Chapter 85

PATENT SETTLEMENT AGREEMENTS

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Various commentators have argued that while agreements in settlement of patent litigation are generally procompetitive, they can harm consumers if they include so-called "reverse payments" from the incumbent patentee to the would-be entrant. Therefore, they suggest, settlements that include reverse payments should be condemned. We show that this proposed filter is not particularly useful: in fact, settlement agreements that include such terms are not necessarily anticompetitive. Moreover, seemingly innocuous agreements—i.e., ones that exclude such terms—may well turn out to be anticompetitive and to harm consumers.

1. Introduction

The interface between antitrust and the laws governing intellectual property presents interesting and challenging questions to students, practitioners, and policy makers alike. The analysis of agreements that firms enter into in order to settle patent disputes, in particular, has a rich history in the antitrust literature, including the *Antitrust Guidelines for the Licensing of Intellectual Property*,[1] numerous scholarly articles,[2] and important recent court decisions.[3] Not surprisingly, as thinking on the subject has evolved, ideas about what constitutes anticompetitive patent settlements have evolved as well.

In this chapter, we demonstrate that the competitive effects of settlement agreements may not be as obvious as they seem: apparently anticompetitive agreements may actually benefit consumers, while seemingly innocuous or beneficial settlements may harm consumers. In Section 2 below, we consider one example of the former type of settlement, one that includes a so-called "reverse payment" from the incumbent patentee to the would-be entrant. While some commentators suggest that such settlements are presumptively anticompetitive, we show that such a general presumption is invalid. In Section 3, we consider examples of licensing agreements that seem to have beneficial (or, at worst, neutral) effects on consumers; we demonstrate that they may in fact harm consumers.

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1. U.S. DEP'T OF JUSTICE & FEDERAL TRADE COMM'N, ANTITRUST GUIDELINES FOR THE LICENSING OF INTELLECTUAL PROPERTY (1995), *reprinted in* 4 Trade Reg. Rep. (CCH) ¶ 13,132.
2. *See, e.g.*, Marc G. Schildkraut, *Patent-Splitting Settlements and the Reverse Payment Fallacy*, 71 ANTITRUST L.J. 1033 (2004); Carl Shapiro, *Antitrust Limits to Patent Settlements*, 34 RAND J. ECON. 391 (2003); Robert D. Willig & John P. Bigelow, *Antitrust Policy Toward Agreements that Settle Patent Litigation*, ANTITRUST BULL. 655 (2004); Robert Kneuper, *Four Economic Principles Underlying the FTC's Position Against Reverse Payments in Patent Settlement Agreements*, ANTITRUST SOURCE (Jan. 2006), www.antitrustsource.com.
3. See, among others, the Eleventh Circuit's decision in *Schering-Plough Corp. v. FTC*, 402 F.3d 1056 (11th Cir. 2005), and the Supreme Court's denial of the FTC's petition for certiorari, 126 S. Ct. 2929 (2006).

2. Reverse payments need not be anticompetitive

In recent years, the Federal Trade Commission (FTC) and various economic and legal commentators have argued that settlement agreements that include reverse payments are inherently anticompetitive and should be condemned. In this section, we demonstrate that such blanket condemnations are unwarranted.

2.1. A proposed litmus test for anticompetitive settlements

The FTC, in its enforcement actions, publications, and public statements, has endorsed a "bright line" litmus test under which any settlement that incorporates a so-called reverse payment—i.e., a payment by the patentee to the alleged infringer—"raises a red flag . . . and mandates a further inquiry."[4] While this approach has not been universally accepted, other commentators have apparently endorsed it.[5]

The FTC's position appears to be that the following three-step test is sufficient to determine whether an agreement that settles a patent infringement case is anticompetitive: (1) Does the patent holder (plaintiff) have monopoly power? (2) Is there a threat to that monopoly power? and (3) Is there a payment to the potential entrant (defendant) to delay entry by the defendant?[6] If the answer to all these questions is

4. Schering-Plough Corp., FTC Docket No. 9297, at 29 (Dec. 18, 2003) (opinion of the Commission) [hereinafter *FTC Schering Opinion*]. In an earlier filing in that case, the FTC stated, "[Respondents] never directly respond to our contention that paying a potential competitor to accept an entry date is a payment not to compete and presumptively anticompetitive." Reply Brief in Support of Complaint at 26, *available at* http://www.ftc.gov/os/adjpro/d9297/index.shtm. According to the Commission's opinion in the case, "Complaint Counsel made an alternative argument that the settlement agreements in issue should be characterized as either *per se* illegal or presumptively anticompetitive. Translated into the terms of the structure outlined above, their claim was that the nature of the restraint is sufficiently troublesome to obviate specific proof of market effects." *FTC Schering Opinion* at 12 (footnote omitted). In 2000, David Balto, then Assistant Director of the Office of Policy and Evaluation in the FTC's Bureau of Competition, wrote, "Typically in patent infringement cases the payment flows from the alleged infringer to the patent holder. A payment flowing from the innovator to the challenging generic firm may suggest strongly the anticompetitive intent of the parties in entering the agreement and the rent-preserving effect of that agreement." David Balto, *Pharmaceutical Patent Settlements: The Antitrust Risks*, 55 FOOD & DRUG L.J. 321, 335 (2000) (footnote omitted). In a recent speech, Jon Leibowitz expressed concern about what he called "exclusion payments." Jon Leibowitz, FTC Commissioner, Exclusion Payments to Settle Pharmaceutical Patent Cases: They're B-a-a-a-ck!, Remarks at the Second Annual In-House Counsel's Forum on Pharmaceutical Antitrust (Apr. 24, 2006).

5. For varying degrees of endorsement, see, e.g., Keith B. Leffler & Cristofer I. Leffler, *Want to Pay a Competitor to Exit the Market? Settle a Patent Infringement Case; An Argument for Per Se Condemnation of Payments by the Patent Holder*, ECON. COMM. NEWSL. (ABA Section of Antitrust Law), Spring 2002, at 26-35; Merril Hirsh & Dan Zoloth Dorfman, *I Didn't Say Orphan Often: The Benefits of a Bright-Line Rule Barring Brand to Generic Payments in Hatch-Waxman Patent Settlements*, 19 ANTITRUST HEALTH CARE CHRON. 2 (Summer 2005); and Thomas F. Cotter, *Antitrust Implications of Patent Settlements Involving Reverse Payments: Defending a Rebuttable Presumption of Illegality in Light of Some Recent Scholarship*, 71 ANTITRUST L.J. 1069 (2004).

6. This three-part test stems from the testimony of Professor Timothy Bresnahan, the FTC's economic expert in its proceedings against Schering-Plough and its correspondents. *See FTC Schering Opinion*, at 15. Addanki, who served as the economic expert for Schering-Plough, addressed these and other issues in his expert report, which was filed in September 2001.

affirmative, the FTC asserts that the agreement must be anticompetitive, that it would necessarily make consumers worse off than they could have expected to be had the matter been resolved through litigation.

The proposed test is defended as follows. To begin with, the FTC argues that the appropriate measure of any "anticompetitive effect" of a given settlement agreement is the amount of time by which it delays entry relative to alternative settlements or litigation, because consumers are better off the sooner the entrant enters the market.[7] The FTC then argues that settlements that involve payments from the patentee to the alleged infringer are necessarily anticompetitive, because, if the parties could reach a settlement without a side payment, the settlements reached with side payments are "more anticompetitive," i.e., result in later entry, than the settlement that those same parties would have reached otherwise.[8]

On the other hand, the argument goes, when payments are necessary for settlement even to be feasible, such payments in the "wrong" direction, from incumbent to entrant, lead to outcomes "more anticompetitive"—i.e., later entry dates—than either party expects under litigation. This conclusion rests on the following argument: Suppose for simplicity that the litigation has reached a stage where discovery is complete, so that the parties have learned all that they could expect to learn prior to trial about their odds of winning at trial; suppose further that both parties agree that each one's probability of prevailing in the litigation is roughly 50 percent. Then each party expects that, if they continued to litigate, the probability that the defendant will prevail and entry will occur virtually immediately is 50 percent, while the probability that the patentee will prevail and entry will be delayed until expiration of the patent is also 50 percent.[9] Therefore, the argument goes, the "expected" time to entry under litigation (i.e., the probability-weighted average of the two entry dates under the two alternative outcomes) is approximately one-half of the term remaining on the patent.[10] Any settlement that results in an entry date *later* than this benchmark would then be deemed anticompetitive.

