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Absorptive capacity and the search for innovation

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ABSTRACT

This paper examines the link between a firm's absorptive capacity-building activities and the search process for innovation. We propose that the enhanced access to university research enjoyed by firms that engage in basic research and collaborate with university scientists leads to superior search for new inventions and provides advantage in terms of both the timing and quality of search outcomes. Results based on a panel data of pharmaceutical and biotechnology firms support these contentions and suggest that the two research activities are mutually beneficial, but also uncover intriguing differences that suggest differing roles of internally and externally developed knowledge.

1. Introduction

It is now well accepted that establishing and sustaining competitive advantage depends upon effectively developing internal knowledge, utilizing external knowledge, and exploiting knowledge to generate innovations (Kogut and Zander, 1992; Teece, 1996). Firms' ability to assimilate and exploit external knowledge is necessarily related to the firms' use of knowledge in the search for innovation. This paper examines the role of two firm research activities, internal basic research and collaborations with external scientists, in identifying, assimilating, and exploiting external knowledge and considers the role of this external knowledge in the search for new inventions. In doing so, this work both contributes to and tests theory related to the "absorptive capacity" of the firm and extends this literature to consider the impact of firm absorptive capacity on the effectiveness of external collaborations. In addition, it adds to the recent literature on the search for innovation, which has largely examined invention importance, by also considering the implications of external knowledge exploitation for the pace of search for new inventions.

The conceptualization of absorptive capacity put forth by Cohen and Levinthal (1989, 1990) highlights the fact that external knowledge does not equally benefit all firms, and that the benefits enjoyed by the firm are determined in part by the firm's own actions and resources. This has led to a vast and growing body of research, much of which has obscured the concept's original meaning or glossed over important assumptions (Lane et al., 2006). The value and appropriateness of various reconceptualization is a matter of current debate in the literature (for example, see Zahra and George, 2002 and Todorova and Dursin, 2007). However, in all renditions, the fundamental argument remains the same: by investing in certain (research or other capability-building) activities, firms can improve their ability to identify, value, assimilate, and apply (or exploit) knowledge that is developed outside of the firm.

The considerable literature addressing the absorptive capacity of the firm has uncovered a multitude of performance benefits associated with a variety of firm activities. Cohen and Levinthal (1989) discuss the role of the firm's own R&D in developing the necessary expertise and ability to make use of external knowledge. Other literature has identified the importance of in-house *basic* research to develop this capability, particularly when the external science from which the firm draws is of a basic nature (Rosenberg, 1990; Lane and Lubatkin, 1998; Dyer and Singh, 1998). Recent work has considered the nature of research and similarity between knowledge sets (Dyer and Singh, 1998; Lane and Lubatkin, 1998), the routines of the firm

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(Zahra and George, 2002), and employee skills (Vinding, 2006) as sources of absorptive capacity.

The development of the firm's ability to access external knowledge sources is not limited to activities that take place strictly within the firm. As emphasized by Cockburn and Henderson (1998) and Zucker et al. (1994, 1998), "connectedness" to outside knowledge sources (particularly scientists) provides benefits in terms of accessing and exploiting external knowledge. Other work has focused on the ability of firms to use connections and collaborations with university and other public sector scientists to gain advantage in accessing and developing public sector science (Zucker et al., 2002). This is consistent with literature examining the effect of a firm's "network" of connections to potential knowledge sources on inventive performance outcomes (Powell et al., 1996; Owen-Smith and Powell, 2004; Stuart, 2000), although network studies most often examine connections to other firms rather than university scientists.

While existing work emphasizes the advantages of accessing external knowledge, it does not provide or test theory regarding how such knowledge benefits firms' search for new inventions. Recent work regarding the role of knowledge in the innovation search process suggests specific mechanisms by which an improved knowledge base contributes to innovative outcomes. Knowledge provides researchers with an understanding of the fundamental principals underlying a system, which may allow researchers to better anticipate the result of various possible experiments without actually proceeding with the experiment (Nelson, 1982; Fleming and Sorenson, 2004). This allows researchers to prioritize potential research avenues and avoid costly and time consuming research trials that end is failure or low-valued outcomes. The limited empirical research in this vein confirms that a better knowledge base, and in particular scientific knowledge, generates more impactful inventions, especially when the search process is complex (Fleming and Sorenson, 2004).

