

Measuring Regional Knowledge Interactions: A Comparison of Data Sources and Regions

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Abstract of a paper to be presented at the 57th ERSa Congress August
2017 in Groningen, The Netherlands

Problem

It is widely acknowledged that innovations play a crucial role for (regional) economic development processes. Innovations are typically generated in interactive and systemic processes that involve various actors (Lundvall 1992; Nelson 1993; Edquist 1997). Such interactions particularly include the exchange of knowledge that may trigger self-re-enforcing local learning processes that result in a region-specific knowledge base (Leydesdorff and Fritsch 2006).

A common approach to analyze such interaction processes is the construction of networks of relationships between actors. Information on the relationships may come from different sources such as patent statistics (see Graf 2006), publications and from statistics that represent other forms of interaction by which knowledge transfer may become manifest. Since each of such data sources is selective in the sense that it only records certain types of interaction and disregards others, analyses of a certain innovation system may show quite different results depending on the data source that is used. As a consequence, actors that appear to be relatively important in a network that is constructed with a certain data source may appear to be unimportant or are even completely disregarded

if a different source of data is applied. In order to avoid such a bias and to gain a more complete picture that includes different types of cooperation it is desirable to combine several sources of information for the construction of innovative networks. Accounting for multiple types of interactions in the innovation process should particularly allow relatively deep insights into processes of knowledge generation and transfer. Empirical analyses that combine different data sources for the construction of networks do, however, hardly exist what is probably due to limited data availability and the more technical problems of combining different sources such as data matching.

Empirical approach

In this study we compare and integrate three different data sources on innovative interactions in six German regions. Beyond patent statistics, we consider co-publications as well as interactions within publicly subsidized collaborative R&D projects. In a first step we construct regional networks based on each of these data sources and compare the coverage of actors and of links between them. This enables us to assess the selection bias that characterizes each of these data sources. In a second step we merge these three databases at the level of actors using comprehensive record-linkages techniques. Finally, we compare the effect of the selection bias of the different data sources across different types of regions, particularly those with relatively high levels and those with relatively low levels of innovation activity.

The unit of analysis (node in the network) is the institution where the respective researchers are affiliated to. The analysis covers the period 2000-2010.

Results

Our analyses show rather considerable differences between the three data sources used (Table 1). While a relatively high share of public research institutions (universities and public research institutes) is involved in all three forms of interactions we observe many private sector

firms that only participate in one specific form of knowledge transfer. Hence universities are included in all three data bases while the coverage of private sector firms, public research institutions and other firms is selective. The largest number of links (83.1 % of all links) is identified on the basis of publications with publicly funded R&D cooperation in the second place (74.8 %) and patents in the third place (69.4 %). More than half (56.7 %) of the total number of links between actors are found in all three data bases.

Table 1: Channels of knowledge transfer by types of actors^b

Types of links (pooled 2000-2010)	Type of actor				Total
	Firm	University	Research institute	Other	
Number of interactions by type					
Patents only	1,312 (21.9)	2 (0.0)	252 (2.4)	1,309 (72.4)	2,875 (10.5)
Publications only	1,465 (24.5)	5 (0.1)	1,900 (18.3)	359 (19.9)	3,729 (13.6)
R&D cooperation only	1,214 (20.3)	52 (0.6)	168 (1.6)	8 (0.4)	1,422 (5.3)
Publications and patents	192 (3.2)	0 (0.0)	79 (0.8)	33 (1.8)	304 (1.1)
R&D cooperation and patents	262 (4.4)	14 (0.2)	33 (0.3)	0 (0.0)	309 (1.1)
R&D cooperation and publications	681 (11.4)	16 (0.2)	2,438 (23.5)	98 (5.4)	3,233 (11.8)
All three forms	860 (14.4)	9,157 (99.0)	5,525 (53.2)	0 (0.0)	15,542 (56.7)
Total	5,986 (100.0)	9,246 (100.0)	10,395 (100.0)	1,807 (100.0)	27,434 (100.0)
Links covered by					
Patents	2,626 (43.9)	9,173 (99.2)	5,889 (56.7)	1,342 (74.3)	19,030 (69.4)
Publications	3,198 (53.4)	9,178 (99.3)	9,942 (95.6)	490 (27.1)	22,808 (83.1)
R&D cooperation	3,017 (50.4)	9,239 (99.9)	8,164 (78.5)	106 (5.9)	20,526 (74.8)

Notes: a) The respective number indicate, which share of regional knowledge transfer is captured by co-patents, co-publications and (granted) R&D collaboration projects. Due to overlap the figures sum up to more than 100.0%. – b) Numbers in parentheses represent the share in %.