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7. This formulation is not strictly correct; risk aversion and discounting (the economic reality that a dollar today is worth more than a dollar payable in the future, even setting aside inflation), among other things, mean that a "date certain" entry four years in the future, for instance, is not equivalent, from the consumer's standpoint, to a lawsuit under which the expected outcome is an entry date four years into the future. It is certainly entirely possible to incorporate these features into an economic model, but we have not done so here, because their inclusion greatly complicates the exposition without materially changing our qualitative results. In any event, much of the public debate has been framed (simplistically) in terms of entry dates.

8. "The issue of exclusion payments has been the subject of significant debate, but the Commission's position is clear. Where a patentholder makes a payment to a challenger to induce it to agree to a later entry than it would otherwise agree to, consumers are harmed *either* because a settlement with an earlier date might have been reached, *or* because continuation of the litigation without settlement would yield a greater prospect of competition." *Barriers to Generic Entry: Hearing Before the Sen. Special Comm. on Aging*, 109th Cong. 18 (2006) (statement of FTC) (footnote omitted).

9. For simplicity of exposition only, we assume that the outcome of the trial will be made known relatively quickly, so that, should the alleged infringer prevail, its entry would not be subject to any additional delay.

10. For instance, if the patent has eight years to run, the probability of instantaneous entry is 50%, but the probability that entry would be deferred for eight years is also 50%, so the expected time to entry under litigation is four years (50% probability of zero and 50% probability of eight years).

The argument further holds that if the parties agreed that their respective odds of prevailing were 50 percent each, neither side would agree, absent side payments, to any settlement that specified an entry date different from this benchmark date; the patentee, according to this view, would accept no date earlier than the benchmark, whereas the entrant would accept no date later than the benchmark, each party reasoning that it could expect to do at least as well should it pursue the litigation to its conclusion. Therefore, the argument for the proposed test concludes, any payment from patentee to entrant must necessarily be a "bribe" to persuade the entrant to delay its entry.[11]

2.2. The proposed test cannot be used to identify anticompetitive settlements

One crucial flaw in this chain of reasoning lies in the assertion that the patentee would not settle for an entry date earlier than the benchmark (i.e., the expected, or probability-weighted average, date of entry under litigation). The logical flaw stems from the implicit assumption that the patentee would view a *date certain* entry of, say, four years in the future as exactly equivalent to engaging in litigation whose *expected* entry date is also four years in the future (because, for example, it offers equal odds of entry today or entry eight years hence).

The problem with this assumption is that it is frequently violated in practice. There are many sound economic reasons why a patentee may be willing to settle for an entry date earlier than that expected under litigation. Among these are risk and people's attitudes toward risk. Economists have long understood that most individuals are "risk averse," in that they value outcomes that are inherently uncertain less than outcomes that can be known with certainty. Everyday experience is replete with examples. Companies whose fortunes are more risky have to offer higher *expected returns* to their investors than do companies that are less risky. The interest rates on corporate bonds reflect the same reality: companies whose prospects are regarded as more risky (and whose ratings by bond rating services like Moody's reflect that assessment) have to offer higher interest rates in order to attract investor interest than do companies that are regarded as less risky.

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11. According to Carl Shapiro, for example:

> Consumers benefit from a negotiated entry date *t* if and only [if] *t* [is earlier than the entrant's expected date of entry under litigation]. Assuming that duopoly profits are less than monopoly profits, however, there is little reason to expect the firms to find such entry dates mutually attractive. If the firms are risk neutral, a reasonable assumption for large, publicly traded firms if not individual managers at those firms, and ignoring litigation costs, there are simply no gains from settlement under these conditions when the only available instrument is the entry date . . . . To the extent that the patentholder believes the patent is stronger than does the challenger, settlement is made even more difficult, as the patentholder will insist on a later entry date and the challenger will not agree to wait so long to enter.
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> In this simple model, a naked cash payment flowing from the patentholder to the challenger (in excess of avoided litigation costs) is a clear signal that the settlement is likely to be anticompetitive. Presumably, the patentholder would not pay more than avoided litigation costs unless it believed that it was buying later entry than it expects to face through the litigation alternative.

Shapiro, *supra* note 2, at 407-08.

The immediate implication, of course, is that an individual who is risk averse might well be willing to sacrifice some portion of his expected return from a venture, if, in exchange, he could reduce the uncertainty associated with that venture. A patentee who has built a substantial business around a patent is very likely to be risk averse in exactly that fashion: when choosing between a settlement and pursuing litigation to its final outcome, the patentee would recognize that the nonzero probability associated with "losing it all" creates very real risk, regardless of the expected value associated with litigation. If, as in our example above, the expected date of entry associated with litigation were four years (equal likelihood of immediate entry or entry after eight years, upon patent expiration), the risk averse patentee would be willing to sacrifice some of that expected value in exchange for reducing the uncertainty attendant upon litigation. In other words, the risk averse patentee would be willing to settle for entry by the would-be entrant at a date certain *earlier* than the expected date under litigation. In effect, the patentee's risk aversion could make the settlement more favorable to consumers than the expected outcome under litigation.

Of course, such a settlement could also be attractive to the entrant, because it would permit entry sooner than might have been expected under litigation. The problem is that the would-be infringer may well also find that its liquidity position does not permit it to "wait out" the period until that entry date. In other words, while attractive, the settlement may not be feasible for the entrant without some sort of cash infusion that would help it to survive until the entry date at issue (even though that date is earlier than the expected date of entry under litigation). In this situation, the only path to a settlement could well be one in which the patentee provides such a cash infusion. Without the infusion, even though the patentee would be willing to entertain a definite entry date earlier than the expected outcome of litigation, that earlier date would remain infeasible for the entrant. Any date that the entrant would regard as feasible (absent the cash infusion) would be too early for the patentee to accept, given its odds of prevailing in the lawsuit (even allowing for risk aversion). Thus, the only alternative to the settlement with a cash payment might, in fact, have been litigation.

Note that this does *not* mean that the resulting date of entry would be later than the expected outcome of the litigation. In fact, the date agreed upon by parties—even with the cash payment—may well be *earlier* than the date that might be expected under litigation. That, of course, is the crucial question: is the entry date specified in the settlement earlier or later than the benchmark entry date that might be expected under litigation? In this example, whether it is earlier than the benchmark date depends upon the degree of risk aversion of the patentee, the amount of the payment required and the returns that each party expects to earn under the alternatives.[12]

The proposed test, therefore, is inappropriate as a litmus or bright line test. Its critical assumption that the patentee would never agree to a settlement that embodied an entry date earlier than the date that might be expected under litigation is fundamentally

12. As Shapiro notes, "This is not to say that such payments [from the patentholder to the challenger] are necessarily anticompetitive if other factors are brought into the analysis, such as risk aversion and asymmetric information about market conditions, as 'reverse cash payments' may be important in more complex settings for successful settlement." Shapiro, *supra* note 2, at 408 (footnote omitted).

invalid. The invalidity of this underlying assumption, of course, necessarily nullifies the proposed test. Moreover, the risk aversion discussed above represents only one of several possible reasons why the test's key underlying assumption could easily be invalid. For instance, the patentee might simply be unduly pessimistic about its case; the judge or magistrate may have placed particular pressure on the patentee to settle; or litigation costs, including out-of-pocket costs as well as the significant opportunity costs that litigation imposes on senior management time and attention, could be a factor. There are certainly other reasons as well why the assumptions may be violated.[13] Therefore, contrary to the arguments made by proponents of the litmus test, agreements that provide for payments from the patentee to the entrant *could*, in fact, be procompetitive.[14]

3. Agreements without reverse payments may be anticompetitive

Just as reverse payments may have procompetitive effects, license agreements with payments flowing from the licensee to the licensor may have anticompetitive effects. Thus, the direction of the flow of payments will not, in and of itself, indicate the effect of the agreement on customers.

3.1. A seemingly innocuous license agreement

In the last section, we demonstrated that license agreements that embody reverse payments from patentee to alleged infringer may, in fact, be procompetitive, so that the bright line test for anticompetitive agreements does not work. Unfortunately, the obverse does no better: license agreements that appear perfectly normal—with royalties flowing in the "right" direction—may, nevertheless, be anticompetitive in their effect: they may lead to market outcomes that are inferior, from the standpoint of customers, to the expected outcomes of litigation.[15]

First, however, consider the following agreement, reached in settlement of patent litigation between Patco (the patent holder) and Mitou (an alleged infringer): Mitou will pay Patco 14 percent of its net revenues in royalties each year. If Mitou's net sales exceed $100 million in any year, in recognition of the marketing and market development efforts undertaken by Mitou, it will earn a credit of $10 million against its royalty obligations that year, reducing its net payment by that amount. Is there anything about this agreement that could raise antitrust concerns?

