

Estimating the Local Average Treatment Effect of R&D Subsidies in a Virtual Common Pot

Dirk Czarnitzki^{abc} Paul Hünermund^{ab}

^a KU Leuven, Department of Managerial Economics, Strategy and Innovation, Belgium

^b Centre for European Economic Research (ZEW), Department of Industrial Economics and International Management, Mannheim, Germany

^c Center for R&D Monitoring (ECOOM) at KU Leuven

Eurostars

Article 185 (TFEU)

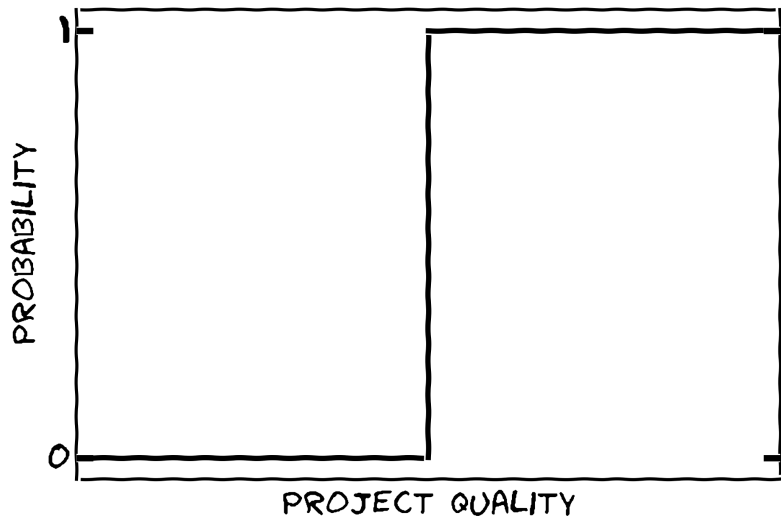
In implementing the multiannual framework programme, the Union may make provision, in agreement with the Member States concerned, for participation in research and development programmes undertaken by several Member States, including participation in the structures created for the execution of those programmes.

- Joint Programming Initiative
- 33 participating countries
- 10 cutoffs (2008 to 2013)
- €472 million
- European Commission contributes 33%
- International project consortia with SME as main applicant

R&D Subsidy Evaluation

- Standard case:
 - ▶ Only data on successful applications
 - ▶ Create a control group by matching observed firm characteristics
 - ▶ Self-selection into applying for a subsidy
 - ★ Applicants might have very different (unobserved) characteristics compared to non-applicants (Blanes and Busom, 2004)
- We have information on all applications to the program
- A second problem: selection by program authorities
 - ▶ Authorities do not grant subsidies randomly but usually "cherry-pick" the best projects
 - ▶ We have detailed information on project evaluation outcomes
- Even if you know the project quality ranking you can usually only estimate the treatment effect of subsidies locally where the treatment status switches (e.g., Regression Discontinuity Design)

Funding Probability (1)

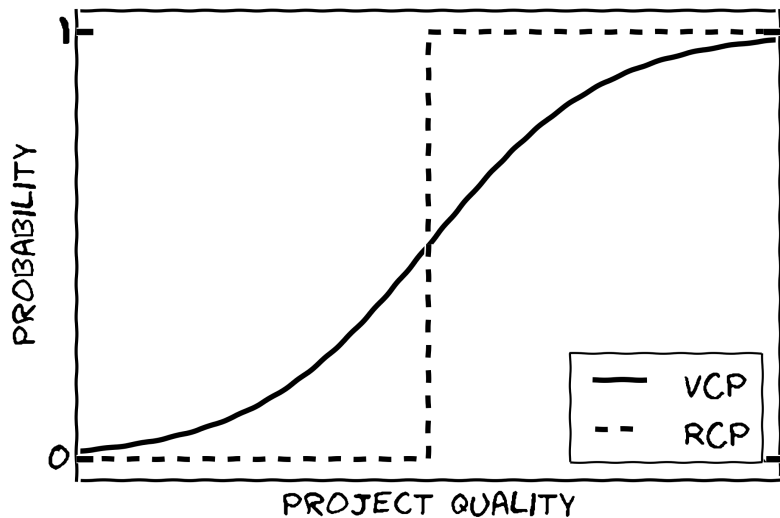


Virtual Common Pot

- Central evaluation of projects (score from 0 to 600)
 - ▶ Projects funded according to central evaluation ranking only
 - ▶ If resources are available for every consortium member
- Hypothetical example
 - ▶ Four countries: A, B, C, and D
 - ▶ Each country has a budget to fund two firms
- Who gets funding under VCP vs. RCP?

