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The effects of licensing-in on innovative performance in different technological regimes

Jong-Seon Lee, Ji-Hoon Park*, Zong-Tae Bae

College of Business, Korea Advanced Institute of Science and Technology (KAIST), 85 Hoegi-ro, Dongdaemun-gu, Seoul, 02455, Republic of Korea

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ABSTRACT

Technology licensing has become an important way to adopt external technology in the growing markets for technology. This study examines the effect of licensing-in on innovative performance and identifies the boundary conditions when this effect is greater in terms of technological regime. We employ the propensity score matching approach and compare the innovative performance between firms that engage in licensing-in and firms that do not to control for the endogeneity issue. Based on the empirical results from the Korean Innovation Survey, this study finds evidence that adopting external technology through licensing-in does not always enhance innovative performance. Additionally, the results show that the effectiveness of licensing-in varies with technological regimes. Adopting licensing-in practices improves innovative performance in industries with relatively (1) high levels of technological opportunities, (2) low levels of cumulateness, and (3) high levels of appropriability. We also discuss the implications of these findings for research on the market for technology and licensing strategies.

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1. Introduction

The emergence of the market for technology has a considerable influence on firms' innovation process through the division of innovative labor and technology transactions in this market (Arora et al., 2001a, 2001b). Traditional perspectives on innovation have regarded the innovation process from idea generation to commercialization as being wholly conducted within the boundary of a firm. However, the growing market for technology implies that firms can profit from licensing their technologies and that formal licensing-in becomes a window of access to external technologies (Arora et al., 2013; Laursen et al., 2010).

Recently, the literature on the market for technology has mainly focused on the supply side of the market. The demand side of the market also deserves scholarly attention to elucidate the nature of the market for technology (e.g., Arora and Gambardella, 2010; Laursen et al., 2010). From the licensee's perspective, previous studies suggested several reasons for firms adopting external technologies through licensing-in. By engaging in licensing-in, firms can reduce the risks and costs associated with the innovation process, keep up with technological advances, and facilitate tech-

nological learning (Atuahene-Gima, 1993; Johnson, 2002; Lowe and Taylor, 1998). Additionally, firms sometimes enter into a licensing-in agreement to acquire industry standards or freedom-to-manufacture (Grindley and Teece, 1997; Lowe and Crawford, 1984). Prior studies examined how licensing-in affects various outcomes, such as financial performance, innovation, and the speed of invention (Laursen et al., 2010; Leone and Reichstein, 2012; Tsai and Wang, 2007; Wang and Li-Ying, 2014; Wang et al., 2013a).

Despite the considerable body of literature, we ensured that value exists in highlighting whether adopting external technology through licensing-in is always beneficial for innovative performance and when does this effect become stronger according to the technological environment. First, in response to the academic need for a better understanding of the demand side of the market for technology, this study examined the treatment effect of licensing-in on innovative performance (Arora and Gambardella, 2010; Kani and Motohashi, 2012). Furthermore, this study attempted to contribute to the literature on the market for technology by identifying the boundaries or environmental contingency factors for licensing-in practices that are advantageous to firms' innovative performance (e.g., Lichtenthaler, 2011; Natalicchio et al., 2014). A technological regime reflects a significant environment that affects firms' innovative activities and performance (Nelson and Winter, 1982). Technological regimes are characterized by three dimensions: technological opportunity, cumulateness, and appropriability conditions (Malerba and Orsenigo, 1993). These

* Corresponding author.

E-mail addresses: leejs@business.kaist.ac.kr (J.-S. Lee),
jihoonpark@business.kaist.ac.kr, jihoonpark@kaist.ac.kr (J.-H. Park),
ztbae@business.kaist.ac.kr (Z.-T. Bae).

three dimensions influence firms' innovative activities and the benefit from participating in the market for technology. The effects of licensing-in may vary with the technological regimes under which firms operate.

Overall, this paper attempts to answer the question of whether engaging in licensing-in is always beneficial to firms' innovative performance and when the effects of licensing-in on innovative performance are more fruitful in terms of the technological regime. The findings of this study show that adopting an external technology through licensing-in does not always have positive effects on innovative performance. Additionally, our results show that technology regimes are significant boundary conditions for licensing-in effects. Firms that engage in licensing-in perform better than firms that do not in industries characterized by relatively high levels of technological opportunity, low levels of cumulateness, and high levels of appropriability.

The remainder of this paper is organized as follows. The next section discusses theoretical perspectives and hypotheses development. The data and the empirical methods are subsequently described. We then report our results and findings, and the final section concludes and provides limitations of this study.

2. Theory and hypotheses

2.1. Implication of the market for technology on firm innovation process

The firm innovation process entails a resource-intensive search to discover valuable new combinations of knowledge (Fleming and Sorenson, 2004; Hargadon and Sutton, 1997; Stuart and Podolny, 1996). Thus, firms need to collaborate with and exchange knowledge from various actors beyond their organizational boundaries (Katila, 2002; Laursen and Salter, 2006; Shan et al., 1994). As a way to achieve their innovation goals, firms are increasingly participating in *markets for technology* (Arora et al., 2001a), in which “transactions for the use, diffusion and creation of technology” (Arora et al., 2001a: 423) are occurring, such as those involving technology packages (patents and know-how), patent licensing, and non-patentable knowledge (e.g., design, software).