Certainly, on its face, this seems like an eminently procompetitive settlement: Mitou will enter the market right away; the royalty rate is not obviously overly onerous; and, moreover, by rewarding Mitou for beating certain sales goals, the agreement seems to

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13. Among other things, there might be antitrust counterclaims that would be disposed of concurrently with the patent litigation, which could bear on the parties' incentives to settle.
14. Appendix A provides an analytical development of this point.
15. For a discussion suggesting that it is not obvious what the "correct" direction is for payments to flow in patent settlements, see Daniel A. Crane, *Exit Payments in Settlement of Patent Infringement Lawsuits: Antitrust Rules and Economic Implications*, 54 FLA. L. REV. 747, 769-76 (2002). *See also* Kevin D. McDonald, *Patent Settlements and Payments that Flow the "Wrong" Way: The Early History of a Bad Idea*, 15 ANTITRUST HEALTH CARE CHRON. 2 (Winter 2002).

provide explicit incentives for increasing output. Could an antitrust enforcer ask for more?

Unfortunately, things are not quite so simple. In fact, this seemingly benign, apparently procompetitive agreement may actually be quite the opposite! It may actually be *worse* from the standpoint of customers than the expected outcome of litigation.[16]

3.2. Understanding the parties' incentives

To see why, it is helpful first to understand the economic incentives facing the three interested parties—patentee, potential entrant, and customer—under the alternative scenarios of continued litigation and settlement via a license. To keep things simple, assume for now, as before, that litigation would be instantaneous and costless and that the probability that the patentee will prevail is known in advance by both parties. In other words, there is no disagreement about the odds of the outcomes and we do not need to concern ourselves with delays due to discovery, appeals and the like.

In this stylized world, litigation could yield two possible outcomes: first, the patentee could prevail, which we will further assume means that for the remaining life of the patent, the patentee will preserve its "monopoly," in that no further entry will occur; second, the alleged infringer could prevail, in which case entry would occur instantaneously to provide competition to the patentee. Should the patentee prevail, the would-be entrant gets nothing for its trouble, and the patentee retains its pretrial profitability. Should the patentee lose, entry occurs immediately, and the entrant and patentee share the market opportunity. Litigation, therefore, represents a lottery with two possible outcomes; the value of the lottery to each firm is simply the mathematical expected value—the probability-weighted average—of the values of the two outcomes.

Finally, what about the effects on the customer? The customer—like the would-be entrant—benefits from entry, although the benefits garnered by the customer are not the same as the profits that will be earned by the entrant. However, the expected value of the litigation outcome from the customer's standpoint is calculated using the same principles: it is simply the probability-weighted average of the two possible market price/quantity outcomes that could result from litigation.

Let us turn now to the alternative scenario, in which the patentee licenses the would-be entrant for immediate entry in exchange for running royalty payments. This scenario differs from the litigation alternative—for each of the three parties—in two key respects. First, there is no longer any uncertainty, so there is no need to weight outcomes by the probability of their occurrence. Rather, the definite outcome is that entry will occur, the market opportunity will be shared by patentee and entrant, and the customer will enjoy the benefit of the competition between them. The second important difference is that, unlike the litigation outcome in which the patentee loses, competition between patentee and entrant—and, hence, the market outcome of that competition—will be fettered somewhat by the royalty payable by the entrant to the patentee. That is because the royalty will, in effect, represent additional *variable* cost to the entrant: each additional unit sold by the entrant will result in added costs to the entrant, who now incurs

16. *See* Appendix B for analytical details.

production and distribution costs *as well as* the additional royalty obligation engendered because of that unit.

These added costs impair the competitiveness of the entrant, to the patentee's benefit. The direct effect of this diminished competitiveness is that market prices will be higher—and market quantities lower—than if the entrant were unhindered by any ongoing royalty obligations. All else equal, the higher the royalty rate, the greater will be the additional cost imposed on the entrant, and the higher the resulting market price. Again, the effect on the customer, while quantitatively distinguishable from the effect on the entrant, moves in the same direction. Note that the royalty rate of interest is the one that would apply to an additional unit that the licensee might contemplate producing; it is the *incremental* royalty rate that counts in influencing the licensee's behavior and, hence, market price and quantity.

To sum up, litigation can result in two outcomes—the patentee's prevailing and retaining its "monopoly" or the patentee's losing and facing unfettered competition from the alleged infringer—and the value of this litigation "lottery," to patentee, would-be entrant, and customer alike, is simply the probability-weighted average of the value that each party realizes under the alternative outcomes. Settlement via a license, in contrast, results in immediate entry and competition by the entrant, although that competition (and its resulting impact on patentee and customer) is somewhat attenuated by the added cost that the license imposes on the entrant.

3.3. Impact of the parties' incentives on the feasibility, private value, and public value of settlement

Armed with this understanding of the parties' incentives, we are ready to explore the circumstances under which settlements are feasible, and then to assess whether feasible settlements will necessarily inure to the benefit of the customer. In what follows, for simplicity, we will focus on potential agreements under which the licensee (alleged infringer) pays a running royalty to the licensor (patentee) and exclude complications such as lump sum payments (in either direction), cross-licenses, and other trappings that may well come into play in real life.

The condition under which a given license agreement is feasible is simple enough to state: an agreement is feasible if it offers the litigants—patentee and alleged infringer alike—an alternative that each prefers to continued litigation. We assume, moreover, that a party will prefer the settlement agreement if that party's total profits under the agreement are no lower than the mathematical expectation (the probability-weighted average) of the value of litigation.[17]

Let P represent the probability that the patentee prevails in the lawsuit, let $PROFIT_{DE}$ represent the entrant's profit under a pure duopoly (i.e., the situation in which the parties do not settle and the patentee loses the lawsuit), let $PROFIT_{DP}$ represent incumbent patentee's profit under the same scenario, and let $PROFIT_{MP}$ represent the patentee's profit in the event that it wins the lawsuit and retains its patent monopoly. Finally, let R

17. In other words, we will not deal with the possibility that one or both parties may be risk averse. Adding that feature does not change the basic outcome or conclusions of the model considered here, but it does needlessly complicate its exposition.

denote the royalty payment under the settlement, and let $PROFIT_{LE}$ and $PROFIT_{LP}$ represent profits that the entrant and patentee, respectively, earn under the license agreement, prior to any royalty payments. Feasibility then requires the following:

$$PROFIT_{LE} - R > (1 - P)* PROFIT_{DE}$$

and

$$PROFIT_{LP} + R > P * PROFIT_{MP} + (1 - P)* PROFIT_{DP}$$

The first of these simply states that the profit earned by the entrant/licensee, after paying its royalty obligations, has to exceed the expected value to the entrant of the litigation alternative—the profits that it would earn as an unfettered duopolist weighted by the probability that it would attain that state. The second is the corresponding condition for the patentee/licensor: its profits plus its royalty receipts must exceed *its* expected value of litigation—the value of a victory weighted by the probability of that outcome *plus* the correspondingly weighted value of a litigation loss.[18]

Examination of these feasibility conditions yields some useful insights. In particular, the test for feasibility is a *total profit* test for each party. In other words, if a license agreement yielded each party total profits that exceeded what that party could expect to get under the litigation alternative, that agreement would be feasible and plausible, *regardless of the incremental royalty rate it contained.* But recall from the last section that the licensee's incentives to expand (or contract) its output are determined by the *incremental* royalty rate that it faces, not the total royalty obligation engendered by the license.

There is no reason, therefore, to suppose that a license agreement that satisfies the parties (because it meets the total profit criterion that each party's total profits are at least as great as it could expect under litigation) would create the appropriate incentives for the licensee to expand its output enough to make the licensing outcome superior—from the customers' standpoint—to continued litigation. And that, indeed, is why the agreement between Patco and Mitou may, in fact, be less competitive—and therefore less beneficial to customers—than continued litigation. Because the agreement allows a lump-sum reduction in Mitou's royalty obligation to Patco, it embodies a higher incremental rate than would license terms that offered the same *total* royalty obligation but with no credit or lump-sum reduction.

