Johannes Herrmann and Stefan Töpfer

STRUCTURAL SIMILIARITY AND DEPENDENCY OF RESEARCH NETWORKS IN THE GERMAN PV-INDUSTRY – DOES THE COMPRENSVENESS OF THE POLICY MIX MATTER?

[SPECIAL SESSION "HOW THE POLICY MIX IS AFFECTING INNOVATION IN RENEWABLE ENERGY TECHNOLOGIES – NEW INSIGHTS FROM THE GRETCHEN PROJECT"]

Johannes Herrmann: Friedrich Schiller University Jena, Chair of Economics/Microeconomics, Carl-Zeiß-Straße 3, 07745 Jena, Germany, e-mail: johannes.herrmann@uni-jena.de

Stefan Töpfer: Friedrich Schiller University Jena, Chair of Economics/Microeconomics, Carl-Zeiß-Straße 3, 07745 Jena, Germany, e-mail: stefan.toepfer@uni-jena.de

Overview

Invention in renewable power generation technologies (RPGT) is an important prerequisite for a successful transition towards the use of renewable energy sources, like the "Energiewende" in Germany. Cooperation and the resulting networks of knowledge transfer and learning constitute one important element of inventive activity (Dosi 1988, Powell et al. 1996, Ahuja 2000). To encourage cooperation, R&D subsidies by the German government increasingly often include the requirement for different partners to cooperate. However, little is known if these subsidies actually lead to cooperative research and if yes, how long the cooperation persists and if it can be observed in research networks constructed from other data sources. The network of public R&D-projects can be seen as an input to the inventive process and is compared with a cooperation network based on patent data, which is seen as an output of the inventive process. In this study, we focus on photovoltaic technology, which received extensive R&D-funding in Germany.

Methodology

We use data from the German "Förderkatalog", which includes detailed information about R&D-projects financed by the German federal government. Social network analysis is used to construct a network of beneficiaries of R&D subsidies. The network is derived from 1441 individual state supported R&D-projects with an average funding of over 1 Mio. €. The network is constructed using 5-year moving windows, as it is assumed that linkages from cooperation have a finite duration (Fleming et al., 2007; Schilling and Phelps, 2007). We compare the actor composition and structure of the network with a network based on patent data, which represents R&D-output. The patent data is obtained from the EPO Worldwide Patent Statistical Database (PATSTAT), from which we selected 3436 patents which have at least one German applicant. Also, using the patent's forward citation, it is possible to identify if public funding leads to more valuable patents than unfunded research.

Research questions and hypotheses

We analyze if cooperation patterns of inventive actors in the R&D-subsidy network can also be observed in the patent network and if both networks share the same central actors. In a second step, using propensity score matching (Rosenberg and Rubin 1983), we analyze to which extend the number of funded joint R&D projects, the received funding, the type of actor and the position inside the R&D-beneficiary network determines the position of actors inside the patent network. Of special interest is if the changing comprehensiveness of the policy instrument mix (Rogge and Reichardt, 2013) regarding the PV-industry in Germany over time can be used to explain emerging differences among the two networks. From this, we derive several hypotheses:

Funding of R&D-projects increases the input into the inventive process, while patents represent a share of inventive outcome. Therefore, we would expect to find a cooperation which appears in both networks first in the network of joint R&D-funding. Also, the structure of the network of joint R&D-funding should appear after a certain period as a part of the patent network.

H1a: Cooperation patterns in the network of joint R&D-funding appear after a number of periods also in the patent network.

H1b: If a single cooperation between specific actors appears in both networks, it appears first in the network of joint R&D-funding.

Since the German federal government started to fund R&D-projects of the photovoltaic industry already in an early stage of the technological life cycle and later added other policy instruments to promote further development of this technology, we expect that the network of R&D-subsidy beneficiaries and patents diverge over time. Also, over time research becomes more applied, which should increase the importance of private firms.

H2a: In the early stage of technological development, networks of R&D-subsidy beneficiaries and patent holders are more similar than in later stages of the technological life cycle.

H2b: The share of private firms increase over time in both networks.

Over time, we assume that early or highly funded actors have been able to build up a meaningful knowledge stock, which should result in an above average stock of patents. In addition, we expect these actors to be, due to their larger stock of knowledge, more likely to be preferred partners for joint R&D-projects with other actors. Furthermore, private firms, who compete with each other on the same market, face the risk of outflowing knowledge through joint R&D projects, possible leading to a stronger incentive to cooperate in public institutions. Therefore, we expect:

H3a: Actors that received funding for R&D-projects early on are more central inside the patent network than unfunded actors.

H3b: Actors that received above average funding for R&D-projects are more central inside the patent network than actors with below average funding.

H3c: Public actors and research institutes are on average more central than private firms.

Conclusion

With this paper we want to investigate to which extend the policy mix influences cooperation patterns among inventive actors by focusing on the development of the public funding of R&D projects over time. Using the photovoltaic industry in Germany as research case, we expect a strong influence of public R&D funding at the early stage of the technological lifecycle on the development of the corresponding patent network. In later stages, other instruments in the policy instrument mix gain influence, which reduces the effect of publicly funded R&D-projects on inventive outcome. In addition, we are offering a possibility to evaluate if funded actors perform different from those not funded, especially if they are more central to the network of inventors.

References

Ahuja, G. (2000): “Collaboration networks, structural holes, and innovation: A longitudinal study”, Administrative Science Quarterly, Vol. 45, No. 3, pp. 425-455.

Dosi, G. (1988): “The nature of the innovative process”, in: Dosi, G.; Freeman, C.; Nelson, R.; Silverberg, G.; Soete, L. (ed.): “Technical Change and Economic Theory”, Pinter, pp. 221-238.

Fleming, L.; King, C.; Juda, A. I. (2007): “Small Worlds and Regional Innovation”, Organization Science, Vol. 18, No. 6, pp. 938-954.

Powell, W. W.; Koput, K. W.; Smith-Doerr, L. (1996): “Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology”, Administrative Science Quarterly, Vol. 41, No. 1, pp. 116-145.

Rogge, K. S.; Reichardt, K. (2013): “Towards a more comprehensive policy mix conceptualization for technological environmental change: a literature synthesis” Working Papers Sustainability and Innovation, No. 3/2013. Karlsruhe: Fraunhofer ISI. Online available at http://www.projekt-gretchen.de/Rogge_Reichardt_2013_policy_mix_concept_WP03_13.pdf

Rosenbaum, P. R.; Rubin, D. B. (1983): “The Central Role of the Propensity Score in Observational Studies for Causal Effects”, Biometrika, Vol. 70, No. 1, pp. 41–55.

Schilling, M. A.; Phelps, C. C. (2007): “Inter-firm Collaboration Networks: The Impact of Large-Scale Network Structure on Firm Innovation”, Management Science, Vol. 53, No. 7, pp. 1113-1126.