Discussion of

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Fiscal Policies for Innovation and Growth: Firm level evidence of public support to R&D

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Summary of results:

1) Growth:

Encourage R&D: Private firms should increase R&D spending by 40%. This increases GDP level by 5% in the long run.

Advanced economies can achieve this by fiscal incentives (and public investment in R&D).

The private rate of return to business R&D is high: typically between 20 and 30% (Hall, Mairesse, Mohnen).

Returns also depend on human capital base: '...R&D can potentially yield high returns, provided there is a sufficiently educated workforce.'

According to meta-analysis (329 estimates) of Donselaar and Koopmans (2016): dR&D 40% => dGDP: 5% (with spillovers the GDP impact would be 8% if coordinated among G7)

Fiscal cost 0.4% of GDP each year.

Which fiscal incentives? R&D subsidies, Tax incentives.

2) Stabilisation:

Support R&D in recessions.

Annex 2.1: Industry level data, higher fiscal counter-cyclicality increases R&D expenditure significantly more in industries that are highly dependent on external finance.

NOTE: Not a direct measure of counter cyclical R&D policy is used but a general measure of the responsiveness of the fiscal balance on the output gap.

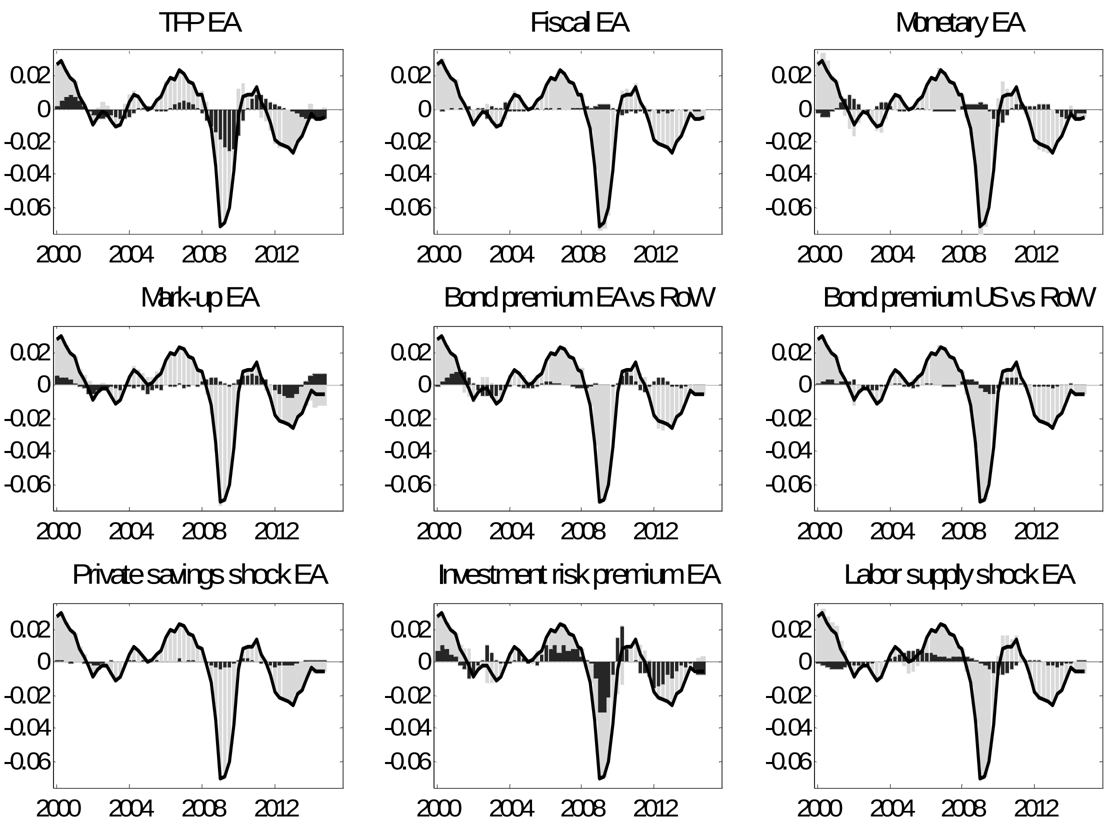
3) Do less:

On supporting small businesses (small business trap).

My discussion concentrates on 1 and 2

Motivation:

The 2009 financial crisis has led to a slowdown of TFP growth, which explains a significant part of the growth slowdown.



How does the rate of return translate into TFP effects of R&D?