Among mechanisms that facilitate inter-firm technology transactions in the market for technology, *licensing* is an ordinary and significant method for technology transfer between firms (Anand and Khanna, 2000; Arora and Fosfuri, 2003). Previous studies on this research domain largely focused on the supply side of the market (e.g., Arora and Fosfuri, 2003; Arora et al., 2013; Gambardella and Giarratana, 2013). For example, on the supply side of licensing transactions, a licensor usually encounters a “licensing dilemma” (Fosfuri, 2006) resulting from the conflict between two licensing effects: the revenue effect and the rent dissipation effect. Recently, the demand side of the licensing phenomenon has also attracted scholarly attention from management and innovation researchers who seek to understand the nature of the market for technology (Arora and Gambardella, 2010; Kani and Motohashi, 2012). In this paper, we attempt to contribute to this research trend by providing valuable insights into the research on the market for technology from the licensee's perspective.

Previous studies argued that sellers' and buyers' incentives to participate in technology transactions are conditioned by various factors (Conti et al., 2013; Jensen et al., 2015). The literature rooted in organizational and management theory investigated the influence of a firm's capability on their likelihood of engaging in technology transactions, which is known as absorptive capacity (Cohen and Levinthal, 1990). For example, Arora and Gambardella (1994: p. 93) distinguished between two dimensions of this capability, which are the “ability to evaluate” and the “ability to utilize”

technological information. They showed that firms with a greater “ability to utilize” seek more external technologies. In other words, they are more likely to license-in technologies. Firms with greater “ability to evaluate” seek fewer external technologies (i.e., less likely to license-in technologies), although the technologies they pursue are more valuable. In contrast, researchers who are closely related to economic tradition are interested in the institutional factors that increase actors' incentives to engage in technology transactions, such as intellectual property rights (Gans et al., 2002), contract effectiveness (Arora, 1996), and industry structures (Anton and Yao, 1994; Fosfuri, 2006). In summary, firms' incentives for licensing-in technologies in the market for technology are affected by the environmental factors and internal capabilities.

From the point of view of licensee firms' innovation strategy, numerous reasons exist for why firms decide to acquire external technologies through licensing-in. First, licensing-in allows a firm to reduce the costs and uncertainties related to expensive and risky innovations. From the traditional view of innovation, a firm ought to conduct an entire R&D process by itself to produce novel innovations. However, the existence of a market for technology, in particular for licensing-in, enables a firm to save considerable investments in internal R&D (Wang et al., 2013a). Firms are able to utilize already developed solutions that enable them to make up for what their technology lacks through licensing-in (Lowe and Taylor, 1998). Second, firms could catch up with state-of-the-art technological advances through licensing-in. Licensing-in enables firms to access ready-made and proven technologies (Atuahene-Gima, 1993). Acquiring external technology in a well-developed market for technology could reduce transaction costs and assist firms in remaining at the technological frontier in a given industry. Third, licensing-in facilitates technological learning (Johnson, 2002). Technology transfers may provide opportunities for technical learning (Lin, 2003). With respect to organizational search, licensing-in external technologies could foster exploring and adopting external knowledge, leading to an expansion of firms' technological search space (Laursen et al., 2010). Fourth, firms choose to license-in external technologies to facilitate entry into new markets (Lieberman and Montgomery, 1988) or to unlock existing technologies (Lowe and Crawford, 1984). Lastly, firms license-in technologies to acquire industry standards (Lowe and Crawford, 1984) and sometimes they need to engage in cross-licensing arrangements to ensure “design-freedom” or “freedom-to-manufacture” (Grindley and Teece, 1997).

Based on these motivations to engage in licensing-in practices, prior studies examined various outcomes of adopting external technologies through licensing-in. For example, Tsai and Wang (2007) tested that inward technology licensing enhances the financial aspect of firm performance measured as value added. Other studies used various measures to investigate whether adopting licensing-in has a positive effect on Chinese firms' innovative performance. They examined the effect of licensing-in on the number of patents applied, new product introductions, and new product development performance (Wang and Li-Ying, 2014; Wang et al., 2013a). Additionally, Laursen et al. (2010) suggested that licensing-in could moderate the relationship between absorptive capacity and explorative innovation such that licensing-in reinforces the positive relationship between assimilation/monitoring absorptive capacity and exploration. Leone and Reichstein (2012) focused on the speed of innovation and showed that licensing-in can shorten the time taken to innovate.

Although previous studies examined that licensing-in could affect the various aspects of financial and innovative outcomes, questions remain as to whether adopting licensing-in always has a positive effect on innovative performance, and how the effect of licensing-in differs across surrounding environments. Because the effectiveness and efficiency of firms' internal innovations and

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