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The coincidence of patent thickets—A comparative analysis

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ABSTRACT

The growth of patent thickets—technology fields that are characterized by a large overlap of rights between different right holders—poses a challenge for innovators. Patent thickets are argued to create strong friction in innovation due to a pronounced potential for holdup. So far, we do not know whether patent thickets coincide in all patent systems or if differences exist that policy makers and managers must take into account when aiming to disentangle and to navigate patent thickets, respectively. To address this gap, we measure patent density of technology fields in the patent systems of the United States, the German patent system governed by the German Patent and Trademark Office (DPMA), and the European patent system governed by the European Patent Office (EPO). Our comparisons reveal both interesting differences and similarities between the analyzed patent systems. Although the United States and the EPO patent system show similar relative patent density patterns across technology fields, the German patent system strongly differs from the previous two. This implies that such deviations need to be taken into account by policy makers when considering regulatory measures as well as by companies in their intellectual property strategy.

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1. Introduction

Patent thickets exist in technology fields that are characterized by a large overlap of exclusion rights of different patent holders (Shapiro, 2001). Such thickets should, in theory, not arise because an efficient patent system prohibits overlap. In practice, they do exist and are argued to create large frictions in innovation. When multiple exclusion rights held by different parties overlap, multiple parties can block each other. The resolution of such multilateral blocking relationships involves substantial bargaining costs (Heller and Eisenberg, 1998; von Graevenitz et al., 2011). Furthermore, overlapping patents increase the complexity of patent clearing processes due to the blurring boundaries of single patents, thus increasing the probability of patent infringement (Bessen and Meurer, 2008; Thumm, 2005) and the danger of holdup. Furthermore, there is strong empirical evidence that firms engage in increased patenting when faced with patent thickets, again nourishing their growth (Hall and Ziedonis, 2001; von Graevenitz et al. 2013; Ziedonis, 2004). Scholars and policy makers increasingly debate patent thickets and attempt to adapt patent law or change patent application fee structures to discourage excessive patent filings (for an overview see Jaffe and Lerner, 2004; Graham and Harhoff, 2014).

Recently, von Graevenitz et al. (2011) proposed a novel approach to measure patent thickets relying on European Patent Office (EPO) patent citation data. In their analysis of the patent density of the patent system governed by the EPO, they identified patent thickets in the same technology fields addressed by qualitative studies that mostly discussed the U.S. patent system (e.g. Hall, 2005). Although it is well known that major differences exist in patent application behavior and actual patent usage between different patent systems (e.g. Cohen et al., 2002; for a comprehensive literature overview see Hanel, 2006; Candelin-Palmqvist et al., 2012), it is still an open question whether patent thickets coincide in all patent systems. We address this gap in our understanding of patent systems by applying the patent thicket identification procedure to study differences in patent thickets in the U.S., German, and European patent system governed by the EPO. To do so, we propose modifications to the original algorithm introduced by von Graevenitz et al. (2011). Most notably, we do not make use of citation classifications that only EPO patent citation data provides, but rather rely solely on citation data available in all patent systems.

Our comparison of patent thickets in different patent systems shows interesting differences and similarities between the analyzed patent systems. Although in the United States and the EPO patent system, semiconductors, telecommunications, information technology, audiovisual technology, and optics are the most dense technology fields (however, in different rank orders), in the German patent system, transportation, engines, pumps and turbines, control technology, and

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mechanical elements dominate with respect to patent rights overlap. Our finding that patent thickets coincide between some but not all patent systems provides a particularly important contribution to the current policy debate that so far has neglected differences between patent systems.

2. Literature review

Since innovation is often sequential, patents not only provide incentives to innovations but also can create frictions in it (e.g. Heller and Eisenberg, 1998). Recently, a growing debate has focused on the question of how much the growth of patent thickets, "a dense web of overlapping intellectual property rights" (Shapiro, 2001, *p*. 120), may stifle innovation. First, empirical research on patent thickets provide us with insights about their economic impact. These studies use two different ways to identify the presence of patent thickets.

