Side payments, litigation risk and settlement outcomes

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A R T I C L E   I N F O

A B S T R A C T

We offer a simple model of patent settlement for examining how litigation prospects, patent strength and expected damage awards affect consumer benefits stemming from settlement agreements providing for per-unit royalties and non-negative fixed fees. The result shows that consumers may be harmed if expected damage payments forgone by settlement lead to agreements with high royalty payments that benefit both the patent holder and licensee at the expense of the consumer.

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1. Introduction

An important question in the economics of patent litigation concerns whether consumers are better off when license holders in patent disputes reach settlement with challengers or pursue litigation. Despite results in Shapiro (2003) showing that under some competitive conditions consumers benefit from settlement agreements with negative fixed fees (i.e. payments from the patentee to the licensee), in practice such agreements are typically viewed as anti-competitive. The logic rests on the idea that a negative fixed fee coupled with a high per unit royalty can restrict competition by inducing an alleged infringer or potential entrant to exit or not enter the product market (Shapiro, 1985).

While prohibiting negative fixed fees or "pay for delay" settlements can be easy for antitrust authorities to enforce, settlement agreements with positive fixed fees can also harm consumers if expected damage payments forgone by settlement lead to agreements with high royalty payments that benefit both the patent holder and licensee at the expense of the consumer. A Supreme Court decision (*F.T.C. v. Actavis, Inc.*, 2013) has already recognized the potential for "pay for delay" settlements to limit competition,[1] and some legal writers have argued for recognizing the same potential in all licensing agreements involving damage forgiveness (Hemphill, 2006).

We offer a simple model of patent settlement following common-information models in Meurer (1989) and Shapiro (2003) for examining how patent strength and expected damage awards affect consumer benefits from settlement agreements providing for per-unit royalties and non-negative fixed fees. We find that consumers are better off with litigation when patents are strong or damages are large, in other words when the expected return to

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[1] Soon after, in *F.T.C v. Cephalon, Inc.* (2015) the Federal Trade Commission has reached a settlement ensuring a payment of $1.2 billion available to compensate purchasers who overpaid because of Cephalon's pay-for-delay agreements with four generic drug manufactures.

litigation from the challenger's perspective is low relative to duopoly competition under licensing. In these circumstances, the royalty rate proposed by the patent holder can be so high as to reduce consumer surplus from settlement below expected surplus from litigation.

The paper proceeds as follows. We develop the baseline model in Section 2. Section 3 shows how licensing agreements affect consumer surplus. Section 4 discusses results, and Section 5 concludes the paper.

2. Model outline

In this section we develop the model. We first set out the baseline assumptions. Then, we solve for the range of accepted settlement offers. Finally, we define expected consumer surplus from litigation and consumer surplus under settlement.

2.1. Assumptions

Our framework follows the common-information model in Meurer (1989) and the Cournot and Bertrand examples in Shapiro (2003) measuring the gains form settlement. As in these models, we consider past rather than prospective infringement.

We consider two competitors, the patent holder (incumbent) and the alleged infringer (challenger) engaged in a patent dispute. (We ignore here the possibility of multiple infringers.) The patent covers a drastic innovation which allows the patent holder to enjoy monopoly profits until the challenger enters the market with a product considered by consumers to be a perfect substitute for the patented product. Based on information collected in the pre-trial process, both the owner and challenger assign a probability θ that the patent holder wins at trial. Following Shapiro (2003), θ is a measure of *patent strength*.[2]

For simplicity, we assume that after filing, disputes are resolved by litigation or settlement without further time or money costs. If the case is litigated, the challenger wins with probability $(1 - \theta)$ and firms earn duopoly profits $\pi_{1d} = \pi_{2D}$. We assume that industry profits are higher under monopoly than duopoly and that consumer surplus S is lower, that is $\pi_m > \pi_{1d} + \pi_{2d}$ and $S_m < S_d$. If the incumbent wins with probability θ, the incumbent earns π_m plus damages D awarded by the court for past infringement. The challenger in this case earns $-D$.

