Locational Conditions, Local vs. Nonlocal Cooperation and Firm Innovativeness

Evidence from Research and Company Spin-Offs

Local to global, global to local
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Introduction

• Spin-offs and their unique role in the economy (means of transferring knowledge and technology, product innovators, higher survival rates)

• Research focus of studies on spin-offs
  – Process of creation and development of spin-offs (parent organization’s support)
  – Locational patterns: role of proximity to knowledge source, locational decisions
  – Either on research spin-offs only or company spin-offs only
Research Questions

• To what extend do locational conditions influence the cooperation activities and innovativeness of spin-offs?

• Does cooperation have an effect on spin-off innovativeness? If so, is it local or nonlocal cooperation that is the more conducive to innovativeness?

• How important is the entry type (research vs. company origin of the spin-off) for the firm’s innovativeness and performance?
Hypotheses

H1: Suitable locational conditions (such as availability of qualified labor, transportation infrastructure, proximity to research facilities) enhance the cooperation intensity, in particular with local partners, and the innovativeness of firms.
Hypotheses

H2(a): High cooperation intensity enhances firm innovativeness.

H2(b): Nonlocal collaboration ties enhance the innovativeness of established spin-offs to a greater extent than purely local links.
H3: Firm performance is positively affected by innovativeness.
Hypotheses

**H4:** Spin-offs are more innovative than firms created in other ways.

**H5:** Established spin-offs show better firm performance than types created in other ways.
Structural Model (Basic)

- Skilled Labor
- Transportation
- Research facilities
- Support
- Cooperation
- Innovative-ness
- Performance
## Estimation of the Structural Equation Model (SEM)

### Comparison of SEM estimation approaches

<table>
<thead>
<tr>
<th></th>
<th>PLS (Herman Wold, 1982)</th>
<th>LISREL (Karl Jöreskög, 1973)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Methodology</strong></td>
<td>variance-based</td>
<td>covariance-based</td>
</tr>
<tr>
<td>OLS</td>
<td></td>
<td>Maximum Likelihood</td>
</tr>
<tr>
<td>Soft-modelling (distribution free)</td>
<td></td>
<td>distributional assumption on model variables</td>
</tr>
<tr>
<td>Explicit estimation of LV</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>Small-sized samples</td>
<td></td>
<td>200 and more observations</td>
</tr>
<tr>
<td>Reflective and formative LV</td>
<td></td>
<td>reflective LV; formative LV only for exogenous LV</td>
</tr>
<tr>
<td>Statistical inference</td>
<td></td>
<td>Direct tests of model parameters using</td>
</tr>
<tr>
<td>Based on bootstrapping</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Data

- Large survey conducted in year 2004 for the German Ministry of Education and Science
- Responses from about 6200 East German firms (response rate 20%)
- 79 research spin-offs, 410 company spin-offs from knowledge-intensive branches
- Special focus on innovativeness and collaboration activities
- Assessment of the (1) the importance and (2) the quality of 12 different locational factors, e.g.
  - local qualified labor availability
  - presence of local public research institutes / universities
  - business promotion and support by the local government
  - ...
Empirical Implementation of the Structural Model

**LV: Skilled Labor**

*Firm assessment of the locational condition:*

- supply of skilled labor
- additional education supply
Empirical Implementation of the Structural Model

LV: Transportation

Firm assessment of the locational condition:
• supra-regional transportation links
• intraregional transportation links
Empirical Implementation of the Structural Model

LV: Research Facilities

Firm assessment of the locational condition:
- proximity to universities
- proximity to research institutes

Skilled Labor
Transportation
Research facilities
Support
Cooperation
Innovativeness
Performance
Empirical Implementation of the Structural Model

LV: Support

Firm assessment of the locational condition:

- support of local financial institutions
- support of job centres
- local government support
- support of business development corporations
- state government support
Empirical Implementation of the Structural Model

Cooperation

Skilled Labor

Transportation

Research facilities

Support

Innovativeness

Performance

Cooperation frequency in:

- basic research
- product development
- process development
- additional education
Empirical Implementation of the Structural Model

LV: Innovativeness
- New products in 2003/04
- New processes in 2003/04
- Number of patent applications in 2003/04
- Deployment share in R&D in 2003/04
Empirical Implementation of the Structural Model

