Patent Litigation and the Role of Enforcement Insurance *

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Abstract

We study the effects of patent enforcement insurance when used by an incumbent patent holder in order to increase its incentives to oppose alleged infringers (entrants). By covering some of the legal costs ex-ante, the incumbent can increase its commitment to litigate and, as a result, deter some potential entrants and, in case of entry, induce a more profitable settlement deal. We find that it is always optimal for the incumbent to undertake patent enforcement insurance, typically with a deductible that either prevents litigation from occurring in equilibrium or trades off its ex post costs in some situations with the ex ante gains in terms of deterring infringement and enhance the settlement deal in some others. We assess the value of enforcement insurance across different legal-cost allocation rules and parameterizations of the model.

JEL Codes: O34, K41.

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1 Introduction

The incidence and costs of patent litigation have become notorious in recent years. According to Lanjouw and Schankerman (1998), every thousand patents in the US generate, on average, 10.7 case filings during their life span. In some sectors, such as biotechnology, up to 6% of patents are eventually subject to litigation. The importance of patent litigation is even more salient if we consider its use as a bargaining tool in settlement negotiations. Lanjouw and Schankerman (2004) reports that 95% of the disputes on patent rights end up in an out-of-court settlement agreement.

For innovative firms, litigation costs are estimated to amount to as much as 25% of their basic R&D expenditures. According to Lerner (1995), these costs are sufficiently important to affect firms' decisions to enter a market. He shows that small innovating firms tend to avoid markets occupied by incumbents with a large patent portfolio. The importance and high costs of patent litigation has impelled the creation of a growing market for insurance policies that, in exchange for an annual premium, cover part of the costs incurred by the insured in patent litigation cases.

In the US, patent litigation insurance is articulated around two types of policies. Policies offering *infringement abatement insurance* (or *patent enforcement insurance*) cover a fraction of the litigation expenses incurred in enforcing the insured patent against infringers, usually a competitor, up to the policy limit.[1] According to Wilder (2001), a typical policy may cover 75% of the enforcement costs up to $500,000 with annual premiums of $3,000 to $4,000.[2] Policies offering *infringement liability insurance* (or *defensive insurance*) protect the insured from allegations of having infringed on someone else's patent. For instance, a defensive

[1]Litigation expenses under coverage typically include most legal and non-legal costs necessary to prove infringement and rebut any counterclaim of invalidity (for instance, the fees and travel costs of expert witnesses).

[2]Anecdotal evidence suggests a substantial expansion of the coverage (up to two million dollars) in recent years; see `http://www.insurancejournal.com/news/national/2007/03/29/78216.htm`.

policy may establish an annual premium of between \$20,000 and \$50,000 for one million dollars in coverage, with a deductible ranging from 15% to 25%. Industry descriptions of these insurance policies as well as some consulting reports on the issue argue that patent litigation insurance is particularly valuable for small firms. For this reason and with the goal of fostering innovation by small firms, the European Commission has recently entertained the possibility of implementing a compulsory insurance scheme (see CJA Consultants (2003)).[3]

We focus on patent enforcement insurance. We consider an incumbent patent holder that faces the possible entry of a competitor with a substitute product. The extent to which this product infringes the patent or not (which we capture with a *patent strength* parameter p) is uncertain, although it becomes known to the competitor before it enters and to the incumbent after entry. There is also uncertainty about the final court ruling. Before entry, the incumbent can contract an insurance policy that covers a proportion $1 - x$ of the total legal costs if litigation were to occur (hence x is a fractional deductible). In case of entry, firms can negotiate a settlement agreement involving the licensing of the potentially infringed patent to the entrant. If negotiation fails, the patent holder may choose to resolve the dispute in court, which implies recovering the monopoly position if it wins.

In this setup, entry may occur due to the entrant's expectation that, because of the low strength of the patent, the incumbent's net gains from litigation are negative and entry will be accommodated. We show that patent enforcement insurance can break this predatory logic. That is, by guaranteeing the coverage of some of the legal costs ex-ante, the incumbent can increase its commitment to litigate, and as a result deter some entrants, obtaining larger expected profits. We show that taking some insurance coverage is always optimal for the incumbent, although in general the coverage must not be full since there is a trade-off between strengthening the incumbent's commitment to litigate and, possibly, inducing

[3]Gørtz and Konnerup (2001) reports the availability of patent insurance policies in, among other countries, Australia, France, New Zealand, Sweden, and the UK.

ex post *excessive* litigation (that is, litigation when the expected gains to the incumbent are lower than the legal costs incurred by the incumbent and the insurer altogether). On occasions, the optimal deductible induces excessive litigation for some realizations of the patent strength parameter p, but its costs are compensated by the lower entry or the better terms of settlement (larger licensing fees) reached for other realizations of p.

The deductible that characterizes the optimal insurance contract decreases with legal costs and increases with the bargaining power of the patent holder. The logic for the first effect is that lowering the deductible (partially) compensates for the incumbents' lowered incentive to litigate when legal costs are higher. With respect to the second, what happens is that the incumbent's bargaining power and the coverage provided by the insurance policy are substitutes in diminishing the entrant's prospect of a favorable settlement deal after entry.

An increase in the incumbent's monopoly profits has an ambiguous effect on the optimal deductible because two opposite forces concur. On the one hand, it increases the incumbent's ex post willingness to litigate, making enforcement insurance less necessary as a commitment device. On the other hand, greater monopoly profits make entry deterrence more appealing. We show that, under a US-type rule for the allocation of legal costs to the litigating parties (that is, when each party pays its own cost), the effect of the stand-alone excess profit over the resulting deductible can have an inverse-U shape, so that the first effect dominates when profits are low and the second when profits are large. In contrast, under a UK-type cost allocation rule (that is, when the loser pays all costs) and for the same parameterization of the model, the first effect always dominates.

Although the literature on patent litigation has developed substantially in recent years, ours is, to the best of our knowledge, the first paper that studies the role of patent enforcement insurance, characterizes the optimal deductible, and discusses the implications for licensing agreements, and the infringement and litigation outcomes. Most of the literature has focussed on the determinants of settlement. A classical example is Meurer (1989) that, in a context where there is private information regarding the validity of the patent, characterizes the licensing agreements that arise from settlement negotiations.[4] Aoki and Hu (1999) stresses the importance of the uncertainty about the outcome of the legal process for the emergence of licensing in equilibrium and study the ex ante effects on the incentives of firms to innovate. Crampes and Langinier (2002) studies the incentives for patent holders to find out whether their patent has been infringed and the ensuing settlement and litigation. In contrast with these papers, we abstract from informational asymmetries between the patent holder and the infringer, and generate the emergence of litigation in equilibrium as the result of the constraints on settlement imposed by antitrust legislation. In particular, we assume that settlement deals that imply an agreed reversion to monopoly after the infringer has entered the market are not permitted, so that when the patent is sufficiently strong, no feasible settlement can dissuade the incumbent from going to court.[5]

As some of the referred papers, we analyze how different rules of legal-cost allocation affect the incentives to settle and litigate.[6] The various possibilities are exemplified by the US and the UK cost allocation rules. We show that most results are qualitatively identical under both rules, even though they differ in the amount of litigation induced in equilibrium and in the size of the gains due to the insurance (both typically higher under the US rule). Fairly-priced patent enforcement insurance adds more value to incumbents with

[4]In the literature the licensor is typically assumed to make take-it-or-leave-it offers. In our paper, we consider generalized Nash bargaining, which allows us to analyze the effects of changes in bargaining power and embeds, as a polar case, the situation in which the incumbent has all the bargaining power.

[5]See Maurer and Scotchmer (2004) for a thorough analysis of the antitrust concerns that such an agreement would raise in the absence of a court decision ruling that the original patent was infringed.

[6]The impact of these rules has also been studied in the literature on litigation in general. See, for example, Shavell (1982), Bebchuk (1984), and Reinganum and Wilde (1986). The findings in the literature are rather mixed and the conclusions, as in our paper, are typically contingent on the relative importance of each party's probability of victory and the legal costs. For example, in Meurer (1989), the UK rule benefits the incumbent if it holds a strong ("valid") patent, but the US rule dominates in terms of total expected profits.

low to medium monopoly profits, high litigation costs, and low bargaining power—intuitively, to incumbents with weaker incentives to litigate.[7] Across legal systems, our findings suggest that the benefits of patent litigation insurance are clearly greater in the US system when monopoly profits are relatively small and litigation costs are large. Interestingly, in this later case, the introduction of insurance reverts the comparison between the US and the UK rule in terms of the incumbent's expected net profits, which become uniformly larger under the US rule.

The rest of the paper is organized as follows. Section 2 introduces the model. Section 3 describes the equilibrium for a given insurance contract. Section 4 discusses the optimal determination of the deductible and shows that undertaking some insurance is always desirable to the incumbent. Sections 5 and 6 characterize the optimal deductible and the final equilibrium outcomes for several parameterizations of the model under the US and UK cost allocation rules, respectively. Section 7 concludes. All proofs are relegated to Appendix A. In Appendix B we briefly describe equilibrium in the absence of insurance.