Instead of litigation, the two firms may choose to settle. A settlement takes the form of a licensing agreement with fixed fee F and per unit royalty payment r paid by

the challenger to incumbent. Profits under the settlement agreement inclusive of royalties are $\pi_1(r)$ for the incumbent and $\pi_2(r)$ for the challenger. The usual conditions on derivatives hold, that is $\pi_1'(r) > 0$ and $\pi_2'(r) < 0$.

The incumbent chooses the royalty rate r and fixed fee F to maximize profits subject to the challenger accepting the offer. If earnings for settlement are not lower than expected profits under litigation, the incumbent makes a settlement offer, otherwise the case is litigated.

2.2. Firms' payoffs

Under settlement, profits inclusive of royalties and fixed fee are $\Pi_{1s}(r, F) = \pi_1(r) + F$ for the incumbent and $\Pi_{2s}(r, F) = \pi_2(r) - F$ for the challenger.

In case of litigation expected profits are $\Pi_{1l} = \theta(\pi_m + D) + (1 - \theta)\pi_{1d}$ for the incumbent and $\Pi_{2l} = \theta(-D) + (1 - \theta)\pi_{2d}$ for the challenger.

We define r_m as the royalty level that solves $\pi_1(r) = \pi_m$ and correspondingly $\pi_2(r) = 0$. Let the negotiation take place in the form of a take-it-or leave-it offer by the incumbent (Choi, 2009). Then, the incumbent chooses r and F to maximize profits under settlement subject to the participation constraint of the challenger and boundary constraints on r and F:

$$\max_{\bar{r}, \bar{F}} \Pi_{1s} = \pi_1(r) + F$$

subject to : $\pi_2(r) - F \geq \theta(-D) + (1 - \theta)\pi_{2d}$,

$r_m \geq r, \quad F \geq 0$.

The Kuhn–Tucker conditions are:

$\pi'_1(r^*) + \mu_1\pi'_2(r^*) - \mu_2 = 0 \qquad 1 - \mu_1 + \mu_3 = 0$

$\mu_1 \geq 0 \quad \mu_2 \geq 0 \quad \mu_3 \geq 0$

$\pi_2(r^*) - F^* \geq \theta(-D) + (1 - \theta)\pi_{2d} \quad r_m \geq r^* \quad F^* \geq 0$

$\mu_1[\theta(-D) + (1 - \theta)\pi_{2d} - \pi_2(r^*) + F] = 0$

$$\mu_2(r_m - r^*) = 0 \quad \mu_3 F^* = 0.$$

From the conditions $1 - \mu_1 + \mu_3 = 0$, $\mu_1 \geq 0$ and $\mu_3 \geq 0$ it follows that μ_1 must be strictly positive. That is, the participation constraint must be fulfilled with strict equality:

$$F^* = \pi_2(r^*) + \theta D - (1 - \theta)\pi_{2d}.$$

As a candidate solution for r we try $r^* = r_m$. In this case the participation constraint reduces to:

$$F^* = \theta D - (1 - \theta)\pi_{2d}.$$

If $\theta D \geq (1 - \theta)\pi_{2d}$ the non-negativity constraint $F_* \geq 0$ is fulfilled: $r^* = r_m$ and $F^* = \theta D - (1 - \theta)\pi_{2d}$ satisfy the Kuhn–Tucker conditions. If instead $\theta D < (1 - \theta)\pi_{2d}$ the non-negativity constraint $F_* \geq 0$ is not fulfilled. Then, we try $F^* = 0$. With $F^* = 0$ the participation constraint becomes:

$$\pi_2(r^*) = \theta(-D) + (1 - \theta)\pi_{2d}.$$

This equation yields the optimal solution r_* as a function of D, θ and π_{2d}, with $0 < r_* < r_m$: the challenger is allowed to use the patented technology in the future in exchange for per-unit royalties.

