

Are R&D tax incentives so effective? A meta-regression analysis

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Motivations

- Limitations R&D subsidies: allocation issues. Persistence of getting subsidies with specialized assets (Peters, 2009), corruption (Faccio et al. 2007).
Reduced effectiveness (Ugur et al. 2016, Dimos and Pugh, 2016). Tax incentives as an alternative to sustain R&D: mitigates risk of picking losers (Dechezlepretre et al. 2016), market-based
- Inconcluding results - specificities of schemes affect the additionality effect found in the literature across countries (Thomson, 2013)
- How can we explain the heterogeneous results found in the literature? To which extent are the features of R&D tax incentives responsible for these differences in effectiveness?

Literature review

- Focus on sources of publications bias
- Castellacci and Lie (2015): sampling (SMEs, and services, low tech). Volume higher than incremental but country dummies limit the comparative analysis
- Ladinska-Gaillard et al (2015): no effect of SMEs but effect from methodology: RD stock vs flow, GMM, and publication status

Diverse avg effects across schemes

- **Volume:** reduced barriers to entry in R&D - attractive for SMEs (financial constraint)
Incremental: rewards persistent R&D players benefit from it (large firms). Reduced risk of relabelling but distortion of R&D investments
Hybrid: at crossroads by having a volume and incremental component
- Mitigating the effects of type scheme by increasing the **generosity** of the refund, **targeted**, and **enhanced deduction**
- Overall effect mediated by the capacity to **learn** how to claim R&D deduction (Hall, 2019)

Inclusion criteria

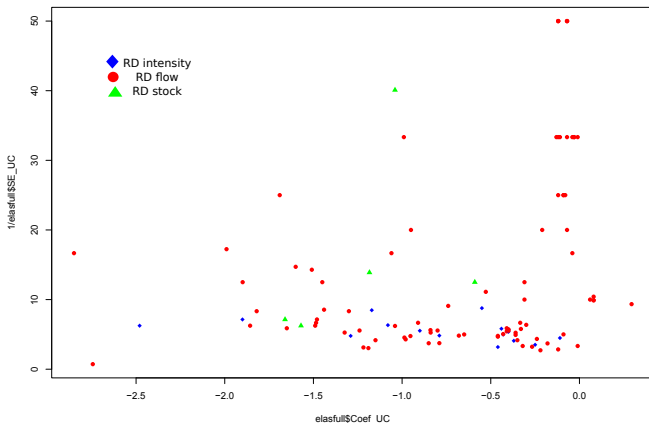
- Data collection: Google Scholar and IDEAS/RePeC
Structural approaches at the firm level for one given country
Economic meaning of the effect of tax incentives (short-run effect)

$$RD_i = \beta_0 + \beta_1 \times UC + \text{Controls} + v_i \quad (1)$$

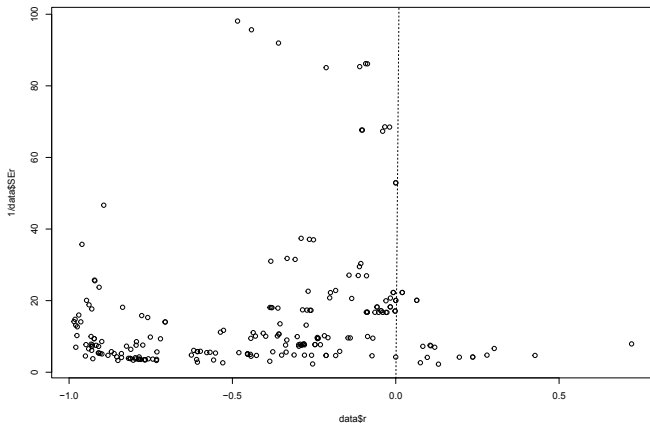
- Sample: 213 estimations from 23 papers. 108 elasticities and various other statistical relationships between UC and RD
- Transformation: Partial Correlation Coefficient for main estimations and elasticities for robustness checks

$$r_{i,s} = \frac{t_{i,s}}{\sqrt{t_{i,s}^2 + df_{i,s}}} \quad SEr_{i,s} = \sqrt{\frac{1-r_{i,s}^2}{df_{i,s}}} \quad (2)$$