2 The Model

Consider an industry where an incumbent i that sells a patented product faces the risk of entry of a rival j with a competing product. All agents are risk neutral. If firm j enters and both firms produce, they share the market equally and obtain profits that are normalized to 1. If no entry occurs, profits are $1 + \pi$ for the incumbent and zero for the rival, where $\pi > 0$ measures the increase in profits due to monopoly.

If entry occurs, however, the incumbent may try to preserve its monopoly position by suing the rival and claiming patent infringement. The uncertainty about the outcome of litigation is captured by the probability that the incumbent wins the trial (and his monopoly

[7] The emphasis on the fact that insurance is fairly priced stresses that asymmetric information plays no role in these findings.

position is restored), $p \in [0, 1]$. Intuitively, this probability measures the strength of the incumbent's case relative to the rival's (that is, the relative quality and originality of the patent, the similarity between the patented and the competing products, the documented innovative efforts of each party, etc.).

We assume that there is some initial uncertainty about the precise quality and similarity of the competing product, so that the patent strength parameter or winning probability p is, ex ante, a random variable with density function $f(p)$, cumulative distribution function $F(p)$, and full support in the interval $[0, 1]$. The realization of p is observed by the rival and the incumbent right before the former decides on entry, but it is assumed to remain unverifiable throughout the entire process.[8]

Litigation entails identical costs $c > 0$ to each of the parties. However, at the end of the legal process these litigation costs are reallocated according to the rule set by the law. In this respect, we consider two polar cost allocation rules (and their convex combinations). At one extreme, each party pays its own cost as under the *US rule*; at the other extreme, the loser pays all the legal costs, as under the *UK rule*.[9] To make the presentation compact, we formulate the legal costs for the incumbent and the entrant as

$$c_i = \alpha c + (1 - \alpha)(1 - p)2c \tag{1}$$

and

$$c_j = \alpha c + (1 - \alpha)p2c, \tag{2}$$

where the parameter $\alpha \in [0, 1]$ can be understood as either the probability of having the costs allocated as in the US system or the description of an intermediate allocation system.

[8] The results are identical if p is observed by the rival before deciding on entry, and by the incumbent if and only if the rival enters.

[9] Our representation of the US and UK rules constitutes a stylized description of what has been extensively discussed by others (see, for instance, Bebchuk and Chang (1996)). Notice that, in the modeling of the US rule, we abstract from the treatment of the so-called *frivolous* or *nuisance* lawsuits: lawsuits without merit in which US courts allocate the legal cost to the suing party (as under the UK rule). See Rosenberg and Shavell (1985) for a study of nuisance suits.

We assume that $c < 1$ so that, under the US system (represented by $\alpha = 1$) and even if litigation is anticipated, the rival's expected net profits from entering, $(1-p)-c$, are positive when the incumbent's probability of winning, p, is sufficiently small.

Prior to the realization of p and the entry of the competitor, the incumbent is allowed to contract patent enforcement insurance with a competitive insurer. According to this arrangement, the insurer pays a fraction $1-x$ of the litigation costs in exchange of an initial premium P, leaving the remaining fraction of the costs as a deductible or copayment. The *fractional deductible* x is a scalar decided at the time of contracting the policy.[10] The fact that the insurer is competitive implies that x will be set so as to maximize the incumbent's expected net profits.

Importantly, after entry and before litigation occurs, the two firms can reach a settlement agreement. In a settlement, the incumbent receives a *licensing fee* $l(p)$ from the entrant in exchange for not going to court. Hence, after settlement, the incumbent and the entrant produce under duopoly and their net profits are $1 + l(p)$ and $1 - l(p)$, respectively. We assume that the licensing payment is determined according to a Generalized Nash Bargaining solution that leaves each party with its disagreement payoff plus a fraction of the surplus from avoiding litigation (if positive). Such a fraction represents bargaining power, and it is assumed to be $\beta \in [0, 1]$ for the incumbent and $1-\beta$ for the rival. The surplus from settlement amounts to the saved legal costs minus the loss in expected industry profits associated with renouncing to the possibility that courts restore the incumbent's monopoly, $p\pi$.[11]

The tree depicted in Figure 1 summarizes the timing of the events and the structure of the game between the incumbent and its rival. Prior to the realization of p, the incumbent can seek patent enforcement insurance from a competitive insurer. After this insurance is

[10] We have assumed that p is verifiable which, realistically, precludes the deductible to be made contingent on p.

[11] Notice that, capturing restrictions coming from antitrust legislation, we assume that agreements implying a "reversion to monopoly" are not permitted (see Maurer and Scotchmer (2004)).

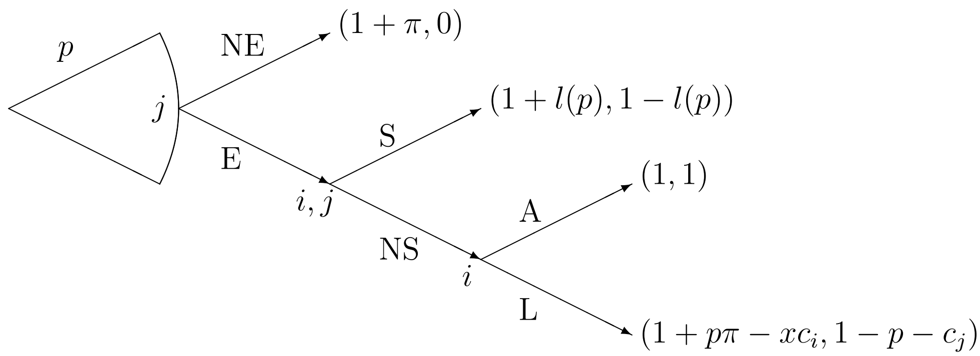


Figure 1: Structure of the Game.

contracted, p is realized and the rival decides whether to enter (E) or not (NE). If entry occurs, both firms engage in a settlement negotiation (S). If no settlement agreement is reached (NS), the incumbent can decide either to simply accommodate the entrant (A) or to litigate against it (L).

3 Determination of the Equilibrium

The game described in the previous section can be naturally solved using backwards induction, which is what we do next.

3.1 Accommodation vs Litigation

We start with the last decision node in Figure 1, where, if the out-of-court settlement fails, the incumbent must decide whether to accommodate or to litigate the rival. It comes directly from comparing the (expected) payoffs of the incumbent under each alternative that it will prefer to accommodate when its patent is not sufficiently strong (that is, for small p). Specifically, there is a critical value

$$p_A \equiv \frac{(2-\alpha)xc}{\pi + 2(1-\alpha)xc} < 1, \tag{3}$$

such that accommodation will occur for $p \leq p_A$ and litigation for $p > p_A$.

3.2 Settlement

Turning to the node in which the incumbent and the rival bargain on settlement, it is now clear that for $p \leq p_A$ no licensing agreement can make both parties strictly better off, since they know that the entrant can guarantee itself the duopoly payoff of 1 by refusing to agree. Hence, we can predict accommodation for $p \leq p_A$.[12]

For $p > p_A$, both parties expect litigation if they fail to agree. A licensing fee $l(p)$ will only be acceptable to the incumbent if

$$1 + l(p) \geq 1 + p\pi - xc_i,$$

and to the rival if

$$1 - l(p) \geq 1 - p - c_j.$$

Putting these inequalities together, and using (1) and (2), we obtain:

$$p + \alpha c + (1-\alpha)2pc \geq l(p) \geq p\pi - \alpha xc - (1-\alpha)(1-p)2xc. \tag{4}$$

So, the existence of a mutually acceptable licensing fee (or a positive surplus from settlement) requires that the previous range is non-empty and, thus, that the settlement surplus is non-negative:

$$s(p) \equiv \alpha(1+x)c + (1-\alpha)2xc - p[(\pi - 1) - 2(1-\alpha)(1-x)c] \geq 0. \tag{5}$$

The first two terms in the left hand side of this condition represent the savings in litigation costs that would accrue if the incumbent's probability of winning in court, p, were zero. The third term, proportional to p, reflects the loss of the net gains associated with the possibility that the incumbent wins and courts restore its monopoly position. If those net gains are not positive, $\pi \leq 1+2(1-\alpha)(1-x)c$, then the settlement surplus is positive for all p. Otherwise,

[12] Accommodation is, in all relevant respects, equivalent to a (trivial) settlement agreement with $l(p) = 0$, so we will not discuss this second possibility separately.

it is only positive for low values of p. That is, settlement only generates value when the incumbent's monopoly profits are relatively low or, otherwise, when its chances to win in court are relatively small.

The following lemma completes and summarizes the discussion on whether accommodation, settlement, or litigation occur after entry.[13]

Lemma 1. *For $p \in [0, p_A]$, entry is* accommodated*. Moreover, if $\pi \leq 1 + 2c - \alpha(1-x)c$, entry is followed by* settlement *for all $p \in (p_A, 1]$. Otherwise, there is a critical value*

$$p_S \equiv \frac{\alpha c + (2-\alpha)xc}{\pi - 1 - 2(1-\alpha)(1-x)c} \in (p_A, 1), \tag{6}$$

such that entry is followed by settlement *for $p \in (p_A, p_S]$ and by* litigation *for $p \in (p_S, 1]$.*

This lemma confirms the intuition that the incumbent's reaction to entry depends crucially on the relative merit of its case in court, represented by p, as well as the monopoly rents π, and the allocation of litigation costs. Other things equal, a higher probability of winning the trial, p, makes the incumbent less willing to accommodate and more willing to arrive to court without settlement. Increasing the monopoly rents π (as well as decreasing the litigation costs c) reduces p_A and p_S, leading to the same qualitative effects. In contrast, the signs of the variations induced by changes in the deductible x and the cost-allocation parameter α are less clear. The threshold p_A is increasing in x, but varies ambiguously with α, while p_S varies ambiguously with both x and α.[14]

In the following lemma, we provide an expression for the licensing fee that results from applying a Generalized Nash Bargaining solution to the negotiations on settlement.

