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Competition and R&D Cooperation with Universities and Competitors

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Introduction

- Competition is an institutional restriction to avoid collaboration
- In economic praxis we observe both competitive behaviour and R&D collaborations.
- Even more, certain competitive conditions (e.g. few principal competitors) may facilitate and promote collaboration.
- We investigate the role of competition for R&D partner choice. Among collaboration partners we mainly distinguish between “competitors” and “universities” controlling for other types of R&D partners.
- Policy: Study shows that innovation policy and competition policy are related

Literature

- Existing literature investigates …
  - … the relationship between innovation and competition (see e.g. Schumpeter 1942, Arrow 1962, Geroski 1990, Aghion et al. 2005)
  - … the driving forces for R&D collaborations with certain partners (see e.g. Cohen and Levinthal 1989, 1990, Cassiman and Veugelers 2002)
  - … but does not look at competition and type of R&D partner
- Investigation at hand should contribute in two ways
  - First, we develop a simple theoretical framework illustrating how competition affect partner choice decision
  - Secondly, we empirically test the relationship between competition and R&D partner choice

Theoretical framework (1)

- R&D collaboration with universities and/or competitors should increases innovation productivity (λ*pcm) of collaborating firms
- In order to investigate the innovation productivity effect of R&D collaboration with different partners we distinguish between ….
  - … "Synergy Effect" (f_j) and a "Competition Effect" (g_j)
- The "Synergy Effect" (f_j) and the "Competition Effect" (g_j) are illustrating the relationship between R&D partner choice and innovation productivity

$$prob\left[C_j = 1 \middle| C_{-j}\right] = prob\left[\lambda_j pcm_j \geq \lambda\ pcm \middle| C_{-j}\right]$$
$$= prob\left[f_j g_j \lambda pcm \geq \lambda pcm \middle| C_{-j}\right] = prob\left[f_j g_j \geq 1 \middle| C_{-j}\right] \quad (1)$$

where, j = {university, horizontal}

Theoretical framework (2)

- Synergy Effect (f_j) …
  - … arises because innovation cooperation eliminates wasteful duplication (see Kamien et al. 1992). Economies of scale and transfer of complementary resources creates synergies (Glaister and Buckley 1996).
  - … increases in incoming spillovers, absorptive capacity, techn. opportunities
  - The meaning of “synergies” for cooperation depends on the relationship between value of innovation and competition (increasing, decreasing, inverted U-shape)
- Competition Effect (g_j) …
  - … captures the relationship between cooperation and competition
  - … comprises two effects: a “collusion effect” and a “spill+ effect” (spillover effect)

Theoretical framework (3)

- Spill+ effect (negative):
  - … arises due to an increase in outgoing spillovers, hence intensifying competition
  - … decreases in appropriability
  - The meaning of “spillovers” for cooperation depends on the relationship between value of innovation and competition (increasing, decreasing, inverted U-shape)
- Collusion effect (positive):
  - Fosters cooperation among competitors and thus leads to a decrease in the number of principal competitors.
  - It is strongest in duopoly and decreases with the no. of principal competitors

Hypothesis

"Synergy effect":

- Incoming spillovers, absorptive capacity, and technological potential increase cooperation with both universities and horizontal firms.

Competition "Spill+ effect":

- Price competition and horizontal cooperation have a significant relationship of ambiguous form (depending on the relationship between value of innovation and competition).
- Quality competition (non-price competition) and firm-university cooperation have a significant relationship of ambiguous form (depending on the relationship between value of innovation and competition).

