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SOLVING THE PATENT
SETTLEMENT PUZZLE

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Abstract

Courts and commentators are sharply divided about how to assess reverse payment patent settlements under antitrust law. The essential problem is that a PTO-issued patent provides only a probabilistic indication that courts would hold the patent is actually valid and infringed, and parties have incentives to structure reverse payment settlements to delay entry more than this patent probability would merit. Some favor comparing the settlement entry date to the probabilistic scope of the patent, but this requires difficult case-by-case assessments of the patent probabilities. Others instead favor a formal scope of patent test that allows such settlements for non-sham patents if the settlement does not delay entry beyond the patent term, preclude non-infringing products, or delay non-settling entrants. However, the formal scope of patent test delays entry more than merited by the patent strength, and it provides no solution when there is a significant dispute about infringement or a bottleneck issue delaying other entrants.

This paper provides a way out of this dilemma. It proves that when the reverse payment amount exceeds the patentholder's anticipated litigation costs, then under standard conditions the settlement entry date will *always* delay expected entry, harm consumer welfare, and exceed the probabilistic patent scope according to the patentholder's own probability estimate. Further, whenever a reverse payment is necessary for settlement, it will also have the same anticompetitive effects according to the entrant's probability estimate. This proof thus provides an easily administrable way to determine when a reverse payment settlement is necessarily anticompetitive, without requiring any inquiry into the patent merits. We also show that, contrary to widespread assumption, patent settlements without any reverse payment usually (but not always) delay entry and exceed the probabilistic patent scope, and suggest a procedural solution to resolve such cases.

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SOLVING THE PATENT SETTLEMENT PUZZLE

Reverse payment patent settlements have led to widespread legal controversy. In such settlements, the patentholder agrees to make a payment to an allegedly infringing potential entrant (called a "reverse" payment because traditionally settlement payment flow was from alleged infringer to patentholder) and the potential entrant agrees to stay out of the market until a later date.[1] Such settlements have anticompetitive potential because the settling parties can set the settlement entry date later than the expected entry date resulting from litigation, which would have reflected the often significant likelihood that the patentholder would have lost. Indeed, unless constrained by the risk of antitrust liability, settling parties would (no matter how weak the patent) always have incentives to set the settlement entry date at the end of the patent term because that maximizes joint profits (by precluding competition for as long as possible), and they can use the reverse payment to split those joint profits in a way that leaves both better off. However, if antitrust liability could be designed to prevent parties from setting a settlement entry date that exceeded the expected entry date, then reverse payment settlements could theoretically avoid litigation costs without causing any anticompetitive effect.

Such reverse payment settlements have been a huge issue in the multi-trillion dollar pharmaceutical industry. But the issue is even bigger than that because reverse payment settlements can occur in *any*

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[1] These are sometimes called "pay-for-delay" settlements, but we avoid that terminology because it presupposes that the settlement entry date does "delay" entry compared to the expected entry date, which is the disputed issue.

market where the patentholder would have greater market power if the entrant were excluded.[2]

The federal courts of appeal are in utter conflict on when reverse payment settlements violate antitrust law. The Sixth Circuit has held that reverse payment settlements are per se illegal.[3] This is the *categorical illegality* position. Two Eleventh Circuit cases rejected this position, holding that reverse payment settlements violate antitrust law only if the settlement exceeds the exclusionary scope of the patent, which it held meant the "settlement cannot be more anticompetitive than litigation" and thus "underscores the need to evaluate the strength of the patent."[4] The test in these Eleventh Circuit cases thus turns on a case-by-case assessment of the objective probability that the patentholder would have won, which the court stressed should be determined at the time of settlement rather than by some later discrete outcome.[5] Call this the *objective probabilistic* scope of patent test.

The Second Circuit rejected an approach that required case-by-case assessments of patent probabilities as inadministrable.[6] Instead, it concluded that, unless the patent was a sham or procured by fraud,

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[2] Delaying entry through a reverse patent settlement is profit-maximizing whenever the patentholder's profit without the entrant in the market exceeds the sum of the patentholder profit and the entrant profit with the entrant in the market. Further, we show below that if the settlement payment amount exceeds the patentholder's anticipated litigation costs, then the patentholder must have believed it had sufficient market power.

[3] In re Cardizem CD Antitrust Litig., 332 F.3d 896, 907-08 (6th Cir. 2003). In this case, Professor Elhauge filed an expert declaration for a generic defendant, in which he opposed application of the per se rule.

[4] In re Schering Plough Corp., 402 F.3d 1056, 1065-66, 1075-76 (11th Cir. 2005); *id.* at 1071 (finding the evidence unrebutted that the settlement "entry date reasonably reflected the strength of [the patent holder's] case"); Valley Drug Co. v. Geneva Pharmaceuticals, Inc., 344 F.3d 1294, 1312 (11th Cir. 2003) (requiring inquiry into whether the settlement terms exceeded patent protections, "considered in light of the likelihood of [the patent holder] obtaining such protections.").

