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The role of essential patents as knowledge input for future R&D

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ABSTRACT

Standards play a key innovation role in industries where a network effect prevails. A standard may contain important technological information that can serve as a basis of further innovation. This study empirically investigates how firms use essential patents as standard-driven technological knowledge for future R&D.

1. Introduction

Essential patents have been attracting much attention lately [1–8]. Firms have been striving to get their (usually patented) technological breakthroughs accepted as technical, and thus essential, standards—through the invention of advanced technology, for example [2]. Firms also eagerly participate in standardization. A study comparing the influence of technological advancement under a patent and the active participation of the patent owner [5] found the latter to be more influential in making a company's patent become essential as a standard. Creating alliances with companies operating outside a standard [9] and participating in the standardization process [7] are also effective ways to gain essential patents. A recent surprising study [8] shows that some firms participating in standardization use an opportunistic patent filing pattern: they file first and then bargain on behalf of their technologies at standardization meetings.

In principle, standardization is the process of setting a standard in order to stimulate innovation by establishing common technological bases of competition [10]. Thus, merely obtaining essential patents is not the primary motivation for participating in standardization. Standards are particularly important for innovation in industries where a network effect prevails [11]. Downstream markets can be formed based on standards, which can also drive R&D in those markets; advancements in downstream markets in turn provide R&D opportunities for the advancement of the standard [12]. This interdependent advancement dynamic produces continuous innovation. Although studies on patents and standardization have provided important implications, they focus on the essential patents' role as an important business asset and assume that producing this asset is what motivates participation in standardization. The question remains whether firms participate in standardization only to obtain essential patents or to achieve innovation in addition to setting a standard as well.

To address this question, we focus on essential patents' role as a knowledge source for future R&D. This study empirically analyzes how firms participating in standardization use essential patents as knowledge within standards to foster R&D. A finding that firms participating in standardization conduct R&D based on essential patents would suggest that they do not intend merely to obtain the patents, but strive for innovation over and above the standards to achieve the ultimate goal of standardization. Otherwise, we can conclude that their standardization efforts are designed to obtain only the essential patents rather than to achieve the goal of standardization.

The contributions of this paper are twofold. The paper provides an empirical investigation of standards as knowledge sources for R&D. Among the many studies on knowledge management (e.g., on internal vs. external knowledge [13–20]), none has shed light on standards as knowledge sources, despite their increasingly frequent adoption. A standard provides important technological information that can serve as a basis for further innovation. This study considers essential patents as a vehicle of technological knowledge within standards and tests how they behave as knowledge sources for R&D. Second, this paper provides evidence of firms' unbalanced R&D efforts during ongoing standardization as well as ex post standardization. Though firms' R&D efforts during standardization have been extensively studied, most studies on ex post standardization focus on legal issues such as fair, reasonable, and non-discriminatory (F/RAND) licensing rather

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than on R&D efforts. This study demonstrates that firms' R&D efforts during standardization are aimed at obtaining essential patents rather than establishing common technology bases for further innovation.

The rest of this paper is organized as follows. The next section discusses the knowledge sources for R&D. Section 3 formulates the study's hypotheses. Section 4 describes the data set used in this analysis. Section 5 presents our findings and tests the hypotheses formulated in Section 3. Section 6 concludes and outlines the study's policy implications.

2. Knowledge in essential patents

This chapter discusses how essential patents are different from other patents in their use as knowledge sources.

The use of knowledge sources for R&D has long been discussed among scholars, a typical example being internal and external knowledge. Naturally, internal knowledge sources contribute to firm innovation [13,15,19]. However, environmental changes such as shortened product life cycles, increasing technological complexities, and the increasing share of R&D expenses in total turnover have made it dangerous to rely only on internal knowledge sources. Firms must also use external knowledge sources to cope with environmental changes [16], while not relying on them completely. Maintaining balance in the use of internal and external knowledge sources is important [14,20].

Patent data are considered among the most precious knowledge sources for R&D. Technology is a most important factor in economic development. Patent data provide information useful in understanding new technology [21]. A patent document provides data such as the name of the breakthrough, its inventors and their addresses, and the applicants and their addresses. The most important piece of information, however, is knowledge of the invention. A patent system is intended to grant exclusive rights to inventions as much as to disclose knowledge about them. Thus, both essential patents and other kinds of patents provide technological information.