User Cost and R&D across studies



Standardizing the link with User Cost and R&D



MRA

■ Meta analysis

FAT-PET-PEESE (Funnel asymmetry test - Precision effect test - Precision effect estimate with standard error). Estimations with smaller samples, larger standard errors, must be weighted. WLS with inverse of variance (or SE)

$$\text{Estimate}_{i,s} = \underbrace{\beta_{0,i,s}}_{\text{True effect}} + \underbrace{\beta_{1,i,s} \times SE_i^2}_{\text{Publication bias}} + \epsilon_{i,s} \quad (3)$$

■ Extended MRA with FAT-PET to assess the sources of heterogeneity

$$\text{Estimate}_{i,s} = \beta_{0,i,s} + \sum_k \beta_k \times Z_k + \beta_{1,i,s} \times SE_i + \sum_j \delta_j K_j \times SE_i + v_{i,s} \quad (4)$$

Variables to tackle heterogeneity

Variable	Definition
K variables	
RDflow	1 if the RD outcome variable was RD expenditures (flows), 0 if RD stock/intensity
RDstock	1 if the RD outcome variable was RD stock, 0 if RDflow/intensity
Published	1 if published in peer-reviewed journals, 0 if working paper
Modeltype	1 if linear GMM estimations, 0 otherwise
Sectors	1 if manufacturing and services/agri are considered, 0 if manufacturing only
Small	1 if only small firms are considered, 0 if large or all firms pooled
Large	1 if only large firms are considered, 0 if SMEs or all firms pooled
Z variables	
Vol	1 if the tax scheme is volume-based, 0 if hybrid or incremental
Incr	1 if the tax scheme is incremental, 0 if hybrid or volume
Target	1 if SMEs have a specific refundability rate/rule, 0 otherwise
Deduction	1 if enhanced deduction, 0 otherwise
Max. rate	max rate applied (beyond the normal regime, or for SME)
Min. rate	normal rate, or the one for large companies
Exp	number of years since the first tax incentive scheme was introduced (difference to the first studied years)

Summary statistics

Table: Descriptive statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Response variable							
r	213	-0.433	0.363	-0.985	-0.787	-0.139	0.722
SEr	213	0.133	0.091	0.010	0.057	0.196	0.443
K variables							
RDflow	213	0.606	0.490	0	0	1	1
RDstock	213	0.136	0.344	0	0	0	1
RDintensity	213	0.258	0.439	0	0	1	1
Published	213	0.545	0.499	0	0	1	1
Modeltype	213	0.451	0.499	0	0	1	1
Small	213	0.192	0.395	0	0	0	1
Large	213	0.319	0.467	0	0	1	1
Sectors	213	0.531	0.500	0	0	1	1
Z variables							
Incr	213	0.300	0.460	0	0	1	1
Vol	213	0.207	0.406	0	0	0	1
Targeted	213	0.587	0.494	0	0	1	1
Min.	213	27.876	12.471	2	20	40.9	50
Max.	213	41.814	20.050	12	25	60.8	80
Deduction	213	0.131	0.339	0	0	0	1
Exp	213	9.629	7.964	-3	2	17	25

Assessing true effect and publication bias

<i>Dependent variable: PCC vs elasticities</i>						
	PEESE	Flow	Stock	Int.	PEESE	Flow vs Int
Var	-7.233*** (1.44)	10.789 (6.682)	-5.050** (1.467)	-3.593*** (2.300)	-8.883*** (5.185)	-6.199 (4.361)
Flow						0.883*** (0.172)
Cst	-0.244*** (0.033)	-0.245*** (0.030)	-0.017 (0.028)	-0.481*** (0.041)	-0.300 (0.208)	-1.174** (0.099)
Obs	219	129	29	55	108	106
k	23	12	8	4	12	10