Rank	Consortium	VCP	RCP
1	A, B, B	✓	✓
2	B, B, C		✓
3	A, C	✓	✓
4	A, B, C, D		
5	C, D, D	✓	
6	A, C, D		

Funding Probability (2)



Setup

- Influence of funding D on dependent variable Y
 - ▶ Employment growth (avrg. per year from year before application until 2013)
 - ▶ Patents growth
- National budget availability serves as an instrument Z

$$(Y^0, Y^1) \perp\!\!\!\perp Z \mid X$$

- Perfect compliance: LATE reduces to a (propensity score) matching estimator in the region of common support S

$$E[Y^1 - Y^0 \mid X \in S] = E[Y \mid Z = 1, X \in S] - E[Y \mid Z = 0, X \in S]$$

- Investigate treatment effect heterogeneity for different evaluation scores

Data

- Official Eurostars application data merged with
 - ▶ Bureau van Dijk's Amdeus (Employment)
 - ▶ PATSTAT (Patents)
- Restrict analysis to
 - ▶ Applicants
 - ▶ Small and medium sized enterprises
 - ▶ Cutoff 1 to 7 (2008 to 2011)
 - ▶ Dependent variable is observed at least 2 years after application
- Region of common support
 - ▶ Score above quality threshold (= 400)
 - ▶ Score below 510
- Gross Sample: $N = 1192$
 - ▶ Drop observations with propensity score outside of $[0.02, 0.98]$ (Crump, Hotz, Imbens, and Mitnik, 2009)
 - ▶ Missing observations for employment ($\sim 35\%$)

Instrument Validity

- Condition on project evaluation scores
- Control for country effects
 - ▶ Nationality of firms possibly affects treatment propensity and potential outcomes
 - ▶ Control for a set of country groups
 - ▶ Control for macroeconomic environment (GDP growth)
 - ▶ Remaining variation:
 - ★ Within country because of international consortia
 - ★ Over time
- Other controls:
 - ▶ Start value of dependent variable
 - ▶ Technology class of project
 - ▶ Cutoff
 - ▶ Decision to self-fund

Descriptive Statistics (1)

	Employment		Patents	
	Mean	Std. Dev.	Mean	Std. Dev.
Employment Growth	1.29	(6.32)		
Employment Start More	28.1	(44.1)		
Patents Growth			0.08	(0.19)
Patent Start More			2.63	(7.65)
Funding	0.64	(0.48)	0.62	(0.49)
Grant Size	232,893	(164,782)	238,539	(203,460)
Score	444.14	(29.05)	444.24	(29.85)
Growth Rate	-0.22	(1.15)	-0.13	(1.47)
Self-funding	0.09	(0.29)	0.08	(0.28)
ICT	0.32	(0.47)	0.34	(0.48)
Engineering	0.33	(0.47)	0.3	(0.46)
Bioscience, Pharma & Chemistry	0.22	(0.41)	0.23	(0.42)
Other	0.13	(0.34)	0.13	(0.34)
N	761		1192	

Descriptive Statistics (2)

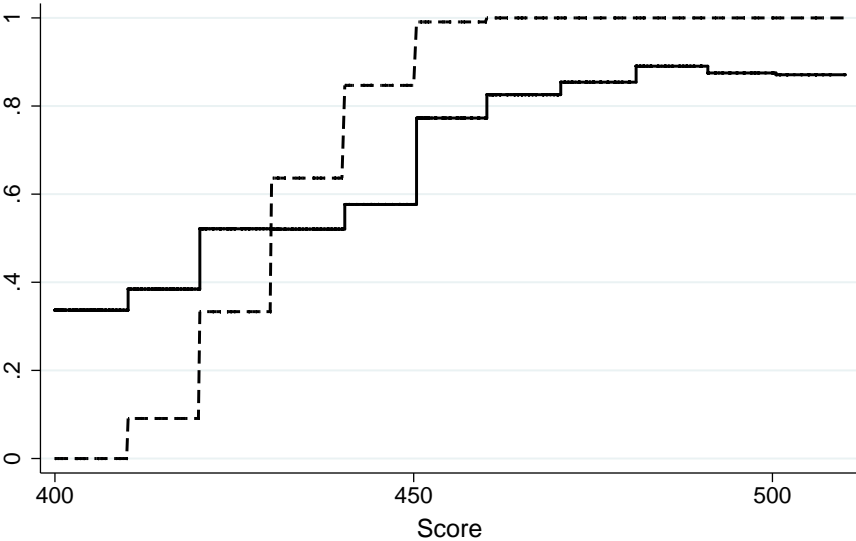
	Employment	Patents
Cutoff 1	0.17	0.17
Cutoff 2	0.14	0.16
Cutoff 3	0.15	0.16
Cutoff 4	0.13	0.11
Cutoff 5	0.13	0.12
Cutoff 6	0.16	0.16
Cutoff 7	0.13	0.13
DE	0.19	0.14
FR	0.08	0.1
IT	0.07	0.06
UK, IE	0.02	0.08
NL, BE, LU	0.12	0.09
AT, CH	0.07	0.08
FI, SE, NO, DK	0.17	0.18
GR, PT, ES	0.17	0.15
Other	0	0.04

