

DO TAX INCENTIVES FOR RESEARCH INCREASE FIRM INNOVATION? AN RD DESIGN FOR R&D

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discussion by

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[†]The views expressed here are those of the authors and do not necessarily reflect those of the Board of Governors or the Federal Reserve System.

Motivation

- ▶ Much evidence on impact of tax incentives on R&D spending: (e.g. survey by Becker, 2015, JES). But:
 - ▶ Difficult to establish causality
 - ▶ Relatively little evidence of impacts on innovative outputs. Important because of “re-labeling” issue, etc.
- ▶ This paper:
 - ▶ Evaluate impact of UK R&D Tax Relief Scheme on firm R&D, patenting, growth and technology spillovers
 - ▶ Exploit discontinuity in generosity of R&D tax relief at new (more generous, lower) eligibility thresholds for Small & Medium Enterprises (SME) in 2008.
 - ▶ SME eligibility determined by pre-2008 assets so can implement fuzzy Regression Discontinuity Design (RDD)

Summary of Results

1. Policy increases R&D and patenting of treated firms by 100% and 60%
 - ▶ driven by the intensive margin
2. Stronger than conventional estimates of user-cost elasticity of R&D
 - ▶ notice SMEs' inclusion
3. Cost-effective policy: £1.7 of additional R&D per £1 of foregone taxes
 - ▶ UK aggregate business R&D would be 10% lower btw. 2006-11
4. Social benefits outweigh private ones: evidence of technology spillovers

Introduction

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- ▶ A solid step forward to establishing causality via an RD design
- ▶ Nice identification using a very convenient policy event (details later)
- ▶ Not only R&D but also patents—real outcomes
- ▶ SMEs vs. large firms
- ▶ Meticulous and extensive analysis

Policy Event and Data

The 2008 change in eligibility thresholds for SMEs in the UK Tax Relief Scheme

- ▶ Reduces taxable profits by “enhanced” deduction of R&D
- ▶ Before 2008: Employment < 250 & {Assets ≤ €43m or Turnover ≤ €50m}
- ▶ Employment: 250 ↗ 500; €43m ↗ €86m; Turnover €50m ↗ €100m
- ▶ Exploit discontinuity at the new cutoff
- ▶ **Only** for R&D policy purposes

Universal administrative tax data on R&D and firm accounts + patent data

- ▶ HRMC (~IRS) for corporate tax returns and R&D tax credits
- ▶ BVD FAME on UK firms' financial accounts
- ▶ PATSTAT data on patent families, citations, tech. classes, etc., applications to 80 offices worldwide

The Discontinuity

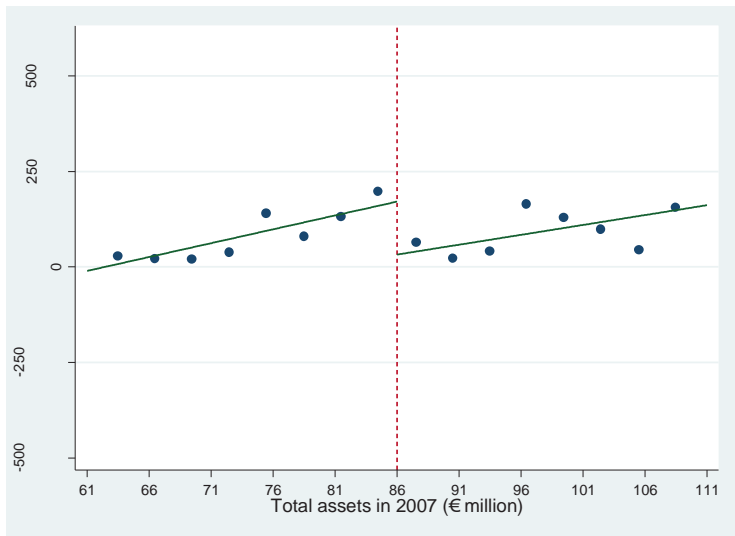


FIGURE: Discontinuity in R&D 2009-11 average

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Model Specification and Identification

- ▶ R&D equation:

$$rd_{it} = \alpha_{1t} + \beta_{FS,t} E_{i,07} + f_{1t}(z_{i07}) + \varepsilon_{1i,t}$$

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Crucial: *Is variation in treatment “random” around the threshold?*