There are, of course, other ways to effect the same divergence between the incremental royalty rate and the total royalty obligation: sliding scales, where the royalty rate increases with licensed output, and royalty "holidays" for the first portion of licensed output are but two. As one example of the latter, a settlement between Patco and Mitou might allow the entrant to sell 200 units annually royalty-free and require royalty payments of $70 per unit for any additional units sold. Under some conditions, such an agreement would reduce consumer welfare relative to the litigation alternative.[19]

Does this mean, then, that we should proscribe, as a matter of policy, license agreements that embody such terms, on the grounds that such arrangements probably

18. There is only one term on the right-hand side of the first inequality, because the would-be entrant earns no profits if it loses the litigation.

19. *See* Appendix B for analytical details.

spring from sinister motives and are likely to be anticompetitive? Unfortunately for the policy maker (but fortunately for potential litigants, because licensing terms of this type are quite commonplace), there is no such easy solution. The mere fact that the credit (or sliding scale or royalty holiday) means that the license's incremental rate can be made higher (and remain attractive to Mitou because the *total* royalty obligation is still superior to litigation) does not, in and of itself, make the license agreement anticompetitive relative to the litigation alternative; it simply creates the wedge between total and incremental royalty rates that makes such an outcome more plausible. In a variety of situations, however, depending on market demand conditions and the parties' relative cost structures, such terms may be necessary in order for there to be an agreement at all, *and* the resulting agreement may well be superior to litigation from the customers' standpoint! In other words, it would be unwise to adopt a blanket proscription on agreements that embodied such terms. Such a policy could preclude many procompetitive and beneficial agreements, resulting in more (and, from the customers' standpoint, less favorable) litigation.

4. Principled analysis requires evaluating monopoly power and litigation odds

What, then, is the correct analytical approach to deal with agreements that appear facially anticompetitive, perhaps because they include a reverse payment, or agreements that appear entirely innocuous but may depress output and elevate price relative to the expected outcome of litigation? As it turns out, the correct analytical framework for dealing with both of these problems is the same.

In many situations, the monopoly power portion of the FTC's proposed test—if properly applied—could obviate the need for further inquiry. If there is no monopoly power present, there is no need for any further inquiry; the agreement could not be anticompetitive in its effect.

Assume, however, that further analysis establishes that the patentee does have monopoly power. In that case, the appropriate test is whether customers are better off under the settlement than they would have been (in expectational terms) under litigation.[20] In evaluating a settlement agreement with a so-called reverse payment and an agreed date of entry, for example, the appropriate test is whether the settlement resulted in an agreed-upon entry date later than what might have been expected under litigation.

To establish whether or not this occurred, one must evaluate the likely outcomes of the patent case, as well as each party's odds of prevailing in litigation. These facts would help establish what the expected outcome would have been under litigation.[21]

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20. Shapiro suggests a similar approach: "I propose and explore . . . the following simple antitrust rule: a patent settlement cannot lead to lower expected consumer surplus than would have arisen from ongoing litigation." Shapiro, *supra* note 2, at 396.

21. The FTC has stated, however, that "we believe that it would not be necessary, practical, or particularly useful for the Commission to embark on an inquiry into the merits of the underlying patent dispute when resolving antitrust issues in patent settlements." Schering-Plough Corp., FTC Docket No. 9297, at 35 (Dec. 18, 2003).

The best source of information about the likely competitive effects of the settlement—relative to the litigation alternative—is likely to be found in the facts surrounding the underlying patent case itself. The objective facts elicited in the patent infringement case—presumably including findings regarding patent claim construction and the like—may constitute the best available information regarding the relative odds that each party would have prevailed in the underlying patent suit. Thus, an agreement that, say, splits the remaining patent term in half, could be viewed as relatively procompetitive if the objective facts uncovered in the litigation suggest that the expected time to entry under litigation was longer—i.e., that the patentee had a stronger case. Analogously, if the patentee had monopoly power, such a settlement might be viewed as anticompetitive if the objective facts suggested that the patentee had relatively low odds of prevailing.

Several practical points are worth noting. First, the court needs to determine the likely outcomes of the patent case and the *objective* odds that each party will prevail in the litigation, *not* the parties' *subjective* estimates of those odds. Consequently, there would generally be no need to examine privileged documents to estimate those odds. Second, it is not generally necessary to estimate those odds with tremendous precision. If the proposed settlement splits the remaining patent term in half, for example, the court need only determine if the expected time to entry under litigation would have been longer, not whether the patentee's probability of prevailing in the litigation is 0.6, 0.7, or 0.75.

In this connection, it is important to recall that the assumption underlying these discussions is that entry would be virtually instantaneous should the entrant prevail in the litigation. In actual fact, even a victory by the entrant could result in deferred entry, either because of appeals or because the entrant's entry would be delayed by the need to undertake various investments or seek regulatory approvals, among other sources of delay. In that case, the expected time to entry would exceed one-half the time remaining on the patent even if the probability of the entrant's prevailing were 50 percent. Therefore, any empirical evaluation of whether or not a given agreement involving delayed entry and reverse payments is anticompetitive requires that we inquire not only about the odds of each party prevailing, but also about the likely entry dates under alternative litigation outcomes.

Analogously, the assessment of whether a seemingly innocuous license agreement—one in which entry is immediate and the payments flow in the "right" direction—is in fact procompetitive (i.e., results in lower prices or higher consumer surplus than the expected outcome of litigation), depends on the same fact-specific investigation outlined above. If the patentee has no monopoly power, the inquiry can end. But if the patentee is found to possess monopoly power, evaluation of the competitive effects of the license vis-à-vis the litigation alternative *must* consider the likely outcomes under litigation as well as the likelihood that the patentee would have prevailed in the lawsuit.

Thus, in those situations in which a properly applied test indicates that the patentee possesses monopoly power, analysis of the competitive effects of a settlement agreement would necessarily involve an assessment of all of the pertinent facts surrounding the underlying patent case, in order to ascertain the outcomes that the case could have generated as well as the relative likelihood of each of those outcomes in litigation. Only

then could one establish whether or not the agreement resulted in an outcome that was superior—whether in terms of entry dates or in terms of prices and quantities prevailing in the marketplace—than the outcomes that might have been expected under litigation.

Although analysis of the underlying patent case is by no means trivial, other commentators—both economists and attorneys—have reached similar conclusions about the need to conduct such analysis. Carl Shapiro, for example, notes:

> I would like to highlight one key practical problem with the approach advocated and analyzed here: typically, to compare consumer surplus under a settlement with consumer surplus from ongoing litigation requires an informed judgment as to the strength of the patent(s) at issue . . . . Except in special cases . . . , there does not appear to be any way around the need to assess patent strength directly if one is trying to determine whether a settlement benefits consumers.[22]

Similarly, in an amicus brief regarding the FTC's petition for certiorari in the Schering-Plough case, the Solicitor General and the Department of Justice stated that "the mere presence of a reverse payment in the Hatch-Waxman context is not sufficient to establish that the settlement is unlawful. Rather, an appropriate legal standard should take into account the relative likelihood of success of the parties' claims, viewed *ex ante*."[23] In a footnote, the brief added, in part, "A court would not need to conduct a full trial on the merits of the patent claims in order to make a determination regarding the likelihood of a patent owner's litigation success. Rather, a court could conduct a limited examination into the relative merits of the patent claims and other relevant factors surrounding the parties' negotiations."[24]

5. Conclusion

Various commentators have suggested the use of relatively simple "red flags" (and corresponding "safe harbors") to vet proposed agreements designed to settle patent litigation. For instance, some have argued that the presence of a reverse payment from patentee to licensee should be a litmus test: agreements that embody these payments should be deemed likely to be anticompetitive, while agreements that do not can be presumed, all else equal, to be innocuous. We have examined the economic incentives facing the parties involved—patentee, licensee/entrant, and customer—and concluded that such tests are unhelpful. Agreements that involve reverse payments may, in fact, be procompetitive relative to litigation, while apparently innocuous agreements that involve no such payments may, in fact, be anticompetitive relative to the litigation alternative. There is, therefore, no substitute for closer, fact-specific analysis of the agreement and its context. This, in turn, underscores two important realities: first, the agreement cannot be anticompetitive if the patentee lacks monopoly power; second, it is difficult to assess the competitive effects of a license agreement in a vacuum. The agreement can only be evaluated relative to the expected outcome of litigation; therefore, a principled

22. Shapiro, *supra* note 2, at 397.
23. Amicus Brief for United States at 11, FTC v. Schering-Plough Corp., 548 U.S. 919 (2006) (No. 05-273).
24. *Id.* n.1.

antitrust analysis must necessarily examine the likely outcomes of the litigation alternative in some detail.