Matching Results

	Employment			Patents		
	(1)	(2)	(3)	(4)	(5)	(6)
$E[Y^1 - Y^0 X \in S]$	0.267 (0.448)	0.371 (0.724)	0.799 (0.776)	0.005 (0.018)	0.017 (0.015)	0.029* (0.015)
Score	✓	✓	✓	✓	✓	✓
Cutoff	✓	✓	✓	✓	✓	✓
Technology	✓	✓	✓	✓	✓	✓
Empl. Start	✓	✓	✓			
Patents Start				✓	✓	✓
Growth Rate			✓			✓
Self-funding			✓			✓
Country		✓	✓		✓	✓
Observations	761	738	733	1192	1176	1175

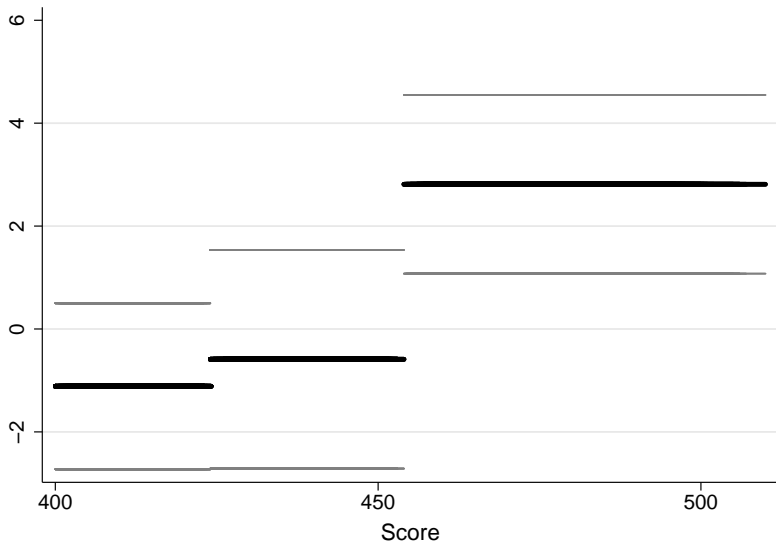
Standard errors in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Funding Allocation: VCP vs. RCP

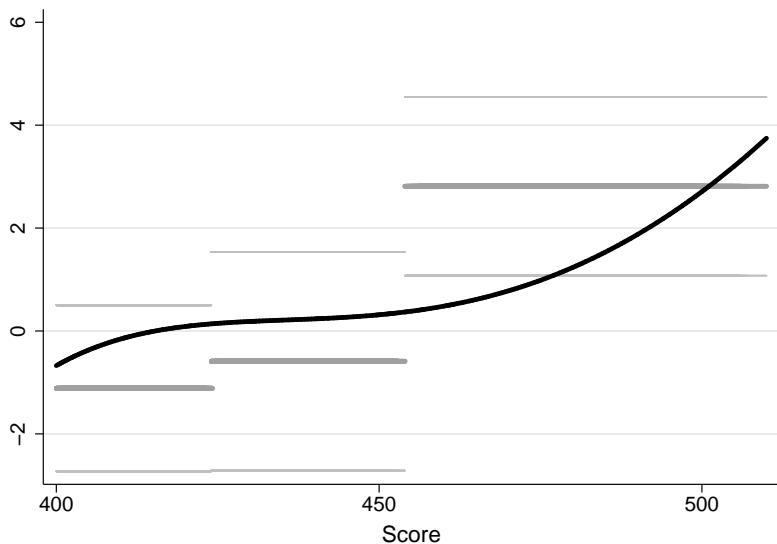


— VCP - - - - RCP

Treatment Effect on Employment



Treatment Effect on Employment



Counterfactual Analysis (Employment)

- Take the total spent budget and redistribute:
 1. According to an RCP funding rule
 2. According to a mixed rule of 50% RCP and 50% VCP

	VCP	RCP	Mixed
Number of funded firms	460	448	455
Grant size per created job (€)	54,679	41,847	42,746

⇒ Under RCP creating an additional job is 23% cheaper

Contribution

- Usually two problems in program evaluation studies
 - ▶ Selection into applying
 - ▶ Selection by program authorities
- Substantial treatment effect heterogeneity of R&D subsidies on employment growth
- Almost no effects on patent applications
- Virtual Common Pot
 - ▶ Coordination problem between central authority and local entities (e.g., states, provinces, ministries)
 - ▶ Incentivize local entities to provide sufficient resources
 - ▶ But *possibly* large inefficiency compared to RCP (depending on effect heterogeneity)
 - ▶ A mixed mode would work (surprisingly) well