[5] *Valley Drug,* 344 F.3d at 1306-07 (holding that thus such a settlement could be proper even if the patent were later held invalid).

[6] In re Tamoxifen Citrate Antitrust Litig., 466 F.3d 187, 203-04 (2d Cir. 2006).

reverse patent settlements were illegal only if the patent exceeded the *formal* scope of the patent by delaying entry after the patent expires, precluding noninfringing products, or delaying the entry of non-settling potential entrants.[7] This *formal* scope of the patent test was then adopted by the Federal Circuit and another panel of the Eleventh Circuit.[8]

Finally, the Third Circuit has just rejected the formal scope of patent test, adopting a presumption that reverse payment settlements are illegal unless the defendant shows that "the payment (1) was for a purpose other than delayed entry or (2) offers some pro-competitive benefit."[9] The Third Circuit held that this presumption could not be rebutted by proof about the merits of the patent suit because the reverse payment itself indicated that the purpose was to delay entry.[10] Instead, it indicated that the first rebuttal required proving that the patentholder received sufficient separate consideration to negate the existence of reverse payment and the second condition required proving some

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[7] *Id.* at 212-13; *id.* at 213-16 (settlement did not exceed scope of patent because it did not preclude "non-infringing products," did not delay other potential entrants, and allowed entry before the patent term expired); Arkansas Carpenters Health & Welfare Fund v. Bayer AG, 604 F.3d 98, 106 (2d Cir. 2010) (stressing that a "settlement agreement did not exceed the scope of the patent where (1) there was no restriction on marketing non-infringing products; (2) a generic version of the branded drug would necessarily infringe the branded firm's patent; and (3) the agreement did not bar other generic manufacturers from challenging the patent.")

[8] *See* In re Ciprofloxacin Hydrochloride Antitrust Litigation, 544 F.3d 1323, 1336-37 (Fed. Cir. 2008); *id.* at 1335 (indicating that if a reverse payment settlement created a bottleneck effect "delaying the entry of other generic manufactures" or covered "non-infringing" products, then it would clearly lie "outside the exclusion zone of the patent"); FTC vs. Watson Pharmaceuticals, 677 F.3d. 1298, 1307-15 (11th Cir. 2012). The *Watson* case apparently missed the language in *Valley Drug* saying that the exclusionary scope of a patent turned on "the likelihood of [the patent holder] obtaining [patent] protections," which it never cited, and offered the strained conclusion that references in *Schering-Plough* to evaluating the "strength of the patent" merely meant the temporal length of the patent. *Id.* at 1311 n.8. But the *Watson* panel was reasonably concerned that the FTC's proposed standard in that case (whether patent victory was unlikely) failed to reliably identify whether the settlement was anticompetitive and required difficult inquiries into the probability that the patent holder would have won. *Id.* at 1312-15.

[9] *In re* K-Dur Antitrust Litigation, 2012 WL 2877662, at *16 (3rd Cir. 2012).

[10] *Id.*

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unrelated procompetitive benefit.[11]   Call this the *presumptive condemnation approach.*

The antitrust enforcement agencies have advocated a similar presumption, but have suggested a broader range of rebuttal.   The Department of Justice Antitrust Division has concluded that reverse payment settlements should be presumed unlawful, allowing defendants to rebut that presumption by showing either that (1) the reverse payment amount was "not greatly in excess of avoided litigation costs" *or* (2) the settlement entry date did not exceed the expected litigation entry date given the settlors' contemporaneous estimates of the likelihood the patentholder would win.[12]   The FTC has advocated the Third Circuit approach of presuming that reverse payment settlements are illegal unless defendants demonstrate offsetting procompetitive effects.[13]   The FTC (like the Third Circuit) has also concluded that this presumption cannot be rebutted by proof of the actual *objective* likelihood that the patentholder would have prevailed.[14]   However, the FTC has suggested that maybe this presumption could be rebutted by evidence of the *perceived* probability at the time of settlement.[15]   Thus, at least for large reverse payment settlements, the Antitrust Division approach would require (and the FTC approach might permit) case-by-case assessments of the perceived probability of patent victory.[16]   Call this the *perceived probabilistic scope of patent* test.

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[11] *Id.*

[12] Brief for the United States in Arkansas Carpenters Health & Welfare Fund v. Bayer AG, 2009 WL 8385027, at *10, 22, 28-32 (July 6, 2009). The Antitrust Division now rejects case by case inquiry into whether the patent holder actually would likely have won, but the Antitrust Division used to favor this objective probabilistic approach. *Id* at 24-27 & n.9.