Appendix A

1. Introduction

This appendix develops a model in which an incumbent patentee (*P*) and a would-be entrant (*E*) individually decide whether to pursue patent infringement litigation brought by the patentee or settle the case without litigation by agreeing that the entrant will defer entry to some date certain in the future. In the model below, we show that there are certain values for the parameters of interest for which there is no feasible settlement that involves only an agreed-upon date of entry for *E*. For such parameter values, the latest date for entry by entrant *E* that would induce *E* to settle is earlier than the earliest date that would induce patentee *P* to settle. We show, however, that the parties *can* reach a settlement in which (1) *P* pays *E* a lump sum, (2) each party prefers to settle rather than litigate, and (3) the agreed-upon date for entry by *E* is earlier than the expected date of entry under litigation.

2. Basic assumptions and outline of the model

1. The current date is $t = 0$; the patent will expire at $t = 2T$. In all cases, after expiration of the patent (for $t > 2T$), free entry ensures that all suppliers, including both *P* and *E*, earn zero economic profits.
2. At time $t = 0$, each party decides unilaterally whether it prefers to settle or litigate.
3. Unless both parties prefer to settle, they litigate at $t = 0$; each party's probability of winning is 0.5. The decision in the litigation—unknown to the parties before they choose between settlement and litigation—is instantaneous.
4. If the parties do litigate,
    - If *E* wins the litigation,
        - — *E* enters immediately (at $t = 0$) and earns profits at a rate of π_E^D (*D* for *duopolist* and *E* for *entrant*)[25] from $t = 0$ to $t = 2T$; and
        - — *P* earns profits at a rate of π_P^D (*D* for *duopolist* and *P* for *patentee*) from $t = 0$ to $t = 2T$.

25. For the numerical examples/simulations below, we have assumed that the entrant's and the patentee's rates of duopoly profit (i.e., their rates of profit before expiration of the patent if both are selling the product) are equal. In the algebraic development of the model, however, we allow for more generality, allowing for different values of (and using different notation for) the two firms' rates of profit. The model, therefore, allows for more elaborate examples/simulations in which the duopolists' rates of profit are not equal.

- If *P* wins the litigation,
  - — *E* cannot enter until $t = 2T$. Since its economic profits will be 0 after $t = 2$T—and, by assumption, it will have to incur ongoing expenditures from $t = 0$ until $t = 2T$ to maintain its viability (see below)—*E* never enters. It "earns" profits at a rate 0, therefore, starting at $t = 0$ (just after resolution of the litigation in favor of the patentee).
  - — *P* earns profits at a rate π^m (*m* for *monopolist*) from $t = 0$ to $t = 2T$ (and 0 thereafter).

5. If the parties each prefer to settle, *E* enters at $t = t^*$.
   - *P*
     - — earns profits at a rate of π^m from $t = 0$ to $t = t^*$, and
     - — earns profits at a rate of π_P^D from $t = t^*$ to $t = 2T$ (and 0 thereafter).
     - — In addition, *P* pays *E* a lump sum payment of *B* at $t = 0$. (In the model below, *B* can, of course, be zero.)
   - *E*
     - — receives the lump sum payment of *B* at $t = 0$;
     - — "earns" profit at a rate of $-\pi_R$ from $t = 0$ to $t = t^*$ (i.e., *E* must make ongoing expenditures at a rate of π_R to remain viable until it enters at $t = t^*$); and
     - — earns profit at a rate of π_E^D from $t = t^*$ to $t = 2T$ (and 0 thereafter).
6. The patentee is risk-averse: The utility of the present value of the patentee's profits is given by $U\left[PV(profits)\right] = \ln\left[PV\left(profits\right)\right]$.

3. The patentee's decision

In this section, we develop expressions for the present value of the patentee's stream of profits under settlement and under litigation. We then develop an expression for the break-even date t_P^* at which the patentee is indifferent between settling and litigating.

3.1. The patentee's profits from settlement

If the parties settle, the present value of the patentee's stream of profits is

$$\pi^m \int_0^{t^*} e^{-rt} dt + \pi_P^D \int_{t^*}^{2T} e^{-rt} dt - B$$

$$= \frac{\pi^m}{r}\left(1 - e^{-rt^*}\right) + \frac{\pi_P^D}{r}\left(e^{-rt^*} - e^{-2rT}\right) - B \quad \text{(A1)}$$

26. The patentee's and entrant's discount rates need not be equal—and, in general, they will not be equal. To minimize notational clutter, however, we omit subscripts on *r* in the general development of the model below. In the numerical examples/simulations that follow, moreover, we assume equal discount

The interpretation of the first two terms in Equation (A1) is straightforward: $\frac{\pi^m}{r}\left(1-e^{-rt^*}\right)=\frac{\pi^m}{r}-\frac{\pi^m}{r}e^{-rt^*}$ gives the value (at $t = 0$) of a perpetuity at rate π^m starting at $t = 0$ *minus* the value (at $t = 0$) of a perpetuity at rate π^m starting at $t = t^*$; $\frac{\pi_P^D}{r}\left(e^{-rt^*}-e^{-2rT}\right)$ gives the value of a perpetuity at rate π_P^D starting at $t = t^*$ *minus* the value of a perpetuity at rate π_P^D starting at $t = 2T$.

3.2. The patentee's profits from litigation

If the parties litigate, the present value of the patentee's stream of profits takes one of two values, each with probability ½. The present value of *P*'s stream of profits is

$$\pi^m\int_0^{2T}e^{-rt}dt=\frac{\pi^m}{r}\left(1-e^{-2rT}\right)\text{ if }P\text{ wins the lawsuit }or \tag{A2}$$

$$\pi_P^D\int_0^{2T}e^{-rt}dt=\frac{\pi_P^D}{r}\left(1-e^{-2rT}\right)\text{ if }E\text{ wins the lawsuit} \tag{A3}$$

3.3. Conditions under which the patentee is indifferent between settlement and litigation

The patentee will be indifferent between settlement and litigation when his utilities from those two options are equal. Using Equations (A1), (A2), and (A3), the patentee will be indifferent when

$$\ln\left[\frac{\pi^m}{r}\left(1-e^{-rt^*}\right)+\frac{\pi_P^D}{r}\left(e^{-rt^*}-e^{-2rT}\right)-B\right]=\left(\frac{1}{2}\right)\ln\left[\frac{\pi^m}{r}\left(1-e^{-2rT}\right)\right]+\left(\frac{1}{2}\right)\ln\left[\frac{\pi_P^D}{r}\left(1-e^{-2rT}\right)\right]$$

Exponentiating both sides of the equation and simplifying the right side,

$$\frac{\pi^m}{r}\left(1-e^{-rt^*}\right)+\frac{\pi_P^D}{r}\left(e^{-rt^*}-e^{-2rT}\right)-B=\left(\frac{1-e^{-2rT}}{r}\right)\sqrt{\pi^m\pi_P^D} \tag{A4}$$

If *B* is constrained to be 0—i.e., we restrict our attention to settlements that do not include lump sum payments between the parties—then the third term on the left side of Equation (A4) drops out. We can then simplify Equation (A4) and solve for t_P^*, the patentee's break-even value of t^* at which he is indifferent between litigation and settlement when $B = 0$:

$$\pi^m\left(1-e^{-rt^*}\right)+\pi_P^D\left(e^{-rt^*}-e^{-2rT}\right)-\left(1-e^{-2rT}\right)\sqrt{\pi^m\pi_P^D}=0$$

$$\Rightarrow t_P^*=\left(\frac{-1}{r}\right)\ln\left[\frac{\left(1-e^{-2rT}\right)\sqrt{\pi^m\pi_P^D}+\left(\pi_P^D\right)e^{-2rT}-\pi^m}{\pi_P^D-\pi^m}\right] \tag{A5}$$

rates for the two parties. Generalization of the model to allow for different discount rates for the two parties is straightforward and obvious.

For given values of the parameters in the expression on the right side of Equation (A5), the patentee

- will prefer settlement to litigation if $t^* > t_P^*$,
- will prefer litigation to settlement if $t^* < t_P^*$, and
- will be indifferent between litigation and settlement if $t^* = t_P^*$.

4. The entrant's decision

In this section, we develop expressions for the present value of the entrant's stream of profits under settlement and under litigation. We then develop an expression for the break-even date t_E^* at which the entrant is indifferent between settling and litigation.

