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# Pre-empted patents, infringed patents and firms' participation in markets for technology



Christoph Grimpe<sup>a,b,\*</sup>, Katrin Hussinger<sup>c,d,e</sup>

<sup>a</sup> Copenhagen Business School, Denmark

<sup>b</sup> Lund University, Sweden

<sup>c</sup> University of Luxembourg, Luxembourg

<sup>d</sup> Katholieke Universiteit Leuven, Belgium

<sup>e</sup> ZEW Centre for European Economic Research, Mannheim, Germany

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## ABSTRACT

In recent years, firms have increasingly contributed to and been confronted with a patent landscape characterized by numerous but marginal inventions, overlapping claims and patent fences. As a result, firms risk their patent applications to be pre-empted or to be infringed upon by rivals. While both aspects constitute major challenges for the appropriation of returns to inventive activity, extant literature suggests that participation in the market for technology might actually resolve or at least alleviate these problems. In this paper, we investigate the effect of pre-empted and infringed patents on firms' engagement in in- and cross-licensing. Based on a sample of more than 1100 German manufacturing firms our results show that firms engage in in-licensing as a reaction to pre-empted patents and in cross-licensing if their protected IP was infringed upon. However, these effects vary depending on the fragmentation of technology fields and whether the firm operates in a discrete or complex product industry.

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## 1. Introduction

Patents have frequently been characterized as the “gold standard” in protecting a firm's intellectual property (IP) (Scotchmer, 2004). They grant the holder the right to exclude third parties from using the protected technology and by that establish a temporary monopoly. As a result, patents allow firms to appropriate the returns from their inventive activities and they provide the incentives to further engage in technology development. In recent years, however, firms using patents with the ambition to protect their inventions have been confronted with two major problems.

On the one hand, firms experience – to an increasing extent – a patent landscape characterized by numerous but marginal inventions (Gallini, 2002), overlapping claims and multiple patent ownerships for complementary technologies (Heller and Eisenberg, 1998; Scotchmer, 2004), as well as by patent fences of substitute technologies owned by a single firm or a group of firms (Cohen et al., 2000; Schneider, 2008). As a result, a firm that wishes to protect

an invention may be blocked by rivals' patents (Graff et al., 2003; Grimpe and Hussinger, 2008). Rival patents might have deliberately been written to include broad claims so that they pre-empt another firm's ambition to file for patent protection, i.e. prior art compromises the patentability of claims in the firm's patent application (Guillec et al., 2012). On the other hand, a firm's granted patents may be infringed upon by competitors since many areas of research are so extensively protected by patents that new projects are likely to touch existing patents (Arora and Gambardella, 2010). Both problems suggest that a firm's opportunities to appropriate the returns from its inventions decrease, providing lower incentives to innovate in the first place.

An aggregate response to these two problems has been an increase in the overall filing of patents because a large patent portfolio enhances firms' bargaining power in disputes over IP rights with rivals (Ziedonis, 2004). This may lead to “overfencing” in technology markets (David, 2001), thereby perpetuating the patent thicket (Shapiro, 2001). At the same time, patents also provide the basis of markets for technology (Cockburn et al., 2010). Markets for technology may improve the efficiency in innovation because patents constitute property rights over inventions that can be contracted and exchanged, either by transferring the patent itself or by licensing (Arora et al., 2004). The ability to negotiate licensing

\* Corresponding author at: Copenhagen Business School, INO, Kilevej 14A, 2000 Frederiksberg, Denmark. Tel.: +45 38152530; fax: +45 38152540.

E-mail address: [cg.ino@cbs.dk](mailto:cg.ino@cbs.dk) (C. Grimpe).

contracts should in principle alleviate the two problems described above. First, licenses allow firms to commercialize their inventions and hence to appropriate value because they can license-in the required IP. If the firm disposes of valuable IP itself, it might also negotiate a cross-licensing contract. Second, licensing, and particularly cross-licensing, may enable a firm to still appropriate value despite its IP being infringed upon by rivals. Since rivals face the threat of being sued for infringement, the firm might be able to negotiate favorable licensing terms.

While the possibility of licensing has been found to support the functioning of the market for technology (Arora et al., 2004), empirical evidence on a firm's use of licensing as a response to pre-empted and infringed patents is rather scarce. In this paper, we seek to look into a firm's licensing activities, both in the form of in-licensing and cross-licensing, when patent filings by the firm had been pre-empted and technological inventions had been infringed upon. We investigate whether these two major challenges in the appropriation of returns from invention influence the likelihood of in-licensing and cross-licensing, while controlling for firm, industry and technology characteristics.

