

The option value of patent litigation: Theory and evidence

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Abstract

In this paper, I use a real options approach to investigate patent litigation when enforcement is costly, winning is uncertain, and beliefs about validity are stochastic. I consider both finite horizon and infinite horizon models. The theoretical results demonstrate that patent value depends not only upon the underlying technology but also upon the degree of uncertainty over the property right. Additionally, imperfect enforceability creates an effective patent term that is less than the statutory term. Using simulation methods and patent data, I estimate the hazard rate of patent litigation. Contrary to previous studies, I find that the rate of forward citations is negatively associated with the litigation rate. The difference arises because (1) I use a dynamic model that exploits the information contained in the timing of litigation and citations, and (2) I control for truncation using a duration model. Using random effects models, I find that heterogeneity in patent litigation is embedded primarily in the heterogeneity in receiving patent citations. Because of this, the patent litigation decision can be modeled as a unilateral decision.
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1. Introduction

Patents are classic examples of real options: a patent holder has the option to develop certain types of products, to license the technology, or to use it as an input for further research. Pakes (1986) models the patent as an option to renew in patent regimes that require renewal fees.

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Reiss (1998) models the decisions of firms to develop and patent innovations when competition arrives stochastically. The paper explicitly examines the trade-off between patents and trade secrets as modes of protection, and it introduces some uncertainty in the patent right, in that competition may develop a substitute technology that does not infringe the patent. Takalo and Kanninen (2000) and Weeds (2002) develop models investigating the patenting decision. Neither paper explicitly models the patent enforcement process, although Takalo and Kanninen incorporate enforcement costs into the general cost of patenting.

Most dynamic models treat the patent holder as having exclusive rights to develop a technology. However, any option on the patented technology presupposes an enforceable property right. The fundamental value of a patent right is the “right to exclude” others from using the technology. Because enforcement is imperfect and costly, the right to exclude becomes the right to sue with some probability of success.

In this paper, I treat the patent as an option to bring a lawsuit against an alleged infringer. As with financial options, the option to sue need not be exercised in order for it to have value. Thus, the value of a patent is a function of the enforceability of the property right, the underlying technology, and the distribution of beliefs about those parameters. The model enables me to be precise about the sources of patent value and to examine the litigation decision.

Section 2 presents the basic framework of patents as options in cases where there is uncertainty over the validity of a patent. I solve the model analytically for infinitely lived patents, and numerically for the finite horizon case. The model establishes that imperfect enforceability leads to an effectively shortened patent life, and that rewards to innovation involve a trade-off between the length, breadth, and strength of patent rights. Failure to recognize the consequences of uncertainty and costly enforcement inevitably leads to myopic patent policy.

In Section 3, I investigate the litigation rate using simulations. The results lead to some testable implications about the timing and incidence of litigation, including: (1) that greater uncertainty over the probability of patent validity should delay litigation, and (2) that greater relative profit flow should decrease the litigation rate. These results are tested using a matched sample of litigated and non-litigated patents, described in Section 4.

Section 5 estimates the hazard rate of patent litigation. I find that the rate at which patents receive citations is a good proxy for profit flow and that patent claims are a proxy for scope. In contrast to previous studies, I find that the patent citation rate – normalized by patent claims – has a negative impact on the litigation rate. This highlights the importance of using dynamic methods to investigate the enforcement decision in both theoretical and empirical models.

Finally, I find that heterogeneity in patent litigation is primarily a function of heterogeneity in the rate of receiving citations. Consequently, patent litigation can be treated as a unilateral decision on the part of the patent holder, conditional on observable patent characteristics. Section 6 concludes with a discussion of policy implications.

2. Model

In the U.S., patents are not born with certain validity when issued by the Patent and Trademark Office (PTO). In enforcing a patent right against alleged infringers, it is quite common to encounter a “validity defense” or a validity counter-suit, the success of which means invalidation of the patent right. That is,

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