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Assessing the impact of mechanisms to promote university-industry research cooperation and knowledge transfer

Dirk Czarnitzki
KU Leuven and ZEW Mannheim

Introduction

- R&D is subject to market failure
- How to close gap between private and social equilibirum?
  - Governments invest in public science
  - Intellectual property rights systems
  - R&D collaborations are exempt from anti-trust policy
    - Remark: Interesting theory papers by Jeroen Hinloopen, Amsterdam
  - Public R&D grants or tax credits for companies
    - **Often preferred treatment for research consortia**
    - **In many OECD countries especially industry-science collaborations**

Introduction II

Structure of talk

- What is the rationale behind subsidizing industry-science collaborations?
- Example: country studies Flanders and Germany
- Potential pitfalls: opportunity cost

R&D collaboration I

- R&D collaborations allow firms to internalize spillovers
  - D'Aspremont / Jacquemin (1988)
- In typical IO theory, „collaborating" = joint optimization of R&D
  - but firms compete in product market (horizontal collaborations)
- R&D increases profits, but knowledge spills over to rival who can free-ride on investment
  - the profits of investor are reduced to some extent
- If spillovers „are large enough", collaboration results in higher R&D in economy compared to no-collaboration

R&D collaboration II

- However, no solid IO theory for industry-science collaboration!
  - no direct, negative externalities involved?
- Is there another market failure argument?
- R&D in industry-science collaborations
  - is usually more basic discovery process and generic knowlege creation
  - broader in scope, etc. (Hall et al. 2003)
- More basic knowledge is more difficult
  - to appropriate by inventor
  - to finance as further away from market than other types of projects
    - Czarnitzki/Hottenrott/Thorwarth (2011)

➔ Market failure possibly larger for such projects

Question

- Do R&D collaborations with science result in higher R&D investment in the firm?
  - Spillover effect
- Do subsidies for industry-science collaborations result in higher R&D investment?
  - Crowding-out effect

Example of an empirical investigation

- Community Innovation Survey data
- Flanders and Germany
- Only samples of collaborating firms
- Dependent variable: R&D intensity
- Controls: firm size, industry, patent activity, firm age, corporate governance structure, export dummy

Means of all variables by subsample: **Flanders**

SAMPLE 1: Firms that collaborate but not with public science *versus* firms that collaborate with public science

	No industry-science partnership (358 obs.)	Industry-science partnerships (532 obs.)	*t*-test on mean differences
Ln(EMP)	4.20	4.34	
GROUP	0.62	0.67	*
FOREIGN	0.33	0.32	
DEX	0.79	0.86	***
Y2006	0.54	0.58	
Ln(AGE)	3.10	3.18	
PATENT	0.09	0.26	***
RDINT	2.00	6.30	***

SAMPLE 2: Firms that collaborate with public science without subsidy receipt *versus* subsidy recipients

	Non-subsidized industry-science partnerships (302 obs.)	Subsidized industry science partnerships (230 obs.)	t-test on mean differences
Ln(EMP)	4.31	4.39	
GROUP	0.70	0.63	*
FOREIGN	0.33	0.30	
DEX	0.90	0.84	*
Y2006	0.56	0.62	
Ln(AGE)	3.22	3.12	
PATENT	0.19	0.35	***
RDINT	3.65	9.76	***

Note: *** (**, *) indicate a significance level of 1% (5%, 10%).
Industry dummies omitted.

Probit regression for treatment dummies

Variable	SAMPLE 1	SAMPLE 2
lnEMP	-0.689 ***	-0.507 ***
	(0.128)	(0.134)
$(\text{lnEMP})^2$	0.076 ***	0.062 ***
	(0.014)	(0.014)
GROUP	0.296 **	-0.228
	(0.117)	(0.158)
FOREIGN	-0.169	-0.061
	(0.116)	(0.146)
Y2006	0.088	0.199 *
	(0.092)	(0.121)
EXPORT	0.221 *	0.279
	(0.126)	(0.184)
lnAGE	0.072	-0.062
	(0.054)	(0.077)
PATENT	0.646 ***	0.451 ***
	(0.133)	(0.141)
Intercept	0.868 **	0.435
	(0.348)	(0.425)
Industry dummies	YES	YES
McFadden R^2	0.09	0.11

Matching Results: Flanders

means of all variables by sub-sample for treated firms and selected controls

SAMPLE 1: *Firms that collaborate but not with public science versus firms that collaborate with public science*

	No industry-science partnership (500 obs.)	Industry-science partnerships (500 obs.)	t-test on mean differences
Ln(EMP)	4.03	4.27	
GROUP	0.62	0.67	
FOREIGN	0.29	0.32	
DEX	0.84	0.86	
Y2006	0.61	0.58	
Ln(AGE)	3.14	3.16	
PATENT	0.22	0.19	
RDINT	2.77	5.87	***

SAMPLE 2: *Firms that collaborate with public science without subsidy receipt versus subsidy recipients*

	Non-subsidized industry-science partnerships (222 obs.)	Subsidized industry science partner ships (222 obs.)	t-test on mean differences
Ln(EMP)	3.90	4.34	
GROUP	0.58	0.63	
FOREIGN	0.31	0.32	
DEX	0.92	0.89	
Y2006	0.66	0.62	
Ln(AGE)	3.14	3.13	
PATENT	0.27	0.34	
RDINT	4.33	9.44	***

Note: *** (**, *) indicate a significance level of 1% (5%, 10%).
Industry dummies omitted. Selected controls are active in the same industries as the treated firms.