LV: Performance

*Firm assessment of the development of:*
- competition situation in 2005/2006
- market volume for a medium term
Estimation Results (I): Test of H1, H2a and H3

### Inner Model

<table>
<thead>
<tr>
<th></th>
<th>Research spin-offs</th>
<th>Company spin-offs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cooperation</td>
<td>Innovativeness</td>
</tr>
<tr>
<td>Skilled Labor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation</td>
<td>0.280</td>
<td></td>
</tr>
<tr>
<td>Research facilities</td>
<td>0.302</td>
<td></td>
</tr>
<tr>
<td>Support</td>
<td></td>
<td>0.477 *</td>
</tr>
<tr>
<td>Cooperation</td>
<td>0.644 *</td>
<td></td>
</tr>
<tr>
<td>Innovativeness</td>
<td></td>
<td>0.334</td>
</tr>
<tr>
<td>R² value</td>
<td>0.326</td>
<td>0.576</td>
</tr>
</tbody>
</table>

* a very large effect size $f^2$
Test of H2b

Local, only local and nonlocal cooperation

- Skilled Labor
- Transportation
- Research facilities
- Support

Cooperation

A: 35% local cooperation links
A ∩ B: 13% non-local cooperation links
B: 30% non-local cooperation links

Innovativeness

Performance

Locality = within 30 km radius from firm headquarter
Estimation Results (II): Research Spin-offs

Cooperation = Local Cooperation (A)

\[ R^2 = 0.309 \]
\[ R^2 = 0.518 \]

\[ f^2 = 0.02, 0.15, 0.35 \rightarrow \text{a small, medium, large effect size} \]
Estimation Results (II): Research Spin-offs

Cooperation = Only Local Cooperation (A\B)

Support + 0.27 Innovativeness

$R^2 = 0.310$

$f^2 = 0.02, 0.15, 0.35 \rightarrow$ a small, medium, large effect size
Estimation Results (II): Research Spin-offs

Cooperation = Nonlocal Cooperation (B)

R² = 0.087

R² = 0.090

f² = 0.02, 0.15, 0.35 → a small, medium, large effect size
Test of H4 and H5: Descriptive Analysis

<table>
<thead>
<tr>
<th>Variables</th>
<th>Research spin-offs Mean</th>
<th>Company spin-offs Mean</th>
<th>Otherwise created firms Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LV: Innovativeness</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New products in 2003/04</td>
<td>0.90 *</td>
<td>0.74</td>
<td>0.71</td>
</tr>
<tr>
<td>New processes in 2003/04</td>
<td>0.44 *</td>
<td>0.35</td>
<td>0.32</td>
</tr>
<tr>
<td>Number of patent applications in 2003/04</td>
<td>1.14 *</td>
<td>0.41</td>
<td>0.39</td>
</tr>
<tr>
<td>Deployment share in R&amp;D in 2003</td>
<td>35.04 *</td>
<td>10.60</td>
<td>10.93</td>
</tr>
<tr>
<td><strong>LV: Performance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expected development of:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>competition situation in 2005/06</td>
<td>3.52 *</td>
<td>3.31</td>
<td>3.27</td>
</tr>
<tr>
<td>market volume</td>
<td>3.58 *</td>
<td>3.10</td>
<td>3.09</td>
</tr>
</tbody>
</table>

* Significantly larger than otherwise created firms at 5% level (t-tests on differences of means)
Structural Model (Basic)

- Skilled Labor
- Transportation
- Research facilities
- Support
- Cooperation
- Innovativeness
- Performance
Structural Model (Extended): Test of H4 and H5

Skilled Labor → Cooperation
Transportation → Cooperation
Research facilities → Cooperation
Support → Cooperation

Cooperation → Innovative-ness

Innovative-ness → Performance

H4: RSO → Performance
H5: CSO → Performance
Estimation Results (III): Test of H4 and H5

### $f^2$ values

<table>
<thead>
<tr>
<th></th>
<th>All firms</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cooperation</td>
<td>Innovativeness</td>
<td>Performance</td>
<td></td>
</tr>
<tr>
<td>Skilled Labor</td>
<td>0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research facilities</td>
<td>0.16</td>
<td>0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Support</td>
<td>0.02</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSO</td>
<td>-</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSO</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooperation</td>
<td>-</td>
<td></td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.225</td>
<td>0.342</td>
<td>0.090</td>
<td></td>
</tr>
</tbody>
</table>