[13] In the Matter of Schering-Plough Corp., 136 F.T.C. 956, 987-991, 1000-1003 (2003),vacated Schering-Plough Corp. v. FTC, 402 F.3d 1056 (11th Cir. 2005).

[14] 136 F.T.C. at 992-998.

[15] *Id.*

[16] The Antitrust Division now rejects case by case inquiry into whether the patent holder actually would likely have won (although the Antitrust Division used to hold that view). *Schering-Plough, supra* note , 136 F.T.C. at 992-998; Brief for the United States, *supra* note , at 24-27 & n.9.

This split in authority does not simply reflect stubbornness or ideological conflict. There seems to be a real dilemma. The underlying problem is that the mere issuance of a patent by the Patent and Trademark Office does not mean a court will hold the patent is actually valid, let alone that another firm's product infringes it. Indeed, even though patentholders get a presumption of patent validity, they lose 48-73% of patent cases.[17] On average, then, even without any at-risk entry during litigation, the expected entry date would be only 27-52% of the patent term that would remain after litigation. And this is the average; weaker patents would lose even more often and thus result in even earlier expected entry dates, especially because they might provoke at-risk entry during litigation. Any settlement entry date later than the expected entry date has anticompetitive effects on consumer welfare because it increases the amount of time consumers must pay monopoly prices. Further, if we assume that patent law has been optimally designed, then the odds of patent victory in litigation reflect the extent to which the patentholder should be rewarded with monopoly profits. Thus, a settlement entry date that exceeds the probabilistic scope of the patent thus also excessively rewards the patentholder.

The *objective probabilistic* scope of patent test provides a straightforward solution: compare the settlement entry date to the expected entry date by directly adjudicating the likelihood of patent victory. But that approach requires the very sort of inquiry into the patent merits that settlement is supposed to avoid, thus defeating the point of settlement. Moreover, once the court does investigate the patent merits, it will conclude that the patentholder should either have won or

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[17] *See* FTC, Generic Drug Entry Prior To Patent Expiration vi (2002) ("Generic applicants have prevailed in 73 percent of the cases in which a court has resolved the patent dispute"); Paul M. Janicke & LiLan Ren, *Who Wins Patent Infringement Cases?*, 34 AIPLA Q.J. 1, 20 (2006) (patent holder loses 70% of the time); RBC Capital Markets, "Pharmaceuticals: Analyzing Litigation Success Rates," (January 15, 2010) (patent holder loses 48% of the cases with generic entrants).

lost, and have difficulty gauging the probability that another court would have been (in its judgment) wrong.[18] Further, this approach subjects settling parties who honestly believe their settlement entry date is earlier than the expected entry date to the threat of trebled antitrust damages if a court later decides the probability of patent victory was different, which may be affected by hindsight bias if other cases later adjudicate the same patent.

The *perceived* probabilistic scope of patent test nicely avoids these problems when those perceived probabilities can reliably be ascertained. This may be possible when the parties carelessly record their probability judgments in contemporaneous documents. But if courts regularly depended on the parties' contemporaneous documents, then settling parties would likely stop documenting the true probabilities, and instead document inflated probabilities in order to protect their profitable settlements. Settling parties might also or instead simply offer self-serving testimony about those perceived probabilities. To avoid those problems, courts could critically examine such self-serving assessments, but to do so they would have to rely on an objective probability that would bring us back to the *objective probabilistic* scope of patent test and all its problems.

One can thus understand the attraction of categorical approaches, but both categorical possibilities have serious problems. The problem with categorical *illegality* is that sometimes a positive reverse payment could be consistent with a socially desirable settlement.[19] The problem with categorical *legality* for reverse payment settlements within the

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[18] This difficulty might be particularly acute because the Federal Circuit has exclusive jurisdiction over patent cases, while antitrust cases can go to any appellate panel. Thus, the appellate panel hearing the antitrust case might worry it lacks the expertise to predict how the Federal Circuit would decide any patent issues. *See Watson,* 677 F.3d. at 1314-15.

[19] However, our proof below shows this possibility exists only when the reverse payment amount is lower than the patent holder's anticipated litigation costs, absent a judgment-proof entrant or other procompetitive justifications.

formal scope of a non-sham patent is that, if it were the accepted rule, settling parties would always set the settlement entry date equal to the patent expiration date, no matter how weak their patent was. Indeed, the Second Circuit has indicated considerable ambivalence about its formal scope of the patent test, acknowledging that it produces the perverse result that the weaker a patent, the more such a rule would produce settlements that benefit the patentholder more than it deserved,[20] and in its most recent decision the Second Circuit suggested that the policy problems were great enough that en banc review was merited to reconsider this rule.[21] Moreover, the formal scope of patent test by its own terms provides no guidance for settlements where there is a serious dispute about whether the entrant product infringes the patent or where the settlement does create bottleneck effects that delay other entrants.