4.1. The entrant's profits from settlement

If the parties settle, the present value of the entrant's stream of profits is

$$-\pi_R \int_0^{t^*} e^{-rt} dt + \pi_E^D \int_{t^*}^{2T} e^{-rt} dt + B$$

$$= \left(\frac{\pi_R}{r}\right)\left(e^{-rt^*} - 1\right) + \left(\frac{\pi_E^D}{r}\right)\left(e^{-rt^*} - e^{-2rT}\right) + B \qquad \text{(A6)}$$

Note that an increase in t^* affects both of the first two terms of Equation (A6). By delaying the entry of *E*, an increase in t^*

- reduces the present value of *E*'s duopoly profits (the second term), *and*
- increases the duration of *E*'s net outflows required before its entry, thereby increasing the magnitude of the first term in Equation (A6), which is negative.

4.2. The entrant's profits from litigation

If the parties litigate, the present value of the entrant's stream of profits takes one of two values, each with probability ½. The present value of *E*'s stream of profits is

$$0 \text{ if } P \text{ wins the lawsuit } \textit{or} \qquad \text{(A7)}$$

$$\pi_E^D \int_0^{2T} e^{-rt} dt = \left(\frac{\pi_E^D}{r}\right)\left(1 - e^{-2rT}\right) \text{ if } E \text{ wins the lawsuit} \qquad \text{(A8)}$$

4.3. Conditions under which the entrant is indifferent between settlement and litigation

The entrant will be indifferent between settlement and litigation when the present values of his profits from those two options are equal. Equating the expression in Equation (A6) and the expected value of the two expressions in Equations (A7) and (A8), the entrant will be indifferent when

$$\left(\frac{\pi_R}{r}\right)\left(e^{-rt^*} - 1\right) + \left(\frac{\pi_E^D}{r}\right)\left(e^{-rt^*} - e^{-2rT}\right) + B = \left(\frac{\pi_E^D}{2r}\right)\left(1 - e^{-2rT}\right) \qquad \text{(A9)}$$

If B is constrained to be 0—i.e., we restrict our attention to settlements that do not include lump sum payments between the parties—the third term on the left side of Equation (A9) drops out. We can then simplify Equation (A9) and solve for t_E^*, the entrant's break-even value of t^* at which he is indifferent between litigation and settlement when $B = 0$:

$$\left(\pi_R\right)\left(e^{-rt^*}-1\right)+\left(\pi_E^D\right)\left(e^{-rt^*}-e^{-2rT}\right)=\left(\frac{\pi_E^D}{2}\right)\left(1-e^{-2rT}\right)$$

$$\Rightarrow t_E^*=\left(\frac{-1}{r}\right)\ln\left[\frac{\pi_R+\left(\frac{\pi_E^D}{2}\right)\left(1+e^{-2rT}\right)}{\pi_R+\pi_E^D}\right] \tag{A10}$$

For given values of the parameters in the expression on the right side of Equation (A10), the entrant

- will prefer settlement to litigation if $t^* < t_E^*$,
- will prefer litigation to settlement if $t^* > t_E^*$, and
- will be indifferent between litigation and settlement if $t^* = t_E^*$.

5. For some sets of parameter values, there is no feasible settlement without a payment *B*

As noted in the introduction to this appendix, it is possible to find sets of parameter values for which there is no feasible settlement without a payment B but for which the parties *can* reach a settlement in which (1) P pays E a lump sum, (2) each party prefers to settle rather than litigate, and (3) the agreed-upon date for entry by E is earlier than T, the expected date of entry if the parties litigate.

To see one such example, consider the following set of parameter values:[27]

$$\begin{aligned}\pi^m &= 4\\ \pi_P^D &= \pi_E^D = 1.5\\ \pi_R &= 0.5\\ T &= 2\\ r_P &= r_E = 0.2\ (20\%)\end{aligned} \tag{A11}$$

Note, of course, that the two parties' discount rates, r_P and r_E, *could* differ. To make the point below, however, we need not specify different values for r_P and r_E.

Plugging those values into the expressions in Equations (A5) and (A10) gives $t_P^* = 1.173$ and $t_E^* = 1.157$. In words, if $B = 0$,

- the patentee will settle (rather than litigate) only if the settlement date is *later* than $t_P^* = 1.173$, while

27. The values listed for π^m and π^D are the monopoly and Cournot duopoly profits, respectively, if demand is given by $Q = 16p^{-2}$ and both parties have constant marginal costs of 1. (To verify those results, see the discussion in Appendix B, which discusses such a Cournot model.)

- the entrant will settle (rather than litigate) only if the settlement date is *earlier* than $t_E^* = 1.157$.

Clearly, without some sort of payment *B*, there is no settlement date that will induce both parties to settle; without a payment *B*, therefore, they will litigate.

But there are an *infinite* number of feasible settlements—settlements that both parties prefer to litigation—once we allow a nonzero payment *B* from the patentee to the entrant. It is easy to show, for example, that *both* parties will prefer settlement to litigation if the entrant enters at $t^* = 1.5$ and the patentee pays the entrant $B = 0.6$. In fact, for entry by *E* at $t^* = 1.5$ (and the parameter values indicated in Equation (A11) above), it is possible to show that both parties will prefer settlement to litigation as long as $0.526801 < B < 0.62549$.[28] Similarly, for entry by *E* at $t^* = 1.75$ (and the parameter values indicated in Equation (A11) above), it is possible to show that both parties will prefer settlement to litigation as long as $0.888103 < B < 1.077116$. In that case, for example, a payment of $B = 1$ would induce both parties to settle.

Note that in both sets of examples in the previous paragraph, the parties can reach a settlement with certain entry by the entrant at a date t^* that is earlier than

$$\left(\frac{1}{2}\right)(0+2T) = \left(\frac{1}{2}\right)\left[0+(2)(2)\right] = 2,$$

the expected date of entry under litigation.

Appendix B

This appendix develops several models that lie behind various examples in the text of this chapter. In particular, we develop models that show how the settlement agreements between Patco and Mitou may harm consumers, even though the parties may prefer settlement to litigation in both cases.

1. Notation

This section sets out briefly the notation used below.

Q	=	total market outupt
q_P	=	the patentee's output
q_E	=	the entrant's output
η	=	the elasticity of market demand; demand is isoelastic: $Q = Kp^{-\eta}$; equivalently, $p = (Q/K)^{-1/\eta}$
K	=	a multiplicative constant (a scale factor)
c_P	=	the patentee's constant marginal cost of production (normalized to 1)

28. For a given value of t^*, we can find the break-even value of *B* at which the patentee is indifferent between settlement and litigation by solving Equation (A4) for *B* in terms of the other parameters, including t^*. Similarly, for a given value of t^*, we can find the break-even value of *B* at which the entrant is indifferent between settlement and litigation by solving Equation (A9) for *B* in terms of the other parameters, including t^*.

c_E = the entrant's marginal cost of production (assumed to be constant)
ϕ = the probability that the patentee wins the litigation if the parties litigate

In general, the subscripts *P* and *E* refer to the patentee and entrant, respectively. To distinguish variables in the litigation scenarios from those in the settlement scenarios, we use superscripts *L* and *s*, respectively.

2. Basic overview of the models

2.1. Litigation

If the parties decide to litigate—i.e., they do not reach a settlement—there are two possible outcomes:

- The patentee wins the lawsuit. In that case, the would-be entrant is not allowed to enter, and the patentee prices the product as a monopolist.
- The patentee loses the lawsuit. In that case, the entrant enters, and the parties compete as Cournot duopolists.

2.2. Settlement

If the parties decide to settle, they compete as Cournot duopolists. We consider two alternative types of settlement if the parties decide to settle: a royalty that is a linear function of the entrant's revenue (i.e., an ad valorem royalty) and a royalty specified as a certain dollar amount per unit sold by the entrant (i.e., a specific royalty). We provide further details about these settlements in the discussion below.

3. Solution of the models

3.1. Litigation

SCENARIO 1: THE PATENTEE WINS THE LAWSUIT

In this case, the patentee behaves as a monopolist in choosing the profit-maximizing quantity. Specifically, the patentee chooses the monopoly price p_m to maximize

$$\pi_P(p_m) = (p_m - c_P)q_P = (p_m - 1)Q = (p_m - 1)Kp_m^{-\eta} = K\left(p_m^{1-\eta} - p_m^{-\eta}\right) \tag{B1}$$

The first-order conditions are then

$$\frac{\partial \pi_P}{\partial p_m} = K\left[(1-\eta)\,p_m^{-\eta} + \eta\,p_m^{-\eta-1}\right] = 0 \Rightarrow p_m = \frac{\eta}{\eta - 1} \tag{B2}$$

At that price, the monopoly patentee's profits are given by

$$\begin{aligned} \pi^m \equiv \pi_P(p_m) &= (p_m - 1)Q = (p_m - 1)(K)(p_m)^{-\eta} \\ &= K\left(\frac{1}{\eta - 1}\right)\left(\frac{\eta}{\eta - 1}\right)^{-\eta} \end{aligned} \tag{B3}$$

SCENARIO 2: THE PATENTEE LOSES THE LITIGATION

In this case, the patentee and entrant compete as Cournot duopolists. To compute the Cournot duopoly price and the parties' profits, we use the general expression for the Cournot oligopoly price for a market with N firms in which firm i's marginal cost is constant at c_i:

$$p = \frac{\eta \sum_{i=1}^{N} c_i}{\eta N - 1}, \tag{B4}$$

where N is the number of firms.[29] (Note incidentally that with $N = 1$ and $c_P = 1$, which apply if the monopolist *wins* the lawsuit, the expression in Equation (B4) simplifies to the expression for p_m in Equation (B2).)