Clustered SE, study level

*p<0.1; **p<0.05; ***p<0.01

Extended MRA: heterogeneity of results and design of tax incentives

	Dependent variable: PCC							
	W/o	Exp	Type	Types	Targ	Ded.	Min	Max
SE	-3.505** (1.771)	-3.713* (2.025)	-1.384 (1.751)	-1.030 (2.320)	-0.227 (1.553)	-1.377 (1.755)	0.116 (2.180)	0.190 (2.251)
Exp		-0.002 (0.005)						
Incr			-0.385*** (0.114)	-0.369*** (0.125)	-0.350*** (0.104)	-0.388*** (0.119)	-0.432*** (0.108)	-0.491*** (0.120)
Vol				0.037 (0.113)				
Targeted					-0.021 (0.131)			
Deduction						0.212*** (0.022)		
Min							-0.006** (0.003)	
Max								-0.004** (0.002)
RDfowSE	0.818 (1.566)	0.722 (1.514)	0.506 (1.057)	0.467 (1.101)	-0.189 (0.938)	0.498 (1.070)	0.861 (1.008)	0.754 (1.008)
RDstockSE	3.169* (1.624)	3.332** (1.674)	2.861* (1.596)	2.927* (1.645)	3.341** (1.626)	2.789* (1.512)	2.165 (1.392)	2.596* (1.432)
Constant	-0.196*** (0.037)	-0.161 (0.108)	-0.198*** (0.033)	-0.229** (0.108)	-0.212*** (0.021)	-0.177 (0.139)	-0.089 (0.055)	-0.061 (0.074)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	213	213	213	213	213	213	213	213
R ²	0.171	0.173	0.280	0.282	0.333	0.280	0.327	0.318
Adjusted R ²	0.138	0.137	0.248	0.246	0.300	0.245	0.294	0.284
Residual Std. Error	5.735 (df = 204)	5.740 (df = 203)	5.357 (df = 203)	5.363 (df = 202)	5.168 (df = 202)	5.369 (df = 202)	5.192 (df = 202)	5.227 (df = 202)

Note:

*p<0.1; **p<0.05; ***p<0.01
Robust standard errors and clustered at publication level

Extended MRA: Design of tax incentives across scheme types

	Dependent variable: PCC							
	Incr	Incr	Hyb	Hyb	Vol	Vol	Vol	Vol
SER	-1.206* (0.618)	2.678 (1.721)	0.147 (2.239)	0.454 (1.903)	-1.716** (0.793)	-1.926*** (0.548)	-2.023*** (0.582)	-1.537** (0.570)
Targeted		0.634*** (0.131)		-0.396*** (0.112)				
Deduction						0.084*** (0.013)		
Min							-0.006*** (0.001)	
Max								-0.005*** (0.001)
smallSE	0.440 (0.500)	-1.105 (0.796)	-3.563 (3.205)	-2.366 (2.464)	-28.140*** (1.915)	-26.518*** (0.110)	-26.512*** (0.110)	-26.616*** (0.326)
largeSE	3.585 (4.965)	2.272 (3.173)	1.200 (1.414)	2.875 (1.781)	0.714 (0.668)	0.436 (0.516)	0.819 (0.532)	-0.207 (0.559)
Constant	-0.599*** (0.119)	-1.216*** (0.257)	-0.279* (0.163)	-0.014 (0.049)	-0.058** (0.026)	-0.073*** (0.007)	0.042** (0.018)	0.112*** (0.028)
Observations	64	64	105	105	44	44	44	44

Note:

*p<0.1; **p<0.05; ***p<0.01
Robust standard errors and clustered at publication level

Conclusion

- Heterogeneity of results explained by the design of tax incentives: incremental scheme > hybrid > volume.
Volume schemes beneficial for SMEs than in incremental based ones, lower effectiveness.
- Moderated by:
Targeted designs help to boost SMEs reaction (hybrid schemes).
Increasing generosity enhances the effectiveness of volume-based schemes but negative effects from enhanced deductions
- Publication bias: type of tax incentives and the R&D proxy. Firm size in the volume case
- Both effects combined lead to significant differences in effectiveness: distribution of elasticities between -1.1 and -0.2.