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In-house versus external basic research and first-to-market innovations



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ABSTRACT

This paper explores to what extent conducting internal basic research, as opposed to external basic research (i.e. outsourcing and collaboration with universities) encourages firms to bring new products into the market ahead of competitors, and contributes to innovation performance. The analysis is based on a sample of Spanish manufacturing firms over the period 2006–2012. Our findings suggest that conducting in-house basic research affects firm's propensity to introduce product novelties. Furthermore, performing this activity continuously affects the probability of being product-pioneer in low and medium–low tech sectors. Collaboration with universities also helps in introducing new products ahead of competitors, but contracting scientific research from universities does not lead to a pioneer strategy. Results also reveal the absence of complementarities.

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1. Introduction

According to the Frascati Manual (OECD, 2002: p. 30) basic research, also known as fundamental research, "is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view". Despite the appropriability problems and high uncertainty related to basic research activities, firms might have incentives to conduct these activities within their boundaries (Nelson, 1959). Cohen and Levinthal (1989) and Rosenberg (1990) argue that first-mover advantages may be an important benefit associated to performing basic research. These advantages may be the result from being the first to possess new knowledge resulting from basic research, or from the development of new products or processes which, brought to the market ahead of competitors, may confer a temporary monopoly. The importance of developing and bringing to market innovative products ahead of rival firms and

the benefits and risks for the firm pursuing this strategy are well recognized (Lieberman and Montgomery, 1988). However, there is a lack of empirical evidence on whether corporate basic research may contribute to help firms to achieve a market pioneer status.

Though most of basic research is nowadays conducted at universities, corporate research labs became widespread in the 1930, with companies such as AT&T (Bell Laboratories), Xerox (PARC) and Dupont investing seriously in basic research (Arora et al., 2015). Scholars have shown that these investments have reported important private benefits and have been a source of advantage to these firms. These include, amongst others, improvement in innovation performance (Gambardella, 1992), in productivity (Mansfield, 1980; Griliches, 1986) or in the development of firm's absorptive capacity (Cockburn and Henderson, 1998).

However, since the 1990s, there has been a gradual re-orientation towards leaner corporate research labs (Tijssen, 2004). Though companies such as Google continue to invest in in-house basic research, other leading companies (e.g. AT&T, Xerox, IBM and Hewlett-Packard) have downsized, shuttered or spun off their research labs and outsourced much of their basic research (Chesbrough, 2003; Andries and Thorwarth, 2014; Arora et al.,

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2015). At the same time, new companies have emerged in sectors like biotech, nanotech and also energy, which are directly engaged in basic research activities (Pisano, 2010).

This paper contributes to expand the literature by analyzing the role of conducting in-house basic research versus using other modes of open innovation, in which basic research is either outsourced or performed in collaboration with universities (Chesbrough, 2003). In particular, we are interested in analyzing the role that these different strategies of performing basic research (internal vs. external) have in shaping the firm's innovation choice, and in particular, in determining the chances to be a pioneer in product development. Additionally, the literature has also embraced the concept of learning-by-doing, i.e. learning effects through the continuous engagement in an activity (Wright, 1936; Arrow, 1962). In the innovation literature, learning, experience and accumulation of knowledge are important sources of the innovation process. Rosenberg (1990, p. 173) stresses that for basic research to be successful it requires the making of stable, long-term commitments. On that basis, we also test the extent to which experience in conducting internal basic research influences the odds of being a pioneer.

More specifically, the aims of this paper are twofold. First, we seek to analyze the impact of performing in-house basic research and doing it continuously, versus conducting basic research externally (either through outsourcing or in collaboration with universities) upon the choice of firms' innovative strategies. We focus on product innovation and, in line with Duysters and Lokshin (2011), we distinguish between three possible strategies: (i) abstaining from innovation, (ii) introducing new or significantly improved products or services that are known to the market but new to the firm (referred to as an imitation strategy¹) and, (iii) introducing original or significantly improved products or services to the firm's market (i.e. pioneer strategy). Our definition of pioneer is consistent with that used by Golder and Tellis (1993, p. 159), who define market pioneer as *the first firm to sell in a new product category*². Second, we assess the importance of doing basic research, in-house and external, upon firm's innovative performance, measured as the sales share of new-to-the market products.

