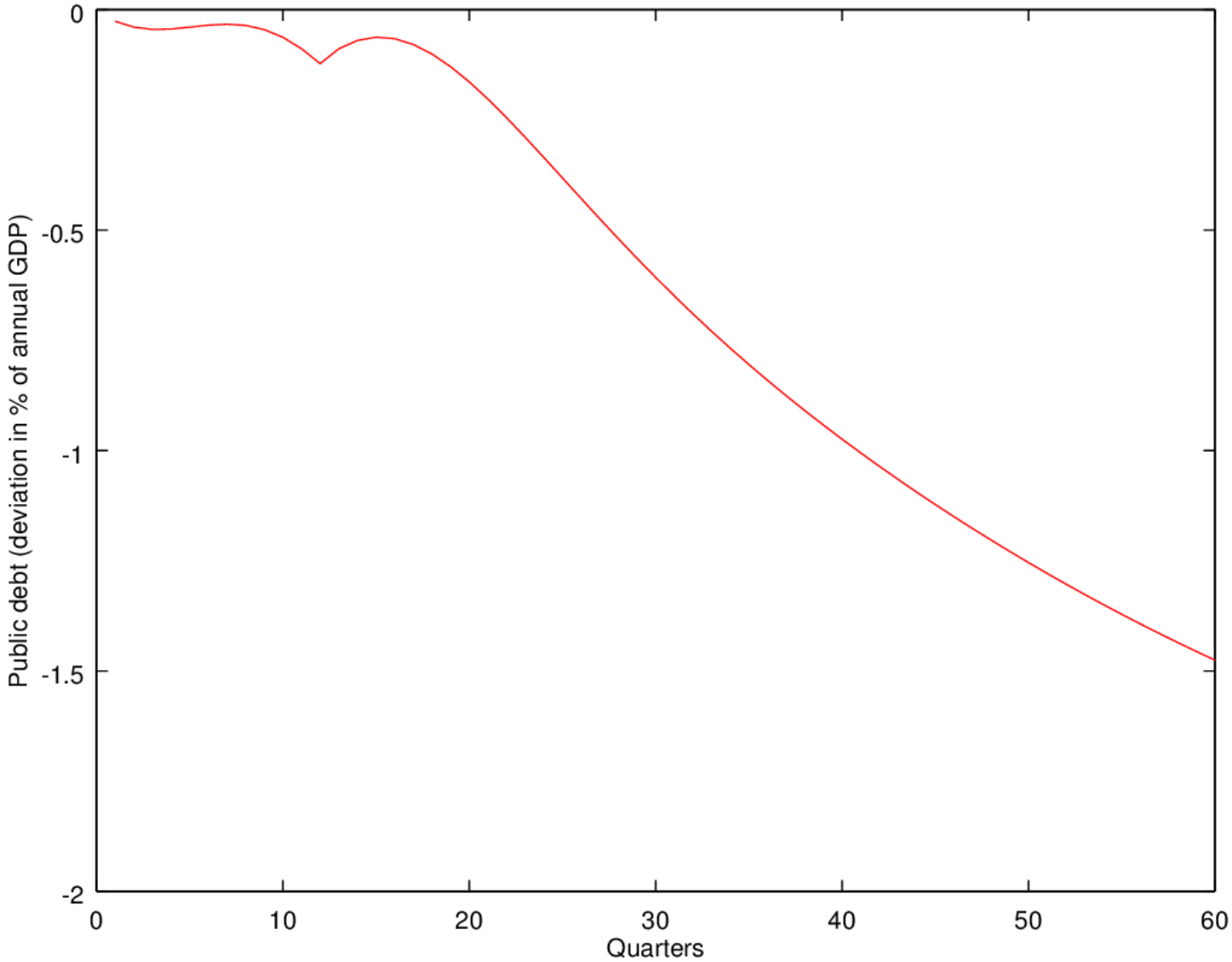
Inflation and interest rates

Baseline scenario



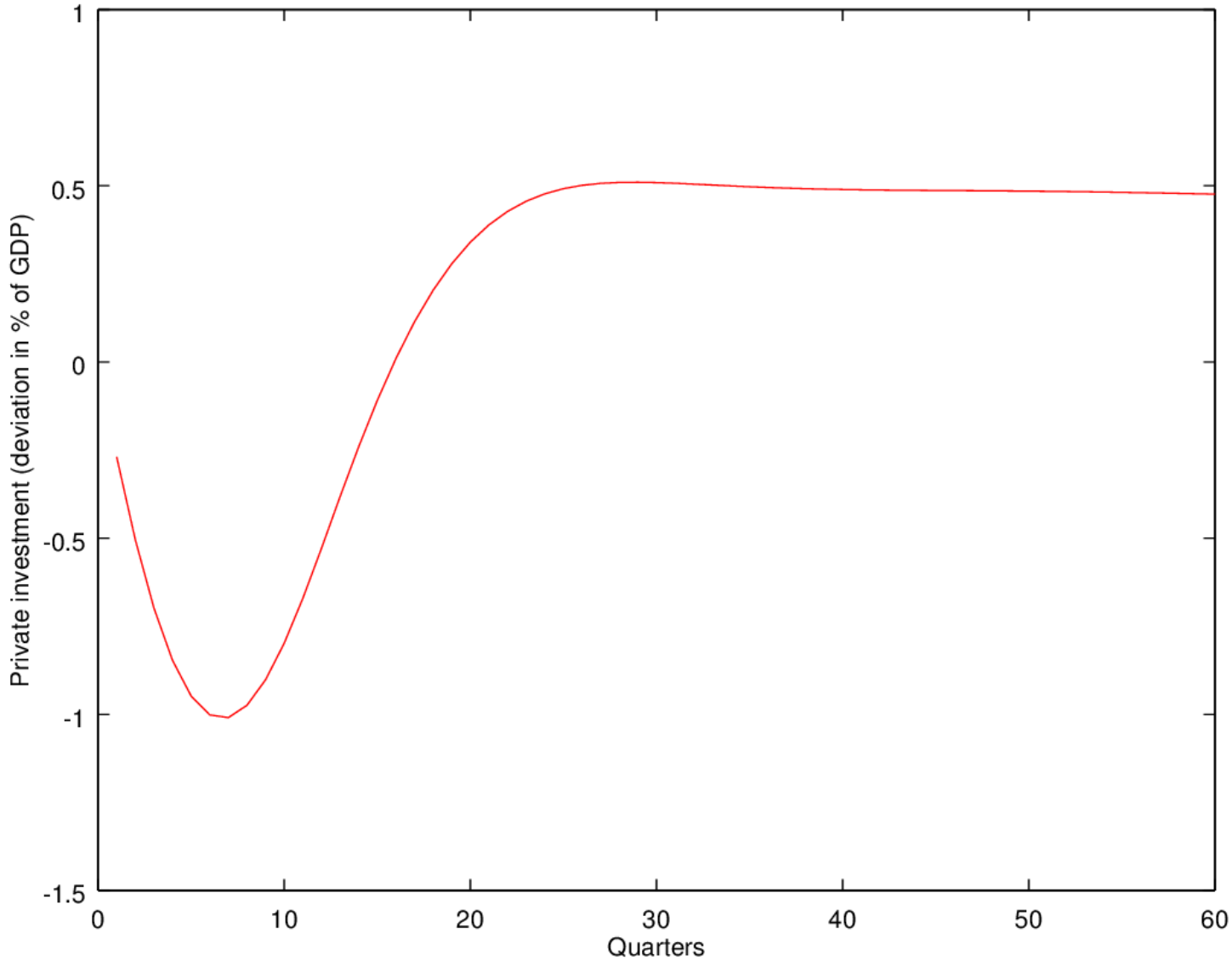
Public debt-to-GDP ratio

Baseline scenario, deviation from steady state



Private investment

Baseline scenario, deviation from steady state



Dynamic multipliers

Baseline calibration

	1 year	*3 years*	*10 years*	*20 years*
Without leverage	1.0	0.8	2.2	4.1
With leverage of 5	5.2	4.2	13.0	24.0

