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Mind the gap: Capturing value from basic research through combining mobile inventors and partnerships☆

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ABSTRACT

To successfully generate more valuable technologies from accessing basic research knowledge, firms need to combine institutional and individual level bridges to universities and research institutes active in basic research. This combination is particularly important when the new technology builds on scientific prior art. While mobile inventors are needed to transfer and translate basic knowledge into new technologies, partnerships provide the commitment, resources and incentive structure to integrate this basic research knowledge more effectively into the firm's innovation process, thus improving the value capture from mobile inventors. Our findings in the micro-electronics field illustrate the importance of jointly accounting for firm and inventor level industry-science links to assess their effectiveness and provides evidence on complementarity from using both. Furthermore, identifying the scientific nature of the technology projects critically determines whether the combination of these links allow to capture more value.

1. Introduction

Since Nelson (1959) asked his famous question "Why do firms do basic research?" much has been written on the subject. More recently access to basic research rather than internally developing basic research has received more attention within the firm's innovation strategy (Arora et al., 2018). Firms collaborate with universities or research centers to access basic research and integrate these insights into their own research efforts and generate superior performance outcomes (Belderbos et al., 2004).

In this paper we argue that successfully accessing basic research requires complementary actions by the firm. On the one hand, basic research knowledge is transferred through individuals. A proper translation and integration of this knowledge into the innovation process of the firm requires the involvement of individuals familiar with this knowledge (Jensen and Thursby, 2001). This holds the more so for scientific knowledge that is more complex and early stage (Zucker et al., 2002; Agrawal, 2006). Moreover, scientific knowledge and technology are developed within different communities requiring bridging these communities by individuals that foster this translation (Dasgupta and David, 1994; Gittelman and Kogut, 2003).

On the other hand, the firm needs to commit to a strategy of accessing basic research. Such a commitment signals the organization's willingness to integrate this knowledge in the firm's innovation process and leverages resources within the organization for this purpose. Partnerships and institutional collaborative agreements are a vehicle for establishing such commitment (Brandstetter and Sakakibara, 1998; Cockburn and Henderson, 1998; Veugelers and Cassiman, 2005).

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In this paper we provide evidence for both of these channels, institutional and individual, to effectively access basic research for firms. Our major contribution is to argue and provide evidence that both channels are complementary. The involvement in both complementary channels directly affects the integration and translation of the basic research into more applied technologies that are closer to commercialization. Firms that are committed through a partnership with institutions active in basic research can benefit more from including individuals familiar with the research performed at these institutions in the internal research projects at the firm. At the same time, such a partnership indicates a commitment to resources and provides incentives that affect the engagement of researchers in its internal research projects. Especially when the knowledge is science-based, we argue that accessing basic research through different channels simultaneously improves outcomes.

To empirically demonstrate this complementarity between different channels for accessing basic research, we need to simultaneously observe different bridging mechanisms that can affect the outcome of technology development by the firm. And we need a reasonable counterfactual for the different alternatives for generating this new technology. We exploit a specific setting in the micro-electronics and semiconductor industry where a research institute's intellectual property management system allows us to identify and trace technologies developed by partner and non-partner firms and where some technologies also have the involvement of individuals familiar with the research developed at the research institute.

Our empirical results support the complementarity between institutional and individual level links for science based inventions. We find that firms that combine a partnership with the use of individuals that were active at the research institute develop patents that receive more forward citations. These individuals are an important mechanism for bridging the gap with basic research, but only when used in combination with a partnership. Poaching of these individuals by firms without a partnership link to the research institute are less successful in developing related technologies. Likewise, firms with an institutional partnership who do not consummate their partnership by having individuals formerly active in the research institute in their technology development teams are not capturing any extra value from their partnership. Interestingly, we find that this complementarity only holds for projects with an important scientific component: individual inventors only support the creation of valuable technologies for those projects at partner firms that rely on scientific prior art.