$f^2 = 0.02, 0.15, 0.35 \rightarrow$ a small, medium, large effect size
Conclusions:

- Cooperation activities and locational condition governmental support have a very large effect on explaining the innovativeness of spin-offs (in particular of research spin-offs)

- Nonlocal collaboration ties are more conducive to the innovativeness of the established research spin-offs

- Type of entry as a research spin-off has only a minor impact on firm innovativeness
Backup

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Literature Review

Determinants of firm innovativeness

- Firm environment / locational conditions: availability of research facilities and skilled labour
- Role of support (seed capital, R&D and network-building grants, commercial advice and consultancy)
- Cooperation and networking
- Geographical proximity to cooperation partners:
  - Crucial (face-to-face interactions and informal contacts, reducing uncertainty, spatial limits of knowledge transfer, complexity of innovative activities, knowledge exploitation, lower transaction costs)
  - Not very important (planned contact, knowledge exploration, middle or lower-ranked locations, Raspe et al. (2007): a very small spatial effect on firm productivity; Britton (2004): market regions shape network connections)
  - Complementary nature of local and external cooperation links
### OECD: Knowledge-intensive Branches

<table>
<thead>
<tr>
<th>NACE</th>
<th>Research spin-offs</th>
<th>Company spin-offs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>in %</td>
</tr>
<tr>
<td><strong>High and medium high technology manufacturing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacture of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 chemicals and chemical products</td>
<td>4</td>
<td>5.06%</td>
</tr>
<tr>
<td>29 machinery and equipment</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>30 electrical and optical equipment</td>
<td>2</td>
<td>2.53%</td>
</tr>
<tr>
<td>31 electrical machinery and apparatus</td>
<td>3</td>
<td>3.80%</td>
</tr>
<tr>
<td>33 medical, precision and optical instruments, watches and clocks</td>
<td>16</td>
<td>20.25%</td>
</tr>
<tr>
<td>34 transport equipment</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>35 and other transport equipment</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Knowledge-intensive services</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70 real estate activities</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>71 renting of machinery and equipment</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>72 computer and related activities</td>
<td>19</td>
<td>24.05%</td>
</tr>
<tr>
<td>73 research and development</td>
<td>15</td>
<td>18.99%</td>
</tr>
<tr>
<td>74 other business activities</td>
<td>20</td>
<td>25.32%</td>
</tr>
<tr>
<td>80 education</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>92 recreational, cultural and sporting activities</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>79</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
Geographical Distribution of (a) Research and (b) Company Spin-offs
BBR: Spatial Development of Knowledge Society

Wissensgesellschaftliches Profil entsprechend der Clusteranalyse:

1: Hochtechnologieregionen
2: Durchschnittliche wissensgesellschaftliche Merkmale
3: Gut ausgestattete Regionen ohne Wissensökonomie
4: Ausschließlich auf Bildung basierendes Profil
5: Unterdurchschnittliche wissensgesellschaftliche Merkmale

* Nach dem Leitbild 1 der Raumordnung: Innovation und Wachstum, BMVBS 2006, S. 9
Cooperation Activities of Research Spin-offs

<table>
<thead>
<tr>
<th>Cooperation field</th>
<th>No cooperation</th>
<th>Cooperation</th>
<th>Partners are</th>
<th>Partners' headquarters are</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>other firms</td>
<td>research facilities</td>
<td>local</td>
</tr>
<tr>
<td>basic research</td>
<td>53</td>
<td>11</td>
<td>42</td>
<td>32</td>
</tr>
<tr>
<td>product development</td>
<td>22</td>
<td>49</td>
<td>43</td>
<td>57</td>
</tr>
<tr>
<td>process development</td>
<td>44</td>
<td>33</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>additional education</td>
<td>49</td>
<td>16</td>
<td>33</td>
<td>23</td>
</tr>
<tr>
<td>sales</td>
<td>49</td>
<td>39</td>
<td>5</td>
<td>33</td>
</tr>
</tbody>
</table>

*Mean* | 44 | 30 | 31 | 35 | 30 | 13 |

*(Mean values in %)*