This paper draws on the literatures describing absorptive capacity, network connections, and the search theories of innovation and makes two contributions to the literature. First, combining these literatures suggests a previously unexplored benefit of absorptive capacity and network connections related to the efficiency of search for new invention. Both the absorptive capacity/networks literatures and the search for innovation literature have been restricted to looking at quantities or importance of firm inventive output, usually with a count of patents or citation-weighted patents. This is consistent with search that leads to superior search outcomes with the guidance of scientific knowledge. However, better access to knowledge inputs useful in the search for new inventions is also expected to lead researches more directly to the better outcomes and help them avoid areas of less valuable outcomes. This suggests a focus on the pace or speed of innovation that is currently absent from these literatures. This paper proposes a novel measure of the pace of innovation, based on the time between establishment of existing knowledge and utilization in a new innovation. Results presented here demonstrate that firm research activities typically associated with building absorptive capacity and network connections do result in a faster pace of innovation, even controlling for the importance of the inventive outcomes.

Second, few studies of firm's collaborative networks consider the effect of variation in the network nodes (Owen-Smith and Powell, 2004). Those that do are interested in the variation across the potential knowledge sources, rather than the focal firms that are accessing the knowledge (Owen-Smith and Powell, 2004; Stuart, 2000). We suggest that the absorptive capacity generated by the firm's internal research influences the ability of the firm to make use of connections to external knowledge sources. Firms with superior internal research knowledge are expected to benefit more from connections to external scientists. Empirical results support this expected complementarity.

The paper proceeds as follows. Section 2 presents theory related to the role of knowledge in the search for innovation and the concept of absorptive capacity, and presents hypotheses related to the relationship between firm research activities and inventive performance. Section 3 describes the sample, data, and key measures employed in the analysis. The empirical methodology and result are discussed in Section 4, and limitations are discussed in Section 5. Section 6 provides a discussion of the implications of this study for the relevant literatures and suggests further research.

2. Theory development and hypotheses

The strategy literature that explores variation in firm performance has highlighted the role of the resources or capabilities of the firm as sources of firm competitive advantage, especially when these capabilities are difficult to imitate and are not available through a market transaction. How firms create, maintain, and enhance these capabilities is a fundamental question in the strategy field and the subject of considerable recent literature (Cockburn et al., 2000; Teece et al., 1997). The initial conditions, past activities and experience, and strategic adaptation by the firm over time determine the current set of capabilities held by a firm (Cockburn et al., 2000; Helfat and Peteraf, 2003). By studying the differences among firm-specific characteristics such as experience, knowledge stock, network position, or organizational focus, this research has demonstrated the influence of these differences on firms' innovative performance.[1] This paper adds to this literature by examining differences in firms' research-related activities and the implications of these activities for a firm's absorptive capacity, access to external knowledge, and resulting inventive performance. The following sections review and build upon existing literature regarding absorptive capacity and search for innovation to develop empirically testable hypotheses.

2.1. Scientific knowledge and the search for inventions

Following Nelson (1982), others have focused on the role of scientific knowledge in the search process for new inventions. Inventions are novel combinations of existing and/or new components (Schumpeter, 1934; Kogut and Zander, 1992; Fleming, 2001; Fleming and Sorenson, 2001). The search for a new invention is an uncertain process across a multi-dimensional space of possible new combinations, conditioned by the bounded rationality and pre-existing familiarity of the researcher with respect to the research space (Fleming, 2001). A search generates a new invention when the new combination provides an outcome above some threshold level of usefulness or value.

What is particularly interesting about this process is the role played by knowledge. Because innovation is cumulative, accumulated knowledge provides a guide to the search process (Helfat, 1994; Nelson, 1982). Scientific knowledge, however, is different from knowledge developed through prior experimentation because scientific knowledge provides an understanding of the underlying fundamental properties generating the observed outcome–knowledge of *why* rather than simply *what* happened (Fleming and Sorenson, 2004). In this way, scientific knowledge provides an understanding of the area being searched and allows researchers to place feedback from experimentation in the overall context of scientific knowledge, providing additional opportunities for extrapolation and learning.

[1] For example, see Gulati et al. (2000), McGahan and Porter (2002), Gambardella (1992), Henderson and Cockburn (1994), Cockburn et al. (2000).