However, essential patents are very different from the others as knowledge sources. First, essential patents provide information about a technical standard. A patent becomes essential to a standard when the technologies used to implement it are legally protected by patents. Although a set of essential patents does not always equal a standard as such, essential patents always reflect the technological components of a standard. The main benefit of a technical standard, especially in a high-tech market, is the simplification it achieves by reducing uncertainties about the innovation [22]. Knowing a standard helps firms avoid wasting resources that would otherwise have been spent through uncertainties and thus increase their R&D efficiency. Second, essential patents are of a higher quality than are the others: they have more forward citation counts [2] and a higher technological value (when the forward citation count is used as a proxy for technological value [23]). Essential patents' endogeneity may be an issue [24], as being essential increases a patent's public visibility as much as it boosts forward citations. However, R&D does not terminate with the development of a standard. Participating firms must develop their R&D in order to improve the standard's efficiency, improve its operation, and create its next generation. Thus, despite their endogeneity issue, essential patents can be a valuable knowledge source for firms.

3. Hypotheses

In this chapter, we formulate our hypothesis. This study conducts in-depth analyses based on Wideband-Code Division Multiple Access (W-CDMA) and Long Term Evolution (LTE), considered the most successful 3G and 4G mobile communications standards. Both are standardized by the Third Generation Partnership Project (3GPP) Radio Access Network 1 group (RAN1). We found all the companies owning essential W-CDMA and LTE patents and participating in 3GPP RAN1 standardization and categorized them into four business models: non-practicing entities (NPEs), chipset vendors, manufacturers, and service providers. Our business model classification is consistent with one formulated by the Open Essential IPR Disclosure Database (OEIDD) [25], an essential patent database containing more than 40,000 intellectual property right (IPR) disclosures and commitment statements made public by IPR owners at main standardization bodies. In addition to essential patents, this database also provides companies' business models outlining their primary activity or dominant revenue sources. We confirmed that our firm classification is justified by the OEIDD's. We thus formulate hypotheses for each business model based on its R&D rooted in a technical standard.

The central hypothesis of this paper is that the selection of knowledge sources for R&D differs among business models. Each firm under study accrues different knowledge and expertise from different R&D and business experiences. Since innovation patterns are technology-specific [20,26], each firm has a different innovation pattern. However, some firms compete in the same business market. It is natural to assume that firms competing in the same market will face identical technological issues and hence will accrue similar technological portfolios.

3.1. NPEs

Non-practicing entities include universities and research institutes; this paper also considers an NPE any entity that does not practice its patented inventions and whose main revenue source is the licensing royalty and/or sale of their own patents [27]. Some may argue that NPEs' role in mobile communication innovation is ambiguous because they do not intend to implement their inventions. However, each component function used in mobile communications products is defined by technologies, many of which are probably protected by intellectual property rights. In this sense, NPEs' role in the division of labor is to create technologies with at least the potential for commercialization though they lack (tangible) products; therefore, NPEs must be included in this study.

In this business model, NPEs must have patents that generate direct licensing income and are easy to sell. For example, manufacturers must not infringe upon patents. It is thus in their interests to obtain essential patents, as they can then demand the licensing royalties generated from the use of the related technical standards. Reference [7] found that manufacturers' subsequent innovations after standardization are based on their own technologies, regardless of whether they are essential patents. By contrast, NPEs' innovations are based on essential patents, regardless of whether they are their own. Creating core competence [28] is not in an NPE's interest because having core competencies in specific technology fields does not necessarily equate to economically important patents in those fields. As NPEs are less confined to specific technologies than manufacturers are, their interest is to have soon-to-be essential or might-be-infringed-upon patents, from which they can earn licensing revenue. Accordingly, we derive the first hypothesis:

H1:. *Essential patents are an important knowledge source for an NPE's R&D.*

3.2. Chipset vendors

A chipset is a group of integrated circuits designed to work together; they are usually marketed as a single product. In a mobile communications system, a chipset, or part of a chipset, manages