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SHOOTING OURSELVES IN THE FOOT TO KILL A FLY? PATENT ENFORCEMENT AND MARKET FOR TECHNOLOGY

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INTRODUCTION

The U.S. patent policy has been subjected to fundamental changes over the last several years and further patent reforms are about to enter the U.S. Congressional calendar. After the enactment of the America Invents Act (AIA) in 2011, the U.S. Congress is willing to resume the patent reform to pass an additional legislation to prevent abusive patent litigation. Supporters of the patent reform assert that it would retrench costly lawsuits, reduce patent abuses, and stimulate innovation. Opponents of the patent reform argue to the contrary that it would depress patent value and stifle innovation. How these ongoing legislative changes have influenced the patent enforcement strength and, in turn, firms' incentives to patent and engage in technology trade is an open question and the main interest of this study.

As Teece (1986) defines, the patent system refers to the environmental factors that govern an innovator's ability to capture the profits generated by an innovation such as the efficacy of legal mechanisms of protection. Gambardella, Guiri & Luzzi (2007) claim that 'patents are stronger if they are well enforced by the judicial system'. Therefore, patent enforcement plays a key role in determining the strength of a patent system.

In this study, I try to answer the following research questions: How does the patent enforcement strength affect firms' patenting decisions? What is the impact of patent enforcement strength on the functioning of market for technology? In doing so, I exploit a recent shift in the U.S. patent policy reflected in an exemplary U.S. Supreme Court decision, i.e. *eBay v. MercExchange* (2006), to present how the weakening of patent enforcement affects the volume of patent applications and licensing agreements of U.S. firms, compared to European firms, in intellectual property (IP)-intensive industries. This research aims at contributing new insights to the market for technology literature by depicting the relationship between patent enforcement strength and firms' incentives to patent and engage in technology trade. For this purpose, it provides systematic evidence on a large dataset to address an important and controversial debate in the literature.

THEORETICAL BACKGROUND

A patent system is composed of three main features: patent duration, patent scope and inventive step (Zaby, 2010). Most of the theoretical arguments on the optimal patent system design is centered on the interplay of these three dimensions constituting a patent. Some scholars use 'patent effectiveness' as a term that combines these factors to denote the strength of patent protection and exploit it as a summary measure of the strength of patent system (Arora & Ceccagnoli, 2006). In addition to the main features constituting a patent, patent enforcement is another important aspect of the patent system. According to World Intellectual Property Organization's (WIPO) Intellectual Property Handbook (Chapter 4, 2004), 'there is no point in

establishing a detailed and comprehensive system for protecting intellectual property rights and disseminating information concerning them, if it is not possible for the right-owners to enforce their rights effectively'. Thus, in addition to the interplay of policy instruments, such as duration, scope and inventive step, patent enforcement is also a crucial dimension of the patent system.