[13] In case of indifference, we use an innocuous tie-breaking rule: we assume that accommodation prevails over settlement, and settlement over litigation.

[14] The ambiguities regarding the effects of changing α are partly due to the fact that the ordering of each party's expected litigation costs across legal systems varies with p. For example, for the incumbent, litigating is strictly more expensive under the US cost allocation rule than under the UK rule if and only if $p > 1/2$. Additionally, under the UK rule, the effect of the deductible x interacts with p and further complicates the evaluation of whether settlement generates a positive surplus or not.

Lemma 2. *In case of settlement, the resulting licensing fee is*

$$l(p) = \beta\{\alpha c + [1 + 2(1-\alpha)c]p\} - (1-\beta)\{(2-\alpha)xc - p[\pi + 2(1-\alpha)xc]\}, \tag{7}$$

which is increasing in p, π, *and* β, *and decreasing in* x.

Notice that, as it is generally the case under efficient bargaining, the allocation of bargaining power does not affect the region where settlement arises, but changes the allocation of the settlement surplus across agents in the obvious direction: the licensing fee $l(p)$ is increasing in the incumbent's bargaining power β. This fee also increases in p and π, and decreases in the deductible x, reflecting its dependence on the strength of the incumbent's case and other aspects that reinforce the incumbent's willingness to defend its patent in court. Changes in the litigation cost parameters α and c affect both parties in a more complicated manner, producing ambiguous predictions for $l(p)$.

3.3 Entry

In the entry stage, anticipating whether the incumbent's reaction will lead to accommodation, settlement or litigation, the rival decides to enter if its expected net profits from doing so are strictly positive.[15] If the entrant expects accommodation, entering is clearly optimal since duopoly profits equal 1 (and staying out yields zero). If settlement is anticipated, the entrant's expected net profits are $1 - l(p)$, which, using (7), are positive if and only if

$$p < p_{ES} \equiv \frac{1 - \beta\alpha c + (1-\beta)(2-\alpha)xc}{\beta[1 + 2(1-\alpha)c] + (1-\beta)[\pi + 2(1-\alpha)xc]} < 1, \tag{8}$$

where p_{ES} is increasing in x and decreasing in π and β.[16] If litigation is expected, entry will occur if

$$p < p_{EL} \equiv \frac{1 - \alpha c}{1 + 2(1-\alpha)c} < 1. \tag{9}$$

[15] As an innocuous tie-breaking rule, we assume that in case of indifference between entering or not, the rival stays out of the market.

[16] Since this threshold satisfies $l\,(p_{ES})=1$, these results are an immediate application of Lemma 2.

The final configuration of equilibrium outcomes over the possible values of p depends on the relative position of some of the thresholds obtained so far. The next lemma establishes the ordering of p_S, p_{ES} and p_{EL}. Remember that $p_A \leq p_S$.

Lemma 3. *If* $x \leq \widehat{x} \equiv \frac{\pi(1-\alpha c)-[1+2(1-\alpha)c]}{\alpha c+4(1-\alpha)c^2}$, *then* $p_S \leq p_{ES} \leq p_{EL}$. *Otherwise,* $p_{EL} < p_{ES} < p_S$.

Notice that for litigation to occur in equilibrium, it must be the case that $p > p_S$ so that the settlement offer is not accepted, and that $p < p_{EL}$ so that the rival prefers entry even when anticipating litigation. Hence, Lemma 3 makes clear that litigation can only occur in equilibrium if $x \leq \widehat{x}$ (for $p \in (p_S, p_{EL}]$). In that case, the premium that a competitive insurer will demand from the incumbent can be computed as

$$P = \int_{p_S}^{p_{EL}} (1-x)c_i \, f(p)dp, \tag{10}$$

whose right hand side is simply the expected value of the part of the legal costs covered by the insurance policy.

Previous lemmas make clear that the final equilibrium configuration depends on x, which is the fractional deductible set in the incumbents' patent enforcement insurance policy at the start of game. Rather than developing a complex taxonomy of equilibria for values of x that, eventually, never turn out to be optimal, in the next section we start establishing that the optimal deductible x^* is either zero (if π is small) or it belongs to the interval $[0, \widehat{x}]$ (if π is sufficiently large). Applying this result, the discussion on relevant equilibrium configurations is dramatically simplified.

4 Optimal Insurance Coverage

The first proposition in this section provides a general insight on the optimal insurance contract. It identifies forces that will push the insurer and the insured to agree, if feasible, on a deductible lower than or equal to the critical value $\widehat{x}$, defined in Lemma 3. This has definitive implications for the optimal deductible when $\widehat{x} \leq 0$, which occurs for low values of π :

Proposition 1. *If* $\pi \leq \widehat{\pi} \equiv \frac{1+2(1-\alpha)c}{1-\alpha c}$, *the optimal deductible* x^* *is zero. Otherwise,* $x^* \in [0, \widehat{x}]$.

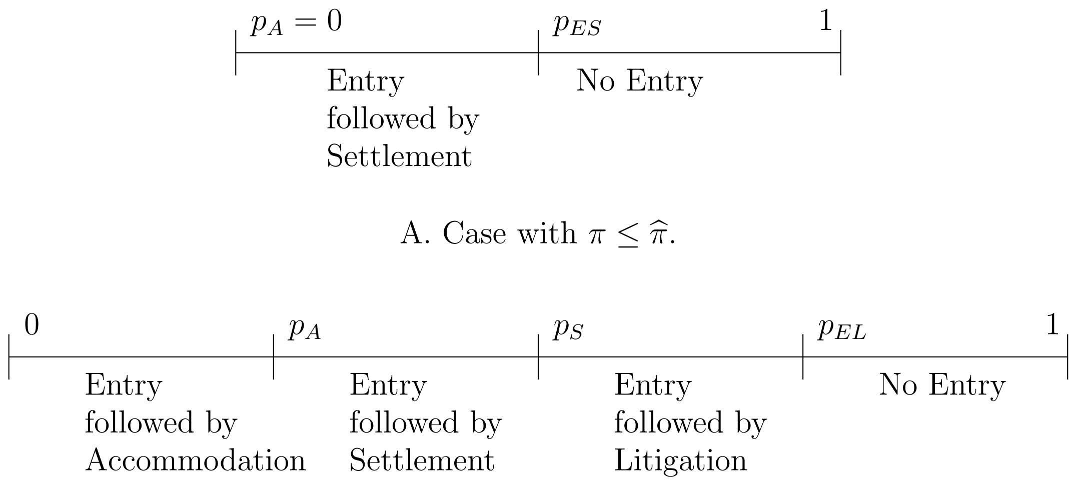
The intuition for this result is that the incumbent always finds optimal to preempt or minimize the type of predatory entry that arises if $x > \hat{x}$. With a too large x the incumbent cannot commit to litigate the infringers of its patent for values of p in the relevant entry margin, and as a result, some entry occurs under the entrant's expectation of a profitable settlement agreement—specifically, for $p \in (p_{EL}, p_{ES}]$ according to Lemma 3. In these cases, the coalition between the incumbent and its insurer can always be ex ante better off by decreasing the deductible, which will reach its lower bound of 0 if $\hat{x} \leq 0$. The intuition is that, insofar as litigation does not occur in equilibrium, a lower deductible improves the incumbent's bargaining position and allows it to obtain a higher licensing fee. Furthermore, the expectation of having to pay a higher licensing fee reduces the infringer's entry threshold, p_{ES}, allowing the patent holder to appropriate monopoly profits with a larger probability.

Thus, for $\pi \leq \widehat{\pi}$, the incumbent and its insurer will choose the full insurance of the litigation costs, $x^* = 0$. In this case, as represented in the top diagram of Figure 2, full insurance does not prevent entry (followed by accommodation) over the lowest range of possible values of p, but it minimizes the length of the range. The incumbent's expected net profits become

$$V = 1 + \int_0^{p_{ES}} l(p) f(p) dp + [1 - F(p_{ES})]\pi, \tag{11}$$

with p_{ES} evaluated at $x = 0$.

