An empirical analysis of knowledge Spillover in German robotic innovation
- in a spatial context

Merits and demerits of using patent data:
+ a good proxy for innovation output
+ promising data for analyzing the geography of innovations
- missing a portion of innovations which are not patented
- different qualities under patent applications

Germany NUTS-3 Region
Robotic patent applications 1980-2010

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Berlin</td>
<td>220</td>
<td>340</td>
<td>420</td>
<td>600</td>
</tr>
<tr>
<td>Munich</td>
<td>180</td>
<td>260</td>
<td>320</td>
<td>400</td>
</tr>
<tr>
<td>Stuttgart</td>
<td>140</td>
<td>200</td>
<td>220</td>
<td>280</td>
</tr>
<tr>
<td>Hamburg</td>
<td>120</td>
<td>160</td>
<td>180</td>
<td>200</td>
</tr>
<tr>
<td>Cologne</td>
<td>100</td>
<td>140</td>
<td>160</td>
<td>180</td>
</tr>
<tr>
<td>Düsseldorf</td>
<td>90</td>
<td>120</td>
<td>140</td>
<td>160</td>
</tr>
</tbody>
</table>

Note: *** indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Main results and conclusions:
The positive and statistically significant spatial autocorrelation (SAC) indicated that in Germany robotic innovation performance at a given region is positively correlated with the performance of its contiguous regions, and showed in space clustering of regions with similar innovation outputs. More importantly, the positive SAC provided the evidence for the existence of knowledge spillover between contiguous regions, since between the contiguous regions knowledge diffusion, especially the transfer of tacit knowledge, becomes efficient, and that contributes to the spatial dependence of robotic innovations. Results of the regressions provided further support to the argument.

Data source: database PATSTAT, RECPAT, and EUROSTAT

**Motivation:**

Why robotics?
- As one of the most important technologies of the 21st century, robotics could generate massive impact on a country’s economy (e.g. improving productivity) and society (e.g. assisting rescue tasks, medical care).

Why knowledge spillover?
- The development of robotics requires highly specialized technologies in various fields, which implies that robotic innovating agents will eventually have to acquire external knowledge resources through knowledge spillover

Why in a spatial context?
- In early studies the analysis of knowledge spillover was limited to single spatial units and knowledge spillover between spatial units was not taken into consideration

**Objective:**
1. To explore the spatial patterns of the robotic innovation activities in Germany
2. To detect the presence of the knowledge spillover between neighboring regions
3. To examine its influence on regional robotic innovation outcome

**Method:**

Exploratory Spatial Data Analysis (ESDA)
- Spatial Autocorrelation (SAC)
- Global Moran’s Index

Spatial Regression Analysis
- Spatial Model

Regression
- Poisson
- Negativ Binomial