Optimal licensing of uncertain patents in the shadow of litigation ☆

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ABSTRACT

This paper investigates the choice of a licensing mechanism by the holder of a patent whose validity is uncertain. We provide sufficient conditions of a general nature under which the licensor prefers to use a per-unit royalty contract. In particular we show that this is the case for the holders of weak patents if the *strategic* effect of an increase in a potential licensee's unit cost on the equilibrium industry profit is positive. The latter condition is shown to hold in a Cournot (resp. Bertrand) oligopoly with homogeneous (resp. differentiated) products under general assumptions on the demands faced by firms. As a byproduct of our analysis, we contribute to the literature on the cost paradox in oligopoly by offering some new insights of independent interest regarding the effects of cost variations on Cournot and Bertrand equilibria.

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1. Introduction

Since the seminal contribution by Arrow (1962), analyzing the licensing contracts offered by patent holders has become an important topic in the economics of innovation and technology diffusion. Arrow compared the revenues that an outside innovator obtains from licensing a cost-reducing innovation to a competitive industry and to a monopolistic industry. He showed that when a per-unit royalty is charged, a perfectly competitive industry generates higher licensing revenues than a monopolistic one. Subsequently, Katz and Shapiro (1985, 1986) and Kamien and Tauman (1984, 1986) analyzed different licensing mechanisms (fixed fee, auction and per-unit royalty) when the potential licensees are members of an *oligopoly*. A key insight of the theoretical literature that has built on those seminal papers is that the optimal licensing mechanism depends on many factors, including the type of downstream competition, the degree of differentiation between products and whether the patent holder is active or not in the downstream market. These three factors have been shown to be

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critical in the sense that predictions regarding the optimal mechanism can be completely overturned by varying any of them.[1]

A common feature of the existing papers on the comparison of different licensing mechanisms is that patents are viewed as certain or "ironclad" rights, the validity of which is unquestionable. This clearly contradicts what we observe in practice: about half of the patents that are challenged before US courts are invalidated (Allison and Lemley, 1998).[2] It is now largely recognized that a patent is not a perfectly enforceable right, as are other forms of property. Patents correspond much more to uncertain or probabilistic rights because they only give a right to try to exclude by asserting the patent in court (Ayres and Klemperer, 1999; Shapiro, 2003; Lemley and Shapiro, 2005). Moreover, this uncertainty is strengthened by the fact that many applications are granted patent protection by the patent office (PO) even though they probably do not meet one or several of the statutory requirements: belonging to the patentable subject matters, utility, novelty and non-obviousness (or inventiveness). As a result, some of the uncertain patents are *weak* in the sense that they have a high probability of being invalidated by a court if challenged by a third party.

The proliferation of uncertain patents is due to several reasons. First, the major patent offices (USPTO, EPO and JPO) have insufficient resources to ensure an effective review process for the huge and growing number of patent applications (Friebel et al., 2006). Second, mistakes are unavoidable because the patentability requirements are difficult to assess, especially for newly patentable subject matters such as software, business methods and research tools. Third, the incentives provided to the examiners are inadequate for making them fully prosecute and reject applications that do not meet the standards (Farrell and Merges, 2004; Langinier and Marcoul, 2009; Lei and Wright, 2010).

This paper investigates the optimal licensing mechanism from the perspective of a licensor holding an *uncertain* patent and facing the *threat of patent litigation*. We consider a model in which a patent holder makes a license offer to potential licensees who can challenge the patent's validity if they do not accept the offer. The potential users of the patented technology are assumed to compete with each other in the output market but the type of competition between them is not specified.[3]

We focus throughout the paper on the case when the patent holder prefers to deter litigation rather than accommodate it. This scenario is supported by both theoretical arguments and empirical evidence that we discuss in detail in Section 3. Moreover, when the patent holder finds it optimal to accommodate litigation then it is maximizing its licensing revenues should the patent be ruled valid. Therefore, it is essentially acting as the holder of an ironclad patent. In that case, the problem of choosing a licensing mechanism for an uncertain patent is the same as its (extensively studied) counterpart for an ironclad patent.

In our baseline model the licensing contracts can involve the payment of either fixed fees or per-unit royalties. We show that two opposite forces drive the patent holder's choice between these two instruments. On the one hand, the use of per-unit royalties allows the patent holder to increase the size of the aggregate profits (the sum of the licensor's and licensees' profits) by relaxing competition between the licensees. Per-unit royalties have this *efficiency effect* whenever a mild condition on the strategic effect of marginal costs on the licensees' profits is satisfied. On the other hand, fixed fee licensing results in a lower profit for a firm that challenges the patent but fails to invalidate it. This *punishment effect* makes the expected payoff of a challenger lower when fixed fees are used. Therefore, the rent that the patent holder has to leave to the licensees for litigation to be deterred is lower under a fixed fee contract than under a per-unit royalty contract.

When an unsuccessful challenger is driven out of the market under both types of contracts, there is no punishment effect. In that case, the patent holder chooses the mechanism that maximizes the aggregate profits, i.e. the per-unit royalty mechanism. However, when the punishment effect is at work, per-unit royalties will be preferred by the patent holder only if the magnitude of the latter is lower than the magnitude of the efficiency effect. We show that this holds for sufficiently weak patents. The key reason for this is that the punishment effect is a second-order effect for weak patents while the efficiency effect is a first-order one. We also show that the superiority of per-unit royalty contracts for the licensing of weak patents remains true in three extensions of our baseline model that account for (i) litigation costs, (ii) the possibility of using two-part tariff contracts, and (iii) the possibility that the patent holder competes against the licensees in the output market.

Our paper contributes to three strands of literature:

1. *The literature that compares various licensing mechanisms.*[4] Our contribution is to extend that comparison to patents whose validity is uncertain. This issue deserves scrutiny in light of the growing proliferation of uncertain patents and, in

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[1] For instance, it has been shown that under Cournot competition with homogeneous products, fixed fees dominate per-unit royalties when the licensor is an industry outsider (Kamien and Tauman, 1984, 1986; Kamien et al., 1992). However, the reverse result holds if the licensor is an industry insider (Shapiro, 1985; Wang, 1998; Kamien and Tauman, 2002; Sen, 2002; Sen and Tauman, 2007, 2012). Furthermore, under price competition with differentiated products, per-unit royalties dominate fixed fees when the products are close substitutes or, if not, when the size of the cost reduction is small, while the reverse holds if the products are weak substitutes and the innovation is large (Muto, 1993). The results are quite different if one considers the same differentiated product environment but assumes that firms compete in quantities instead of prices (Wang, 2002).

[2] This concerns the patent disputes that are not settled prior to the court judgment.

[3] We assume only that a unique equilibrium in the competition game exists and set very mild assumptions on the resulting equilibrium profits (as functions of the unit costs).

[4] See Bhattacharya et al. (2012) for a recent survey on the licensing of ironclad patents and other R&D arrangements.