“As Good as Random” around Threshold

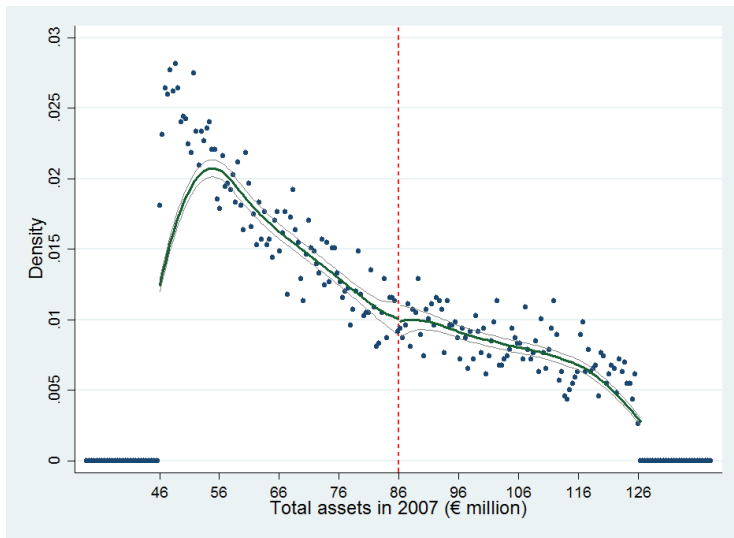


FIGURE: McCrary(2008) Test \Rightarrow No manipulation at threshold

Table 2: Discontinuity in R&D spending

Year	Before (pre-policy)			After (post-policy)			Before	After	Diff
	2006	2007	2008	2009	2010	2011	2006-08 average	2009-11 average	After - Before
Dependent variable:	Qualifying R&D expenditure (£ '000)								
Below new SME asset threshold in 2007	61.5 (58.5)	96.1 (72.1)	32.0 (40.4)	120.7** (59.0)	157.8*** (58.6)	137.2** (53.7)	63.2 (53.4)	138.5** (55.3)	75.3** (36.3)

Notes: 5,888 observations. ***significant at 1%, ** 5%, *10% level. RDD coefficients with robust standard errors in brackets. Running variable: 2007 assets; threshold is €86m; sample includes firms with 2007 between €61m and €111m. Controls are 1st order polynomials of running variable separately for each side of the threshold. **Mean R&D expenditure was £72.3k between 2006-08 and £80.5 2009-11.** 2007 prices.

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A Few Comments

1. Exogenous policy: guarding against revelations in prior year's budget discussions
 - ▶ SME eligibility definition in 2006
2. Could you plot "no-manipulation" figures for other covariates?
 - ▶ Also, smoothness in other firm characteristics around the cutoff
3. Model specification: can you try a log-log specification?
 - ▶ ... in addition to the Poisson regression
4. A direct look at the absence of relabeling
 - ▶ How do other expenses / taxes on those behave around the cutoff?
5. More results on heterogeneous impact of tax incentives
 - ▶ e.g. by export intensity of industries

Tax-price elasticity of R&D

- ▶ Tax-price elasticity of R&D given by

$$\eta \equiv \frac{\partial \ln rd}{\partial \ln \rho} = \frac{\ln rd_{SME} - \ln rd_{LCO}}{\ln \rho_{SME} - \ln \rho_{LCO}}$$

- ▶ where the tax-adjusted user cost of R&D is given by

$$\rho = \frac{(1 - A_f)}{(1 - \tau_f)} (r + \delta)$$

- ▶ $\eta \approx -2.63$ higher than most estimates
 - ▶ driven by young and constrained (loss-making) firms

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- ▶ **Question:** How would internationally generated rents from IP affect the user cost calculation?
 - ▶ Similarly, are foreign-owned subsidiaries common in the sample?
 - ▶ These would affect the relevant τ_f in the denominator.

Spillovers

- ▶ Knowledge externalities \Rightarrow social return $>$ private return \Rightarrow underinvestment in R&D
- \Rightarrow What is the effect of other firms' R&D on patenting activity of a particular firm (above and beyond that firm's own R&D)?

Spillovers

- ▶ Define

$$SpilltechRD_{i,09-11} = \sum_{j \neq i} \omega_{ij} rd_{j,09-11}$$

- ▶ ω_{ij} is technological proximity between firms i and j à la Jaffe (1986)
- ▶ instrumented by

$$SpilltechSME_{i,09-11} = \sum_{j \neq i} \omega_{ij} E_{j,2007}$$

- ▶ Structural patent equation:

$$pat_{i,09-11} = \delta SpilltechRD_{i,09-11} + \theta rd_{i,09-11} G(z_{j07}) + f_4(z_{i07}) + \varepsilon_{4i}$$

- ▶ Spillovers found even when controlled for product market proximity!

Conclusion

- ▶ Impressive exercise to establish causal effect of tax incentives on R&D (and more)!
- ▶ For the interested reader: a GE analysis of the effect of tax incentives in an open economy setting in Akcigit, Ates, Impullitti (2017)!