Allocation of R&D Grants in the Business Sector

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Introduction

- Spillover effects motivate that Government authorities finance R&D projects in the business sector
- R&D is expected to have higher social returns than private returns

- **Direct financing** and tax incentives

- Firms apply for R&D grants (often 50 – 50 % financing)

- Review committee evaluate applications

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Purpose and Contribution

- Purpose: Empirically test which firm and project characteristics determine acceptance / rejection.

- Database on 3 400 R&D applications from Austria 2005–12.
  - Firm characteristics
  - Project characteristics

- **Contribution:**
  - Project characteristics available for the first time
  - Literature have mainly compared granted firms to those without such funding (including non applicants and rejected ones).

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Theories and previous studies

- Picking the winner (Stiglitz and Wallsten 2000). Fund managers select projects with high probability of success rather than risky projects with high return but lower probability of success.
  - Public choice: Strong political commitment is required to justify many failed projects.
  - If winners are selected, distortion of competition is minimized.

- Application experts (Lerner 2009).
  - Firms gain insights into the grant application process with each proposal submitted.
  - “Matthew effect”. Previously awarded scientists get more financing.

Previous empirical studies

- Firm characteristics important for grants:
  - Large firms
  - High R&D-intensity
  - Novel R&D-projects
  - Previous successful applications

(Antonelli and Crespi, 2013; Aschhoff, 2010, Busom *et al.*, 2017; Cantner and Kösters, 2012; Dumont, 2017; Duguet, 2004; Feldman and Kelley, 2006; Gonzalez *et al.*, 2005; Hussinger, 2008; Silva, Silva and Carneiro, 2017; Takalo, Tanayama and Toivanen, 2013)

- Previous studies have compared granted firms with non-granted ones. **Do not know if non-granted firms have applied or not.**
- **Aggregation level, firm-level.**

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Database

- Austrian R&D funding agency (FFG)
  - Largest provider of R&D grants in Austria (300 MEur annually)
- Basic program – Homogenous evaluation criteria
- 3400 R&D applications in the database
- 1900 different applying firms
- Firm level data (3 years prior application)
  - Sales, employment, exports, cash flow
  - R&D activities - employees and expenditures
  - Industry affiliation, age
- Project level data
  - Approval or rejection
  - Duration, costs, share of funding
  - Fund's expert rating of R&D proposal (see next page)

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Fund's rating of 30 evaluation criteria

- Each variable rated on an ordinal 5-level scale (1 to 5). Measured as dummies: if 5 or 4 then = 1, if 3, 2 or 1 then = 0)
- Expected effects of project
  - Additionality and know-how gains
  - Overall economic and social effects
- Quality of the R&D project
  - Novelty / technological innovation
  - Complexity of development
  - Environmental effects
- Degree of commercialization
  - Market experience and prospects
- Suitability of project team
- Financial suitability

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Table 1. Distribution of rating scores

Evaluation criteria 2005-12	1	2	3	4	5
Expected additionality (firm)	0.5	3,0	35.3	56.8	4.6
Knowledge gains	0.1	7.1	40.3	46.0	6.6
Complexity of task	0.3	10.4	44.7	40.0	4.7
Environmental aspects	0.0	0.4	76.4	21.9	1.3
Exploitation potential	0.9	4.5	28.9	56.6	9.1
Qualification of staff	0.3	2.6	16.5	64.9	15.7
Technical equipment	0.2	3.2	27.8	57.1	11.8
Scope of technology	0.0	6.0	52.6	38.0	3.4
Evaluation criteria 2008-12	**1**	**2**	**3**	**4**	**5**
Expected additionality (project)	2.8	2.1	26.1	56.5	12.5
Innovative content	1.1	3.2	34.9	56.3	4.6
Novelty of technology	0.1	15.6	49.0	30.6	4.8

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Table 2. Characteristics of rejected and approved projects (median)

Evaluation criteria	Rejected projects	Accepted projects	t-test (median)
R&D-intensity	0.067	0.070	0.664
No. of employees	55	89	0.055 *
Export share	0.566	0.700	0.003 ***
Cash-flow ratio	0.089	0.084	0.620
Firm age (years)	14	16	0.046 **