The empirical analysis is performed for a sample of Spanish manufacturing firms drawn from the Technological Innovation Panel (PITEC) database from 2006 to 2012. A distinguishing feature of the database is that it provides detailed information about firms' R&D activities, allowing for differentiation between basic and applied research and development expenditures; as well as for distinguishing between in-house and external R&D activities. With this information we are able to study the extent to which firms performing in-house basic research, conducting research externally or through collaborations are more likely to launch new products ahead of competitors.

The rest of the article proceeds as follows: Section 2 provides an overview of the literature on the potential private benefits from conducting internal and outsourcing basic research. Section 3 presents the data and the empirical model. The empirical results are discussed in section four, and the final section concludes.

¹ Other studies interpret also the introduction of products new to the firm but known to the market as resulting from an imitation strategy (Kleinknecht et al., 2002).

² Other studies have used market entry and market entry time to define and measure pioneering (Lieberman and Montgomery, 1988). For instance, the definition of market pioneer provided by Robinson and Fornell (1985, p. 305) is *the first entrant in a new market*, while Urban et al. (1986) define a pioneer as the first product to enter the market.

2. Related literature

2.1. Basic research and firm's performance

Despite the extensive literature focusing on the role of R&D, the literature on firm's basic research activities is relatively scarce. Existing studies on basic research are either theoretical or focus their attention onto academic/scientific research as the source of basic research, overlooking the importance of corporate basic research. Notable exceptions, however, highlight the benefits from private basic research. These include, amongst others, improvement in innovation performance (e.g. Gambardella, 1992; Bean, 1995), in productivity (Griliches, 1986) or in the development of firm's absorptive capacity, which allows firms to better screen and absorb external information (Cockburn and Henderson, 1998; Fabrizio, 2009).

The empirical studies by Gambardella (1992) and Fabrizio (2009) show that firms engaging in basic research activities obtain advantages in the innovation outcome, in terms of number, quality and timing. In contrast, Lim (2004) finds no significant effect of internal basic research on the patenting performance of pharmaceutical firms, while a negative effect is found for firms in the semiconductor industry. Findings from Mansfield (1980), Griliches (1986), and Czarnitzki and Thorwarth (2012) show that not only basic research is an important determinant of firm's productivity but also exhibits a premium with respect to other types of R&D, particularly in high-tech sectors. Similarly, Bean (1995) finds that basic research contributes to productivity growth, but its contribution is indirect, enhancing the gains realized through product and process development. In addition, Cassiman et al. (2002) find that basic research enhances applied research productivity and argue that it allows firms to develop their absorptive capacity, an idea previously embraced by Rosenberg (1990) and supported also by Cockburn and Henderson (1998). Complementarity effects between basic and applied research are additionally found in Henard and McFadyen (2005). Moreover, Stern (2004) shows that a focus on basic research may lead to labor cost reductions, as researchers may be willing to accept lower salaries in exchange of permission to keep up with scientific research.

From a more theoretical point of view, basic research has been linked to the generation of pioneering and revolutionary ideas, as well as breakthrough applications, even in the short term (Pavitt, 1991). Basic or fundamental research has the potential to enable significant commercial opportunities through facilitating entirely new product areas rather than just incremental changes. Many important and commercially viable products have been developed based on breakthroughs made by basic research. Examples are the birth of radio astronomy at Bell Laboratories, and the discovery of high temperature superconductivity at IBM research labs.

Breakthrough innovations are not the only economic benefits of basic research for industrial innovation. Additionally, according to the absorptive capacity theory, scientific knowledge, resulting from basic research activities, has a dual nature. It also helps firms gain a better understanding of the technological landscape in which they search for new inventions, informs them about the most profitable directions for applied research, avoiding wasteful experimentation, and helps them better interpret findings of applied research (Rosenberg, 1990; Fleming and Sorenson, 2004; Kelchtermans et al., 2013). Internal basic research capabilities also allow firms to expand firm's absorptive capacity, by allowing to better monitor, interpret and absorb scientific knowledge that is conducted externally to firms (Cohen and Levinthal, 1990; Cockburn and Henderson, 1998; Fabrizio, 2009). Further benefits include signaling firm's scientific competencies to universities or research centers for collaboration and to public authorities

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