



Search patterns and absorptive capacity: Low- and high-technology sectors in European countries

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ABSTRACT

Searching for externally available knowledge has been characterised as a vital part of the innovation process. Previous research has, however, almost exclusively focused on high-technology environments, largely ignoring the substantial low- and medium-technology sectors of modern economies. We argue that firms from low- and high-technology sectors differ in their search patterns and that these mediate the relationship between innovation inputs and outputs. Based on a sample of 4500 firms from 13 European countries, we find that search patterns in low-technology industries focus on market knowledge and that they differ from technology sourcing activities in high-technology industries.

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1. Introduction

Innovation activities have frequently been shown to be a cornerstone for increasing the market share and market value as well as the long-term survival prospects of firms (e.g. Banbury and Mitchell, 1995; Brockhoff, 1997, 1999). In order to sustain the ability to introduce new products to the market successfully, many firms have shifted to a model of ‘open innovation’ that exploits the knowledge of a wide range of actors (Chesbrough, 2003). Such innovation inputs from external sources like customers, suppliers, competitors or universities can be conceptualised as the main elements of a firm’s *search strategy*, which has been shown to have a substantial impact on innovative performance (Katila, 2002; Katila and Ahuja, 2002; Laursen and Salter, 2006). The search strategy can be defined as an “organisation’s problem-solving activities that involve the creation and recombination of technological ideas” (Katila and Ahuja, 2002, p. 1184). Problem-solving activities hence occur along the spectrum from exploitation to exploration (March, 1991). The definition of an appropriate search strategy, however, critically depends on an ability to recognise the potential value of

external knowledge sources. This ability has been summarised as the *absorptive capacity* of firms (Cohen and Levinthal, 1990).

Interestingly, there is often an implicit assumption in the literature that search strategies for external knowledge are particularly beneficial for firms operating in those environments where research and development (R&D) is key to overall firm strategy, i.e. in high- or medium-high-technology (HMT) industries. Shan et al. (1994) investigate the relationship between organisational learning through cooperation and innovative output in the biotechnology industry. The relationship between inter-organisational collaboration and innovation in the same industry is studied by Powell et al. (1996). Rosenkopf and Nerkar (2001) focus on the optical disc industry to examine boundary-spanning searches. Katila (2002) and Katila and Ahuja (2002) look into the search strategies of firms in the robotics industry. Generally speaking, the studies substantiate a positive impact of search activities on innovation performance, although there are also hints of possible ‘over-searching’ that could impede innovation. Medium-low-technology and low-technology industries (LMT), however, have been largely ignored so far. Exploring the search strategies of LMT firms seems even more intriguing as firms from these sectors account for by far the largest share of modern manufacturing in terms of value-added and employment (OECD, 2006).

Furthermore, research on the nature of these search strategies has largely focused on the dimensions of breadth and depth (see for example Katila and Ahuja, 2002; Laursen and Salter, 2006), where

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breadth designates the diversity and depth the intensity of search activities. Very little is known about the complementary or contradictory effects of external knowledge from various sources. This is especially relevant as effective knowledge acquisition depends heavily on a firm's ability to transform new knowledge so that a variety of combinations become possible (Todorova and Durisin, 2007). Hence, we suggest that distinctive *search patterns* can be identified that reflect a firm's technology and market environment. In that sense, we propose that these search patterns vary between HMT and LMT industries. Moreover, we assume that there is not a single uniform association with innovation success but rather that the search patterns mediate the relationship between innovation input and output. Consequently, there are differences in the extent to which firms can appropriate external innovation inputs and hence generate returns on their absorptive capacities.

Our research, therefore, aims at extending the existing literature in two ways. First, we investigate whether different patterns of search strategies exist between HMT and LMT industries. Second, we analyse the link between these search patterns and the payoffs from R&D investments with regard to market success. The empirical part of this research is based on the third Community Innovation Survey (CIS-3), providing insights into the innovation processes of firms from 13 European countries using latent class methodology. This enables us to derive targeted policy recommendations as we obtain fine-grained input–output relationships for different industries (HMT versus LMT) and under different search patterns. Our paper is organised in six further sections. Section 2 provides a brief review of absorptive capacities and search strategies, while Section 3 presents the research questions driving the analysis. Section 4 focuses on our empirical study, outlining data, variable measurements and estimation methodology. Section 5 provides the results of the quantitative analysis. Based on the results, we discuss our findings in Section 6. Section 7 closes with concluding remarks.