Outline

The dual effect of a public investment push

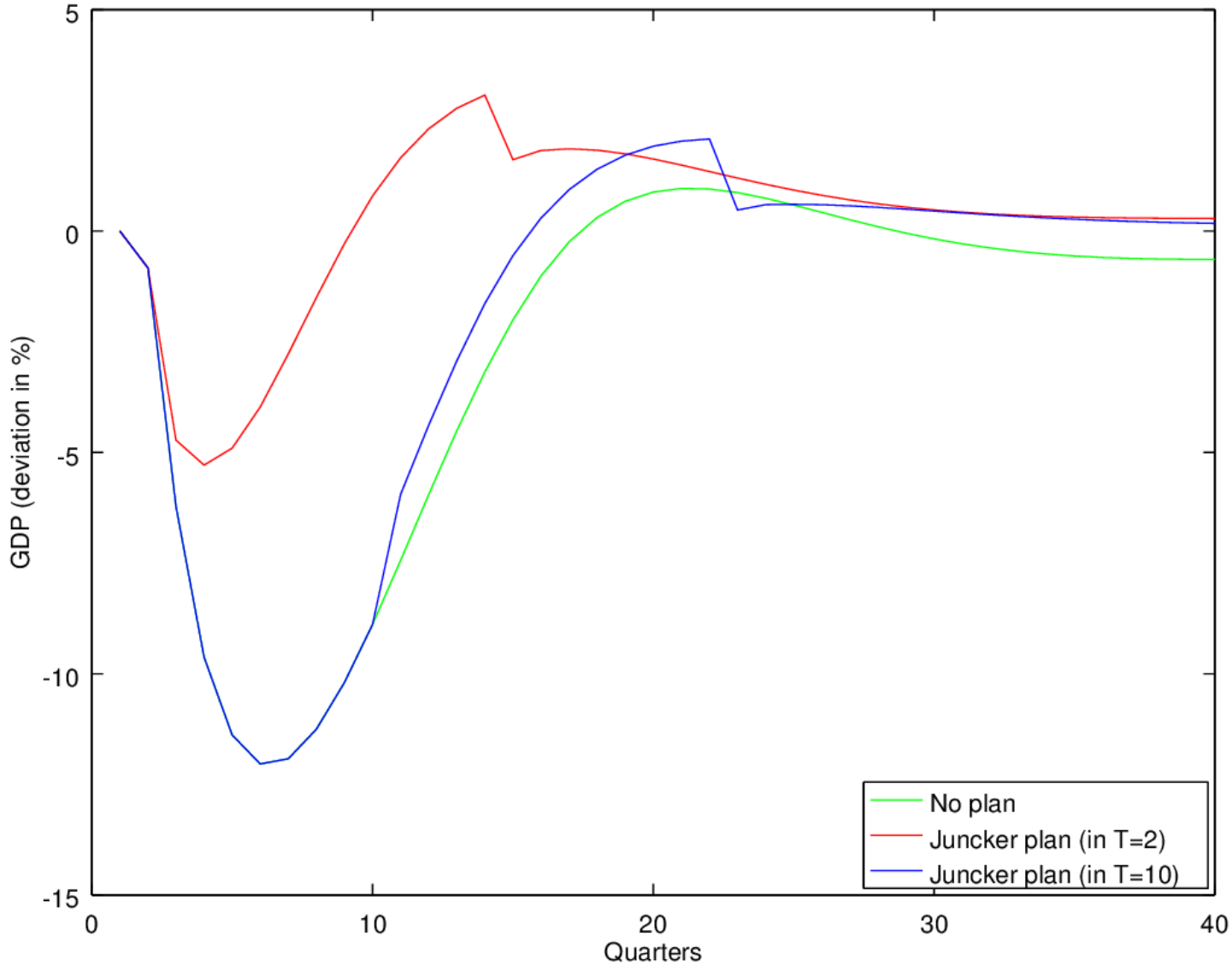
- Short run: demand effect, hence inflationary
- Long run: supply effect, hence deflationary
- Time-to-build governs relative timing of the two
- Bouakez et al. (2014): longer time-to-build beneficial in ZLB

Simulating a liquidity trap

- Shock to time preference rate (negative demand shock)
- Solution method: extended path
- Multiple equilibria problem: equilibrium selection based on Euro area experience
- Without government intervention
  - ZLB lasts 14 quarters
  - GDP through at 12% below pre-crisis level, 5 quarters after shock

