Welfare Effects of European R&D Support Policies

Dirk Czarnitzki Elena Huergo Mila Köhler
Pierre Mohnen Sebastian Pacher
Tuomas Takalo Otto Toivanen

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Motivation

- R&D subsidies constitute one of the largest forms of industrial support in OECD countries.
- R&D tax credits used in an increasing number of OECD countries.
- Both policy tools used also in developing countries (e.g. India).
- $>$ 100Bio\$/p.a spent on support.
- Ongoing discussion about the effectiveness of public support to private R&D.
- Justifications for policies: spillovers, financial market imperfections, effects at the extensive margin (whether to do R&D or not).

Objectives

- Ultimate goal of ex-post evaluation: Does the policy increase welfare?
- Little research looking at whether R&D support policies welfare enhancing (excl. Acemoglu, Akcigit, Bloom & Kerr 2014, König, Liu & Zenou 2014, TTT 2013, 2014).
- Next to no such research that uses data on R&D subsidies.
- We seek to measure the welfare effects of the policy.
- Conduct counterfactual analysis, comparing (optimal) subsidy and tax credit - policies against laissez - faire.
- Counterfactual of EU-wide innovation policy.

Approach

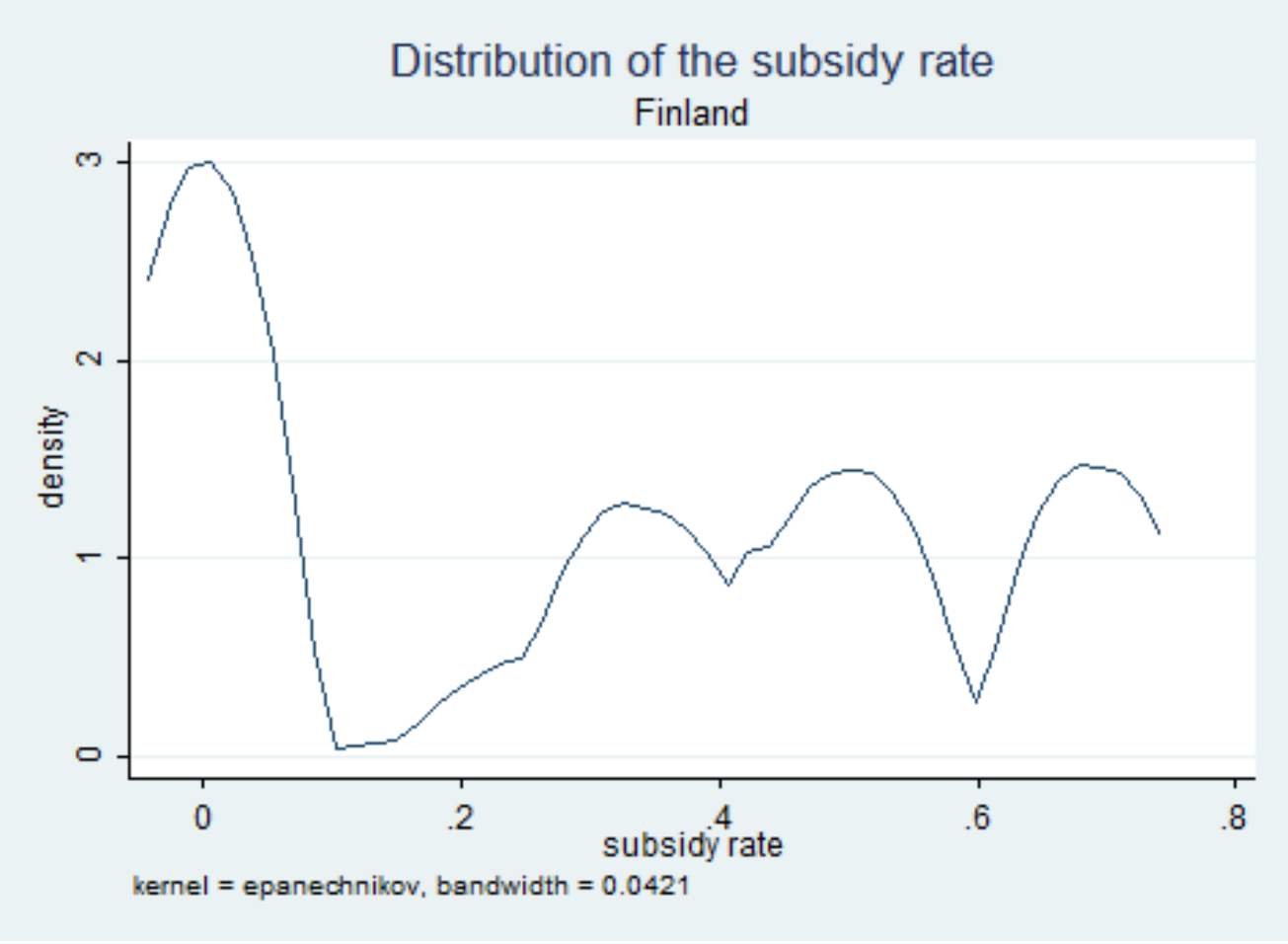
- Structural econometric modeling of R&D support policies (e.g., Bloom, Griffith, van Reenen 2002 & Jaumandreu, Gonzalés, and Pazò 2005, TTT2013)
- Model the behavior of firms and the subsidy agency in a regime of R&D subsidies, and R&D tax credits.
- Allow for intensive and extensive margin (how much R&D, whether to invest in R&D or not).
- Allow for financial market imperfections.
- Explore their effect on subsidy decisions, and their identification.
- Estimate the model using Belgian, Finnish & German R&D project level data.