Government support of R&D can be motivated by high social returns of knowledge investment

$$Y = L^{\beta} K^{\alpha} A^{\gamma} \exp(\lambda t)$$

With: L: labour; K: physical capital; A: knowledge (patents)

$$TFP = A^{\gamma} \exp(\lambda t)$$

Rate of return on knowledge capital

$$\frac{\partial Y}{\partial A} = RR = \gamma \frac{Y}{A}$$

Implication for TFP growth contribution of R&D:

$$\Delta tfp = \lambda + RR * \frac{\Delta A}{Y}$$

RR=20% and R&D share of 2.5% can explain an annual TFP growth of 0.5%

Note: Trend TFP growth in the EA is currently at around 0.4%

1) Estimates are very uncertain: (Ugur et al. (2016) Research Policy)

Recent meta studies provide ranges from: 11% to 40%

Ugur et al.: Mean gross rate of return 14%

Note: This contains depreciation (not physical but technological obsolescence: creative destruction).

Other sources of TFP growth:

Human capital formation

Start ups (new ideas)

2) One must be careful when interpreting these estimated rate of return measures

The R&D share is not a policy parameter but is itself the result of the availability of R&D resources (qualified natural scientists and engineers, research infrastructure, sector composition)).

When extrapolating (esp. increasing R&D expenditure by 40%) one should consider:

1. Non linearity

2. Crowding out

3. Reallocation effects

2.1 Nonlinearity (decreasing returns):

⇒ The quasi linearity (constant RR with varying R&D share) is not guaranteed: This is especially relevant if one thinks of increasing R&D share by 40%. Such increases could be associated with a substantial decline of RR.

This is for example suggested by semi-endogenous growth models

Knowledge production

$$\Delta A_t = \nu A_t^{\theta} L_t^{H\,\mu}$$

Linear in growth: $\theta = 1$ => Increasing L^H increases the growth rate of knowledge permanently

Linear in level: $\frac{\mu}{\theta - 1} = 1$ => Increasing L^H by x% increases A by x%

Estimated: $\theta = 0.58 < 1$ and $\frac{\mu}{\theta - 1} \approx 1$ =>evidence for linearity in levels

2.2 Crowding out:

Especially when there are supply constraints (for scientists), an increase in the demand for R&D could result in a wage increase for high skilled workers. (Goolsbee, 1998)

$$\frac{R\&D}{GDP} = \frac{W^{H} * L^{H,R\&D}}{P * Y}$$

2.3 Reallocation effects

An increase of R&D could be associated with a relocation of resources (high skilled workers) from production into R&D. There can be a trade-off between higher R&D output and declining efficiency of production (esp. in the short run).

$$L^{H} = L^{H,R\&D} + L^{H,Prod}$$

Illustrate these points by using the QUEST model:

Semi endogenous growth model (with the 3 features)

$$Y = L^{\beta} K^{\alpha} A^{\gamma} \exp(\lambda t) = L^{\beta} K^{\alpha} A^{(mup\ (\sigma))\alpha} \exp(\lambda t)$$

The output elasticity of knowledge capital (γ) is a function of:

output elasticity of physical capital (innovations increase the efficiency of physical capital)

and

degree of complementarity/substitutability of new intermediate capital goods.