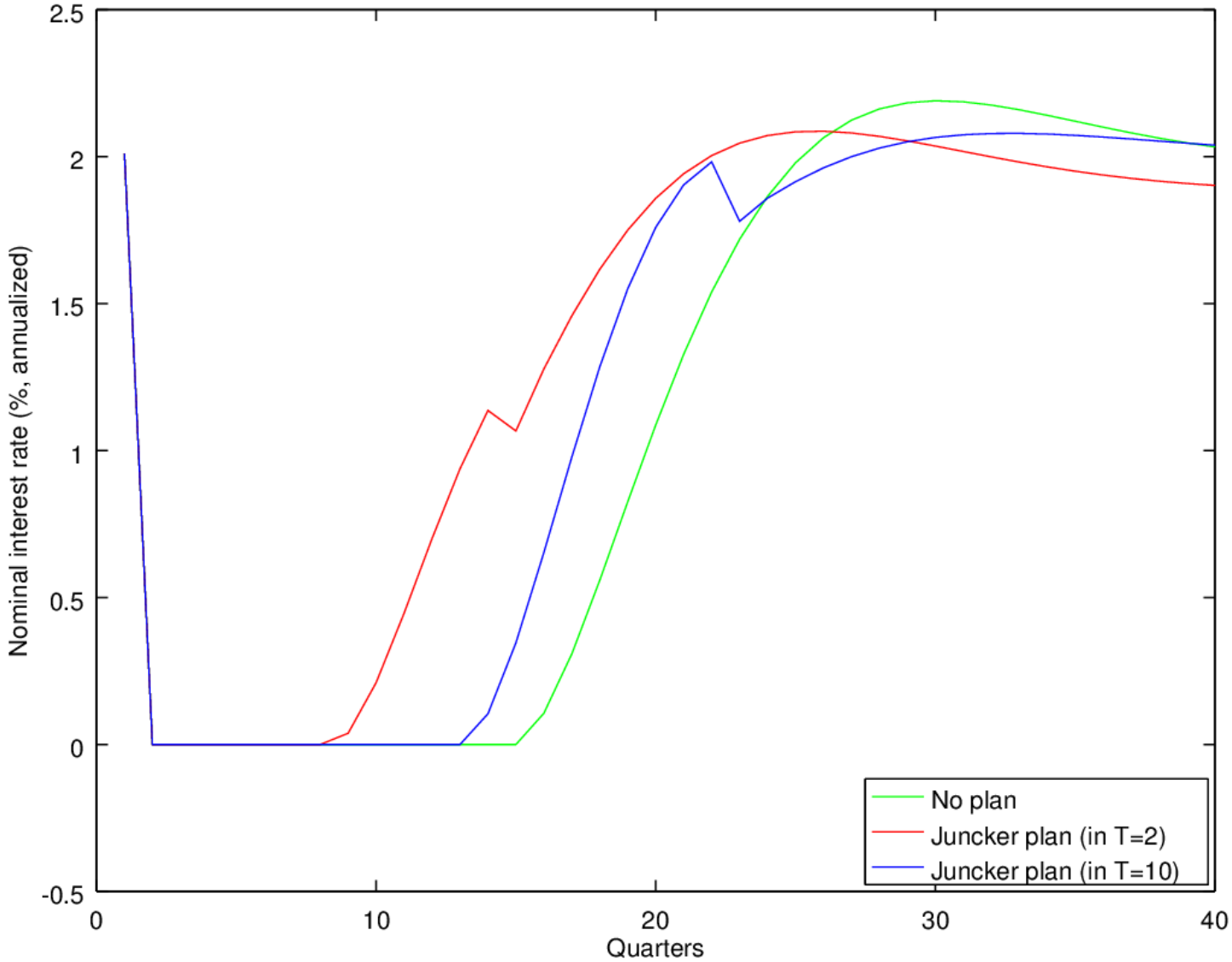
Impact on GDP

ZLB case, deviation from steady state



Nominal interest rate

ZLB case



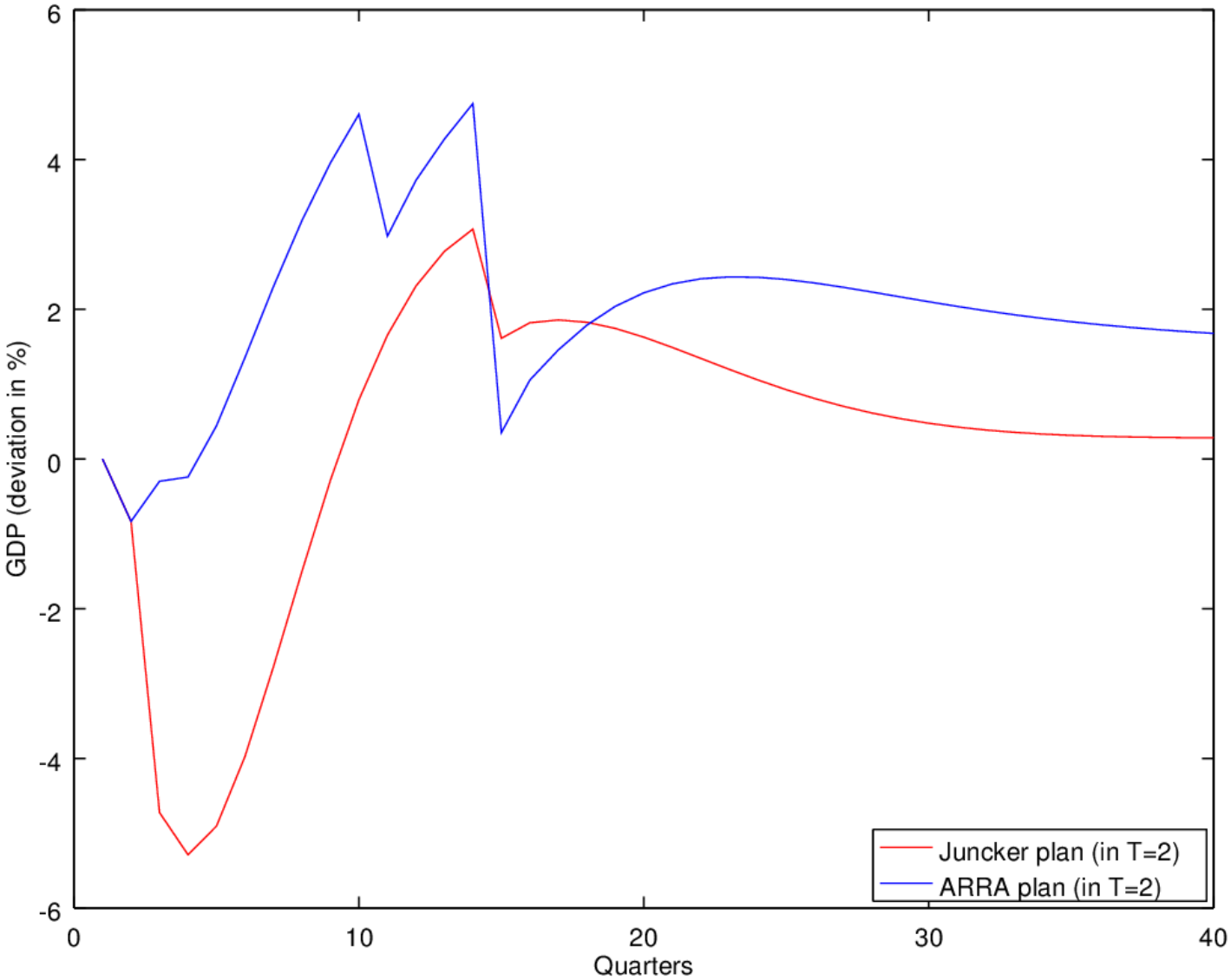
Outline

The Obama plan

- American Recovery and Reinvestment Act (ARRA)
- \$789bn = 5.5% GDP
- 4% GDP over 2 years in tax breaks, 1.5% GDP public investment
- Quick implementation: voted Feb 2009, disbursements in summer