Neglecting patent statistics in the construction of regional innovation networks leaves 72.4 % of the “other” actors¹ and 21.9 % of the private sector firms unidentified. Not including information on publications leads to an underassessment of 24.5 % of the links of private sector firms, 19.9 % of links of “other” actors and 18.3 % of the links of public research institutes. Small private sector firms are more likely to be unrecorded in the data than larger ones.

To illustrate the selective coverage of the three data sources we construct networks based only on one of these sources as well as using an integrated data set. Figure 1 shows the four versions of the main component of the network for the Dresden region. Remarkably, the Technical University Dresden and three of the extra-university public research institutes (marked as 2, 3 and 4) are included in all three data sets while private sector firms are covered rather selectively. Hence, the most comprehensive picture of the role of private sector firms and their interaction within a regional innovation system is provided by a combination of all three data sources.

Comparing the six case study regions we find that the underassessment of network actors and their relationships has a stronger impact on the resulting structure of the innovation network in regions with lower density of actors and innovation activities. This has consequences for interregional comparisons.

Keywords: Regional Innovation Systems, Social Network Analysis, Knowledge Interactions

JEL codes: O30, R12, R30

Literature:

Edquist, Charles (1997): Systems of innovation approaches – their emergence and characteristics. In Charles Edquist (ed.): *Systems*

¹ The „other“ actors are those that could not be assigned to any institutions such as private inventors and authors.

of Innovation: Technologies, Institutions and Organizations, 1–35, London: Pinter.

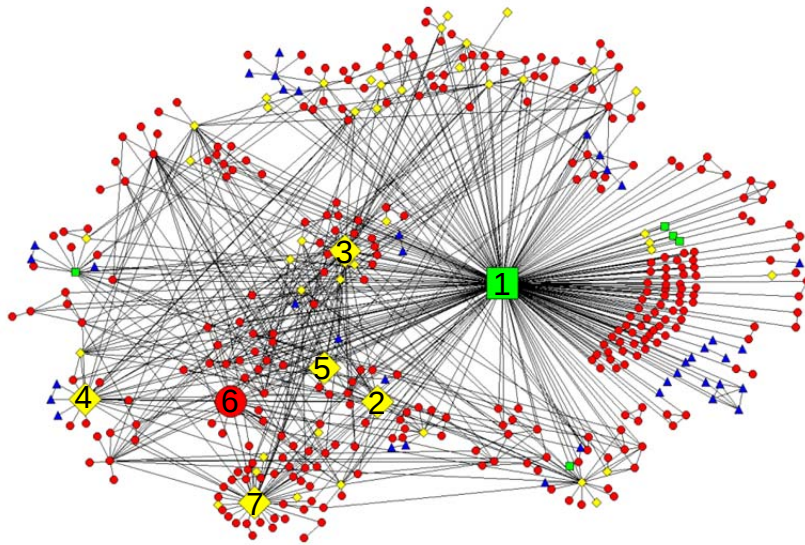
Graf, Holger (2006): *Networks in the Innovation Process: Local and Regional Interactions*. Cheltenham: Elgar.

Leydesdorff, Loet and Michael Fritsch (2006): Measuring the knowledge base of regional innovation systems in Germany in terms of a triple helix dynamics. *Research Policy*, 35, 1538–1553.