Results on R&D intensity I

- **Treatment effects in Flanders:**
  - Industry-science vs. other collaboration
    - 3.1 percentage points (5.9 – 2.8)
      ➔ significant at the 1% level
  - Subsidized industry-science collaboration
    - 5.1 percentage points (9.4 – 4.3)
      ➔ significant at the 1% level

Results on R&D intensity II

- **Germany (not shown, same procedure)**
  - Industry-science vs. other collaboration
    - 4.0 percentage points (8.9 – 4.9)
      ➔ significant at the 1% level
  - Subsidized industry-science collaboration
    - 3.7 percentage points (13.1 – 9.3)
      ➔ significant at the 1% level

Discussion

- This example suggests that
  - industry-science collaboration leads to increased R&D investment because of
    - spillover effects
    - the monetary value of the subsidy
      - in both Flanders and Germany
  - thus, preferential treatment of industry-science partnerships in technology policy schemes may be justified
  - **but.....**

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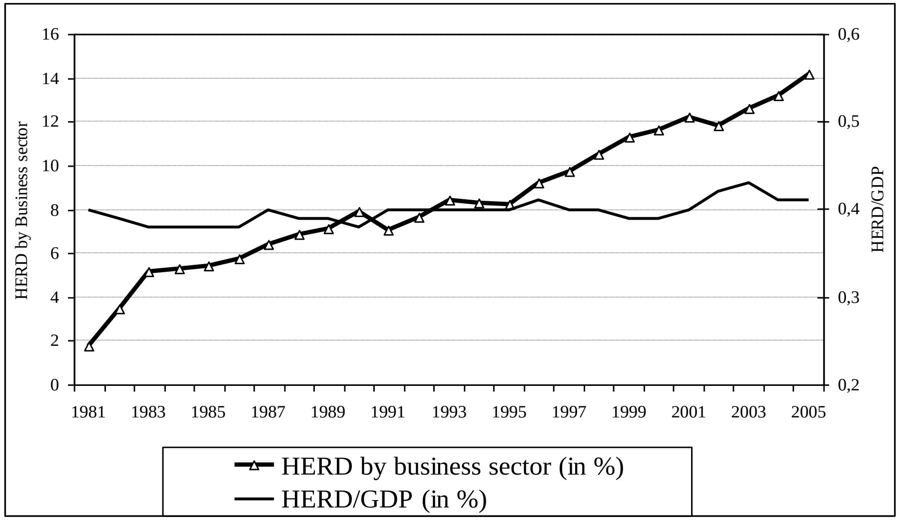
Opportunity cost !

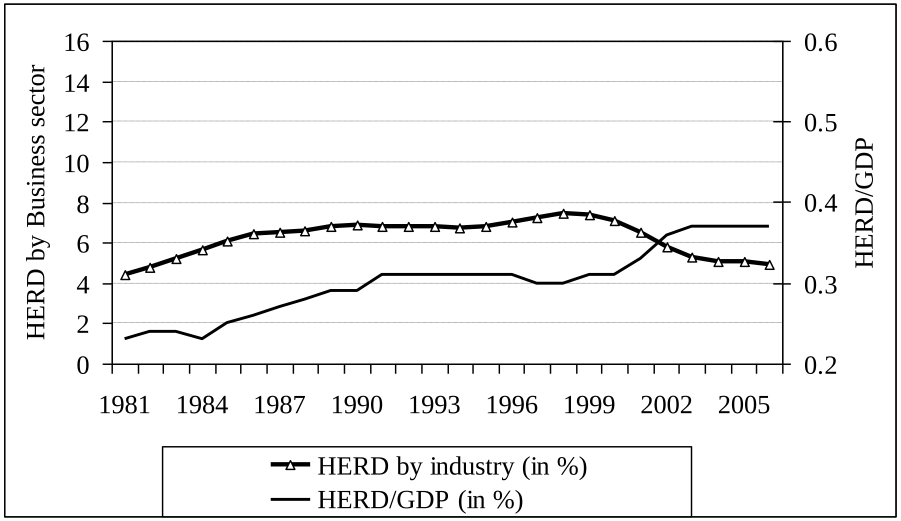
- Technology transfer involves increased attention of university researchers to industrial projects
- Is it a good idea to invest more in such subsidy programs, as the price is possibly a reduction in basic research funding?