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[2] Asymmetric information about patent strength is generally considered the primary reason why disputes are litigated rather than settled. More precisely, it has been proven that under asymmetric beliefs about θ there exists a "bluffing equilibrium" in which the holder of a strong patent always refuses to license, while the holder of a weak patent sometimes settles and sometimes bluffs about patent strength by refusing to license (Meurer, 1989). However, the fact that empirically a very little percentage of filed patent cases are litigated to a resolution in court suggests that the extent of asymmetric information may often be modest (Lanjouw and Schankerman, 2001; Shapiro, 2003). Scotchmer (2004, p. 201) notes that during the "discovery process" (a pre-trial procedure in civil lawsuits) firms refine their beliefs about the likely outcome of litigation, often approaching a close agreement on the prospects.

Putting the two cases together, in terms of $\pi_2(r_*)$ we can write:

$$\pi_2(r^*) = \begin{cases} 0 & \text{if } \theta D \geq (1-\theta)\pi_{2d} \\ \theta(-D) + (1-\theta)\pi_{2d} & \text{if } \theta D < (1-\theta)\pi_{2d}, \end{cases} \quad (1)$$

and for F_* we have:

$$F^* = \begin{cases} \theta D - (1-\theta)\pi_{2d} & \text{if } \theta D \geq (1-\theta)\pi_{2d} \\ 0 & \text{if } \theta D < (1-\theta)\pi_{2d}. \end{cases} \quad (2)$$

The two distinct cases $\theta D \geq (1-\theta)\pi_{2d}$ and $\theta D < (1-\theta)\pi_{2d}$ correspond respectively to the so called *retroactive licenses,* where the licensee does not obtain the right to use the patented technology in the future and is expected to cease its presumptive infringement, and *forward looking licenses*, where the licensee is allowed to continue its activity in exchange for some kind of compensation to the patent holder.

As forward looking licenses do not provide for lump sum transfers from the challenger to the incumbent, this might be interpreted, at first sight, as a sign of "damage forgiveness". But the expected value of damages is charged on the future challenger production through the royalty rate. As a matter of fact, damage forgiveness is a particular kind of side payment (negative fixed fee) allowing the challenger to limit competition.

Proposition 1. In the interval $0 \leq D \leq (1-\theta)\pi_{2d}/\theta$ there exists a D_0 such that for $D \geq D_0$ the incumbent profits under settlement are not lower than expected profits from litigation.

Proof. We define G as the difference between the incumbent profits under settlement and the expected profit from litigation:

$$G = \pi_1(r^*) + F^* - \theta(\pi_m + D) - (1-\theta)\pi_{1d}. \quad (3)$$

If $\theta D < (1-\theta)\pi_{2d}$, from Eqs. (1) and (3) we obtain the derivative

$$\frac{dG}{dD} = \frac{\theta(\pi'_1(r^*) + \pi'_2(r^*))}{-\pi'_2(r^*)},$$

which, under the usual assumptions $\pi'_1(r) + \pi'_2(r) > 0$ and $\pi'_2(r) < 0$, is positive.[3] Moreover, G approaches the positive value $(1-\theta)(\pi_m - \pi_{1d} - \pi_{2d})$ as D approaches $(1-\theta)\pi_{2d}/\theta$ from below. Let D_0 denote the value of D such that $G = 0$. Then, for $D \geq D_0$ we have $G \geq 0$. $\square$

Summing up, for $D \geq D_0$ the incumbent makes a settlement offer (r_*, F_*) as determined by Eqs. (1) and (2), and the challenger accepts the offer. Because in the interval $D_0 \leq D < (1-\theta)\pi_{2d}$,

$$\frac{\partial r^*}{\partial D} = \frac{\theta}{-\pi'_2(r^*)} > 0 \quad \text{and} \quad \frac{\partial r^*}{\partial \theta} = \frac{D + \pi_{2d}}{-\pi'_2(r^*)} > 0,$$

comparative statics confirms the intuition that higher damages and/or higher patent strengths lead to higher optimal royalties. It remains to see how large damages and strong patents affect consumer surplus under settlement and under litigation.