Competition "Collusion effect":

- The number of principal competitors decreases horizontal cooperation

Data

- This investigation is based on a panel of Swiss firms observed across five periods (1994-1996, 1997-1999, 2000-2002, 2003-2005, and 2006-2008).
- The surveys were based on a stratified random sample of firms having at least five employees covering all relevant industries in the manufacturing, construction, and service sectors. Stratifications is on 28 industries and, within each industry, three firm size classes.
- Responses were received from 1748 firms (32.5%), 2172 firms (33.8%), 2583 firms (39.6%), 2555 firms (38.7%), and 2141 (36.1%) firms for the years 1996, 1999, 2002, 2005, and 2008 respectively.
- The employed sample entails only R&D active manufacturing firms
- Dropping observations with missing values yields a highly unbalanced firm-panel with 3272 observations

Empirical specification (1)

Theory	Variable	Description
Price competition	PRICECOMP	Category of price competition intensity on a five point Likert scale (1 very weak … 5 very strong)
Quality competition	QUALCOMP	Category of non-price, or quality competition intensity on a five point Likert scale (1 very weak … 5 very strong)
No. of principal competitors	NCOMP	Category of number of principal competitors between 1 and 5 (0-5,6-10,11-15, 16-50, 50+ competitors)
Spillovers	SPILLINC	Incoming spillovers, calculated as the average relevance of universities, other research institutions, competitors, suppliers, customers and firm group as a source of information for the R&D activity on a five point Likert scale (1 none … 5 very important)
Absorptive capacity	ABSCAP	Absorptive capacity, measured by the share of workers holding a tertiary education degree
Technological potential	TECHPOT	Technological potential outside the firm on a five point Likert scale (1 very low … 5 very high)
Appropriability	APPROP	Appropriability, measured by six minus the relevance of the innovation obstacle “easiness to copy” on a five point Likert scale (1 none … 5 crucial)

Empirical specification (2)

$$\text{prob}[\text{COOP UNI}_{i,t}=1|\text{COOP HOR}_{i,t}] = \text{prob}\,[\beta_{u,0} + \beta_{u,1}\text{SPILLINC}_{i,t} + \beta_{u,2}\text{ABSCAP}_{i,t} + \beta_{u,3}\text{TECHPOT}_{i,t} + \beta_{u,4}\,\text{APPROP}_{i,t} + \Sigma_j\beta^j_{u,5}\text{QUALCOMP}^j_{i,t} + \Sigma_j\beta^j_{u,6}\text{PRICECOMP}^j_{i,t} + \Sigma_j\beta^j_{u,7}\text{COMPETITORS}^j_{i,t} + \beta_{u,8}\text{Control}_{i,t} + \varepsilon_{u,i,t}?0]$$

$$\text{prob}[\text{COOP HOR}_{i,t}=1|\text{COOP UNI}_{i,t}] = \text{prob}\,[\beta_{h,0} + \beta_{h,1}\text{SPILLINC}_{i,t} + \beta_{h,2}\text{ABSCAP}_{i,t} + \beta_{h,3}\text{TECHPOT}_{i,t} + \beta_{h,4}\,\text{APPROP}_{i,t} + \Sigma_j\beta^j_{h,5}\text{QUALCOMP}^j_{i,t} + \Sigma_j\beta^j_{h,6}\text{PRICECOMP}^j_{i,t} + \Sigma_j\beta^j_{h,7}\text{COMPETITORS}^j_{i,t} + \beta_{u,8}\text{Control}_{i,t} + \varepsilon_{h,i,t}?0]$$

where i refers to firm and t to time. j={1,2} describes the quadratic polynomial of competition variables. Subscripts u and h denote coefficients of the estimation with university and horizontal cooperation as dependent variable, respectively.

Estimation methods

- Taking into account the interdependence of R&D partner decisions, we use a mvprobit estimator with 400 draws (see Green 2003, p. 710)
- We also estimate a mvprobit taking into account other cooperation partners, i.e. customers, suppliers (vertical), and group internal partners
- Endogeneity of competition variables is addressed through an instrumental variable approach (400 iterations)

Results (1)