Our analysis reflects the special characteristics of today's patent landscape that firms are exposed to in two ways. First, we control for the extent to which ownership rights to external technologies are distributed among different firms by including a citation-based measure of fragmentation (Ziedonis, 2004; von Graevenitz et al., 2008). Potential hold-up problems are more likely to occur in fragmented technology areas which might have strong implications for a firm's licensing activities. Second, we distinguish between complex product industries and discrete product industries (Cohen et al., 2000). Industries characterized as complex are associated with products that require a large number of patentable elements while industries characterized as discrete produce products based on relatively few patentable elements. Recent contributions have shown that technology landscapes in complex product industries are characterized by high fragmentation (Ziedonis, 2004). As a result, the transaction costs associated with licensing activities increase due to a large number of assignees. Differentiating between complex and discrete product industries in this context is important because the writing of contracts about technologies is easier and less costly in discrete product industries, on the one hand. On the other hand, hold-up is more likely in complex product industries so that licensing is expected to be more important to mitigate such hold-up problems. The overall effect on firms' licensing activities thus remains an empirical question.

Analytically, we will derive two hypotheses regarding the effect of pre-empted patents and infringed patents on in-licensing and cross-licensing. The contribution of this paper is thus threefold: First, we analyze the effects of a firm's technologies being blocked or infringed upon on licensing activities. We focus on both in- and cross-licensing of technologies which extends prior studies that exclusively focus on in-licensing (e.g. Cockburn et al., 2010; Siebert and von Graevenitz, 2010) or cross-licensing (Galasso, 2012). Moreover, our research complements and extends the very few studies that look into the extent of patent infringement and its consequences (Weatherall et al., 2009; Galasso, 2012). Second, our analysis reflects the characteristics of the patent landscape that firms experience by accounting for fragmentation and complex versus discrete product industries (Cohen et al., 2000; Ziedonis, 2004). Our research thus provides a more nuanced understanding of the effects of pre-empted and infringed patents on both in- and cross-licensing with an eye on the conditions under which those effects are likely to emerge. Third, our analysis rests on a comprehensive sample of 1162 manufacturing firms in Germany that experienced pre-emption and infringement of patents on their technologies. The sample combines survey and patent data from the European Patent Office (EPO) which, contrary to the U.S. Patent and

Trademark Office, allows for a precise identification to what extent patent applications filed by a firm are being blocked by prior art.

The remainder of this paper is organized as follows. Section 2 provides the literature background and details our theoretical framework. Section 3 shows our empirical methods while the results are presented in Section 4. We discuss key findings as well as limitations and future research avenues in Section 5.

## 2. Theoretical framework

### 2.1. Literature background

Despite the prominence of patents as instruments to appropriate the returns from inventive activity, there is ample evidence for the U.S. and Europe that the protection of IP is often not the most attractive feature of patents (Arundel et al., 1995; Cohen et al., 2000; Encaoua et al., 2006; Amara et al., 2008). The value of patents is rather determined by their importance as bargaining chips in the market for technology, e.g. in licensing or M&A negotiations, and by their potential to block the inventions of competitors (Graff et al., 2003; Grimpe and Hussinger, 2008). Although patents facilitate bargaining in technology markets, they are difficult to value, their boundaries are often blurry and difficult to define, and parties owning related, previously patented technologies are often unknown in advance (Merges and Nelson, 1990). This is, for one, because the patent system in practice works like a "signpost" system in which the patent specification is rather indicative of the patented idea (e.g. Meurer, 1989; Waterson, 1990) rather than providing an exact coverage of the patented idea like in a "fencepost" system where there is no role for courts to judge over questions of interpretation (e.g. Horstmann et al., 1985). Moreover, this is the result of enhanced incentives to patent strategically (Levin et al., 1987; Arundel et al., 1995; Duguet and Kabla, 1998; Cohen et al., 2000; Blind et al., 2006) in the presence of fragmented technology landscapes, patent thickets and patent fences (Ziedonis, 2004) and of increased attempts to build up own patent portfolios explicitly for a better bargaining position in licensing negotiations and disputes over IP rights (Reitzig, 2004; Blind et al., 2009). In consequence, fragmentation accelerates and multiple ownership, overlapping claims, patent thickets and patent fences occur more frequently, leaving patenting firms in an increasingly opaque and uncertain environment (Ziedonis, 2004). Ziedonis (2004) finds that firms which are confronted with fragmented property rights required to commercialize an innovation will patent more aggressively to reduce the uncertainty of being litigated or to threaten competitors with a reciprocal suit. In fact, the surge in patent applications worldwide over the past two decades has been accompanied by an increase in the number of legal disputes over patent rights (Lanjouw and Schankerman, 1997). As a consequence, using patents as instruments to protect a firm's IP has actually become more complicated. On the one hand, a firm's patent applications are being blocked by rivals' patents or patent applications. On the other hand, patents are being infringed upon as a result of rivals' new technology development. Both aspects constitute major problems in a firm's efforts to appropriate the returns from invention.

Several recent contributions have dealt with patent blocking. In general, existing patents can block successive patent applications by threatening their novelty requirements (Scotchmer, 1991; Shapiro, 2001; Jaffe and Lerner, 2004; Ziedonis, 2004; Grimpe and Hussinger, 2008). However, even though an invention may involve an inventive step, rival patents might have deliberately been written to include broad claims so that they pre-empt the firm's ambition to file for patent protection (Guellec et al., 2012). Guellec et al. (2012) find that those patent applications that are later withdrawn have the strongest pre-emptive power. A recent

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