In the duopoly case at hand, the Cournot duopoly price is just a special case of Equation (B4):

$$p^L = \frac{\eta\left(1 + c_E\right)}{2\eta - 1}, \tag{B5}$$

where the superscript L refers to the outcome under *litigation*. We can then compute total quantity demanded by substituting that price into the demand function:

$$Q^L = K\left(p^L\right)^{-\eta} \tag{B6}$$

To compute the quantities produced by each party, note that in this model (see note 29),

$$\frac{q_i}{Q} = \eta\left(1 - \frac{c_i}{p}\right) \Rightarrow q_i = \eta\left(1 - \frac{c_i}{p}\right)Q, \tag{B7}$$

so the quantities produced by the patentee and entrant, respectively, can be computed using the following expressions:

$$q_P^L = \eta\left(1 - \frac{c_P}{p^L}\right)Q^L = \eta\left(1 - \frac{1}{p^L}\right)\left(K\right)\left(p^L\right)^{-\eta} \tag{B8}$$

---

29. Let Q and q_i denote total market quantity and the quantity supplied by firm i, respectively. Firm i maximizes profits $\pi_i = pq_i - c_i q_i$. Defining $\lambda_i = d\sum_{j \neq i} q_j / dq_i$, the first-order condition for firm i is as follows:

$$\frac{\partial \pi_i}{\partial q_i} = p + q_i p'(Q)\left(1 + \lambda_i\right) - c_i = 0$$

If firms behave in Cournot fashion ($\lambda_i = 0$ for all i), the latter equation implies

$$\frac{q_i}{Q} = \eta\left(1 - \frac{c_i}{p}\right)$$

Following Roger Clarke & Stephen W. Davies, *Market Structure & Price-Cost Margins*, 49 ECONOMICA 277 (1982), we can sum both sides of the latter equation over the N firms and solve for p:

$$p = \frac{\eta \sum_{i=1}^{N} c_i}{\eta N - 1}$$

$$q_E^L = \eta\left(1-\frac{c_E}{p^L}\right)Q^L = \eta\left(1-\frac{c_E}{p^L}\right)(K)\left(p^L\right)^{-\eta} \tag{B9}$$

Finally, we can use the expressions in Equations (B5), (B8), and (B9) above to generate expressions for the parties' profits in the Cournot duopoly equilibrium:

$$\pi_P^L = \left(p^L - c_P\right)q_p^L = \left(p^L - 1\right)q_P^L \tag{B10}$$

$$\pi_E^L = \left(p^L - c_E\right)q_E^L \tag{B11}$$

The parties' *expected* profits from litigation are then just weighted averages of their profits in Scenarios 1 and 2, with weights ϕ and $(1 - \phi)$, respectively.

3.2. Settlement 1: An ad valorem royalty

If the parties decide to settle, they compete as Cournot duopolists, taking account of the effect of the royalty on their profits. In the discussion below, we consider two alternative types of settlements. We first consider a settlement in which the entrant pays the patentee a linear royalty given by

$$\alpha + \beta\left(\textit{entrant revenue}\right),$$

where α and β are parameters.

THE PATENTEE'S PROBLEM

The patentee chooses q_P^s to maximize

$$\pi_P^s = \left(p^s - c_P\right)q_P^s + \alpha + \beta p^s q_E^s = \left(p^s - 1\right)q_P^s + \alpha + \beta p^s q_E^s \ ,$$

where the superscript *s* on price and quantities indicates *settlement* price and quantities, and π_P^s denotes the patentee's profits in the settlement equilibrium. The patentee's first-order condition, therefore, is

$$\begin{aligned}
&\frac{\partial \pi_P^s}{\partial q_P^s} = p^s - 1 + q_P^s p' + \beta q_E^s p' = 0 \\
&\Rightarrow p^s + \left[q_P^s + \beta q_E^s\right]p' = 1 \\
&p^s + p^s\left(\frac{q_P^s}{Q}\right)p'\left(\frac{Q}{p^s}\right) + \beta p^s\left(\frac{q_E^s}{Q}\right)p'\left(\frac{Q}{p^s}\right) = 1 \\
&\frac{q_P^s}{Q^s} = \frac{\eta\left(1-\frac{1}{p^s}\right)-\beta}{1-\beta}
\end{aligned} \tag{B12}$$

THE ENTRANT'S PROBLEM

The entrant chooses q_E^s to

$$\max_{q_E^s} \pi_E^s = \left(p^s - c_E \right) q_E^s - \alpha - \beta p^s q_E^s$$

The entrant's first-order condition, therefore, is

$$\frac{\partial \pi_E^s}{\partial q_E^s} = p^s - c_E + q_E^s p' - \beta \left(p^s + q_E^s p' \right) = 0$$

$$\Rightarrow (1-\beta)\left(p^s + q_E^s p' \right) = c_E \tag{B13}$$

$$p^s + p^s \left(\frac{q_E^s}{Q} \right) \left(\frac{Q}{p^s} \right) p' = \frac{c_E}{1-\beta}$$

$$\frac{q_E^s}{Q} = \eta \left[1 - \frac{c_E}{p^s (1-\beta)} \right] \tag{B14}$$

THE EQUILIBRIUM PRICE WITH A LINEAR ROYALTY

We can then add the expressions for the two firms' shares in Equations (B12) and (B14) to solve for the equilibrium price in the settlement scenario as a function of demand elasticity, the firms' marginal costs, and β:

$$\frac{\eta\left(1 - \frac{1}{p^s}\right) - \beta}{1-\beta} + \eta \left[1 - \frac{c_E}{p^s (1-\beta)} \right] = 1$$

$$\Rightarrow p^s = \frac{\eta (1 + c_E)}{2\eta - (1 + \eta\beta)} \tag{B15}$$

THE PARTIES' PROFITS

Having derived the expression for the equilibrium price p^s in Equation (B15) as a function of c_E, η, and β—and, therefore, the equilibrium quantity through the demand function $Q = Kp^{-\eta}$—as well as expressions for the firms' equilibrium shares in Equations (B12) and (B14), we are now in a position to compute the parties' profits under settlement.

3.3. Settlement 2: A specific (per unit) royalty

In this case, we consider a settlement in which the entrant pays the patentee a per unit royalty. We first outline the model in which the per unit royalty is fixed at a certain level, regardless of the quantity sold by the entrant (i.e., the royalty = aq_E, where a is a parameter); we refer to such a royalty as a one-tier per unit royalty. We then outline

another version of the model, the version mentioned in the text, in which the per unit royalty increases once the entrant's quantity exceeds a certain threshold; we call that structure a two-tier per unit royalty.

THE ONE-TIER PER UNIT ROYALTY

If the parties decide to settle, they compete as Cournot duopolists, taking account of the effect of the royalty on their profits. The formal solution of the model is, of course, very similar to the solution of the Cournot model in Scenario 2 of the Litigation outcome (see note 29 and the previous section of the text).