In the complementary case with $\pi > \widehat{\pi}$, the force described above tends to push the optimal deductible towards the interior of the $[0, \hat{x}]$ interval. With $x < \hat{x}$, however, litigation



A. Case with $\pi \leq \widehat{\pi}$.

B. Case with $\pi > \widehat{\pi}$ and $x^* < \widehat{x}$

Figure 2: Equilibrium outcomes as a function of p. The top and bottom diagrams correspond to the cases without and with litigation in equilibrium, respectively.

will arise in equilibrium, implying a configuration like the one depicted in the bottom diagram of Figure 2. In such a case, because part of the litigation costs are covered by the insurer, some litigation occurs, at the margin, for realizations of p such that $1 + p\pi - xc_i \geq 1 + l(p)$ but

$$1 + l(p) > 1 + p\pi - c_i.$$

That is, the overall expected profits from litigating (inclusive of the part of the litigation costs paid the insurer) are lower than the profits from settlement, so insurance induces litigation for realizations of p where, without insurance, it would not occur. For those realizations of p, some surplus is lost, but the loss is offset by the gains obtained, either in the form of a larger licensing fee or a lower entry threshold, for lower realizations of p. The optimal deductible maximizes the expected net gain. The relevant objective function is in this case

$$V = 1 + \int_{p_A}^{p_S} l(p)f(p)dp + \int_{p_S}^{p_{EL}} (p\pi - xc_i)f(p)dp + [1 - F(p_{EL})]\pi - P, \tag{12}$$

where the initial insurance premium P captures the part of the litigation costs paid ex ante.

Using (10) to substitute for P and rearranging terms, we obtain

$$V = 1 + \int_{p_A}^{p_S} l(p)f(p)dp + \int_{p_S}^{p_{EL}} (p\pi - c_i)f(p)dp + [1 - F(p_{EL})]\pi, \tag{13}$$

where p_A, p_S, and $l(p)$ are all functions of x, as specified in previous pages.

Interestingly, Proposition 1 already identifies $\widehat{x} < 1$ as a sufficient condition for some patent enforcement insurance coverage (i.e., $x^* < 1$) to be optimal. In addition, it is possible to verify that, when $\widehat{x} > 0$, the derivative of V (as defined in (13)) with respect to x is strictly negative at $x = 1$, which implies that the optimal deductible x^* must be strictly lower than one.

Proposition 2. *It is always optimal to use some patent enforcement insurance, i.e., to set* $x^* < 1$.

Further characterization of the optimal deductible would generally require specifying a probability distribution for p and proceeding numerically. For concreteness, in the remaining of the paper we will study the case in which p is uniformly distributed over the interval $[0, 1]$. It happens that, under this assumption, we can analytically solve for the optimal deductible under the US cost allocation rule ($\alpha = 1$). After discussing the analytical results under this rule, we will move to compare it numerically with the UK rule ($\alpha = 0$), since no closed form solution exists under the latter.

5 Outcomes under the US Cost Allocation Rule

Our stylized description of the US cost allocation rule corresponds to $\alpha = 1$, so that each party pays its own litigation costs. To analyze the optimal deductible and the associated equilibrium outcomes in greater detail, we consider the example in which the probability of victory of the incumbent is uniformly distributed over the interval $[0, 1]$.[17] The next

[17] When the distribution of p is uniform, the optimal deductible, when interior, has a closed form solution. Considering the whole interval $[0, 1]$ as its support is a just a convenient form of avoiding additional param-

proposition makes use of Proposition 1 and equations (11) and (13) to derive a closed form solution for the optimal deductible.

Proposition 3. *When p is uniformly distributed on the interval $[0,1]$, the optimal deductible under the US cost allocation rule ($\alpha = 1$) is:*

$$x^* = \begin{cases} 0 & \text{if } \pi \leq \frac{1}{1-c}, \\ \frac{\pi(1-c)-1}{c} & \text{if } \pi \in (\frac{1}{1-c}, \overline{\pi}), \\ \frac{\beta\pi}{\pi^2+\pi-\beta} & \text{if } \pi \geq \overline{\pi}, \end{cases} \tag{14}$$

where the threshold $\overline{\pi} > 1/(1-c)$ is increasing in c and β.

For sufficiently low π (relative to c), we are in the case with $\pi \leq \widehat{\pi}$ and $x^* = 0$, as established in Proposition 1. As argued before, the optimal deductible is zero when litigation does not arise in equilibrium and, hence, reducing the deductible strengthens the bargaining position of the incumbent at no cost. For an intermediate range of values of π (that moves upwards with c and lengthens with β), the optimal deductible is $\widehat{x}$, that is, the minimal deductible that prevents litigation from happening in equilibrium. This outcome reflects a corner solution to the trade-off between strengthening the bargaining position of the incumbent (by lowering x) and inducing inefficient litigation (if x goes below $\widehat{x}$). Finally, for sufficiently large values of π, the optimal deductible belongs to the interval $(0, \widehat{x})$ and solves the first order condition for the maximization of (13). In this case, x^* is such that the marginal gain from strengthening the bargaining position of the incumbent (which preempts entry at the p_{EL} margin and raises the licensing fee in the interval $(p_A, p_S]$) equals the marginal cost due to the additional litigation induced at the p_S margin.

For illustration purposes (and to facilitate the comparison with the results for UK system, that must necessarily be numerically solved), the solid lines in Figure 3 show how x^* moves with each of the parameters of the model around a baseline scenario with $\pi = 2.3$, $c = 0.4$, and

eters and a cumbersome discussion of situations in which the thresholds for p derived in previous sections fall out of the support.

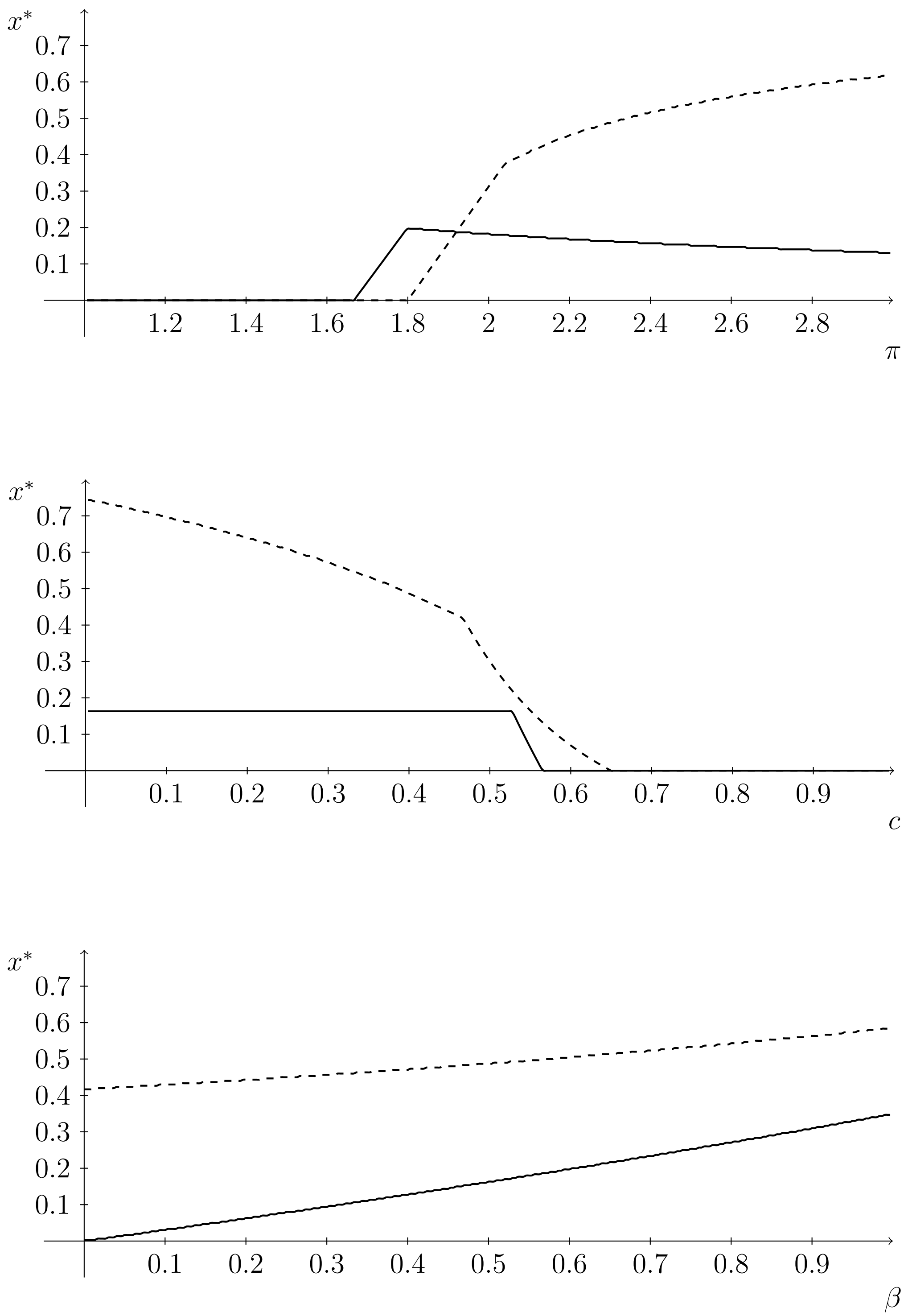


Figure 3: Optimal deductible under each cost allocation rule. The solid (dashed) line represents the optimal fractional deductible under the US (UK) rule. The model is parameterized as indicated in Section 5, except for the varying parameter that appears on the horizontal axis in each panel.