2.3. Consumer surplus

Under litigation consumers enjoy the monopoly surplus S_m if the incumbent wins the suit and the duopoly surplus $S_d > S_m$ if the infringement claim is declared unfounded. In other words, expected consumer surplus from litigation is given by $\theta S_m + (1-\theta)S_d$. If the two firms settle, consumer surplus amounts to $S(r)$, with $S'(r) < 0$. We define $\hat{r}$ as the royalty rate such that:

$$S(\hat{r}) = \theta S_m + (1-\theta)S_d. \quad (4)$$

Then, if $r^* > \hat{r}$ the settlement agreement harms consumers.

3. Licensing agreements

From Eqs. (1) and (4) it is clear that, other things equal, both the royalty r_* that settle the dispute and the royalty $\hat{r}$ that would leave consumers as well off under the settlement as under litigation depend, via π_{2d} or S_d, on the kind of competition which would prevail if the infringement claim were rejected in court. To show how the gains from settlement to consumers vary with market equilibrium outcomes under litigation and challenger's success, in what follows we adopt a standard conjectural variation model in a linear context.[4] Specifically, we will assume that the two firms sell a homogeneous product, the demand for which is $p = 1 - x_1 - x_2$, where p is price and x_i is firms i's output. Moreover, suppose the two firms are equally efficient and unit production costs are constant, so that they can be normalized to zero. Some standard calculations, along the lines indicated for example in Dixon and Somma (2003), show that under the above demand and cost assumptions, and symmetric conjectural variations, the challenger's duopoly profits if successful in the possible trial are given by

$$\pi_{2d} = \frac{1-\lambda}{(3-\lambda)^2}, \quad (5)$$

where λ is the conjectural variation parameter. By varying λ from 0 to 1 the intensity of competition increases. In particular for $\lambda = 0$ the two firms are Cournot rivals, while $\lambda = 1$ corresponds to Bertrand competition.

3.1. Retroactive licenses

What happens when the two firms are Bertrand competitors ($\lambda = 1$) is easy to understand. Since in this environment duopoly profits are zero, for all positive θ and D the condition $\theta D > (1-\theta)\pi_{2d}$ is fulfilled, so that for all positive θ and D we have $r^* = r_m$. If, notwithstanding this, the challenger had entered the market (perhaps because before the dispute had reached the crucial stage it optimistically believed that the probability of infringement was zero) the patent dispute will be settled with a retroactive license agreement, that is with the challenger exiting the

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[3] As r^* increases the sum $\pi_1(r) + \pi_2(r)$ approaches π_m. The condition $\pi'_1(r) + \pi'_2(r) > 0$ follows.

market after paying the patent holder a fixed fee to avoid a lawsuit for past infringement. When, by contrast, the challenger had anticipated the event, it will have stayed out of the market from the outset.

Proposition 2. Suppose the two firms are potential or actual Bertrand rivals in a homogeneous product market. Then, from the outset or after settlement the incumbent will enjoy full monopoly power even when the patent strength θ is close to zero.[5]

That is to say, under Bertrand competition consumers are always better off with litigation.

3.2. Forward looking licenses

When the two firms compete less fiercely than in the Bertrand case, that is when $\lambda < 1$, the challenger's duopoly profits π_{2d} are positive. Then, only some constellations of past infringement damages D, patent strength θ, and intensity of competition λ allow the patent holder to impose a retroactive license agreement. Moreover, as λ approaches 0, the conditions required for this kind of settlements become more and more stringent in terms of patent strength and damages.

If the patent holder cannot impose a retroactive license agreement, that is if $\theta D < (1 - \theta)\pi_{2d}$, it must be content to settle the patent dispute with a forward-looking license which allows the challenger to stay on the market. However, even in these cases the patent settlement may harm consumers. We first study the role of damages.

