

Do different types of innovation rely on specific kinds of knowledge interactions?

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Abstract

It is commonly accepted nowadays that innovations are brought forward in an interactive process of knowledge generation and application. The business sector, the science sector, and policy actors are involved in this process as has been stressed in concepts such as innovation systems and the network approach. It is still unclear, however, as to what extent different kinds of innovation rely on specific knowledge sources and links. More advanced innovations on the one hand might draw more on scientific knowledge, generated in universities and research organizations. Such knowledge is often exchanged in personal interactions at a local or regional level. Incremental innovations and the adoption of new technologies, on the other hand, seem to occur often in interaction with partners from the business sector also at higher spatial levels. In this paper, we analyze such patterns of knowledge links. After dealing with knowledge interactions from a conceptual view and reviewing the relevant literature, we present an empirical analysis for Austria. The findings show that firms introducing more advanced innovations are relying to a higher extent on R&D and patents, and that they are cooperating more often with universities and research organizations. Firms having introduced less advanced innovations rely more on knowledge links with business services. Furthermore, the employment of researchers was identified as a key factor enhancing knowledge interactions of firms with universities.

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1. Introduction

Innovations are to an increasing extent seen as the result of an interactive process of knowledge generation, diffusion and application. The importance of knowledge interactions for innovation has been stressed by the literature on innovative milieu (Camagni, 1991), knowledge spillovers (Bottazzi and Peri, 2003), innovation networks (Powell and Grodal, 2005), and innovation systems (Edquist, 2005). According to the innovation systems model, the business sector, the science sector, and policy actors are involved in this process. What is often neglected in the literature is the aspect as to what extent different kinds of innovation rely on specific

knowledge sources and links. Advanced or radical innovations are said to draw on new scientific knowledge, generated in universities and research organizations. It is often assumed that the exchange of this type of knowledge requires intensive personal interactions, favoring local and regional levels over others. Incremental innovations on the other hand are said to take place more in interaction with partners from the business sector often located at higher spatial levels beyond the region. Such a pattern might be too simple, however, since there is often a more complex interplay of different types of knowledge and of knowledge sources involved (Bathelt et al., 2004).

In the present paper, we will analyze, thus, the relationship between innovation and external knowledge links of companies. More specifically we will investigate which types of innovation are related to particular kinds of knowledge links—characterized by the kind of innovation partners and the mode of knowledge exchange, i.e. whether these are formal market transactions, networks, or

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informal spillovers and milieu effects. Since universities are regarded as key knowledge sources of firms for more advanced innovations, we investigate in a second step the factors influencing knowledge links between firms and universities.

In the following section, we will deal conceptually with the interactive innovation approach and the types of knowledge interactions involved. In Section 3, we present a literature survey regarding empirical evidence on the role of knowledge links, in particular of cooperations, for innovation. In Section 4, then, it will be investigated empirically for Austria which company characteristics and kinds of innovation partners influence their innovation output. This analysis is based on a telephone survey of Austrian firms and it applies a modified knowledge production function model. Section 5, finally, is focusing specifically on the knowledge links of firms with universities and analyzes which factors have an influence on this particular kind of relation. Section 6 summarizes the major findings and draws some policy conclusions.

2. Innovation and knowledge interactions—conceptual background

The suggestion that innovation is an interactive process is nowadays broadly accepted. In fact, a number of approaches and concepts such as the following have supported this argument:

- The innovative milieu approach (Aydalot and Keeble, 1988; Camagni, 1991; Maillat, 1998),
- Innovation system concepts in different variants: national (NIS: Lundvall, 1992; Nelson, 1993; Edquist, 1997, 2005), sectoral and technological (SIS: Breschi and Malerba, 1997; Malerba, 2005), and regional innovation systems (RIS: Cooke et al., 2000, 2004; Doloreux, 2002; Asheim and Gertler, 2005),
- Innovation networks and related works (De Bresson and Amesse, 1991; Cooke and Morgan, 1998; Powell, 1998; Hagedoorn, 2002; Fritsch, 2003; Quimet et al., 2004; Grodal, 2004; Powell and Grodal, 2005; Hagedoorn et al., 2005; Giuliani, 2007; Nieto and Santamaría, 2007; Katzy and Crowston, 2008),
- Studies on clusters and knowledge spillovers (Audretsch and Feldman, 1996; Baptista and Swann, 1998; Feldman, 2000; Keeble and Wilkinson, 2000; Malmberg and Maskell, 2002; Beaudry and Breschi, 2003).

Although these approaches share the interactive view of innovation (Kline and Rosenberg, 1986), they differ with regard to the conceptualization of the specific actors, key factors and relations seen to be central for innovation:

- The studies on innovative milieu have stressed the importance of informal relationships among local firms and protagonists, and soft factors such as a common

understanding and behavioral attitudes for starting and maintaining innovation processes in a region.

- The innovation systems literature argues that the institutions relevant for a specific sector (SIS), a country (NIS) or a region (RIS) have an influence on innovation. Of key importance are the regulatory context (such as intellectual property rights, technical standards), organizations for knowledge generation and diffusion (universities, education, technology transfer) as well as firms willing and capable to commercialize such knowledge.
- The network approach looks at specific, well-selected relationships in the innovation process among specific actors both in the region and beyond. It stresses motives for engaging in cooperations such as technological complementarities or access to resources and specific knowledge, and it emphasizes the role of trust and social capital for the development of networks.
- The studies on clusters and knowledge spillovers finally argue that the spatial concentration of firms and supporting organizations in specific industries may give rise to knowledge spillovers and enhanced innovation. In this type of approach, the knowledge flow is regarded as an externality, where the mechanisms of knowledge transmission often remain unclear. These may be the monitoring and imitation of competitors (Malmberg and Maskell, 2002), the reading of patents or scientific articles (Jaffe et al., 1993), the setting up of spin-offs or the mobility of qualified labor (Keeble and Wilkinson, 2000).

Of particular relevance for our questions are the innovation systems approach and the studies on innovation networks, since they are more explicit on the kinds of knowledge sources and types of interactions and links involved in the innovation process. The sectoral innovation systems approach (SIS: Breschi and Malerba, 1997; Malerba, 2005) has focused on the key actors (firms and organizations), regulations and institutions relevant for innovation in a particular sector or technology. Sectoral innovation systems and related networks are not confined to particular territories, often they have an international or even global reach. In territorial innovation systems (NIS and RIS), the role of national and regional institutions is pointed out and the relationships among the different actors are conceived as being socially and territorially embedded (Granovetter, 1973; Asheim and Gertler, 2005). The NIS approach (Lundvall, 1992; Nelson, 1993) emphasizes the institutional particularities of countries as relevant for innovation and has put the nation as the appropriate territorial unit into the center. However, advanced by the tacit knowledge debate, there has recently been a shift in the spatial focus from the national to the regional level. The creation of new knowledge is characterized by the interaction of codified and tacit knowledge (Nonaka and Takeuchi, 1995). Personal interactions in a common institutional context facilitate the transfer of tacit

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