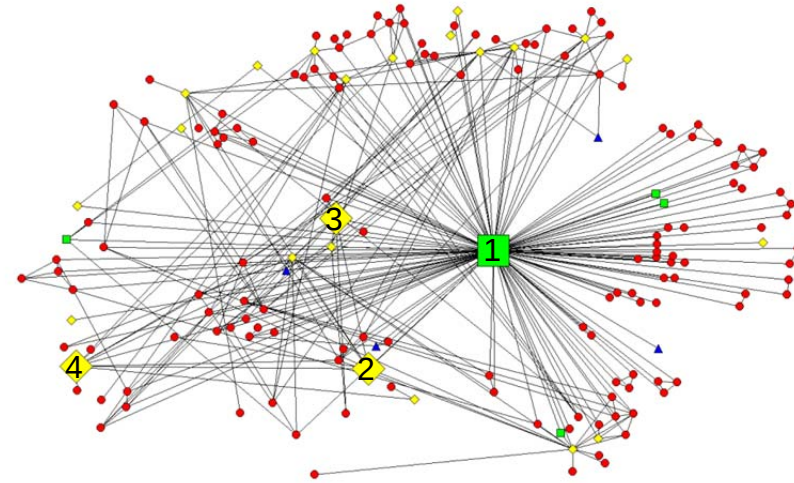
Lundvall, Bengt-Ake (1992): *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. London: Pinter.

Nelson, Richard R. (1993): *National Innovation Systems: A Comparative Analysis*. New York, NY: Oxford University Press.

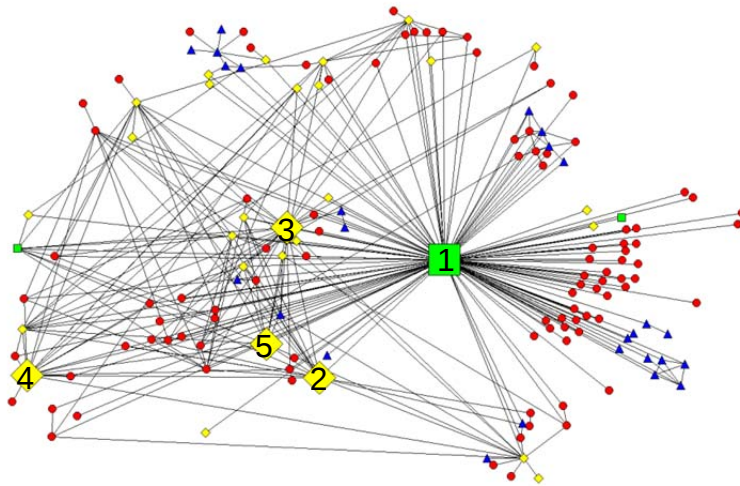
a) all Layers



b) collaborative R&D projects



c) co-publications



d) co-patents

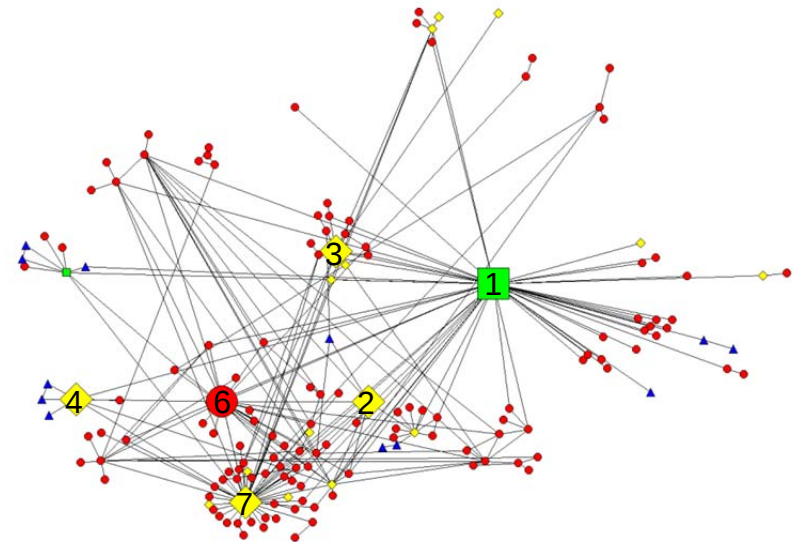


Figure 1: Networks of the Dresden region (largest component, period 2000-2010)

Legend:

● Private Sector (firms) ■ University ◆ Research Institute ▲ Other actors

Legend actors with central positions:

1: TU Dresden 2: Leibniz Institute for Solid State and Materials Research 3: Helmholtz-Zentrum Dresden-Rossendorf

4: Leibniz Institute for Polymer Research 5: Max Planck Institute for Chemical Physics of Solids 6: Infineon 7: Fraunhofer Society

Source: Authors' own illustration.