2. A brief review of absorptive capacity and search strategies

2.1. External knowledge and absorptive capacity

Unique knowledge, be it internal or external, is the most valuable asset of a firm for achieving competitive advantage (Liebeskind, 1996). Theoretically, this perspective has emerged from the resource and capability based views of the firm (Barney, 1991; Conner, 1991; Peteraf, 1993; Wernerfelt, 1984) and culminated in a knowledge-based view of the firm (Grant, 1996). Knowledge is crucial for firm success as it provides a platform for decisions on what resources and capabilities to deploy, develop or discard as the environment changes (Ndofor and Levitas, 2004). However, building a competitive strategy around knowledge is challenging. Knowledge is by its very nature a public good (Jaffé, 1986) that may 'spill over' to competitors and allow them to free-ride on a firm's investments in knowledge production. Hence, firms have strong incentives to keep their knowledge proprietary (Liebeskind, 1997). It is therefore not surprising that the traditional approach of producing knowledge through investments in R&D has been dominated by secretive and self-contained in-house processes. However, this negative perception of knowledge spillovers between firms and their environment is fading as recent literature has pointed towards the merits of acquiring external knowledge (Tsang, 2000) and moving from 'research and develop' towards 'connect and develop' (Huston and Sakkab, 2006).

External sources of knowledge have become more significant in the shift towards 'open innovation' systems, and more readily available, for example as information and communication technologies

have improved. Chesbrough (2003) identifies four interconnected factors that propel a more open innovation process: the increasing availability and mobility of skilled workers, a venture capital market that endows entrepreneurs with the necessary capital to compete, external options for previously shelved ideas, and finally the increased capabilities of external suppliers. Hence, firms have to reach out to actors beyond firm boundaries to maximise the benefits from inventions and ideas (Rosenkopf and Nerkar, 2001). This openness takes the form of a heightened demand for external knowledge and other external inputs in the innovation process (Fagerberg, 2005; Monjon and Waelbroeck, 2003; Peters, 2003). Several studies have identified positive performance effects from incorporating external knowledge at various levels. Such effects range from innovation success (Gemünden et al., 1992; Love and Roper, 2004) to increased novelty of innovations (Landry and Amara, 2002) and higher returns on R&D investments (Nadiri, 1993).

External sources of knowledge need to be identified, activated and managed for success (Gottfredson et al., 2005; Stock and Tatikonda, 2004). A firm's capability to achieve this has probably been summarised best in the literature on absorptive capacity (Cohen and Levinthal, 1989, 1990): the identification of valuable knowledge in the environment, its assimilation with existing knowledge stocks, and the exploitation phase for successful innovation. These continuous learning engagements increase awareness of market and technology trends, which can be translated into pre-emptive actions. Absorptive capacities provide firms with a richer set of diverse knowledge, giving them more options for solving problems and reacting to environmental change (Bowman and Hurry, 1993; March, 1991). As a result, absorptive capacities enable firms to predict future developments more accurately (Cohen and Levinthal, 1994), allowing them to engage in exploratory innovation activities through unpredictable or rare combinations of resources (Jansen et al., 2006; Subramaniam and Youndt, 2005).

Absorptive capacities comprise a set of organisational routines and processes for this purpose (Zahra and George, 2002). Their roots, mechanisms and consequences have been major issues in recent scientific discussion (Lane et al., 2006, count 289 articles in their excellent review). They are generally developed as a by-product of R&D activities (Cohen and Levinthal, 1989). However, some authors have defined them more broadly as dynamic capabilities that refocus a firm's knowledge base through iterative learning processes (Szulanski, 1996; Zahra and George, 2002). In that sense, the effect of absorptive capacities varies across sources (Lane and Lubatkin, 1998) and is mediated by a stable or turbulent knowledge environment (Van den Bosch et al., 1999). Absorptive capacities enable firms to find and recognise relevant external knowledge sources or require more resources to transform the knowledge so that it can be assimilated with existing knowledge stocks (Todorova and Durisin, 2007).

2.2. Search strategies

While investing in absorptive capacity is an important part of succeeding in an open innovation environment, it is not the only issue. Firms need to identify the most promising external knowledge sources and align their absorptive capacities accordingly. Hence, firms need search strategies that provide direction and priorities (Laursen and Salter, 2006). The search strategy should reflect the environment. Cohen and Levinthal (1990), for example, have discussed the availability of technological opportunities and the turbulence of the environment as well as other factors affecting search activities. Investments in problem-solving activities should result in a favourable combination of linkages among users, suppliers and other relevant actors in the innovation system.

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