Higher education expenses

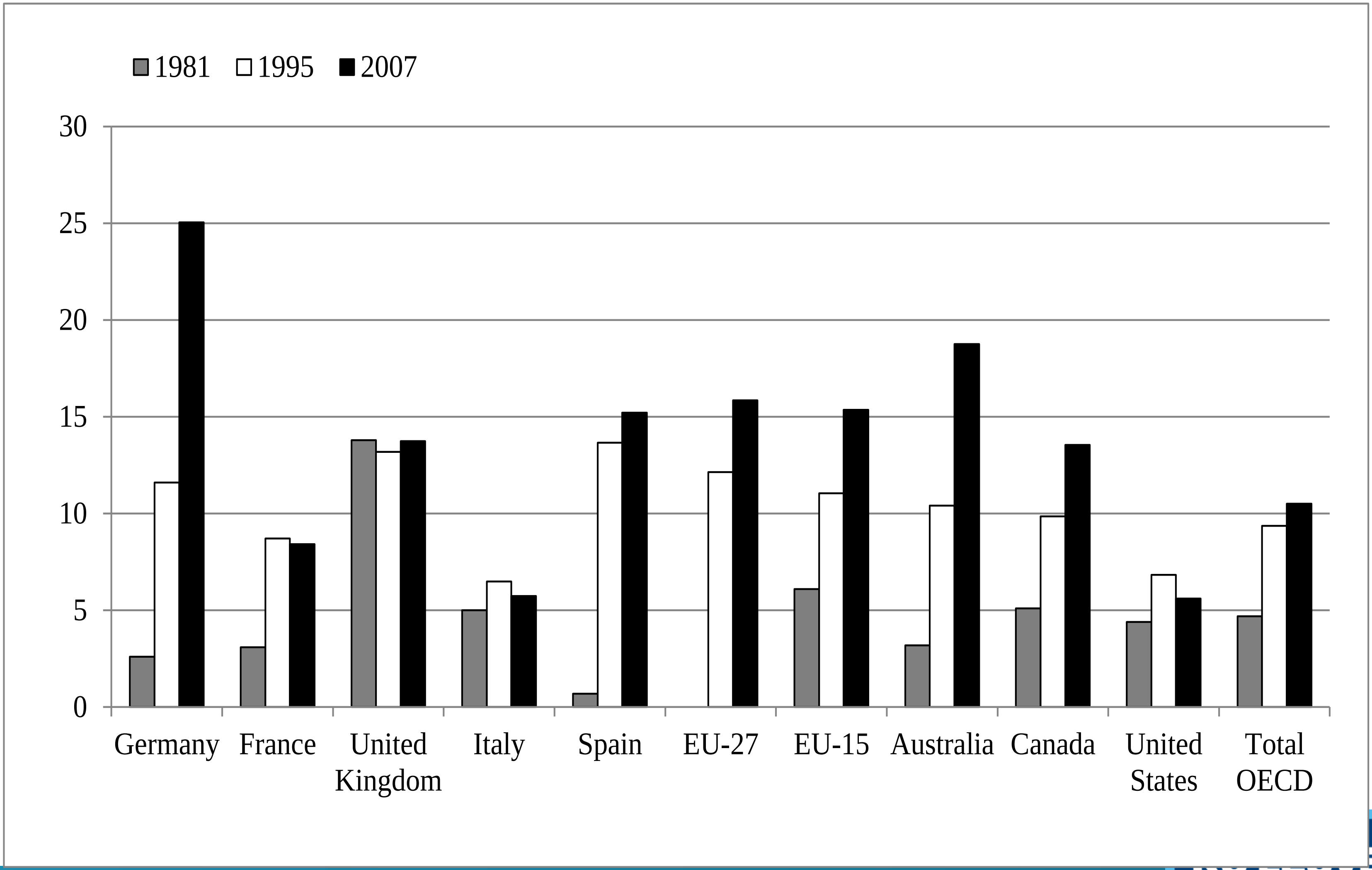
Germany



United States



Percentage of higher education and government R&D financed by industry 1981, 1995, 2007



Possible consequences for public science I

- Increased attention towards industry funding may change the type (basicness) of academic research
  - Czarnitzki/Hussinger/Schneider (2008):
    - „academic“ patents are more basic than corporate patents in the period of 1980 to mid 1990s, but
    - afterwards differences gradually disappears.
    - Pattern coincides with change in policy: more technology transfer from science to industry
  - Czarnitzki/Glänzel/Hussinger (2009):
    - publication record of university scientists is positively correlated with commercialization activities (patents), but...
    - patenting with industry reduces publication counts and quality

Possible consequences for public science II

- Industry involvement may create IP issues
  - Results of public science usually yield publications, i.e. knowledge accessible in public domain
  - Firms are ‘for-profit’ entities and need to appropriate research results

  ➔ Clash of ‘open science’ with business motives
- Czarnitzki et al. (2014a, b) show that industry sponsorship may jeopardize disclosure of academic research
  - Industry-sponsored academic researchers are more likely to experience withholding of research results (delays, partial or full publication bans)
  - Industry-sponsored academic researchers are less likely to share research inputs (materials, data, program codes, etc.) with other academic researchers

    ➔ no further research or replication studies possible