The relationship between the strength of patent system on firms' incentives to innovate has long been a scholarly interest (e.g. Arrow, 1962; Hall & Ziedonis, 2001; Kaufer, 1989; Kitch, 1977; Kortum & Lerner 1999; Machlup, 1958; Mansfield, 1986; Nelson, 1959; Nordhaus, 1969; Scherer, 1980). Yet, the extant literature on the role of patent system on firms' innovativeness presents conflicting views. On the one hand, a significant amount of research has highlighted the benefits of a strong patent system (Arora et al., 2001; Kitch, 1977). This body of literature suggests that a strong patent system may facilitate firms' incentives to innovate and engage in patent trade in the market for technology, encourage further investment in R&D with commercial potential, and mitigate disincentives to disclose and exchange knowledge which might otherwise remain secret (Arora et. al., 2001; Gans & Stern, 2000; Hall & Ziedonis, 2001; Merges & Nelson, 1990, 1994). For instance, Kitch (1977) argues that strong patents are valuable precisely because they can function as broad technological prospects. Firms can, thereby, explore and develop new ideas free from the interference of others. Some survey evidence also suggests that, a strong patent system stimulates innovation (Mansfield, 1986). It is also suggested that, within the context of university research, a strong patent system offers important incentives to move nascent discoveries out of the 'ivory tower' and into commercial practice (Hellman, 2007). On the other hand, opponents of a strong patent system assert that it stifles innovation. For instance, the expansion of patent rights results in privatizing the scientific commons and limited scientific progress (Argyres & Liebskind, 1998; Heller & Eisenberg, 1998; Merges & Nelson, 1990; Scotchmer, 1991). Another body of literature warns for accelerated hold-up and royalty stacking problems specifically in information technology industry where patent ownership is highly fragmented and one patent covers a component or feature of a complex product (Cockburn, MacGarvie & Muller, 2010; Lemley & Shapiro, 2006; 2007). Furthermore, strengthening of the patent system is considered as increasing the cost of innovation due to accelerated defensive patenting and patent portfolio races among firms, especially in semiconductors industry (Hall & Ziedonis, 2001, Shapiro, 2000), and the need for navigating through patent thickets (Cockburn, MacGarvie & Muller, 2010; von Graevenitz, et.al., 2013). Reflecting on this debate, some scholars argue that there is lack of empirical evidence on the negative impact of a strong patent system (Denicolo, et.al.,2008). The potential patent hold-up and royalty stacking problems are argued to be rather sporadic than pervasive (Denicolo, et.al.,2008). Although, a recent study by Galasso & Schankerman (2014) shows that removal of patent rights by court invalidation leads to an increase in subsequent patent citations from other firms, their follow up study presents that patent invalidation reduces innovativeness by the focal firm (Galasso & Schankerman, 2016). These studies examine the removal of patent rights in a strong patent system where patents are still highly enforceable. Therefore, it is not certain how subsequent patenting would be influenced upon a decrease in enforcement strength. Conversely, Williams (2013) documents that patents on human genes may not discourage follow-on innovation because patents preserve open access to materials for scientists due to information disclosure requirement. Given the contrasting views on the patent system's effectiveness in stimulating innovation, I propose two competing hypotheses to determine the actual effect of patent enforcement strength on innovation.

Hp 1a: The strength of the patent enforcement is positively associated to the firms' incentives to patent.

Hp 1b: The strength of the patent enforcement is negatively associated to the firms' incentives to patent.

Market for technology literature highlights the role of institutional factors in facilitating technology trade. This body of literature contends that the strength of patent system is an essential factor in firms' licensing activities (Arora & Gambardella, 2010; Conti, Gambardella & Novelli, 2013; Gans & Stern, 2010). From the potential licensor's perspective, one concern is the risk of expropriation. When an invention is disclosed to potential licensees so that they can assess its value, the underlying knowledge may leak out (Arrow, 1962). Arora & Fosfuri (2003) assert that the potential licensor's incentives to out-license are diminished when the patent system is weak and the firm cannot rely on legal rights to protect the use of a technology. Yet, from the potential licensee's perspective, the scope of the invention may be uncertain and there may be concerns about inventing around the invention without infringing it (Gans, et.al, 2002). For instance, Gans, et.al. (2008) show that licensing activities largely take place within a narrow window around the grant of the patent which is argued to reflect the patent system's influence in reducing the uncertainty and asymmetric information regarding the scope of the invention. Moreover, firms' technology commercialization strategies heavily depend on the level of excludability from imitation (Gans & Stern, 2003). For example, Gans, et.al. (2002) present that in the biotech industry, firms are more likely to out-license their technologies when the patent system is strong; otherwise, firms are more inclined to commercialize the technology through downstream integration. Thus, strong patent enforcement is expected to foster licensing.

Hp 2: The strength of the patent enforcement is positively associated to the firms' incentives to out-license.

THE U.S. PATENT POLICY

Pre-eBay Case Period

Starting from early 1980s, important changes in the U.S. patent rights created a pro-patent shift towards a stronger patent system. The pro-patent shift in US revealed itself mainly in three ways: increase in the plaintiff success rates, expansion in patentable subject matter and extension of eligibility regarding who can patent (Cohen, 2005). The pro-patent movement in the U.S. has altered the patenting behavior of firms. The annual rate of patent grants increased substantially after 1980 (Hall & Ziedonis, 2001; Kortum & Lerner, 1999). The increase in patenting has brought along with it a notable increase in patent litigations. The patent dispute rate has doubled the average of federal civil litigation, patent trials have become expensive, and filings have increased rapidly (Bessen & Meurer, 2005). Some attributed this increase in the number of patent litigations to the emergence of new actors in the IP market, such as non-practicing entities (NPEs) (Reitzig, Henkel & Heath, 2007).