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Table 3. Acceptance rate

Evaluation criteria 2005-12	1-3	4-5
Expected additionality (firm)	47.7	81.6
Knowledge gains	51.6	83.7
Complexity of task	56.0	84.0
Environmental aspects	66.0	76.7
Exploitation potential	50.0	78.1
Qualification of staff	37.6	75.9
Technical equipment	52.7	75.6
Scope of technology	61.0	79.1
Evaluation criteria 2008-12	**1-3**	**4-5**
Expected additionality (project)	48.3	79.8
Innovative content	39.8	89.5
Novelty of technology	59.3	89.7

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Dependent variable and method

- One application = one observation
- Binary dependent variable
  (approval =1 / rejection = 0) → Probit model
  Approval percentage = 80 %.
- $Pr(Y=1) = Pr(Y= 1IX) = \phi(X'\beta)$
  Latent variable $Y^* = X' \beta + \epsilon$
  $Y = 1$ if $Y^*>0$ and 0 if $Y^*\leq 0$

- X represent firm and project characteristics
- Random effects probit model (error terms allowed to vary across firms)

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Explanatory variables in probit model

- Firm characteristics
  - R&D-intensity
  - Firm size dummies
  - Age dummy (0-5 years)
  - ln sales/employee
  - Export/turnover
  - Sector, year and region dummies
- 2005-2012
  - 12 evaluation criteria
- 2008-2012
  - 16 evaluation criteria

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Table 4. Probit model (2005-12)

Evaluation criteria		ME probit (dF/dx)	Standard probit (dF/dx)
Additional effects (firm)	+	0.134 ***	0.189 ***
	++	0.229 ***	0.182 ***
Knowledge gains	+	0.133 ***	0.172 ***
	++	0.144 ***	0.140 ***
Complexity of task	+	0.112 ***	0.145 ***
	++	0.114 **	0.122 ***
Environmental aspects	+	0.042 **	0.055 **
	++	0.088	0.091
Exploitation potential	+	0.127 ***	0.180 ***
	++	0.157 ***	0.155 ***
Qualification of staff	+	0.132 ***	0.192 ***
	++	0.127 ***	0.140 ***
R&D intensity (t-1)		-0.033	-0.044
Young firms (0-5 years)		-0.029	-0.041
Dummy Firm size +250 (t-1)		-0.180 ***	-0.262 **
Export to turnover (t-1)		-0.036	-0.055 *

Table 5. Probit model (2008-12)

Evaluation criteria		ME probit (dF/dx)	Standard probit (dF/dx)
Additional effects (project)	+	0.149 ***	0.222 ***
	++	0.141 ***	0.118 ***
Innovative content	+	0.182 ***	0.285 ***
	++	0.375 ***	0.135 ***
Novelty of technology	+	-0.013	-0.020
	++	-0.130 ***	-0.284 **
Development risk	+	0.084 ***	0.107 ***
	++	-0.037	-0.058
R&D intensity (t-1)		-0.017	-0.020
Young firms (0-5 years)		-0.009	-0.011
Dummy Firm size +250 (t-1)		-0.214 ***	-0.374 ***
Export to turnover (t-1)		-0.021	-0.032

Additional effects (firm) + Exploitation potential + Qualification of staff have also strong effects on acceptance

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Conclusions

- Firm level characteristics are not relevant for R&D funding except size
- Many evaluation criteria have a significant impact on likelihood of approval, but with varying magnitude
  - Most important:
    Innovative content
    Expected additionality effects (firm + project levels)
    Qualification of staff
    Exploitation potential
  - Less important:
    Environmental aspects
- R&D managers in firms should focus on radical new innovative ideas rather than minor improvements when applying for grants.

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To be done in future work:

- Applicant experts. Impact of firm's previous experience on evaluation criteria and acceptance

- **Two steps!**
  - Step 1. How does previous experience and firm characteristics affect ratings?
  - Step 2. How does evaluation criteria and firm characteristics affect acceptance? Evaluation criteria might be endogenously determined.

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