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Testing patent value indicators on directly observed patent value—An empirical analysis of Ocean Tomo patent auctions

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ABSTRACT

The valuation of patents is an important, albeit challenging task. Extant research to identify patent value indicators has so far relied on expert estimates of patent value, exploited patent renewal data, or depended on more indirect measures of patent value. Recently, specialized market places for patent transactions have emerged that allow us for the first time to directly observe patent's private value. One of the most prominent market places for patents is Ocean Tomo, a platform that offers periodical patent auctions. We make use of this auction data to empirically test predictions on patent value identifiers on real-world auction prices. We find empirical support for forward citations and the patent's family size; however, both indicators explain only a small variance in patent value. In contrast, our full model explains a large share of variance, making us optimistic that with increased directly observed patent value, such models can be useful tools in patent valuation.

1. Introduction

Many studies have tried to identify indicators for patents' private value (see Bessen, 2008 for a recent overview). Unfortunately, we do not observe a transparent liquid market for patents to obtain value estimates. Lanjouw and colleagues (1998, p. 407) summarize that "patent rights are seldom marketed," and confirm the statement by Schankerman and Pakes (1986, p. 1052), that "their private value is in general unobserved." Furthermore, to date, no precise or commonly agreed upon approach on monetary patent valuation exist. This difficulty in assessing a patent's private value has complicated the attempts to identify indicators for patent's value. Thus, researchers mostly relied on indirect measures to approximate patent value in order to explore patent value indicators, for example, renewal decisions (Bessen, 2008), the value of firms holding patents (Deng et al., 1999; Hall et al., 2005; Lerner, 1994), or the probability of infringement and challenging suits (Harhoff and Reitzig, 2004; Lanjouw and Schankerman, 2001). Others, like Albert et al. (1991), Harhoff et al. (1999, 2002), Reitzig (2003), and Gambardella et al. (2008) chose to obtain subjective patent value estimates from patentees, a set of experts, or the inventors in order to test patent value indicators.

However, recently specialized platforms for patent transactions have emerged that facilitate observing patent's private value. Ocean Tomo, a platform that offers periodical patent auctions, is one of the most prominent market places. We make use of the resulting auction data to test patent value indicators. Thus, while all of the prior studies were forced to employ only estimates of patent's private monetary value, our study uses real-world patent auction data of more than 1800 patents. Since 2006, Ocean Tomo has hosted periodical auctions of intellectual property (IP). In the majority of cases, patents are auctioned, but sometimes trademarks, copyrights, and domain names are also offered. Selling entities range from individual inventors or investors, academic institutions, mid-sized companies to large corporations, and government agencies.

We collected data from the auction catalogs and matched it to the outcome of each auction published by Ocean Tomo. We complement this dataset with patent-level data from PATSTAT and INPADOC patent databases. Eventually, our dataset included 1784 U.S. patents, 617 of which had been successfully sold at Ocean Tomo's auctions.

The patents sold on Ocean Tomo between 2006 and 2009 have a high share of information technology patents and are potentially not representative for all patent sales. This makes it difficult to compare our descriptive results on observed patent value to patent value estimates of previous studies that looked at different time frames and used less selective samples in detail. Nonetheless, we can report that the patent values observed in our study are roughly consistent with previously obtained patent value estimates. For the testing of patent value indicators, we use Heckman models to control as best as possible for any sample selection effects. However, if patents of some industries where not offered or sold at Ocean

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Tomo, we cannot generalize our results based on them. To test for the predictive power of various patent value indicators discussed in the extant literature, we estimate regressions on the auction price of sold patents, taking into account the sample selection of sold over unsold patents and the sample selection of patents that were offered at Ocean Tomo over average technology and cohort matched patents. We find that forward citations and family size are significant indicators for patent value but find no support for the relation between value and the number of International Patent Classification (IPC) classes a patent applies to. Most interestingly, our full model has high explanatory power for patent value while the explanatory power of single patent value indicators is limited.

2. Theory and hypotheses

The definition of a patent's private value followed in this paper is in line with Harhoff and colleagues' (2002, p. 1345–1348) definition of the asset value of a patent. They define a patent's value by the benefits that the winner of a patent race will perceive. When a firm acquires a patent, it gains all associated rights including the right to exclude competitors from using the underlying invention and the right to block other patent rights that depend on the one transferred. Firms that unsuccessfully compete for the patent right suffer the consequences of a competitor becoming the leader. The difference in profits between the two options constitutes the asset value of the patent right.