Approach

- Use decisions to learn parameter values $\Longrightarrow$ Revealed preference.
- Firm R&D levels tell about profitability of the last R&D euro.
- Firm decision (not) to invest in R&D reveals fixed costs.
- Firm decision (not) to apply for a subsidy reveals costs of applying.
- Government (agency) decision on the subsidy rate tells about the value of the last R&D euro to the government.

Approach

Agency decision - Finland



Current policies

Table 1. Description of R&D Support Policies

	Belgium/Flanders	Finland	Germany
Subsidies	YES	YES	YES
max (max SME)	0.7 (0.8)	0.6 (0.7)	0.7
thematic/generic	NO/YES	YES/YES	YES/YES
basic/applied	YES/YES	YES/YES	YES/YES
soft loans	NO	YES	NO
interest rate	-		-
tax credits	YES	NO	NO
only central gov.	YES	YES	YES

1. Model

Structure of the model

- Each firm has an idea (one / period).
- Ideas vary in quality both across firms, and w/in firm across time.
  - Quality has two dimensions:
    1. How large profits the idea generates / euro of R&D.
    2. How large spillovers the idea generates / euro of R&D.
- Firms have no funds of their own
  - can/must raise funding from both public and private sources.
- There is a fixed cost to start R&D, also varying across firms.
- There is a cost to apply for a subsidy.

1. Model

Structure of the model

Four stage game of incomplete information between a firm (with an R&D idea/project), the public agency, and a (competitive) financier:

1. Firm decides whether or not to apply for a subsidy.
2. Agency screens and decides on subsidy rate. Agency decision rule known, but agency type not.
3. Firm raises outside funding from competitive financiers. Double MH (Holmstrom & Tirole 1997).
4. Firm decides whether or not to invest, and how much.

1. Model

Firm decisions

$$\Pi^E(R,s) = (1-\tau)[PA\ln R - (\rho - s(1-\tau_w) - \tau_w)\,R - \rho F]. \quad (1)$$

$$\Pi^E\left(R^{**}(s),s\right) = \alpha[\ln\alpha - \ln(\rho - s(1-\tau_w) - \tau_w) - 1] - \rho F \geq 0. \quad (2)$$

$$\mathbb{E}_v\left[max\left\{0,\Pi^E\left(R^{**}\left(s^*\right),s^*\right)\right\}\right] - K \geq max\left\{0,\Pi^E\left(R^{**}\left(0\right),0\right)\right\} \quad (3)$$

1. Model

Agency decision

$$U(R(s),s) = vR(s) + \Pi^E(R(s),s) + \Pi^B - g[s(1-\tau_w)+\tau_w]R(s) \tag{4}$$

$$s^{**} := \arg\max_{s\in\mathbb{R}} U(R^{**}(s),s) = \frac{v+(\rho-\tau_w)(1-g)-g\tau_w}{1-\tau_w}. \tag{5}$$

$$\widehat{s} := \frac{1}{1-\tau_w}[\rho-\tau_w-\exp(\ln\alpha-1-\frac{\rho F}{\alpha})] \tag{6}$$

2. Alternative policies

Optimal tax credit

- We scrap the subsidies s and introduce a tax credit τ_w.
- Now firm gets τ_w for sure, if only it invests.
- Agency optimizes τ_w over all firms' projects.
- We keep the objective of the agency fixed.
- We take into account that τ_w affects both the number of executed projects, and their scale.