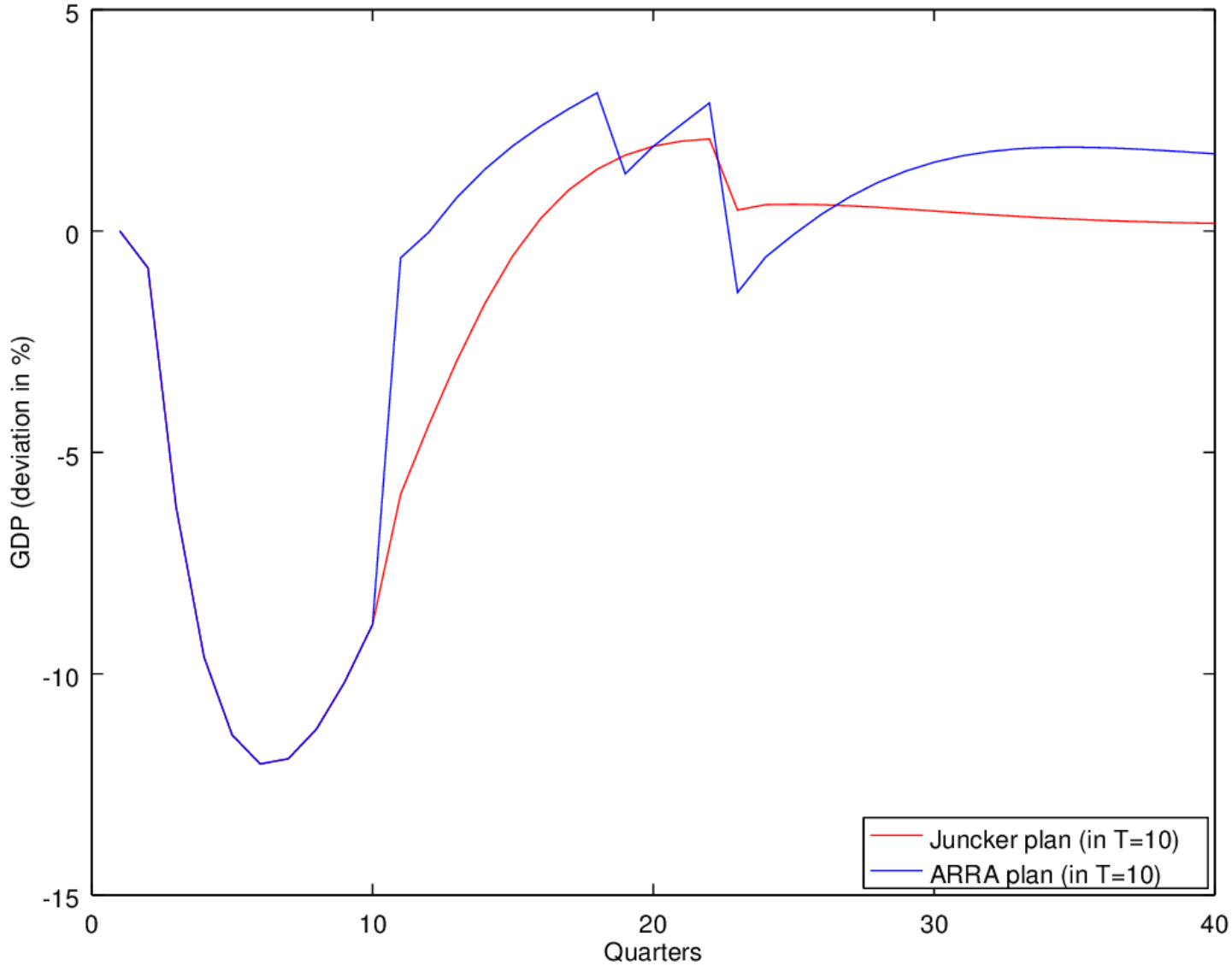
Impact of Juncker and Obama plans (in T=2)

ZLB case, deviation from steady state



Impact of Juncker and Obama plans (in T=10)

ZLB case, deviation from steady state



Outline

Sensitivity of dynamic multipliers

To elasticity of production to public capital

Elasticity (ν)	*1 year*	*3 years*	*10 years*	*20 years*
0	1.12	0.79	0.24	−0.08
0.05	1.07	0.78	1.21	1.98
0.10	1.02	0.77	2.19	4.05
0.15	0.97	0.76	3.17	6.13
0.17	0.95	0.76	3.57	6.96

Sensitivity to time-to-build

- Reducing time-to-build has two effects:
  - demand effect short-lived (crowding out disappears)
  - deflationary effect comes sooner (bad for ZLB exit)
- Last property (Bouakez et al., 2014) verified:
  - if TTB of 1 quarter, ZLB exit is postponed
  - if plan at $T = 2$, by 6 quarters (and recession worsened)
  - if plan at $T = 10$, by 1 quarter

Sensitivity to private leverage

- Fiscal multiplier = quasi-linear function of private leverage
- However non-linear impact on debt-to-GDP: increase if no private leverage
- Important for pulling economy out of ZLB. If no private leverage, multiple equilibria (for Juncker plan at $T = 2$):
  - good equilibrium worse than with private leverage (2 more quarters in ZLB)
  - bad equilibrium: slightly worse than no government intervention (deflationary impact of public investment dominates)
- Policy conclusion: if private support does not follow expectations, need for bigger public involvment

Outline

Conclusion

- Initial intuition of "too little and too late" confirmed
- Criticism could be rephrased as "probably too little, certainly too late"
- Points to major flaw in European governance: rapidity of reaction
- Institutional architecture needs to be adapted to the post-"Great Moderation" world
- Limitations of our exercise: replication of the ZLB and of the plan complexity