Early estimates of patent value showed a highly skewed distribution (e.g., Schankerman and Pakes, 1986). This considerable variation in the value of patents spurred the research for patent value indicators. In the following, we focus on three of the most often examined patent value indicators, which we chose to test using patent auction data.[1] Nearly every researcher who examined patent value with the help of indicators from patent databases included the number of forward citations in his or her studies (e.g., Gambardella et al., 2008; Harhoff et al., 1999, 2002; Lanjouw and Schankerman, 1999; Trajtenberg, 1990), and all of them have assessed a significant and positive relationship between them. The number of family members of a patent (Gambardella et al., 2008; Harhoff et al., 2002) and the breadth of a patent (Harhoff et al., 2002; Lanjouw and Schankerman, 2001; Lerner, 1994) have similarly sound theoretical foundations, but while the size of a patent's family is consistently significant as a value indicator, the results on the scope of a patent are more ambiguous.[2]

2.1. Indicators of patent value

2.1.1. Patent's technological quality measured by forward citations

From early on, the technological quality of a patent has been related to its value (Albert et al., 1991; Green and Scotchmer, 1995; Nordhaus, 1967). The higher a patent's technological quality, the higher the patent's legal robustness should be (e.g., Bessen, 2008; Reitzig, 2003). Furthermore, the higher the patent's technological quality, the more inventions should build upon the underlying invention of the focal patent, thus increasing the value of its exclusion right. A widely accepted patent value indicator that captures patent's technological quality is the number of forward citations a patent receives (e.g., Hall et al., 2005; Harhoff et al., 1999; Trajtenberg, 1990) in the patent examination process, prior art that would limit the patent's novelty is identified. Patents representing prior art are cited and they receive forward citations. The more forward citations a patent receives, the higher is its contribution to the prior art, making it a good proxy for patent's technological quality. Thus, we posit:

Hypothesis 1. The number of forward citations a patent receives is positively related to its private value.

2.1.2. Patent's economic relevance measured by family size

The value of the patent should also depend on both the technological quality and the economical relevance of the underlying invention. Even if inventions are comparable regarding technological quality, market sizes or industry characteristics may differ, giving them diverging economic qualities. To proxy the economic relevance, we make use of the patent's family size (Harhoff et al., 2003; Lanjouw et al., 1998; Putnam, 1996). A patent's family size captures the number of jurisdictions in which patent protection for a single invention has been sought. The expansion of patent protection involves additional costs—e.g., translation, patent attorneys' filing fees, examination fees—for every jurisdiction. If the applicant chooses to spend additional money, the exclusion right should be worth the extra costs. Hence, we posit:

Hypothesis 2. The number of family members of a patent is positively related to its private value.

2.1.3. Patent scope measured by distinct IPC classes

Furthermore, the scope of a patent should be related to its value. Broad patents read on many products or processes and hence increase the attractiveness of the right of exclusion (Merges and Nelson, 1990; van Zeebroeck et al., 2009). Furthermore, competitors will find it more difficult to "invent-around" a broader patent, adding value to the exclusion right. To proxy the scope of a patent, we used the number of distinct four-digit IPC classes to which the patent is assigned (Lerner, 1994).

Hypothesis 3. The number of distinct IPC classes to which a patent is assigned is positively related to its value.

3. Empirical approach

3.1. Empirical setting

We make use of Ocean Tomo's patent auctions data, which allows us to observe the private value of patents (cf. Schankerman and Pakes, 1986). Ocean Tomo claims to have held the first public auction of IP rights, such as patents, trademarks, and copyrights, in 2006 (cf. Tietze, 2012 for a detailed presentation of Ocean Tomo auctions). Between 2006 and 2010, Ocean Tomo held 10 different auctions. Every patent auction follows the same structure. First, auction date and location are announced by Ocean Tomo, followed by the registration of sellers and the patents they have on sale. These patents are evaluated by Ocean Tomo Patent Ratings, a specialized patent rating agency. Patents that meet certain quality standards set by Ocean Tomo (which are not disclosed) are accepted and published in the auction catalog. The next phase consists of the registration of the potential bidders and due diligence procedures that include private meetings or conference calls between seller and potential buyers. Finally, the auction itself takes place. Usually the auction (in fact, a series of auctions of many "lots") is embedded into a two-day program of conferences and get-togethers at an exclusive and varying location. Bidder anonymity is secured by Ocean Tomo by identifying bidders by paddle number only. Bidders can even choose "double-blind bidding" by requesting Ocean

[1] Previous studies also examined indicators such as the outcome of opposition cases for European patents (Harhoff et al., 2002), the number of backward references (e.g., Gambardella et al., 2008; Harhoff et al., 2002) or the number of claims (Bessen, 2008; Gambardella et al., 2008). As we analyze U.S. patents, we only include the latter two as control variables in our calculations.

[2] Insignificant in Harhoff et al. (2002) and Harhoff and Reitzig (2004); significant and negative in Lanjouw and Schankerman (2001); significant and positive in Lerner (1994).