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Subsidized and non-subsidized R&D projects: Do they differ?

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Introduction

- Innovation is one of the main drivers of economic growth (Solow 1957).
- The market economy may fail to provide sufficient incentives for firms to engage in innovation, due to *limited appropriability* and *financing constraints* (Arrow 1962).

  → **Governments intervene to increase incentives to invest into R&D.**

- R&D subsidies
  - Reduce costs of doing R&D → increase incentives for firms to invest into R&D.
  - Even though a good instrument in theory, it is unclear if they can be effectively implemented in practice.
  - *Firm-level* studies mostly find…
    - that subsidized firms spend more on R&D as compared to the counterfactual situation (see e.g. Zúñica-Vicente et al. 2014) and
    - that publicly induced R&D has a similar productivity in terms of the probability to file a patent or the sales share with new products (e.g. Czarnitzki and Hussinger 2004, Czarnitzki and Licht 2006, Aschhoff 2009).

Introduction

- Almost all existing studies are on the *firm-level*, not *project-level*, as project-level data is hardly available. BUT R&D subsidies are distributed to *projects*.
- So far, little is known about subsidized *projects:*
  - Which projects are selected by the firm and the agency?
  - Is there an effect of the subsidy on the project?

→ **Project-level analysis needed.**

- Two studies:
  - Schneider (2008) analyses differences in the outcome of subsidized and non-subsidized R&D projects. For a sample of 495 Danish patents: Patents from subsidized R&D projects are more important in terms of forward citations.
  - Takalo, Tanayama, Toivanen (2013), analyze the funding decision of the granting agency in Finland for a sample of 379 Finnish projects: higher technological challenge, (lower) economic risk.

→ **Nothing is known so far about how subsidized R&D projects differ from non-subsidized R&D projects conducted by the same firm.**

Novel project-level dataset

- Patent applications filed at the GPO between 1995-2005, where we can identify, if a patent application stems from a subsidized or non-subsidized project.

- Gain deeper understanding about how subsidized and non-subsidized R&D projects of the same firm differ.

- Differences may arise from three channels:
  - Firms select with which projects they apply for public funding.
  - The funding agency selects which projects it finally supports.
  - The subsidy may change the quality of the R&D project and affect its results.

The case of Germany

- Germany is an interesting case to study because…
  - …R&D subsidies are the most important tool to support private R&D investments. There are no tax credits in place.
  - …there is substantial federal government support to private sector R&D. Annually spent between 1-2 billion euros 1995 to 2011 (3-4%) of private sector R&D spending.
  - …it is one of Europe‘s biggest and most innovative economies (BMBF 2012, OECD 2011). R&D expenditure as a percentage of the gross domestic product (GDP) 2.8% in 2013 (Eurostat).

- Thematic and generic R&D subsidies to the private sector
  - Thematic: targeted to specific technologies perceived as important for the future competitiveness of Germany.
  - Generic: to support especially SMEs and firms located in Eastern Germany to build innovation networks and enhance their innovation infrastructure.

Econometric approach

- Econometric Approach: Probit
  - Check differences between subsidized and non-subsidized patents for a **variety of patent indicators**.
  - **Private value**: self-citations, triadic (D)
  - **Spillovers**: external citations, co-application (D)
  - **Basicness**: generality and originality, backward citations
  - **Project size**: number of inventors
  - Control for year, technological area, and firm-specific heterogeneity.

- Interpretation:
  - Patent indicators reflect project characteristics.
  - Endogeneity: There may be reverse causality at work → interpret findings as correlations.
    - We estimate the probabilty that a patent (project) is subsidized.
    - There may be reverse causality at work in the sense that the subsidy itself may affect the characteristics of the R&D project.

- Data
  - Patent applications filed at GPO between 1995-2005 from firms that filed at least one subsidized patent application.
  - Sample1: 174,311 patent applications by 249 firms, 1,207 stem from subsidized R&D projects.