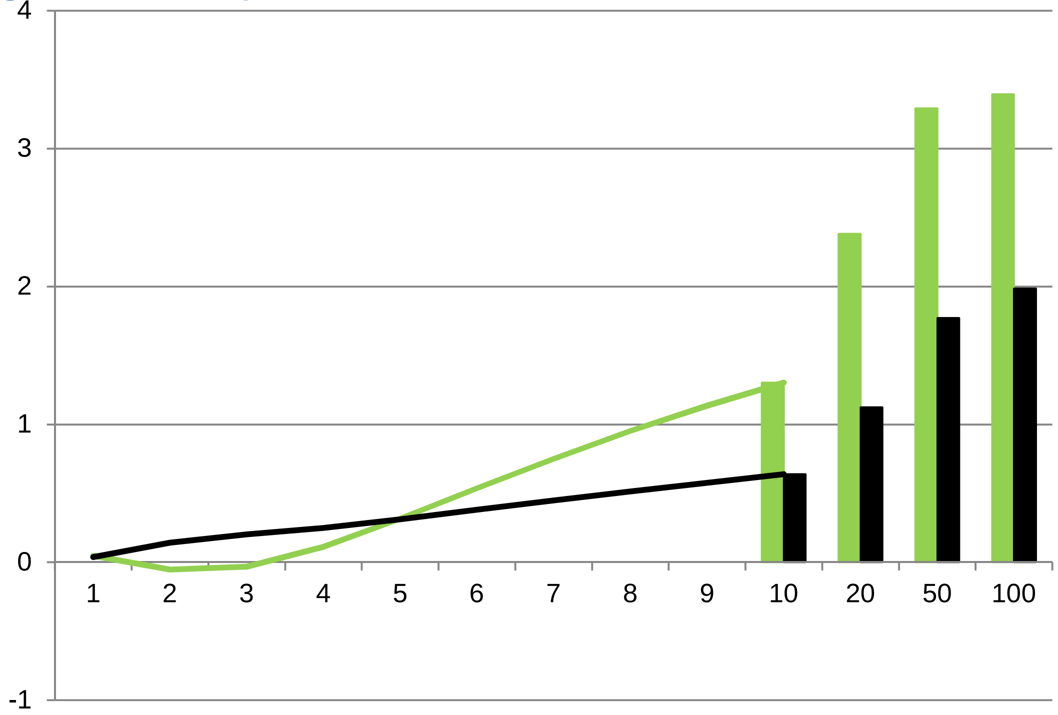
Estimation uncertainty related to degree of substitutability. Often used measure: mark up in the intermediate sector (manufacturing). Estimates range from 10% to 30%.

MUP 30%: 0.3*0.4*0.05 => 0.6% TFP growth

MUP 10%: 0.1*0.4*0.05 => 0.2% TFP growth

Experiment:
R&D subsidies: 0.4% of GDP (compared to public investment)

GDP level effect (100 years)
High Mark up case: RR ca. 25%



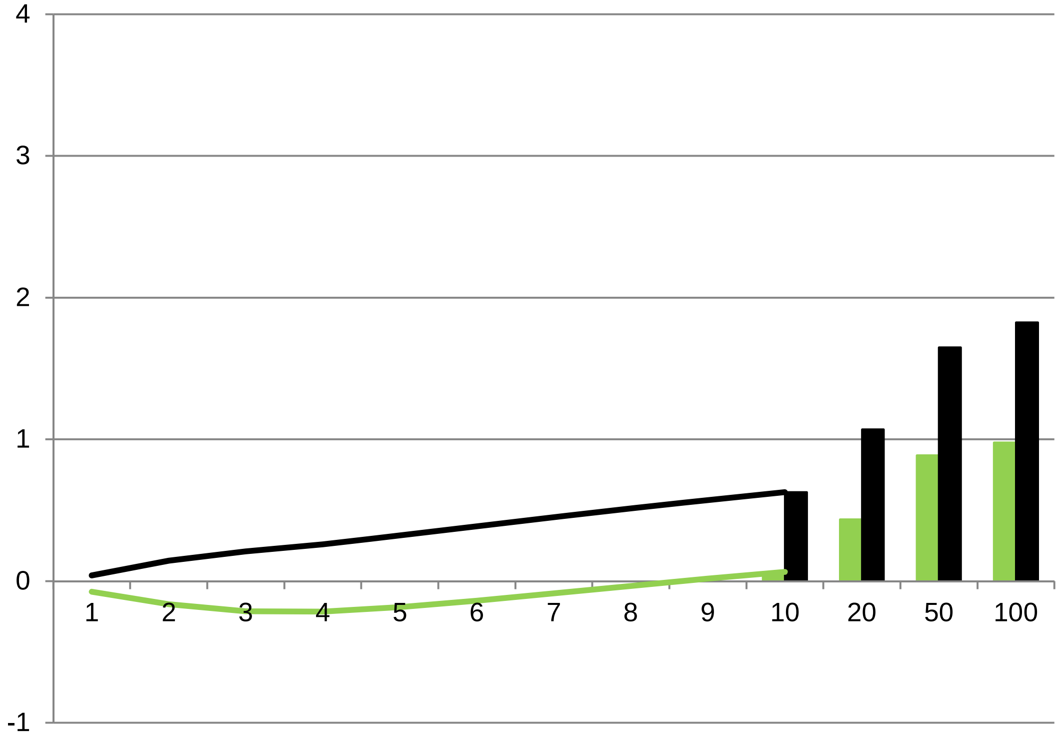
Because of relocation effects, it takes time for effects of R&D support to emerge.

Casts doubt on R&D policy as a stabilisation instrument.