The raised concerns about pro-patent shift, i.e. anticommons, patent hold-up, royalty stacking, and escalated number of patent litigations, in turn, drew attention of U.S. policy

makers. With the desire to protect patent exclusivity to incentivize innovation while preventing patent trolling activities and potential hold-up problems which may undermine innovation, in 2006, the U.S. Supreme Court unanimously rejected a general rule supporting the grant of a permanent injunction following a finding of patent infringement.

eBay Case and Post-eBay Period

In addressing a patent dispute between eBay and MercExchange, regarding the infringement of one of MercExchange's patents related to the fixed-price auction feature that makes up an integral part of eBay's "Buy It Now" section of its website, the U.S. Supreme Court upheld the notion that '*an injunction should not be automatically issued based on a finding of patent infringement*'. The Supreme Court ruled that the traditional "principles of equity" should be applied to permanent injunction decisions for disputes arising under the Patent Act. In other words, the court determined that in order to receive a permanent injunction in a patent litigation the victorious plaintiff needs to demonstrate that: (a) it has suffered an irreparable injury; (b) remedies available at law, such as monetary damages, are inadequate to compensate for that injury; (c) considering the balance of hardships between the plaintiff and defendant, a remedy in equity is warranted; and (d) the public interest would not be disserved by a permanent injunction. In effect, this ruling has reduced the probability of securing a permanent injunction for infringed patents. By removal of the presumption of irreparable injury from equitable balancing, it has become harder, especially for small firms and firms which solely focus on monetizing their patents through licensing and litigation, to obtain a permanent injunction.

The Supreme Court's decision on eBay case was followed by other court rulings and legislative changes which have decreased potential damages awards by limiting the royalty base to value of the sub-component reading on the infringed patent (Lucent v. Gateway, 2009), lowered the bar for invalidating patents on the base of obviousness (KSR v. Teleflex, 2007), and raised the bar for evidencing willful infringement (Convolve v. Seagate, 2007). These subsequent court decisions have added to the weakening of patent enforcement and raised further the bar for succeeding in patent assertion (Ludlow, 2014).

EMPIRICAL EVIDENCE

Data and Sample

I tested the hypotheses of this study by comparing the volume of patent filings and out-licensing agreements of U.S. firms in pre- (2001-2005) and post-eBay case period (2007-2010) with those of European firms (i.e. Germany and Switzerland). I gathered a panel dataset of 976,207 firm/year observations in six IP-intensive industries, i.e. chemicals, machinery, computer/electronics, electrical equipment, medical devices and software; in the U.S., Germany and Switzerland. I obtained the sample of U.S. firms from ORBIS database and the data on German and Swiss firms from AMADEUS, provided with a matching of firms with their patenting information obtained from PATSTAT. I complemented this dataset by licensing agreements of the firms from ktMINE and FACTIVA databases.

Measures

Dependent variables

Patent applications are measured by the number of patent filings per year by each firm for the period of 2001-2010. I terminated sampling for firm patenting activities by the end of year 2010 for the following reason. In September 16th, 2011, America Invents Act came into effect which brought several changes in the U.S. patent system, including inter partes review for invalidating patent claims. Therefore, I test the patenting behavior of firms during 2001-2010, where there is no change in the legal patent rights (i.e. duration, scope and inventive step) but rather a shift in patent enforcement strength following the Supreme Court's eBay case decision.

Out-licensing agreements are measured by the number of out-licensing agreements per year by each firm in the sample for the period of 2001-2010. Licensing agreements are categorized depending on the type of the deal. The sample consists of all the technology transfer agreements available in the databases for U.S., German, and Swiss firms.