In order to establish the most successful routes to access basic research, our empirical methodology needs to deal with several selection issues. Do the best firms, most apt to effectively access basic research, select into an institutional partnership with a research institute? Do the best inventors, most apt to bridge scientific and technology communities, get targeted? Unfortunately, the setting where we apply our methodology does not provide clear exogenous variation to pin down the causal effects of partnering and using inventors formerly active at the research institute. Nevertheless, as we examine the effects at the invention level, we are able to compare which technologies are more successfully developed within partner firms, controlling for company and inventor characteristics potentially driving selection. Moreover, we look at different cuts of the data to examine potential selection issues. In the end we cannot eliminate all uncertainty about the actual mechanisms at work, but we believe that our findings provide sufficient support to advocate for future research to look at the portfolio of bridging mechanisms and the nature of the technological inventions when analyzing the effect of firms relying on basic research in other settings. While our findings are derived from the analysis of the interaction with a particular research organization focusing on basic research in microelectronics and semiconductors, the methodology developed is sufficiently generic so that it can be applied in other settings to test the robustness of our findings.

In the following section, we discuss the gaps in the literature and develop empirical predictions related to how firms effectively appropriate returns from accessing basic research in their innovation process. Section 3 discusses our empirical setting. Section 4 elaborates on our data development and methods while Section 5 presents our results. Section 6 concludes with some caveats and directions for further research.

2. Accessing basic research

2.1. Why firms want to access basic research?

Any explanation for why firms want to tap into basic research needs to argue that ultimately basic research enhances firm performance (Nelson, 1959; Evenson and Kislev, 1976; Cassiman et al., 2002). Basic knowledge leads to a better identification, absorption and integration of external (public) knowledge (Cohen and Levinthal, 1989; Gambardella, 1995; Cassiman and Veugelers, 2006). Faster identification, absorption and integration of external knowledge in turn leads to increased productivity of the applied research process, resulting in more valuable technologies (Fabrizio, 2009; Laursen and Salter, 2006). This process of integration requires firms to develop the initially acquired basic knowledge further into new technologies and eventually into products and processes. In addition, Fleming and Sorenson (2004) and Arts and Fleming (2018) argue that scientific knowledge serves as a map for technological search, guiding research towards the most promising technological directions, thereby avoiding wasteful experimentation. Moreover, basic knowledge can simultaneously fertilize different research projects (Henderson and Cockburn, 1996).

Fleming and Sorenson (2004) find that patents which rely on scientific prior art are more valuable as measured by forward citations, particularly in case of more complex and interdependent lines of technology. Consistent with these results, Cassiman et al. (2008) find that firms that actively engage in scientific research develop patents that receive more forward citations. As a result, access to science-based basic research can enhance the innovation performance of the firm by increasing the average value of the new technologies.

2.2. The difficulty of accessing basic research

While firms can derive benefits from accessing basic research in their innovation process, there are three key reasons why they may encounter difficulties in doing so. First, basic research is experimental or theoretical work undertaken primarily to acquire new knowledge without any particular application or use in view (OECD, 2002). It is typically conducted in institutional settings other than firms, i.e. in organizations like universities and basic research organizations. Aghion et al. (2009) show that universities have a larger incentive to engage in early stage basic research with uncertain commercial returns. Firms are only willing to step in closer to commercialization. By outsourcing more basic R&D projects to universities, rather than developing them in-house, firms provide a credible commitment not to abort or alter projects with a more basic character and less certain commercial outcomes (Lacetera, 2009). Such a commitment through outsourcing provides the right incentives for the researchers involved to invest effort in these research projects. But at the same time, the difference in the institutional environment where these types of projects are embedded complicates the further development by the firm because firms have to cross this institutional divide (Gittelman and Kogut, 2003).

Second, basic research at the frontier of knowledge is often complex, early stage, and not yet fully codified (Zucker et al., 2002; Bechky, 2003; Agrawal, 2006). As Bessen (2011) argues, the tacitness of basic knowledge is, at least partly, endogenous. Organizations will only cover