Experiment:
R&D subsidies: 0.4% of GDP (compared to public investment)

GDP level effect (100 years)

Low Mark up case: RR ca. 10%



Experiment: R&D subsidies: 0.4% of GDP

High Mark Up (30%) => RR: 25%

R&D 0.4% of GDP													
Years	1	2	3	4	5	6	7	8	9	10	20	50	100
GDP	0,05	-0,05	-0,03	0,11	0,32	0,54	0,75	0,95	1,14	1,30	2,38	3,29	3,39
Patents	0,34	1,65	3,68	5,94	8,15	10,21	12,06	13,71	15,17	16,46	23,48	25,58	24,73
High-med	0,92	2,27	3,09	3,32	3,29	3,19	3,08	2,98	2,88	2,79	2,35	2,18	2,19
Lump-s. tä	-0,05	-0,14	-0,18	-0,23	-0,28	-0,34	-0,40	-0,47	-0,54	-0,61	-1,02	-0,91	-0,79
IG 0.4% of GDP													
Years	1	2	3	4	5	6	7	8	9	10	20	50	100
GDP	0,04	0,14	0,20	0,25	0,31	0,38	0,45	0,51	0,58	0,64	1,12	1,77	1,98
Patents	0,00	-0,01	-0,02	-0,03	-0,04	-0,04	-0,04	-0,04	-0,04	-0,04	-0,01	0,01	0,01
High-med	0,02	0,04	0,02	0,00	0,00	0,00	0,01	0,01	0,01	0,01	-0,01	-0,02	-0,03
Lump-s. tä	0,01	0,06	0,13	0,18	0,22	0,24	0,25	0,24	0,23	0,21	-0,01	-0,12	-0,08

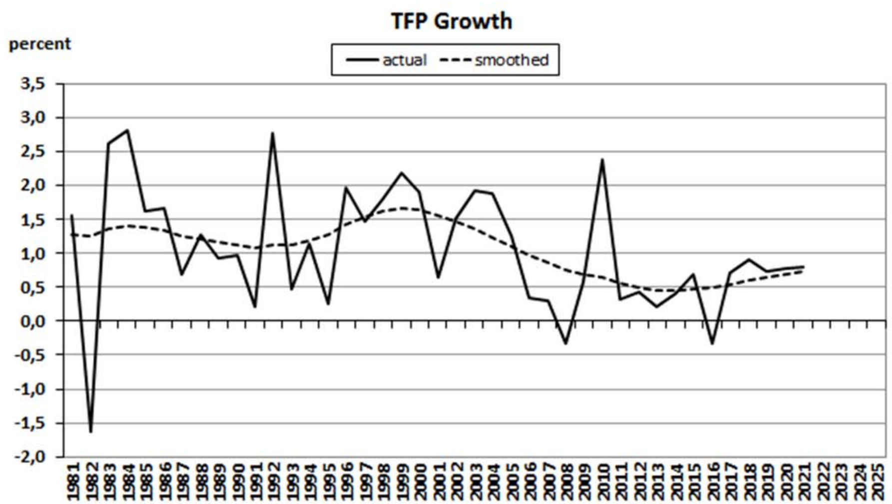
Low mark Up (10%)

R&D 0.4% of GDP													
Years	1	2	3	4	5	6	7	8	9	10	20	50	100
GDP	-0,08	-0,16	-0,21	-0,21	-0,18	-0,14	-0,09	-0,03	0,02	0,07	0,43	0,89	0,98
Patents	0,21	1,15	2,73	4,56	6,43	8,23	9,94	11,53	13,00	14,38	23,66	30,39	29,75
High-med	0,62	1,87	2,81	3,16	3,23	3,21	3,18	3,15	3,11	3,08	2,86	2,71	2,70
Lump-s. tä	0,00	0,03	0,08	0,11	0,14	0,15	0,16	0,15	0,15	0,13	-0,05	-0,18	-0,17
IG 0.4% of GDP													
Years	1	2	3	4	5	6	7	8	9	10	20	50	100
GDP	0,04	0,15	0,21	0,26	0,32	0,39	0,45	0,51	0,57	0,63	1,07	1,65	1,82
Patents	0,00	-0,01	-0,03	-0,04	-0,05	-0,05	-0,05	-0,05	-0,04	-0,04	0,02	0,09	0,10
High-med	0,01	0,03	0,03	0,01	0,01	0,02	0,02	0,02	0,02	0,02	0,02	0,01	0,01
Lump-s. tä	0,02	0,07	0,15	0,22	0,26	0,29	0,30	0,30	0,30	0,28	0,07	-0,07	-0,07