Proposition 3. Suppose the two firms compete with intensity $\lambda < 1$ and $\theta D < (1 - \theta)\pi_{2d}$. Then, there exists a D_* such that in the interval $D^* < D < (1 - \theta)\pi_{2d}/\theta$ the forward-looking licensing agreement settling the patent dispute leaves consumers worse off than under litigation.

Proof. By definition, $\pi_1(r) = x_1(1 - x_1 - x_2) + rx_2$ and $\pi_2(r) = x_2(1 - x_1 - x_2) - rx_2$. Under symmetric conjectural variations profit maximization requires $1 - 2x_1 - x_2 + \lambda x_1 - \lambda r = 0$ and $1 - x_1 - 2x_2 + \lambda x_2 - r = 0$. At this point, some tedious algebra yields.

$\pi_2(r) = (1 - \lambda)(1 - 2r)^2/(3 - \lambda)^2$, that is, by using Eq. (5), $\pi_2(r) = \pi_{2d}(1 - 2r)^2$. So, when $\theta D < (1 - \theta)\pi_{2d}$ Eq. (1) gives

$$r^* = \frac{1 - \sqrt{1 - \theta - \theta D/\pi_{2d}}}{2}. \tag{6}$$

Then, as D approaches $(1 - \theta)\pi_{2d}/\theta$ from below the royalty rate r_* settling the patent dispute approaches $r_m = 1/2$. On the other hand, since $S(r_m) = S_m$, the royalty rate $\hat{r}$ which leaves consumers as well off under the settlement as under litigation must be strictly smaller than 1/2, and for $r^* > \hat{r}$ the gains from settlement to consumers are negative. The statement follows immediately. □

Obviously, for given past infringement damages D and patent strength θ, the condition, $\bar{D} < D$, under which the lack of a court decision harms consumers irrespective of
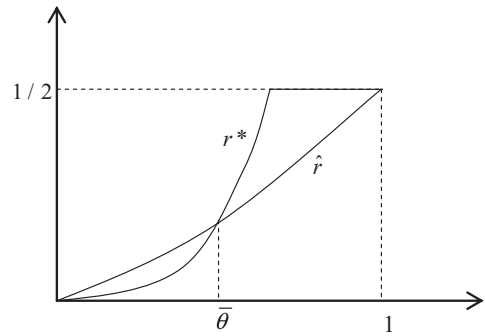
Fig. 1. Patent strength and royalty rates.

the nature of settlement, is the more likely fulfilled the greater the intensity of competition λ. More precisely, some algebra shows that under Cournot competition

$$\bar{D} = \frac{1 - \theta - (\sqrt{16 - 7\theta} - 3)^2}{9\theta}$$

Starting from this benchmark, $\bar{D}$ decreases toward zero as λ increases toward one (Bertrand competition).

Let us now consider the role of patent strength. The following proposition holds.

Proposition 4. Suppose the two firms compete with intensity $\lambda < 1$ and $\theta D < (1 - \theta)\pi_{2d}$. Then, if $D > 0$ in the interval $(0, \pi_{2d}/(\pi_{2d} + D))$ there exists a $\bar{\theta}$ such that for $\theta \in (\bar{\theta}, \pi_{2d}/(\pi_{2d} + D))$ the forward-looking licensing agreement settling the patent dispute leaves consumers worse off than under litigation.

Proof. Some calculations yield

$$S(r) = \frac{(2 - (1 + \lambda)r)^2}{2(3 - \lambda)^2}.$$

Since $S_m = 1/8$ and $S_d = 2/(3 - \lambda)^2$, from $S(\hat{r}) = \theta S_m + (1 - \theta)S_d$ we obtain

$$\hat{r} = \frac{4 - \sqrt{16 - 16\theta + (3 - \lambda)^2\theta}}{2(1 + \lambda)}. \tag{7}$$

Then, as θ approaches 1, the royalty rate $\hat{r}$ that leaves consumers indifferent between settlement and litigation approaches $r_m = 1/2$. On the other hand, from Eq. (6) the royalty rate r_* settling the patent dispute approaches $r_m = 1/2$ for θ approaching $\pi_{2d}/(\pi_{2d} + D) < 1$. So, for some θ high enough $r^* > \hat{r}$. □

Fig. 1 illustrates a possible situation.