$\beta = 0.5$. Overall, x^* is a continuous but non-monotonic function of π. The non-monotonicity is associated with the shift from the corner solution that arises for $\pi \in (\frac{1}{1-c}, \overline{\pi}]$, which is increasing in π and decreasing in c, to the interior solution that arises for $\pi > \overline{\pi}$, which is decreasing in π and increasing in β. There are two opposing forces behind this inverse U-shaped dependence on π. On the one hand, a larger π makes predation less likely, so that insurance becomes less relevant. On the other hand, a larger π makes the reward that the incumbent obtains from litigation (as opposed to settlement) more relevant. Notice that, when successful, litigation allows the incumbent to capture the whole monopoly profits π as opposed to a proportion $\beta\pi$. This second force becomes more important as π increases and eventually dominates.

Figure 4 displays the critical values of p that delimit the regions for the various equilibrium outcomes under the same parameterizations explored in Figure 3. The range of realizations of p for which litigation occurs is contained between the lines corresponding to p_S and p_{EL}. As established in Proposition 3, litigation only occurs when the underlying parameters lead to $x^* < \widehat{x}$, that is, when π is large relative to c and β. Furthermore, litigation monotonically increases in π while it decreases in β and c. Under the featured parameterization, the accommodation region (between the lines corresponding to p_A and either p_S or p_{ES}) seems small in all cases, which can be explained by the fact that the endogenous deductible is also rather small. In fact, the accommodation region reaches its maximum size at intermediate values of c, reflecting that, although for a given x the relevant threshold, $p_A = xc/\pi$, is increasing in c, the optimal x is decreasing in c, which offsets the incumbent's (excess) tendency to accommodate for large c.[18] Finally, notice that the size of the entry region (upper delimited by the lines p_{EL} or p_{ES}) is decreasing in π and c, and invariant to β.

To conclude this section, we look at the equilibrium expected profits of the incumbent un-

[18] In the baseline parameterization we have $x = x^* = 0.16$, so without insurance ($x = 1$) the accommodation region would be about six times its size under the optimal deductible.

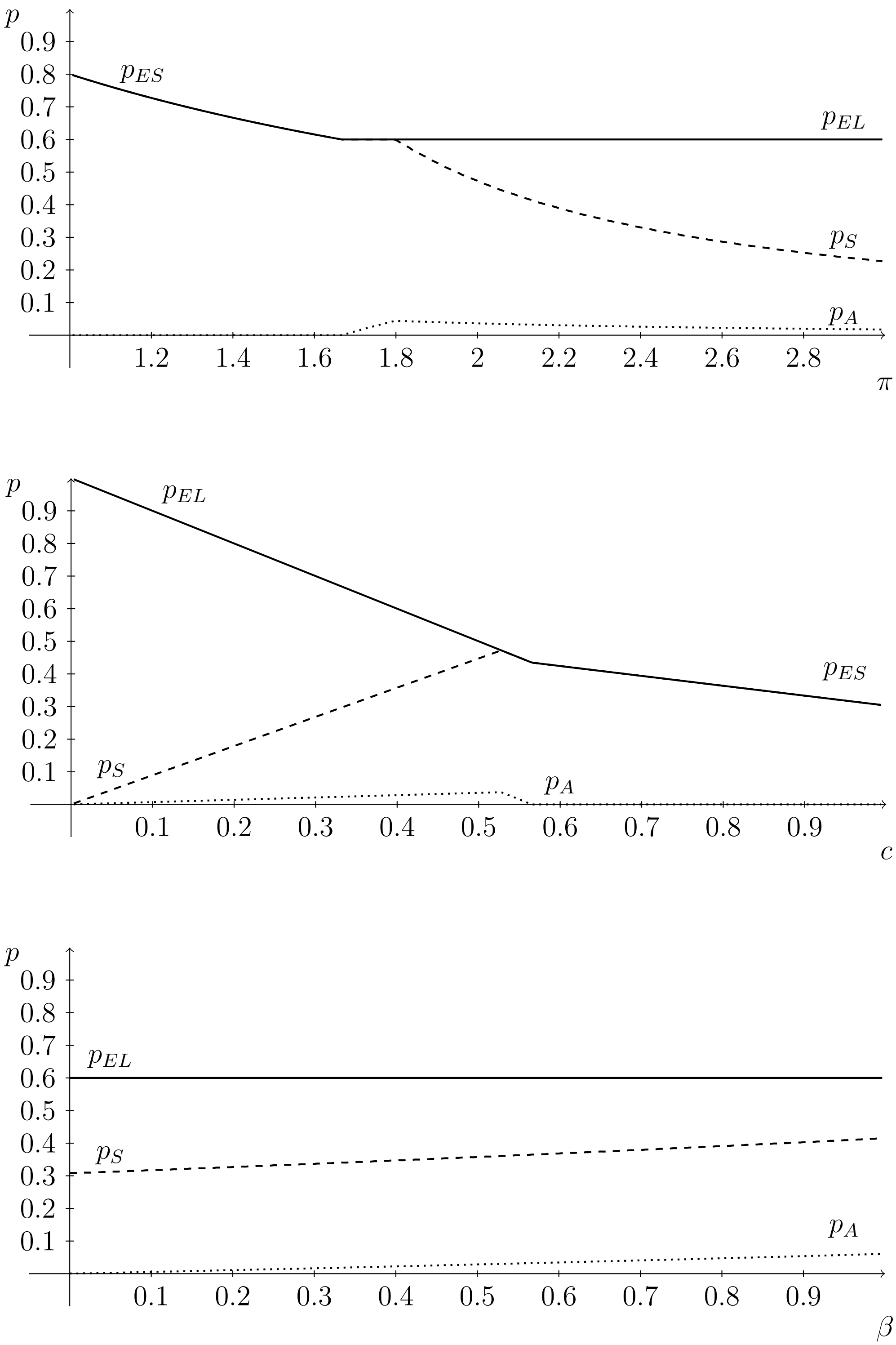


Figure 4: Equilibrium outcomes under the US cost allocation rule. The critical values of p displayed delimit the regions for the various equilibrium outcomes: accommodation (below p_A), settlement (between p_A and either p_S or p_{ES}), litigation (between p_S and p_{EL} or p_{ES}), and no entry (above p_{EL} or p_{ES}). Parameters and the underlying deductible are set as in Figure 3 (US rule).

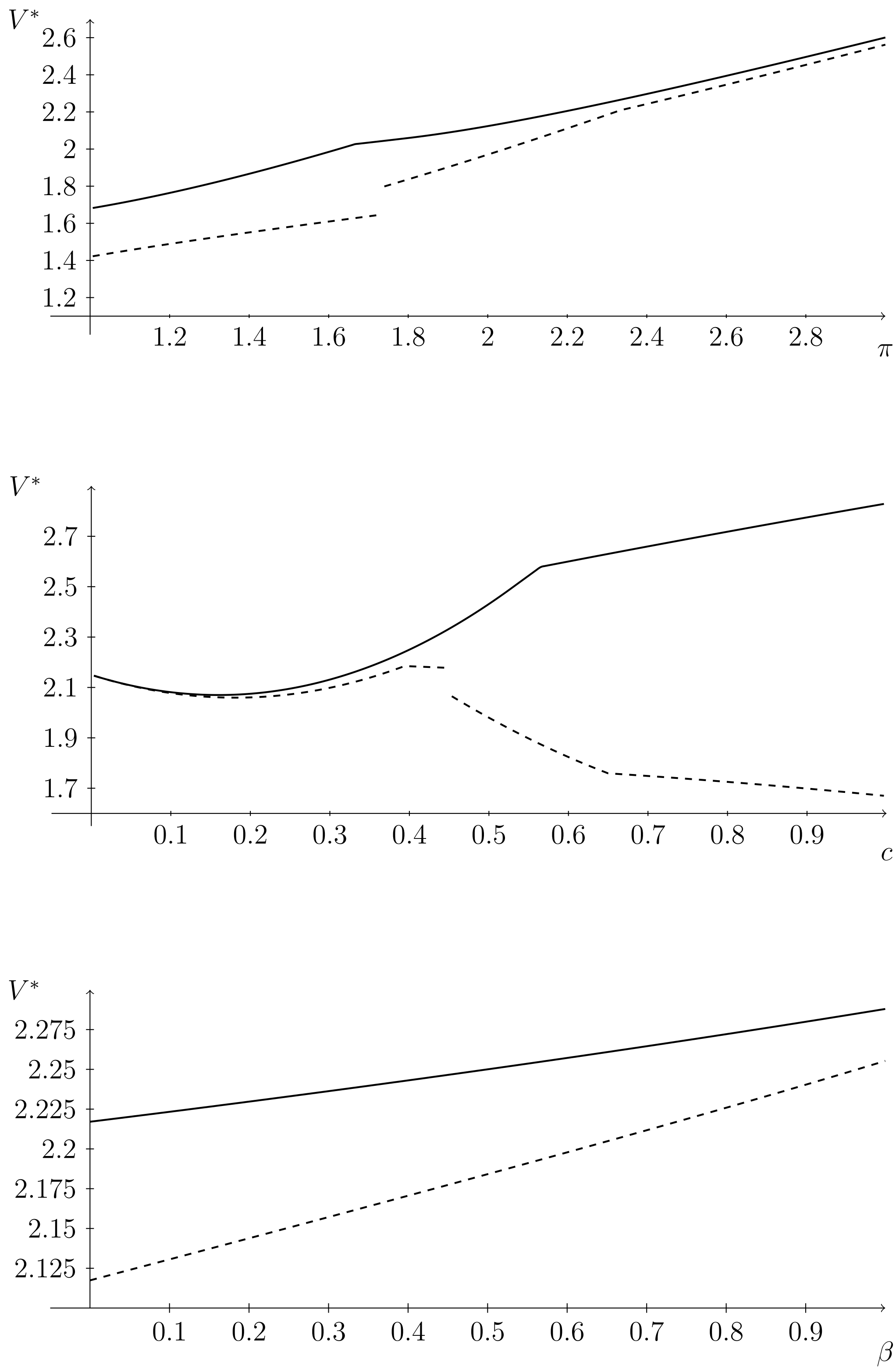


Figure 5: Profits under the US rule with and without insurance. The solid (dashed) line represents profits with (without) insurance. The model is parameterized as indicated in Section 5, except for the varying parameter that appears on the horizontal axis in each panel.