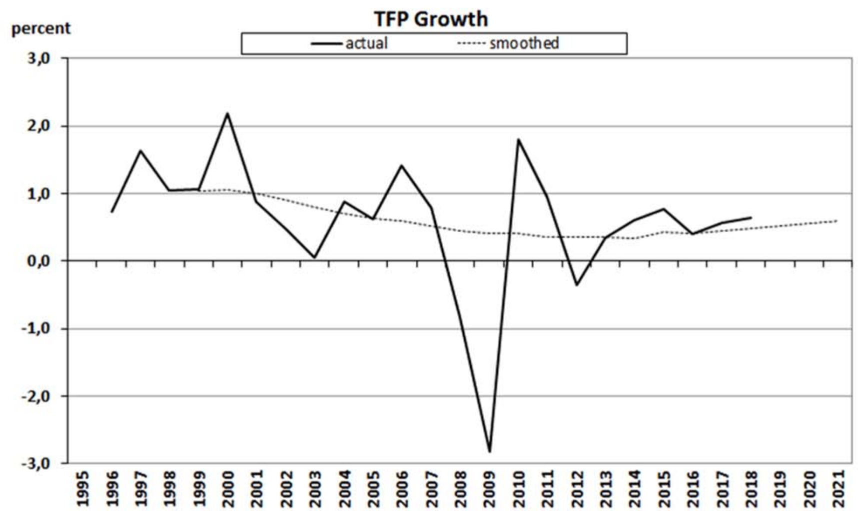
Is Technology/R&D a major factor for explaining the post crisis slump?

The TFP evidence: Trend TFP growth declined both in the EA and the US

US:

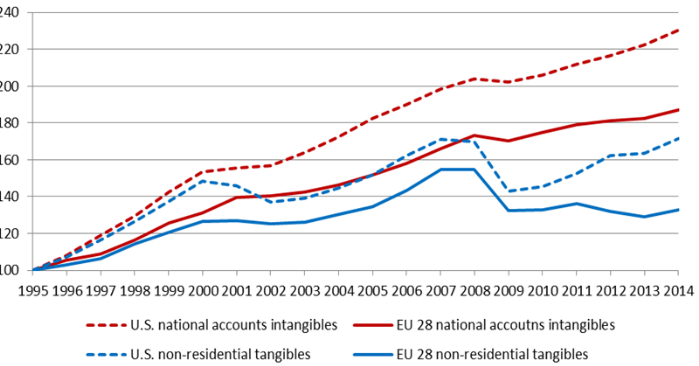


EA 19



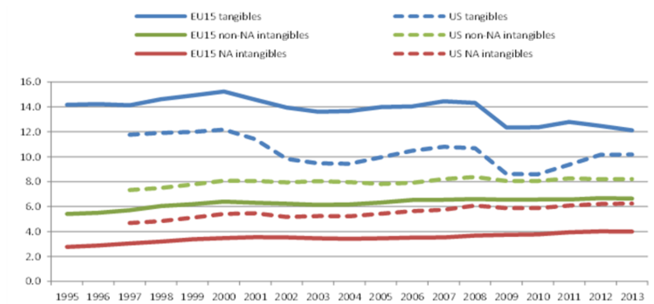
But: Intangibles less affected by 2009 recession than physical capital

Graph 1: Non-residential intangible and tangible investments in the EU-28 and the U.S., total economy; Chain linked volumes, index 1995 = 100



Sources: Eurostat national accounts for EU-28, BEA for U.S., ECFIN (B2)

Graph 3: Business sector non-residential GFCF by asset type, EU-15 vs. US (% of business sector GVA)



Note: Business sector defined as NACE Rev. 2 activities A to N (excluding L) plus R and S.
Source: ECFIN calculations based on INTAN-invest data and Eurostat/BEA national accounts data (business sector GVA).

NA Intangibles: R&D+software

Tentative conclusion from these two pieces of evidence:

The decline of TFP growth cannot be explained by a slowdown of R&D investment, but could possibly be explained by a slowdown of adoption of new technologies (e. g. financing constraints of start ups).

R&D policy for fiscal stabilisation?

There is little evidence that R&D is very cyclical.

R&D is usually conducted in a relatively stable business environment (research labs in large companies). Work is done by very specialised and (long) trained personnel. Search costs for increasing research staff plus supply constraints for this type of labour are probably severe in the short run.

Also macro effects appear to have long lags. Creative destruction could make this even worse.