2. Alternative policies

Others

- Laissez-faire: no public support.
- 1^{st} best: Projects executed at the level the gov. would want, regardless of profitability.
- 2^{nd} best: Projects executed at the level the gov. would want, but only if profitable.

2. Alternative policies

European innovation policy

- Assume a European-wide agency deciding on subsidies.
- Takes into account European spillovers instead of only domestic ones.
- We model these through (industry-specific) patent citations across countries.
- $\Longrightarrow$ larger subsidies $\Longrightarrow$ more R&D for applicants$\Longrightarrow$ higher probability of applying for subsidies.

3. Data

In each of the countries

- All firm applications between (max. observation period 2000 - 2010, varies by country).
- $s_i > 0$.

Registry data

- R&D participation.
- age, sales, employment, industry, region.
- Treat as a repeated cross-section.

3. Data

We observe the following decisions:

- Firms decision to invest or not into R&D for all firms (40 - 60%).
- Actual R&D at project level, conditional on receiving a subsidy (300-700 K€).
- Firms decision to (not) apply for a subsidy (some 3- 20% do).
- The agency's subsidy rate decision, conditional on an application (average subsidy $30-50\%|$ acceptance; $\Pr(accept) = 0.6-0.8$).

6. Counterfactual

Regimes

1. First best: Agency decides R&D & participation.
2. Second best: Agency decides R&D, firm decides participation.
3. Laissez-faire: No public support.
4. Optimal R&D tax credit.
5. Current policy.
6. EU-wide innovation policy (only Belgium for now).

6. Counterfactual

R&D investment

Table 9 Counterfactual R&D investment estimates

	Belgium/Flanders	Finland	Germany
laissez-faire	167 000	278 000	54 000
1st best	697 000	774 000	156 000
2nd best	685 000	769 000	171 000
optimal tax credit	270 000	330 000	93 000
current policy	316 000	381 000	54 000

6. Counterfactual

R&D participation

Table 10 Counterfactual R&D participation estimates

	Belgium/Flanders	Finland	Germany
laissez-faire	0.41	0.57	0.40
1st best	0.44	0.59	0.43
2nd best	0.30	0.50	0.38
optimal tax credit	0.42	0.58	0.42
current policy	0.41	0.57	0.40

6. Counterfactual

Welfare

Table 15 Counterfactual welfare estimates

	Belgium/Flanders	Finland	Germany
laissez-faire	3 284 000	5 337 000	349 000
1st best	3 381 000	5 428 000	362 000
2nd best	3 307 000	5 424 000	361 000
optimal tax credit	3 307 000	5 341 000	353 000
current policy	3 314 000	5 349 000	349 000
	Belgium/Flanders	Finland	Germany
1st best	1.03	1.02	1.04
2nd best	1.03	1.02	1.03
optimal tax credit	1.01	1.00	1.01
current policy	1.01	1.00	1.00

6. Counterfactual

EU subsidy policy vs. other policies - outcomes for Belgium & Germany

Table 13 Counterfactual welfare estimates - EU policy

	Belgium	
	EU Welfare	Relative to laissez-faire
laissez-faire	3 425 000	1
1st best	4 090 000	1.19
2nd best	4 066 000	1.19
optimal tax credit	3 534 000	1.03
current policy	3 604 000	1.05
EU subsidies	3 726 000	1.09

7. Conclusions

Policy conclusions for national policies:

- R&D support policies generate higher R&D and spillovers,
- but clearly below the social first best.
- Increase in welfare modest.
- Room for welfare improvement.

European innovation policy:

- increases clearly subsidy rates and hence probability of applying and R&D $\mid s > 0$ and spillovers.
- has more room for welfare improvement.
- leads to higher welfare increase than at national level.