der the optimal patent enforcement policy, and compare them with their value in the absence of insurance, that is, for $x = 1$ (see Appendix B for the characterization of the equilibrium in this case). As depicted in Figure 5, the equilibrium expected profits are unambiguously monotonically increasing in π and β, but may be non-monotonic in c (notice the effects for values of c around 0.2 in the second panel of the figure). This results stems from the fact that increasing c has two opposite effects since it simultaneously affects the enforcement costs of the incumbent (which encourages entry and reduces its profits) and the potential costs of the entrant (which discourages entry and, indirectly, benefits the incumbent). The presence of insurance (with an optimal deductible which is decreasing in c) improves the balance of these two effects, so that the net gains from insurance (as measured by the vertical distance between the solid and dashed lines on Figure 5) are clearly increasing in c.

Figure 5 also shows that the net gains from insurance are larger for low to medium values of the monopoly profits π and for low values of the incumbent's bargaining power β. To the extent that the insurance market might not be perfectly competitive and/or the access to it might be subject to frictional costs (search or setup costs, adverse selection, etc.), this wedge in profits might help predict when the benefits from developing a patent litigation insurance market would be higher.

6 Outcomes under the UK Cost Allocation Rule

The UK cost allocation rule under which the litigation costs are shifted to the loser, corresponds to the case with $\alpha = 0$ in the general formulation. In this case, the optimal deductible x^*, whenever it falls in the interior of the interval $[0, \widehat{x}]$, does not have a closed-form solution. For this reason, in this section we rely on the numerical solutions found for the parameterizations already explored in Section 5 under the US rule. The dashed lines on Figure 3 represent the optimal deductible under the UK rule, which is typically, but not always, larger than under the US rule. Qualitatively the deductible behaves similarly under both rules in a number of dimensions. Specifically, when positive, x^* is non-increasing in the litigation costs c and increasing in the incumbent's bargaining power β, while it becomes zero when the monopoly profits π are small and c is large.

The most striking difference relative to the US case refers to the variation of x^* with π. Under the UK rule, x^* is monotonically increasing in π, which means that, in this case, over the region with equilibrium litigation, it is optimal to moderate the incumbent's increasing tendency to litigate as π increases—recall the trade-off between the costs and benefits of litigation spelled out when commenting on the determination of the optimal deductible under the US rule. This effect is most likely due to the fact that some of the excess litigation induced for large π in these simulations occurs for $p < 0.5$, that is, for realization of p such that the expected litigation costs eventually paid by the incumbent under the UK rule (contingent on losing the trial) are larger than those incurred under the US rule (independent of the outcome).

In fact, as depicted in Figure 6, the equilibrium outcomes under the UK rule look again qualitatively very similar to those obtained under the US rule, but the sizes of some regions differ. The results reinforce the intuition that some effects are due to the larger effective or potential litigation costs incurred under the UK rule for $p < 0.5$. In the three panels on Figure 6, the accommodation areas (below the p_A line) are larger than in their counterparts on Figure 4, while the litigation areas (between p_S and either p_{EL} or p_{ES}) are smaller than on Figure 4. (Notice also that part of the excess litigation occurs for $p < 0.5$.)

Figure 7 shows the equilibrium expected net profits of the incumbent under the UK rule. Again the big picture is similar to the US case: they increase with π and β, are non-monotonic (although eventually increasing) in c, and become significantly enhanced by the presence of insurance, especially for low π, large c, and low β. As under the US rule, the use

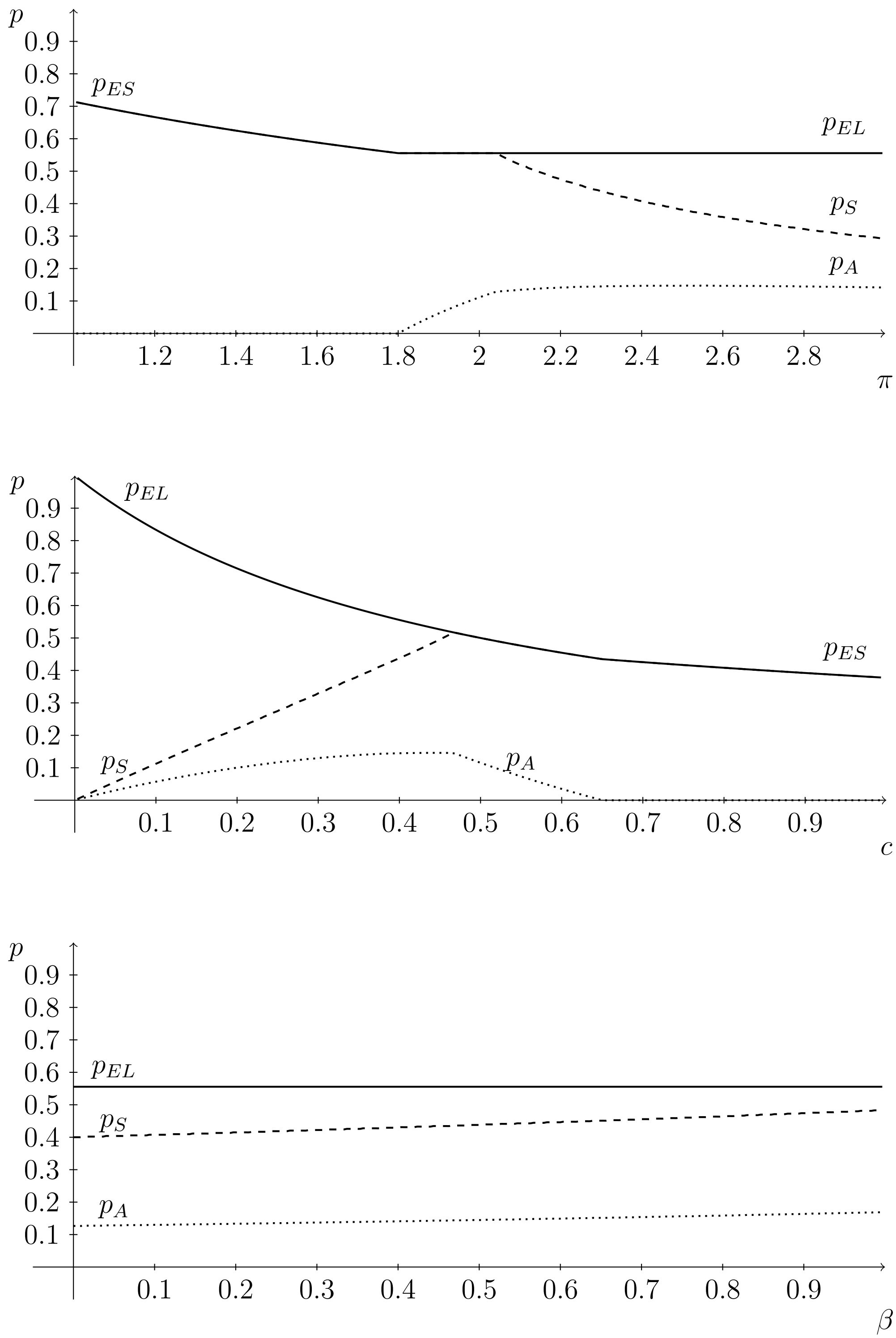


Figure 6: Equilibrium outcomes under the UK cost allocation rule. The critical values of p displayed delimit the regions for the various equilibrium outcomes: accommodation (below p_A), settlement (between p_A and either p_S or p_{ES}), litigation (between p_S and p_{EL} or p_{ES}), and no entry (above p_{EL} or p_{ES}). Parameters and the underlying deductible are set as in Figure 3 (UK rule).