4. Comments

Proposition 2 shows that if Bertrand competition prevails, in a homogeneous product environment the amount of damages and the patent strength, provided they are positive, are not relevant: the patent holder is able to capture monopoly profits even if damages D and the probability θ are arbitrarily small (but still greater than zero). Under this type of duopolistic competition, consumers' losses from the lack of a ruling on patent infringement are at the maximum level for any given patent strength, and they

are greater the weaker the patent involved. In particular, some calculations show that under our assumptions on demand and costs, consumer losses, in percentage of expected consumer surplus from litigation, approach 0.52 as θ approaches zero.

This suggests that, as Farrell and Shapiro (2008) stressed in another context, there may be large social benefits from expanding post-grant reexamination of issued patents covering valuable technologies that are useful to actual or potential challengers, thus reducing the number of weak patents which unduly restrict market competition.

In turn, Propositions (3) and (4) say that for any given intensity of competition lesser than Bertrand, the lower the challenger's expected returns from litigation, the more likely litigation is preferable to settlement from the consumers' point of view. In other words, consumers benefit from settlement only when the patent strength or damages are low enough to render the litigation option not so unattractive for the challenger.

Conversely, for higher damages or patent strength, litigation becomes more hazardous for the challenger, allowing the patent holder to extract a royalty rate high enough to reduce consumer surplus below the level expected from the final verdict by court, even if a retroactive-license agreement is not feasible and the challenger continues to stay on the market.

Finally, it is worth stressing that the threat of punitive damages, by reducing the challenger's return from litigation, may drastically restrict competition even when the involved patent is very weak and a retroactive-license agreement is not feasible.[6] As a policy implication, it follows that that awarding "pure" lost profits as damages may suffice to preserve the right incentive to innovate, thus benefiting consumers in the short run (the settlement would provide for a lower royalty rate) without harming society in the long run.

4.1. Litigation costs

Our framework, as Shapiro's (2003), leaves out litigation costs. This exclusion needs to be justified, as it might seem crucial for our results. As a matter of fact, although in our setting litigation costs would have some quantitative effects, from a qualitative point of view our assumption is innocuous. This is because litigation costs play the same role as damages: for the alleged infringer expected costs of litigation amount to the sum of expected damages θD and litigation costs in a strict sense L_2. So, for $\theta D + L_2 < (1 - \theta)\pi_{2d}$ the royalty rate settling the patent dispute solves $\pi_2(r^*) = \theta(-D) - L_2 + (1 - \theta)\pi_{2d}$. The unique consequence is that with positive litigation costs consumer are more likely better off with litigation.

4.2. Pay-for-delay settlements: a comparison

A very simple model of settlements specifying the date of entry can help to link our results to the debate on pay-for-delay agreements in pharmaceutical industries (see Shapiro, 2003). Assume for simplicity, as before, that disputes are resolved by litigation or settlement at date $t = 0$ without further time or money costs. If we call $t = 1$ the expiration date of the patent and $t = \tau$ the negotiated date of entry, expected consumer surplus from settlement is $\tau S_m + (1 - \tau)S_d$. Comparing this outcome with consumer surplus under litigation, $\theta S_m + (1 - \theta)S_d$, we can immediately conclude that if $\tau > \theta$, in this model consumers are better off under litigation. On the other hand, it can be easily proven that there is little reason to expect firms to find the entry date $\tau = \theta$ mutually attractive (Shapiro, 2003). A settlement specifying a date of entry becomes mutually attractive for risk neutral firms only if the patent holder makes a money transfer to the generic challenger, in exchange for accepting an entry date $\tau > \theta$.