The first strand of literature relies on a measure for the fragmentation of rights between firms operating in an industry, first introduced by Ziedonis (2004) to study the influence of fragmentation of rights on firm behavior. This indicator, a Herfindahl concentration index, measures the fragmentation of rights on a firm level based on patent citation data. Fragmentation of rights between different right holders in a technology field is a phenomenon that should strongly relate to the existence of a dense web of overlapping rights. Ziedonis (2004) makes use of a fragmentation index to show that firms patent more when faced with patent thickets, thus further nourishing their growth. Noel and Schankerman (2006) show that greater fragmentation is associated with lower market value but higher research and development and, again, higher patenting activity. Cockburn and MacGarvie (2009) show that software start-ups experience more difficulties in obtaining venture capital financing when operating in fragmented technology fields. Cockburn et al. (2010) provide empirical evidence that a negative relationship between fragmentation of rights and innovative performance exists. This effect is particularly strong for firms that do not hold many patents, emphasizing the role of patenting to mitigate the negative effects of patent thickets. Galasso and Schankerman (2009) test the hypothesis that a high fragmentation of overlapping rights can have a positive effect on technology transfer among patent holders by speeding up agreements of settlement. They find some empirical support for this hypothesis, but cannot provide clear results for total dispute settlement time. Such assessment is critical since the presence of patent thickets may speed up settlement duration but increase the number of settlements. Grimpe and Hussinger (2014) on the contrary find no positive effect of fragmentation on engagement in cross-licensing agreements.

The second strand of literature does not target the fragmentation of rights but the overlap of rights to identify patent thickets using the recently proposed triples indicator (von Graevenitz et al., 2011). The triples indicator measures the degree of overlap between patent portfolios of firms on a technology level based on patent citation data. Using the triples indicator and the fragmentation index, von Graevenitz et al. (2013) show that firms patent more when faced with a high degree of overlap between rights and a high degree of fragmentation of rights. Fischer and Henkel (2012) make use of the triples indicator to show that patent trolls, firms that capture value only by enforcing patents, focus on patents in technology fields with a high density of overlapping rights.

While the fragmentation index is useful to study the effects on more or less fragmentation of patent rights on a firm level, the triples indicator offers the opportunity to study the overlap of patents on a technology field level. This allows us to assess for the first time which technology fields hold denser patent thickets and thus suffer from a higher degree of friction created by the patent system. The introduction of the triples indicator allows us, also for the first time, to study differences in patent thicket density between different patent systems, a research gap we aim to close in this article. To do so we chose to compare three important patent systems, the patent systems governed by the U.S. Patent and Trademark Office (USPTO), the EPO, and the German Patent and Trademark Office (DPMA), respectively. One could wonder whether the German patent system governed by the DPMA is not just a subset of the European patent system governed by the EPO. However, DPMA and EPO govern distinct patent systems that use different examination processes, citation rules, and different post-grant quality control measures. As the growth of patent thickets may be due to such differences in legal schemes of the patent systems and particular innovations patented in it, we study patent thickets on a patent system level.

3. Method

3.1. Identifying patent overlap based on patent citations

To obtain a patent, an innovator has to file an application at a patent office. The patent office, in turn, examines the patent with respect to novelty and inventive step. In this examination process, all relevant prior art is referenced using different types of citations. However, the way patent references and, hence, patent citations are awarded differs between patent systems. At the USPTO, applicants have to list prior art themselves while at the EPO or the DPMA it is only examiners who add references to a patent. Also, the amount of information a reference holds differs between patent offices. While USPTO and DPMA do not differentiate the restricting effects of references, the EPO does. In the examination process, an EPO patent examiner rates prior art documents as critical (Type X and Y) when they limit the patentability of the corresponding invention applied for. The EPO examiner places an X reference if the cited document is particularly relevant when taken alone. A Y reference is placed when the cited document is particularly relevant if combined with another document of the same category. There are also other citation types that are not critical for the patent's novelty and inventive step but do lay general grounds of state of the art.

The original patent thicket identification algorithm proposed by von Graevenitz et al. (2011) builds on patent citation data generated in the EPO patent examination process and relies only on critical references. Von Graevenitz et al. (2013) interpret such a critical reference as a blocking relation, where the blocked firm holding the patent that receives the critical reference has to obtain a license from the blocking firm. If two firms have mutual X and Y references, they block each other. Eventually, constellations where three firms are mutually blocking each other (von Graevenitz et al., 2011) form a so-called blocking triple. The more triples that exist in a technology field (classified by the OST-INPI/FhG-ISI technology nomenclature, see OECD, 1994), the denser the patent thicket. The procedure is illustrated in Fig. 1. The algorithm first identifies all patent portfolios of firms holding patents in a technology field. In a next step, it identifies the number of mutual blocking X and Y references between patent portfolios. Finally, it counts how many such mutual blocking dependencies exist between patent portfolios of three firms in the respective technology field.

3.2. Modifications to the original algorithm

To be able to compare patent thickets between different patent systems, we modify the original algorithm. We include all citations of the patents in the patent portfolios, since the differentiation between critical (Type X and Y) references, used by von Graevenitz et al. (2011), and other references is only available for the EPO patent examination process. Furthermore, our Structured Query Language

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