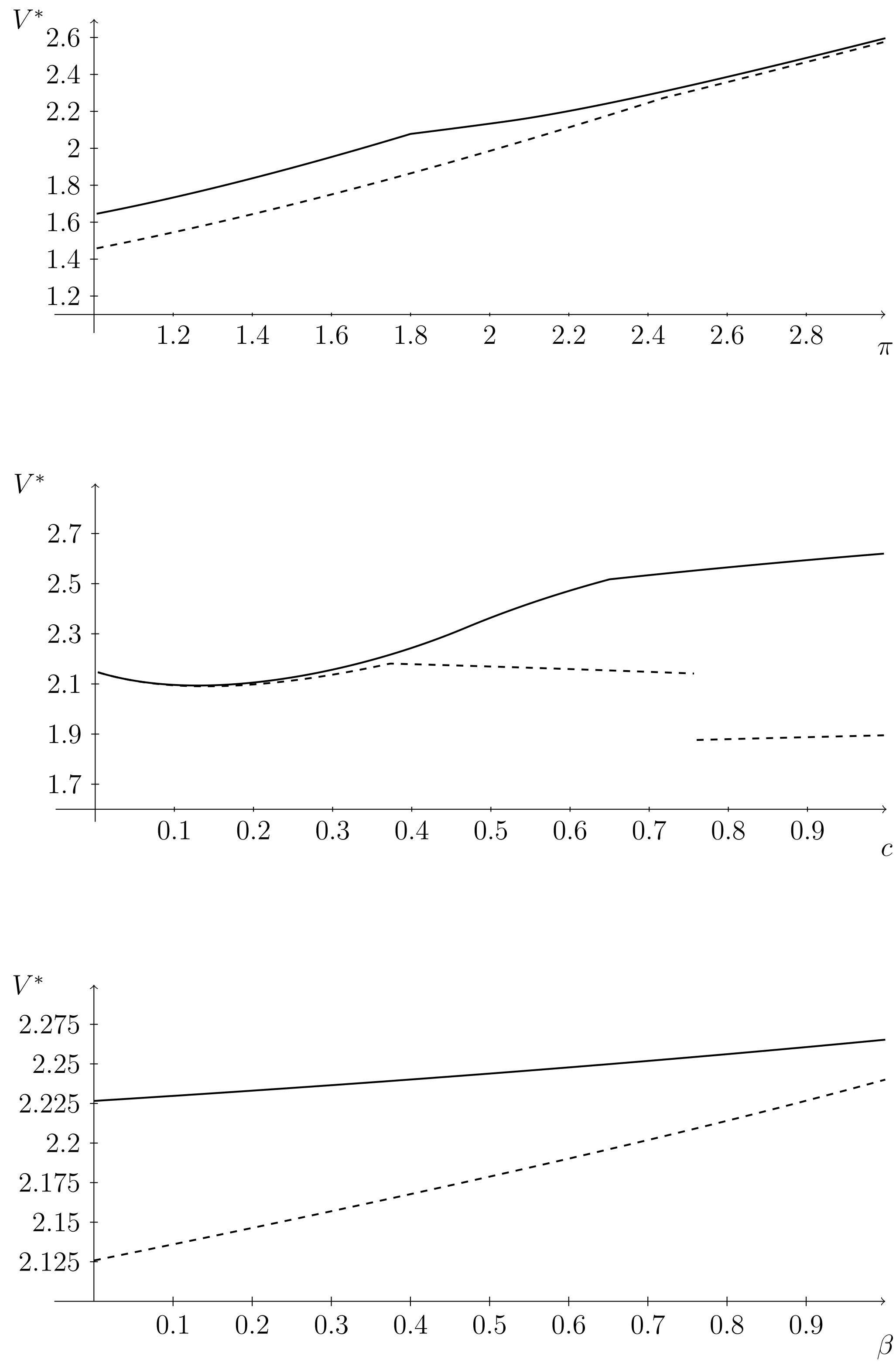


Figure 7: Profits under the UK rule with and without insurance. The solid (dashed) line represents profits with (without) insurance. The model is parameterized as indicated in Section 5, except for the varying parameter that appears on the horizontal axis in each panel.

of insurance allows the incumbent to offset the negative impact of c on its profits when c is large. Yet, the incumbent's overall profitability (and the contribution of insurance to it) tends to be larger under the US rule than under the UK rule, mainly in the scenarios with large c. In those scenarios, the presence of insurance actually turns around the comparison between the US and UK rules in terms of the incumbent's net profits: for large c, without insurance the UK rule would be more beneficial than the US rule, but with insurance the US rule becomes uniformly more beneficial to the incumbent than the UK rule.

7 Concluding Remarks

This paper has studied the effects of patent enforcement insurance in a situation where the patent holder faces the risk of infringement by a competitor. The main insight of the paper is that insurance has commitment value for the incumbent. Allowing for policies that incorporate a (fractional) deductible optimally set by the insurer and the insured when contracting them, we have shown that the deductible is always lower than 100% (implying that taking some insurance is always optimal) but typically strictly positive, in order to limit excessive litigation. A properly chosen deductible makes credible the threat to litigate alleged infringers, even when the incumbent's chances in court are small. This strategy reduces entry and, when entry occurs, allows the incumbent to reach more profitable licensing agreements in the out-of-court settlement of the dispute. The downside, however, is that, sometimes, insurance produces actual litigation in instances where, otherwise, it would not occur. The optimal deductible trades off the costs of excessive litigation with the aforementioned advantages.

We have compared the outcomes of the model under the US cost allocation rule (with no cost shifting) and the UK rule (with cost shifting to the loser). Although qualitatively the results are similar under both rules, in the parameterizations that we have explored, litigation tends to occur more frequently under the US rule, but the incumbent's expected net profits (and the contribution of insurance to them) tend to be also higher under the US rule. Interestingly, there are circumstances (e.g., for high litigation costs) were the introduction of patent enforcement insurance reverts the ranking between the rules in terms of the patent holder's expected net profits. This suggests that some of the normative implications found in the existing literature on patent litigation (that abstracted from the possibility of insurance) might not be robust to the introduction of insurance.

Future research should pay attention to the empirics of patent litigation insurance and test the validity of the predictions of our analysis. We will just elaborate on three predictions associated with comparative statics results already discussed in the body of the paper. First, insurance should be more valuable for patents involving smaller monopoly profits as well as for patents that, because of the nature of their technologies or the legal environment, are exposed to larger litigation costs. Second, if firms with larger portfolios of patents enjoy more bargaining power (say, because of their larger incentive to build a reputation as tough bargainers or their greater financial strength), then enforcement insurance should be more valuable to small firms, whose policies will tend to feature smaller deductibles. Third, after controlling for endogenous selection, that is, conditional on other factors that explain the tendency to litigate (e.g., the strength of the infringed patent), enforcement insurance should lead to more litigation. Unfortunately, the incipient nature of the enforcement insurance market and, to the best of our knowledge, the lack of data describing the use of insurance by the potentially insurable patent holders as well as the ex post performance of the insured ones, makes it unfeasible to check the validity of our predictions at this time.

Appendix

A Proofs

Proof of Lemma 1: The patent holder and the incumbent will agree on settlement if they can jointly obtain more than the sum of their outside options. In other words, the surplus $s(p)$, defined in (5), must be positive. Clearly, if $\pi \leq 1+2c-\alpha(1-x)c$, we have $s(p) \geq 0$ for all p, and settlement occurs up to $p=1$. Otherwise, there exists a critical value $p_S < 1$ such that $s(p_S) = 0$ and $s(p) \geq 0$ for all $p \leq p_S$. By inspection of the corresponding expressions, it is immediate that $p_S > p_A$.■

Proof of Lemma 2: The incumbent's payoff from a successful negotiation is $1+l(p)$, where $l(p)$ is the licensing fee. Under Nash Bargaining, we should have $1+l(p) = (1+p\pi - xc_i) + \beta s(p)$, which yields the expression for $l(p)$ in equation (7). The comparative statics of $l(p)$ with respect to π, p and x is immediate. Regarding β, notice that

$$\frac{\partial l}{\partial \beta} = \alpha c + (2-\alpha)xc - p\left[\pi - 1 - 2(1-\alpha)(1-x)c\right]. \tag{15}$$

If $\pi < 1+2(1-\alpha)(1-x)c$, the expression in brackets is negative and, thus, we clearly have $\partial l/\partial\beta > 0$ for all p. Otherwise, (15) is decreasing in p, so it is sufficient to notice that, actually, $\partial l/\partial\beta = 0$ at $p = p_S$, defined in (6), which is the upper bound of the settlement range.■

Proof of Lemma 3: Simple manipulation of p_S, p_{ES}, and p_{EL}, defined in (6), (8), and (9), respectively, yields the result that the inequalities $p_S \leq p_{ES}$ and $p_{ES} \leq p_{EL}$ are both satisfied if and only if $x \leq \widehat{x}$. So the result follows.■

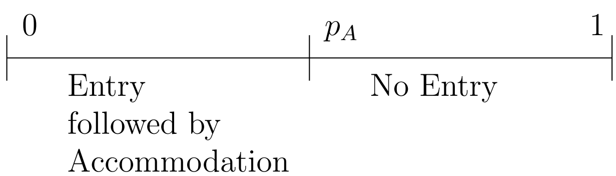
Proof of Proposition 1: Notice first that $\widehat{x} \leq 0$ if and only if $\pi \leq \widehat{\pi}$. Thus the discussion can be divided in two cases, depending on the value of π.

1. Case with $\pi \leq \widehat{\pi}$. We have $\widehat{x} \leq 0$. Then for all relevant x, we have $x \geq \widehat{x}$ and, hence, by Lemma 2, $p_{EL} \leq p_{ES} \leq p_S$, where the inequalities are strict except if $x = \widehat{x} = 0$. In principle, depending on the relative positions of p_A and p_{ES}, two possible subcases may emerge.

(a) Subcase $p_A < p_{ES}$. The relevant thresholds would be ordered as indicated in the following diagram, giving raise to three different types of outcomes over the range of possible realizations of p:

However, with this configuration, reducing x would decrease both p_A and p_{ES}, reducing the region where entry is accommodated, increasing licensing fees, and decreasing overall entry. This change would not trigger litigation and would thus keep $P = 0$.