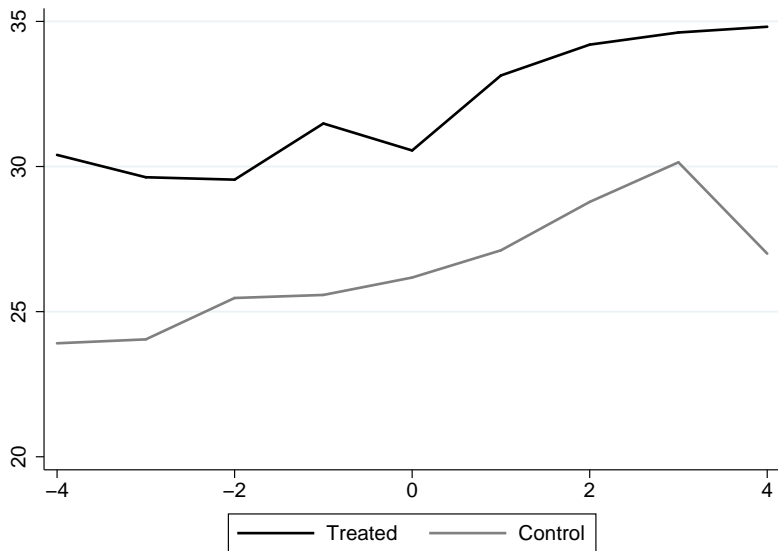
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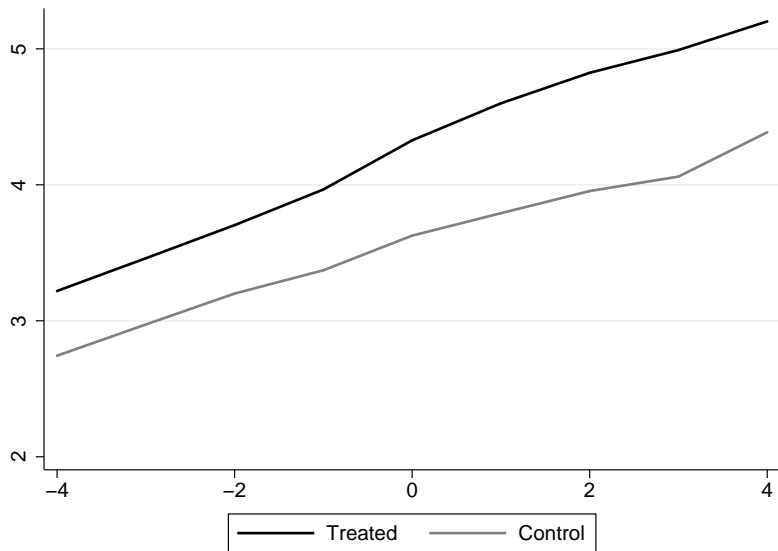
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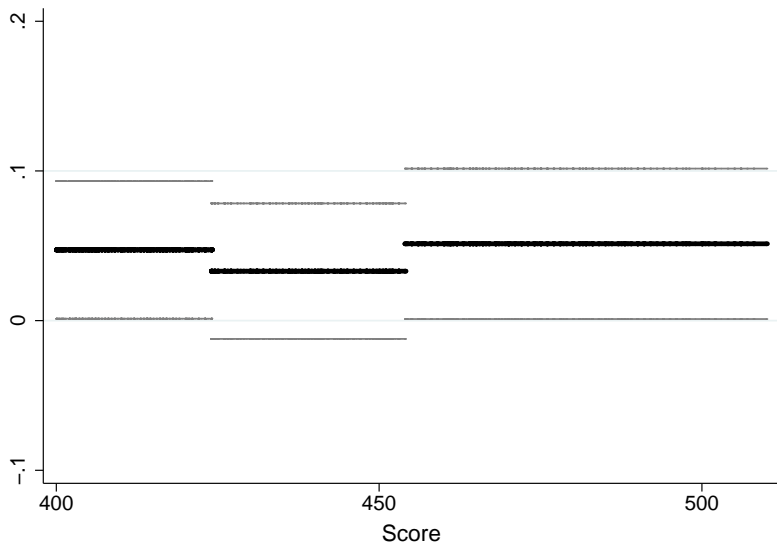
Pre-trend (Employment)



Pre-trend (Patenting)



Treatment Effect on Patenting



References

- BLANES, J. V., AND I. BUSOM (2004): “Who participates in R&D subsidy programs? The case of Spanish manufacturing firms,” *Research Policy*, 33, 1459-1476.
- CRUMP, R. K., V. J. HOTZ, G. W. IMBENS, AND O. A. MITNIK (2009): “Dealing with limited overlap in estimation of average treatment effects,” *Biometrika*, 96(1), 187–199.