Regression results

	(1)	(2)
	sample 1	
VARIABLES	w/o firm dummies	with firm dummies
Private value		
SELFCIT	0.00029	0.00016
	(0.00021)	(0.00020)
+ TRIADIC	-0.00034	0.00128**
	(0.00046)	(0.00053)
Spillovers		
EXTCIT	-0.00038*	-0.00017
	(0.00020)	(0.00018)
+ COAPP	0.00869***	0.00413***
	(0.00158)	(0.00142)
Basicness		
+ GENERAL	0.00326**	0.00345**
	(0.00166)	(0.00166)
NOFORW	-0.00030	-0.00066
	(0.00051)	(0.00049)
ORIGINAL	-0.00005	-0.00006
	(0.00110)	(0.00107)
BACKCIT	-0.00008	0.00002
	(0.00010)	(0.00010)
- NOBACK	-0.00448***	-0.00271***
	(0.00061)	(0.00071)
Project size		
+ INVCNT	0.00044***	0.00075***
	(0.00011)	(0.00015)
year dummies	x	x
area dummies	x	x
firm dummies		x
No. of obs.	174,311	174,311
No. of firms	249	249

Notes:
Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Regression results

	(1)	(2)	(3)	(4)
	sample 1		**sample 2**	
VARIABLES	w/o firm dummies	with firm dummies	w/o firm dummies	with firm dummies
Private value				
SELFCIT	0.00029	0.00016	0.00048	0.00015
	(0.00021)	(0.00020)	(0.00059)	(0.00058)
+ TRIADIC	-0.00034	0.00128**	0.00274**	0.00462**
	(0.00046)	(0.00053)	(0.00134)	(0.00188)
Spillovers				
EXTCIT	-0.00038*	-0.00017	-0.00004	-0.00024
	(0.00020)	(0.00018)	(0.00051)	(0.00051)
+ COAPP	0.00869***	0.00413***	0.02382***	0.00895**
	(0.00158)	(0.00142)	(0.00496)	(0.00421)
Basicness				
+ GENERAL	0.00326**	0.00345**	0.00498	0.00712
	(0.00166)	(0.00166)	(0.00461)	(0.00485)
NOFORW	-0.00030	-0.00066	-0.00080	-0.00092
	(0.00051)	(0.00049)	(0.00136)	(0.00134)
ORIGINAL	-0.00005	-0.00006	-0.00030	0.00078
	(0.00110)	(0.00107)	(0.00302)	(0.00292)
BACKCIT	-0.00008	0.00002	0.00014	-0.00035
	(0.00010)	(0.00010)	(0.00030)	(0.00031)
- NOBACK	-0.00448***	-0.00271***	-0.00871***	-0.00770***
	(0.00061)	(0.00071)	(0.00162)	(0.00273)
Project size				
+ INVCNT	0.00044***	0.00075***	0.00151***	0.00188***
	(0.00011)	(0.00015)	(0.00030)	(0.00059)
year dummies	x	x	x	x
area dummies	x	x	x	x
firm dummies		x		x
No. of obs.	174,311	174,311	61,065	61,065
No. of firms	249	249	206	206

Notes:
Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Conclusion

- **How differ subsidized R&D projects from non-subsidized ones?**
  - When compared to a firm‘s whole project portfolio subsidized R&D projects are more often collaborative, have a higher private value, are more general, but less original and are of larger size.

→ Subsidized projects result into patent applications that are more valuable when compared to the rest of the patent portfolio of the firm, except for the fact that they are less original.

Limitations and future research

- Limitations
  - Our results are only representative for successful R&D projects whose results were patented.
    Hence our findings apply rather for firms active in technological fields where results can be patented and may underrepresent SMEs.
  - We try, but cannot completely disentangle the selection effect from a reverse causality where the subsidy itself changes the character of the R&D project.

- Future research
  - More analysis on the project-level.
  - Compare situation before and after the selection to disentangle selection and subsidy effect.
  - Observe rejected projects.

Thank you!