(b) Subcase $p_{ES} < p_A$. Here we would have:



However, reducing x would decrease p_A, reducing entry without triggering litigation (and hence keeping $P = 0$).

Previous arguments imply that only $x^* = 0$ can be optimal, since any other policy could be improved by reducing x. Setting $x = 0$ implies $p_A = 0 < p_{ES} < 1$.

2. Case with $\pi > \widehat{\pi}$. We have $\widehat{x} > 0$. By the same arguments used in points 2(a) and 2(b) above, any arrangement involving $x > \widehat{x}$ (if at all relevant, since only $x \leq 1$ make sense) could be improved by reducing x. Thus we must have that x^* belongs to the non-empty interval $[0, \widehat{x}]$.■

Proof of Proposition 2: As mentioned, given Proposition 1, we only need to show that $x^* < 1$ in the case with $\widehat{x} \geq 1$. In such a case, the equilibrium configuration must be as in the top panel of Figure 2 under any x, included the optimal x^*. The derivative of (13) with respect to x is:

$$\frac{\partial V}{\partial x}=\int_{p_A}^{p_S}\frac{\partial l}{\partial x}f(p)dp-\frac{\partial p_A}{\partial x}l(p_A)f(p_A)-\frac{\partial p_S}{\partial x}\left[p\pi-c_i-l(p_s)\right]f(p_s).$$

For a general value of x, the sign of this expression is ambiguous. Whereas the first two terms are negative, the sign of the last one depends (among other things) on the value of x. However, for $x=1$, this last term becomes zero and hence we unambiguously have $\partial V/\partial x<0$, which implies that $x=1$ cannot be optimal and, hence, x^* must be lower than 1.■

Proof of Proposition 3: By Proposition 1, we can focus the discussion on the case with $\pi>\widehat{\pi}=\frac{1}{1-c}$, where $\widehat{x}=\frac{\pi(1-c)-1}{c}>0$ and $x^*\in[0,\widehat{x}]$; otherwise $x^*=0$. In this case, x^* must maximize (13) within the referred range. After replacing $f(p)=1$ and $F(p_{EL})=p_{EL}$ in (13), we obtain a quadratic and strictly concave function of x that reaches an unconstrained maximum at $x'=\frac{\beta\pi}{\pi-\beta+\pi^2}>0$. Obviously, if $x'<\widehat{x}$ then $x^*=x'$; otherwise, $x^*=\widehat{x}$. We next show that there is a unique critical value $\overline{\pi}$ such that $x'<\widehat{x}$ if and only if $\pi>\overline{\pi}$. To see this notice that with $\pi=\widehat{\pi}=\frac{1}{1-c}$, we have $\widehat{x}=0<x'$, while for $\pi=\frac{1+c}{1-c}>1$ we have $\widehat{x}=1>x'$ since, clearly, $x'>1$ requires $\pi<\beta$, where $\beta\leq 1$. Hence, by continuity, we must have $\widehat{x}=x'$ for at least one value of π in the interval $(\frac{1}{1-c},\frac{1+c}{1-c})$. Actually, such a value is unique since, for $\pi>\frac{1}{1-c}$,

$$\frac{\partial\widehat{x}}{\partial\pi}=\frac{1-c}{c}>0>\frac{\partial x'}{\partial\pi}=\frac{\beta}{1-\frac{\beta}{\pi}+\pi^2}\frac{\beta-\pi^2}{\pi^2},$$

where the second inequality follows from the fact that $\pi>\frac{1}{1-c}>1>\sqrt{\beta}>\beta$. Finally, notice that the comparative statics of $\overline{\pi}$ is immediate from the fact that x' is increasing in β and independent of c, whereas $\widehat{x}$ is decreasing in c and independent of β.■

B Equilibrium in the Absence of Insurance

To assess the effects of patent enforcement insurance it is useful to compare the results discussed in the main body of the paper with a benchmark situation where no insurance is available. When the incumbent lacks insurance, the structure of the game remains unchanged. The relevant thresholds and the licensing fee corresponding to this case can be obtained from (3) and (6)-(9) by setting $x = 1$. In this case we have $p_A < p_S$ and using Lemma 3, one can obtain the following result.

Lemma 4. *In the absence of insurance ($x = 1$), there exist two critical values, $\pi_L \equiv \frac{4c^2+\alpha c}{1-\alpha c}$ and $\pi_H \equiv \frac{1+(2-\alpha)c+4(1-\alpha)c^2}{1-\alpha c}$, such that the configuration of equilibrium is as follows:*

1. *If $\pi \leq \pi_L$, then $p_{EL} \leq p_A < p_{ES} < p_S$ or $p_{EL} < p_{ES} \leq p_A < p_S$. Entry occurs for $p \leq p_S$, it is accommodated for $p \in [0, p_A]$, and settlement occurs for $p \in (p_A, p_S]$.*

2. *If $\pi \in (\pi_L, \pi_H]$, then $p_A < p_{EL} < p_{ES} < p_S$. Entry occurs for $p \leq p_{ES}$, it is accommodated for $p \in [0, p_A]$, and settlement occurs for $p \in (p_A, p_{ES}]$.*

3. *If $\pi > \pi_H$, then $p_A < p_S < p_{ES} < p_{EL}$. Entry occurs for $p \leq p_{EL}$, it is accommodated for $p \in [0, p_A]$, and settlement and litigation occur for $p \in (p_A, p_{ES}]$ and $p \in (p_{ES}, p_{EL}]$, respectively.*

Proof. The threshold π_L is obtained as the value of π for which $p_A = p_{EL}$ with $x = 1$. The threshold π_H is obtained as the value of π for which $\widehat{x} = 1$, according to the definition of $\widehat{x}$ in Lemma 3. The equilibrium outcomes associated with each region are obtained using arguments similar to those in the rest of the paper. We omit further details for brevity.■

Using the previous lemma, it is immediate to check that the incumbent's expected net profits in the absence of insurance becomes

$$V = \begin{cases} 1 + \int_{p_A}^{p_S} l(p)f(p)dp + [1 - F(p_S)]\pi, & \text{if } \pi < \pi_L, \\ 1 + \int_{p_A}^{p_{ES}} l(p)f(p)dp + [1 - F(p_{ES})]\pi, & \text{if } \pi \in [\pi_L, \pi_H], \\ 1 + \int_{p_A}^{p_S} l(p)f(p)dp + \int_{p_S}^{p_{EL}} (p\pi - c_i)f(p)dp + [1 - F(p_{ES})]\pi, & \text{if } \pi > \pi_H. \end{cases}$$

The dashed lines on Figures 5 and 7 are generated using this expression for $\alpha = 1$ and $\alpha = 0$, respectively.

References

Aoki, R., and Hu, J.-L., 1999, "Licensing vs. Litigation: Effect of the Legal System on Incentives to Innovate," *Journal of Economics and Management Strategy*, 8: 133–160.

Bebchuk, L. A., 1984, "Litigation and Settlement under Imperfect Information," *RAND Journal of Economics*, 15: 404–415.

Bebchuk, L. A., and Chang, H. F., 1996, "An Analysis of Fee Shifting Based on the Margin of Victory: On Frivolous Suits, Meritorious Suits, and the Role of Rule 11," *Journal of Legal Studies*, 25: 371–403.

CJA Consultants, 2003, "Patent Litigation Insurance: A study for the European Commission on possible insurance schemes against patent litigation risks," .

Crampes, C., and Langinier, C., 2002, "Litigation and Settlement in Patent Infringement Cases," *RAND Journal of Economics*, 33: 258–274.

Gørtz, M., and Konnerup, M., 2001, "Welfare Effects of a Patent Insurance - Microeconomic Evaluation and Macroeconomic Consequences," *unpublished*.

Lanjouw, J. O., and Schankerman, M., 1998, "Stylised Fact of Patent Litigation: Value, Scope and Ownership," STICERD WP 20.

——, 2004, "Protecting Intellectual Property Rights: Are Small Firms Handicapped?" *Journal of Law & Economics*, 47: 45–74.

Lerner, J., 1995, "Patenting in the Shadow of Competitors," *Journal of Law & Economics*, 38: 463–95.

Maurer, S. M., and Scotchmer, S., 2004, "Profit Neutrality in Licensing: The Boundary between Antitrust Law and Patent Law," NBER WP 10546.

Meurer, M., 1989, "The Settlement of Patent Litigation," *RAND Journal of Economics*, 20: 77–91.

Reinganum, J. F., and Wilde, L. L., 1986, "Settlement, Litigation, and the Allocation of Litigation Costs," *RAND Journal of Economics*, 17: 557–566.

Rosenberg, D., and Shavell, S., 1985, "A Model in which Suits are Brought for their Nuisance Value," *International Review of Law and Economics*, 5: 3–13.

Shavell, S., 1982, "Suit, Settlement, and Trial: A Theoretical Analysis under Alternative Methods for the Allocation of Legal Costs," *Journal of Legal Studies*, 11: 55–81.

Wilder, R., 2001, "Fostering the Innovation Potential of SMEs in the Globalization Era: the Role of Patents," *WIPO Milan Forum On Intellectual Property and Small and Medium-Sized Enterprises*.