



# When do firms benefit from university–industry R&D collaborations? The implications of firm R&D focus on scientific research and technological recombination <sup>☆</sup>



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## ABSTRACT

Firms' access to academic discoveries through R&D collaborations has been shown to enhance their patent performance. However, increasing both internal and external R&D activities can lead to high knowledge redundancy and coordination costs. This paper examines what kind of R&D focus inside the firm will improve or reduce the benefits of R&D collaborations with universities. Our results show that technological recombination focus strengthens the relationship between university collaborations and patent performance, whereas scientific research focus weakens the relationship. These results also differ between young and old firms, implying that firms may shift their R&D focus according to their collaborative objectives.

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## 1. Executive summary

Prior studies that adopt the organizational learning and absorptive capacity perspectives show that firms with greater internal R&D activities gain more benefits from R&D collaborations with universities. However, recent evidence suggests that increasing overlap in resources and expertise between firms and universities can lead to knowledge redundancy and coordination costs, which can reduce the expected returns from university collaborations. Current literature on university–industry linkages has paid insufficient attention to different types of internal R&D focus which influence how firms access and acquire external sources of scientific knowledge and discoveries arising from universities. To address the research gap, we propose in this study to investigate the interdependency between internal R&D focus and R&D collaborations with universities. A firm's ability to leverage both internal and external R&D activities has important implications for generating economic value from innovation and sustaining the firm's competitive advantage, especially in science-based business that faces high uncertainty over prolonged time periods.

Using a knowledge-based perspective, we suggest that scientific research and technological recombination are two distinct dimensions of a firm's R&D focus, which may substitute for or complement university collaborations. We refer to scientific research

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focus as the intensity of the firm in conducting scientific experiments and publishing research findings, and technological recombination focus as the extent to which the firm applies and combines existing knowledge from diverse technological domains in creating patented technologies. In translating scientific research into commercial applications, firms must draw on their experience in both types of R&D activities. However, not both of these activities will complement university collaborations. Firms with strong scientific research focus may depend less on university collaborations for scientific novelty because these firms typically engage internal scientists: 1) to develop the basic scientific knowledge and know-how that may overlap with university research, and 2) to act as boundary spanners who can draw on scientific resources and expertise from the broader scientific community. On the contrary, firms with strong technological recombination focus enjoy greater benefits from university collaborations because the experimental, problem solving approach emphasized in technological recombination facilitates the process of translating scientific discoveries into technological innovations.

Using patent, publication and alliance data from 222 biotechnology firms, our analysis shows that technological recombination focus strengthens the relationship between university collaborations and the patent performance of the firm, whereas scientific research focus weakens the relationship. While the above findings hold true for older firms, only the scientific research focus of younger firms enables them to benefit more from university collaborations. Thus, managing internal and external R&D activities is more challenging for older firms. By building on the knowledge management view of industry–university collaborations, we show that different types of R&D focus can enhance or reduce the performance impact of R&D collaborations with universities. This research contributes to the burgeoning literature on university–industry linkages, particularly relevant to the entrepreneurial development of academic discoveries, explaining why some university collaborations are more successful than others.

## 2. Introduction

Scholars have underscored the role of university–industry R&D collaborations in transforming academic discoveries into commercial technologies (Faulkner and Senker, 1994; George et al., 2002; Markman et al., 2009). Through these collaborations, universities actively explore and exploit their academic discoveries and promote technology commercialization (Baba et al., 2009; Lavie and Drori, 2012; Markman et al., 2008). From a firm's perspective, collaborations with universities are imperative not only for accessing and leveraging valuable resources such as star scientists and state-of-the-art research facilities but also for exploiting scientific knowledge and novel discoveries (Audretsch et al., 2012; Liebeskind et al., 1996; Subramanian et al., 2013). Emerging science-based firms thus play a complementary role in generating the economic value of scientific discoveries from universities (Pisano, 2010; Stuart et al., 2007).

Extant studies have attributed the success of university–industry R&D collaborations to a multitude of factors ranging from market conditions to governance structures and entrepreneurial orientation of universities and firms (Bruneel et al., 2010; Markman et al., 2009; Perkmann et al., 2011; Santoro and Saporito, 2003). Despite an extensive body of literature on this subject, insufficient attention has been paid to understanding what kind of R&D focus inside the firm can enhance or undermine the benefits arising from external collaborations (Markman et al., 2008; Perkmann et al., 2013). The widely held notion of absorptive capacity suggests that firms with greater internal R&D activities will benefit more from university collaborations (Bercovitz and Feldman, 2007; Fabrizio, 2009). Yet, from a knowledge management perspective, increasing overlap in scientific resources and expertise between firms and universities can lead to undesirable knowledge redundancy and coordination costs, which in turn reduce the effectiveness of their collaborative efforts (Grant and Baden-Fuller, 2004; Lavie and Drori, 2012; Rothaermel and Hess, 2007). Our research therefore investigates the influence of firm-specific R&D focus on the relationship between R&D collaborations with universities and the patent performance of the firm. Understanding when firms can rely on such collaborations is central to organizing and managing internal resources and routines for accessing and exploiting external knowledge assets (Grant and Baden-Fuller, 2004).

Building on the knowledge management literature, we make a distinction between scientific research focus and technological recombination focus in a firm's R&D activities and examine their respective implications for capturing benefits from collaborations with universities. We refer to scientific research focus as the intensity of the firm in conducting scientific experiments and publishing research findings, and technological recombination focus as the extent to which the firm applies and combines existing knowledge from diverse technological domains. In scientific research, value is derived from the creation and absorption of novel knowledge (Cohen and Levinthal, 1989; Gambardella, 1992). In technological recombination, firms put emphasis on creating and reusing combinations of diverse technological components, which lead to patented technologies (Carnabuci and Operti, 2013). While both types of R&D focus are important, resource constrained entrepreneurial firms in science-based business often have narrow focus (Greenwood, 2010; Pisano, 2010). Therefore, the relative level of scientific research focus versus technological recombination focus may account for variation in the relationship between university collaborations and a firm's patent performance.

We chose the biotechnology industry as our research context because this industry stands at the confluence of multiple technologies and depends substantially on collaborative work between the public and the private sectors (Phene et al., 2006; Silber, 2010). In the evolution of biotech commercialization, there are also differences between young ventures that conduct more exploratory research and established firms that focus on a broad range of activities in the value chain (Arora and Gambardella, 1990; Rothaermel and Deeds, 2004).

Based on the patent and collaboration data from 222 publicly listed biotech firms, our analysis shows that a firm's R&D focus on technological recombination strengthens the relationship between university collaborations and the firm's patent performance, whereas its focus on scientific research weakens the relationship. Interestingly, only the scientific research focus of younger firms enables them to benefit more from university collaborations, while no change is observed in the results for older firms.

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