THE PATENTEE'S PROBLEM

The patentee chooses q_P^s to maximize

$$\pi_P^s = (p - c_P) q_P + a q_E = (p - 1) q_P + a q_E \ ,$$

where the superscript s in π_P^s denotes the patentee's profits in the *settlement* equilibrium. The patentee's first-order condition is

$$\frac{\partial \pi_P^s}{\partial q_P} = p + q_P p' - 1 = 0$$

Since the patentee's first-order condition does not depend on q_E, we can use the general expression for firm i's share in such a model (see note 29) to rewrite the patentee's first-order condition as follows:

$$\frac{q_i}{Q} = \eta\left(1 - \frac{c_i}{p}\right) \Rightarrow \frac{q_p}{Q} = \eta\left(1 - \frac{1}{p}\right) \tag{B16}$$

THE ENTRANT'S PROBLEM

The entrant chooses q_E to maximize

$$\pi_E^s = (p - c_E) q_E - a q_E = q_E (p - c_E - a)$$

The entrant's first-order condition, therefore, is

$$\frac{\partial \pi_E^s}{\partial q_E^s} = p - c_E - a + q_E p' = 0$$

Formally, the entrant's problem is equivalent to the problem faced by a firm with marginal cost $c_E + a$. Therefore, we can rewrite that first-order condition, using the general expression for firm i's share in such a model (see note 29), as follows:

$$\frac{q_i}{Q} = \eta\left(1 - \frac{c_i}{p}\right) \Rightarrow \frac{q_E}{Q} = \eta\left(1 - \frac{c_E + a}{p}\right) \tag{B17}$$

THE EQUILIBRIUM PRICE WITH A ONE-TIER PER UNIT ROYALTY

We can then add the expressions for the two firms' shares in Equations (B16) and (B17) to solve for the equilibrium price in the settlement scenario as a function of demand elasticity, the firms' marginal costs, and *a:*[30]

$$\frac{q_P}{Q}+\frac{q_E}{Q}=\eta\left(1-\frac{1}{p}\right)+\eta\left(1-\frac{c_E+a}{p}\right)=1$$

$$\Rightarrow 2\eta-\eta\left(\frac{1+c_E+a}{p}\right)=1$$

$$p^s=\frac{\eta\left(1+c_E+a\right)}{2\eta-1} \qquad \text{(B18)}$$

OVERVIEW OF THE TWO-TIER PER UNIT ROYALTY

The structure and the solution of the model with a two-tier per unit royalty are very similar to their counterparts for the model with a one-tier per unit royalty, so we provide a briefer outline for the two-tier model.

If the parties decide to settle, the entrant pays the patentee a royalty of *a* per unit for each unit up to a threshold quantity $\tilde{q}$; for each unit beyond that threshold, the entrant pays a royalty of $a + b$ per unit. Formally,

$$\text{Royalty} = \begin{cases} aq_E & \text{if } q_E \le \tilde{q} \\ aq_E + b\left(q_E-\tilde{q}\right)=\left(a+b\right)q_E-b\tilde{q} & \text{if } q_E > \tilde{q} \end{cases}$$

With that settlement structure, the patentee's first-order condition is the same as in the model of the one-tier per unit royalty: although the patentee's profit function depends on q_E, its first-order condition does not. In the settlement equilibrium, therefore, the patentee's share is given by Equation (B16).[31]

The relevant version of the entrant's first-order condition depends on whether the entrant's equilibrium quantity exceeds the threshold $\tilde{q}$. Since we have already considered the one-tier model, we focus here on parameter values for which q_E does exceed $\tilde{q}$. In that case, the entrant's first-order condition is similar to its first-order condition in the one-tier model—see Equation (B17)—except that $a + b$ replaces *a:*

$$\frac{q_E}{Q}=\eta\left(1-\frac{c_E+a+b}{p}\right) \qquad \text{(B19)}$$

Similarly, the equilibrium price is given by Equation (B18), except that $a + b$ replaces *a:*

30. As expected, the expression for p^s is a special case of the general expression for equilibrium price in the Cournot model discussed in note 29.

31. Because the *entrant's* first-order condition with a two-tier royalty is different from its first-order condition with a one-tier royalty (see the discussion below), the equilibrium settlement price will also differ for the two types of royalties.

$$p^s = \frac{\eta\left(1 + c_E + a + b\right)}{2\eta - 1} \tag{B20}$$

Having derived the expression for the equilibrium price p^s in Equation (B20) as a function of c_E, η, a, and b—and, therefore, the equilibrium quantity through the demand function $Q = Kp^{-\eta}$—as well as expressions for the firms' equilibrium shares in Equations (B16) and (B19), we are now in a position to compute the parties' profits under settlement.

4. The parties' preferences for settlement or litigation

If each firm is risk neutral, it will prefer settlement to litigation if its equilibrium profits under settlement exceed its expected profits under litigation. The parties' expected profits under litigation depend on the probability that the patentee will win the litigation, which we denote by ϕ; we assume that both parties have the same estimate of ϕ.

The patentee will prefer settlement to litigation if

$$\pi_P^s > E\left(\pi_P^L\right), \text{ i.e., if}$$

$$\pi_P^s > \varphi\pi^m + \left(1 - \varphi\right)\pi_P^L$$

$$\Rightarrow \varphi < \frac{\pi_P^s - \pi_P^L}{\pi^m - \pi_P^L}\ , \tag{B21}$$

where π^m, π_P^L, and π_P^s are functions of the underlying parameters (η, c_E, etc.). For given values of those underlying parameters, Equation (B21) indicates the values of ϕ for which the patentee would prefer settlement.[32]

The entrant will prefer settlement to litigation if

$$\pi_E^s > E\left(\pi_E^L\right), \text{ i.e., if}$$

$$\pi_E^s > \varphi\left(0\right) + \left(1 - \varphi\right)\pi_E^L$$

$$\Rightarrow \varphi > \frac{\pi_E^L - \pi_E^s}{\pi_E^L}\ , \tag{B22}$$

where π_E^L and π_E^s are functions of the underlying parameters. For given values of those underlying parameters, Equation (B22) indicates the values of ϕ for which the entrant would prefer settlement.

5. Consumer surplus

If demand is isoelastic ($Q = Kp^{-\eta}$), as assumed, and $\eta > 1$, consumer surplus at any price p is given by

32. More generally, given values of all but one of the underlying parameters, Equation (B21) generates the range of values for the other parameter for which the patentee would prefer settlement.

$$\int_p^{\infty} Kx^{-\eta}\,dx = \frac{Kx^{1-\eta}}{1-\eta}\Bigg|_{x=p}^{x=\infty} = \frac{Kp^{1-\eta}}{\eta-1} \tag{B23}$$

Using Equation (B23) and the appropriate expressions for price in the various scenarios considered above, we can compute expected consumer surplus under litigation and consumer surplus under settlement for any particular parameter values. To compute expected consumer surplus under litigation, we use the same estimate of ϕ as the parties.

6. Choice of parameter values

It is now possible to show that settlements that both parties prefer to litigation and that look quite innocuous may well harm consumers.

6.1. Settlement 1: The ad valorem royalty

Suppose, for example, the settlement includes an ad valorem royalty of the type considered in Settlement 1, with the following parameter values:

$$\eta = 3$$
$$K = 1{,}000$$
$$c_P = 1$$
$$c_E = 1.1$$
$$\alpha = -10$$
$$\beta = 0.14$$
$$\varphi = 0.5$$

If Q is measured in millions of units, these parameters correspond to the example cited in the text: a royalty rate of 14 percent per dollar of the entrant's gross revenue, with a rebate of $10 million if the entrant's revenue exceeds $100 million. (In equilibrium, given these parameter values, that condition will be satisfied.) The reader can verify that both Equations (B22) and (B21) are satisfied—i.e., both parties prefer this settlement to litigation—but expected consumer surplus is higher under litigation than consumer surplus under this settlement.

6.2. Settlement 2: The two-tier per unit royalty

Alternatively, suppose the settlement includes a two-tier per unit royalty of the sort considered in Settlement 2, with the following parameter values:

$$\eta = 2$$
$$K = 1{,}000$$
$$c_P = 1$$
$$c_E = 1$$
$$a = 0$$
$$b = 0.07$$

$$\tilde{q} = 200$$
$$\varphi = 0.1$$

If prices are denominated in thousands of dollars, those parameter values correspond to the last example cited in the text: royalty-free sales of the first 200 units, with royalties of $70 per unit for any additional units sold. For those parameter values, in equilibrium, q_E does exceed $\tilde{q}$, so the entrant does pay a two-tier royalty, and both parties prefer settlement to litigation. Expected consumer surplus under litigation, however, is actually higher than consumer surplus in the settlement equilibrium. Thus, as indicated in the text, although the parties would prefer to settle, settlement will actually harm consumers.

Note also that for some parameter values there is no one-tier per unit royalty that both parties would prefer to litigation.[33] To effect a settlement that both parties—and consumers—prefer to litigation, therefore, a two-tier royalty or some other royalty structure may be necessary.

33. For example, if $h = 2$, $c_P = 1$, $c_E = 0.95$, $a = 0.01$, $b = 0.1$, $\tilde{q} = 200$, and $\phi = 0.15$, it is possible to show that there is no *one*-tier per unit royalty that both parties would prefer to litigation.