Control variables

To account for the potential confounding effect of firms' financial resources on patenting and out-licensing decisions, I controlled for firms' operating revenues. I measured operating revenue by the yearly revenue amount (in thousand \$) reported by each firm in the sample. I also controlled for the firm profitability which may affect firms' investment in R&D. For that purpose I used the firms' profit margin which is measured by the yearly percentage of [(profit before tax/operating revenue)*100] reported by each firm in the sample.

For the potential patent portfolio effect, I measured and controlled for cumulative number of patent applications by each firm up to one year before the focal year of observation. To control for the potential age effect, I constructed a firm age variable by taking the difference of each year observed from the year of incorporation as the age of firms. Firm size is measured by number of employees. The firm, country and year dummies are also inserted in the analyses.

Model

In order to compare the patenting and licensing activities of U.S. firms in the pre- and post-eBay case period with those of the European firms, a difference-in-difference method is adopted. One advantage of this estimation is that it removes the biases in post-treatment period comparisons between the treatment and control group that could be the result from permanent differences between those groups, as well as biases from comparisons over time in the treatment group that could be the result of trends (Wooldridge, 2007). The difference-in-difference estimator is specified below:

$$Y_{it} = \beta_0 + \beta_1 X_i + \beta_2 T_t + \beta_3 X_i * T_t + \beta_k(\text{control variables})_{it} + \epsilon_{it}$$

where X_i is a dummy variable taking the value of 1 if the firm is in U.S. (treated), else 0; T_t is a dummy variable taking the value of 1 in the post-treatment period (2007-2010) and 0 in the pre-treatment period (2001-2005), omitting year 2006 in which the U.S. Supreme Court decision was made. The coefficient of β_3 gives the treatment effect, namely, the impact of the court decisions in the post-eBay period on U.S. firms patenting and out-licensing activities. Since the dependent variables are count data with non-negative integers, I applied a log transformation in

the fixed-effects (within) regressions in panel data analyses. I preferred fixed-effects (within) OLS regression because of the short panel, i.e. many individual units and few time periods, characteristic of the dataset.

Results

The regression results for the difference-in-difference estimations with fixed effects model show that the interaction term is negative and significant -0.034 ($p < 0.01$), which confirms Hp 1a, while rejecting Hp 1b. This result presents that, upon the weakening of patent enforcement in the post-eBay case period the U.S. firms' patent applications have decreased compared to those of European firms. The analyses for out-licensing agreements show a similar pattern. The results show that the interaction term is negative and significant -0.001 ($p < 0.01$), supporting Hp 2, which asserts that in the post-eBay period the weakening of patent enforcement is negatively associated with out-licensing activities of U.S. firms. Thus, on average, U.S. firms' patenting and out-licensing activities have declined upon the weakening of patent enforcement.

DISCUSSION AND CONCLUSION

The decrease in patenting and licensing activities of U.S. firms in the post-eBay period points to the fact that, the weakening of patent enforcement triggers a disincentive for firms to file patents and a reluctance to engage in technology trade. In line with the prior literature highlighting the benefits of a strong patent system (Arora et al., 2001; Gans & Stern, 2000; Hall & Ziedonis, 2001; Kitch, 1977; Merges & Nelson, 1990, 1994), the weakening of patent enforcement results in a decreased number of patenting and out-licensing activities. As the probability of succeeding in patent assertion decreases in the post-eBay period, the risk of expropriation raises for potential licensors. The inflated risk of expropriation may pose disincentives for those firms to out-license their inventions (Arora & Fosfuri, 2003). Furthermore, due to weaker patent enforcement, it may become harder for firms to negotiate on a license agreement with potential infringers. Due to the decreased bargaining power of the licensor, the potential licensee may refrain from an ex-ante licensing agreement with the hope of challenging the licensor's patents in the court (Davis, 2008; Mulder, 2007; Tang, 2006). These results also have some policy implications. Weakening of patent enforcement to prevent patent trolling, abusive patent litigations, and hold-up problems stifles patenting and market for technology. Policy makers are advised to take into account the adverse impact on technology trade in stimulating innovation and addressing problems in the patent system.

REFERENCES AVAILABLE FROM THE AUTHOR