This does not imply that all pay-for-delay settlements are necessarily anticompetitive: in the presence of risk aversion and asymmetric information cash payments from the patent holder to the challenger may be important in reaching agreement that benefit consumers (Willig and Bigelow, 2004). However, the above arguments seem to furnish sound economic basis for the recent Supreme Court opinion that pay-for-delay settlements are subject to antitrust scrutiny and should be analyzed case by case (*F.T.C. v. Actavis, Inc.*, 2013).

Our results suggest that the implications stemming from the Supreme Court decision concerning pharmaceuticals should be appropriate for settlements in other sectors where pay-for-delay agreements are not usual.[7] In particular, antitrust scrutiny should be extended to settlement agreements implying per unit royalties, but not a lump sum transfer from the challenger to the incumbent for probabilistic damages θD.

In order to prove that a settlement with a positive fixed fee equal to θD is pro-competitive, let us consider the challenger's participation constraint with $F = \theta D$, that is to say $\pi_2(r) = (1 - \theta)\pi_{2d}$. Then Eqs. (6) and (7) become

$$r^* = \frac{1 - \sqrt{1 - \theta}}{2} \quad \text{and} \quad \hat{r} = \frac{4 - \sqrt{16 - 16\theta + (3 - \lambda)^2\theta}}{2(1 + \lambda)}$$

Some further calculation shows that for all θ smaller than 1, $r^* < \hat{r}$: consumers always benefit from settlement. The extension of antitrust scrutiny from pay-for-delay settlements in the pharmaceutical sector to settlements involving damage forgiveness in other markets might bear relevant pro-competitive effects.

5. Conclusion

By using a very simple model of patent settlement, we show that a licensing agreement to settle a patent dispute

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[6] The U.S. law holds that if the infringement is deemed willful, damages can be increased up to three times the amount assessed (35 U.S.C. Section 284).

[7] The frequent resort to pay-for-delay agreements in the pharmaceutical sector seems due to some legislative innovations introduced by the 1984 Hatch-Waxman Act (Hovenkamp, 2014). Particularly relevant are the rules governing the commercializing of new products requiring: (1) a minimum of 45 days during which the patent holder may file suit in court, (2) a 30-month stay of the Food and Drug Administration's approval of the generic product whenever a patentee sues an infringer, and (3) a 180-day exclusivity period benefiting the first generic entrant once the patent expires or is found invalid.

can harm consumers in comparison with the expected outcome of the lawsuit. This may occur when the challenger's expected return from litigation is low, that is when probabilistic damages are high relative to the challenger's expected profits from competing on the same technological footing with the incumbent. In these circumstances, the royalty rate proposed by the patent holder in its take-it-or-leave-it licensing offer may be so high as to drive the consumer surplus from settlement below the expect surplus from litigation.

If the two firms are Bertrand competitors selling a homogeneous product, the patent holder can act as a monopolist whatever the strength of its patent. This is due to the fact that under this kind of competition the threat of probabilistic liability forces the challenger to stay out of the market even if the probability of patent infringement is close to zero. In this case, consumers suffer the highest possible losses from the lack of a decision on patent infringement. Since consumers' losses are very relevant when the patent involved is weak, our model suggests that there may be large benefits to reap from "better examining commercially significant patents" in circumstances other than those identified by Farrell and Shapiro (2008, p. 1361).

Even when the intensity of market competition is less than in the Bertrand case, there are situations in which consumers would prefer that the two firms resolve the dispute in court. This occurs when a retroactive-license agreement is feasible, but also under forward-looking licenses when involved patents are strong and/or damages at stake are large. In particular, for relatively weak patents there exist damage levels so high as to reduce consumer surplus from settlement below expected surplus from litigation. So, the model predicts that the threat of punitive damages, allowing the incumbent to extract a royalty rate higher than that which would have been accepted by the challenger under a "pure" lost profit rule, may negatively affect consumers' welfare, perhaps in circumstances where awarding lost profits would be enough to ensure the right incentive to innovate.

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