	IV Uni	IV Hor	MV Uni	MV Hor
NCOMP	**-0.068**	**2.141****	**-0.045**	**0.277****
	(0.897)	(1.047)	(0.098)	(0.109)
NCOMP^2	**-0.115**	**-0.312***	**0.007**	**-0.050*****
	(0.174)	(0.187)	(0.017)	(0.019)
PRICECOMP	**3.966****	**3.348***	**0.011**	**0.080**
	(1.806)	(1.992)	(0.177)	(0.202)
PRICECOMP^2	**-0.512****	**-0.402**	**0.004**	**-0.006**
	(0.227)	(0.249)	(0.024)	(0.027)
QUALCOMP	**-6.003***	**-0.862**	**-0.317****	**-0.140**
	(3.335)	(1.975)	(0.149)	(0.177)
QUALCOMP^2	**0.701**	**0.082**	**0.049****	**0.026**
	(0.467)	(0.288)	(0.023)	(0.026)
SPILLINC	**0.551*****	**0.194*****	**0.321*****	**0.169*****
	(0.141)	(0.065)	(0.047)	(0.052)
ABSCAP	**0.010*****	**0.010*****	**0.011*****	**0.007*****
	(0.002)	(0.003)	(0.002)	(0.002)
TECHPOT	**0.256*****	**0.085****	**0.166*****	**0.080****
	(0.055)	(0.036)	(0.028)	(0.032)
APPROP	**0.025**	**0.018**	**0.060****	**-0.010**
	(0.030)	(0.030)	(0.024)	(0.026)
OCOST	**0.189*****	**0.035**	**0.150*****	**0.023**
	(0.070)	(0.078)	(0.055)	(0.061)
N	3272	3272	3272	
atrho			0.679***	
			(0.046)	

Results (2)

- We observe a “Synergy effect” for both university and horizontal R&D cooperation: our proxies for incoming spillovers, absorptive capacity, and technological potential are significant positive
- Price competition matters for firm-university cooperation and for horizontal cooperation. The relationship shows an inverted U-shape.
- Quality competition (non-price competition) matters for firm-university collaboration but not for horizontal R&D cooperation. The relationship is U-shaped.
- Number of principal competitors matters for horizontal cooperation only. The relationship is inverted U-shaped.
- Costs are an important factor mainly for firm-university cooperation
- Appropriablility matters mainly for firm-university cooperation

Interpretation of the results (1)

- H1 can be confirmed; there are synergies for both types of coop.
- H2 (price competition): inverted U-shape relationship for both types:
  - This points at an inverted U-shape relationship between value of innovation and competition, at which the “synergy effect” prevails.
  - At lower levels of competition, synergies increase incentives for cooperation. At higher levels of competition the value of synergies are lower (since the value of innovation is lower), hence incentives for cooperation are lower, too.

Interpretation of the results (2)

- H3 (quality competition): U-shape relationship for firm-university cooperation only
  - This points at an inverted U-shape relationship between value of innovation and competition, at which the “spill+ effect” prevails.
  - At lower levels of competition the “spill+ effect” decreases incentives for cooperation, since the market value increases for innovation. At greater levels of competition the “spill+ effect” increases incentives for cooperation, since the market value decreases for innovation.
- H4 (no. of competitors): inverted U-shape relationship for horizontal cooperation only
  - At lower level of competition (few principal competitors) we have great incentives for “collusion”. However, competition law may ban cooperation. In markets with greater no. of competitors, gains from “collusion” are diminishing. “Market overview” seems to be important.

Conclusions

- First, competition plays a different role for horizontal and firm-university cooperation
  - Horizontal R&D cooperation:
    - Price competition is important (inverted U-shape)
    - Number of principal competitors is very important
  - Firm-University R&D cooperation:
    - Price competition is important (inverted U-shape)
    - Quality competition is important (U-shape)
- Secondly, innovation policy and competition policy are related
  - If competition policy mainly looks at price competition, we would see fewer R&D cooperation, hence fewer innovation activities
  - If competition policy considers non-price competition factors – it would also promote firm-university R&D collaboration, hence more innovation activities

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THANK YOU VERY MUCH FOR YOUR ATTENTION

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