Further, if the formal scope of patent test prevails, its anticompetitive potential can be multiplied. In many cases, the parties to a patent dispute *each* have some non-sham patent that applies to the relevant market. The formal scope of the patent test means such parties would maximize joint profits with settlements that declare the validity of whichever patent ends last, even if the other patent is actually more likely to be valid. They can then split those maximized joint profits with reverse payments to make both settling parties better off, while harming consumer welfare and providing rewards that bear no relation to any innovation. They could further exacerbate the problem by creating a stream of weak (but non-sham) patents precisely for the purpose of enabling these last-to-expire settlements that preclude competition as long as possible. Such a stream could even allow horizontal competitors to create a chain of reverse payment settlements that span multiple patent periods, trading the monopoly power back and forth between each other and splitting the profits with their counterpart throughout.

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[20] *Tamoxifen,* 466 F.3d at 211.
[21] *Arkansas Carpenters*, 604 F.3d at 108-110.

Clearly then, adopting the formal scope of the patent test can have disastrous consequences. But how can courts prevent anticompetitive settlements without also deterring socially beneficial ones, engaging in an expensive direct inquiry into the patent merits that effectively precludes real settlement of the patent issues, or relying on documented perceptions of the patent strength that the parties will predictably exaggerate?

In this paper, we present a proof that solves this puzzle for the lion's share of cases. We begin in Part I by showing that although the two are often conflated, the expected entry date with litigation is relevant to ex post consumer welfare, while the probabilistic scope of the patent is instead relevant to the optimal patent reward. Both are thus relevant to policy, but the two can differ from each other. A strong patent deters at-risk entry with certainty during litigation, even though there is a probability of patent loss. Thus, for strong patents, the expected entry date always exceeds the probabilistic patent scope. In contrast, a weak patent produces at-risk entry with certainty during litigation, even though there is a probability of patent victory. Thus, for weak patents, the probabilistic patent scope always exceeds the expected entry date.

We then prove in Part II that, when a reverse payment exceeds the patentholder's anticipated litigation costs, then the settlement entry date will always *both* delay entry *and* exceed the probabilistic patent scope according to the patentholder's *own* probability estimate. Further, whenever such a reverse payment is necessary for settlement, the settlement entry date will also have both those anticompetitive effects according to the probability estimates of *both* the patentholder and the entrant. Nor is there any reason to tolerate any reverse payment that is not necessary for settlement, because without it the settlement would have provided an earlier entry date less harmful to consumer welfare, while still exceeding the probabilistic patent scope according to the patentholder's own estimate. This proof thus provides an easily administrable way to determine when a reverse payment settlement is

anticompetitive, without requiring any inquiry into the patent merits. Unlike prior analysis, this proof does not depend at all on actually knowing what the patentholder or entrant perceive the patent strength to be, and it applies even if patentholders and entrants disagree about the strength of the patent and the future profitability of the patented product.

Although we formally illustrate our proof using a mathematical model below, the basic logic is as follows. If the reverse payment amount exceeds the patentholder's anticipated litigation costs, then we show that the settlement entry date necessarily delays entry and exceeds the probabilistic patent scope according to the patentholder's own estimate of the patent strength, because otherwise the patentholder would be better off litigating. If the entrant's estimate of patent strength is below the patentholder's, then this settlement entry date must also delay entry and exceed the probabilistic patent scope according to the entrant's estimate as well. If the entrant's estimate of patent strength exceeds the patentholder's, then no reverse payment is necessary for settlement because without one the parties could have agreed to a settlement entry date that lies between their estimated patent strengths and still make both better off.

Our proof assumes that at-risk entrants are not judgment proof and that the reverse payment does not have some other procompetitive justification. Courts therefore should presumptively condemn reverse payments that exceed the patentholder's anticipated litigation costs, but allow defendants to rebut that presumption by proving either: (a) the entrant would have entered at risk and is judgment proof to a sufficient extent to indicate the settlement entry date could or would be within the probabilistic patent scope, or (b) that some other procompetitive justification exists that offsets the anticompetitive effects. Absent one of those rebuttals, the proof holds. One important implication is that, contrary to the recommendations by the DOJ (and perhaps the FTC), defendants should *not* be able to rebut this presumption by arguing that the settlement entry date did not delay entry or exceed the probabilistic patent scope, because this proof precludes that possibility for reverse

payments that exceed the patentholder's anticipated litigation costs. Nor should the defendants be able to rebut the presumption by arguing that the patentholder lacks market power because that possibility is also precluded by the size of the reverse payment.

In Part III, we address patent settlements that set entry dates without using reverse payments that exceed the patentholder's anticipated litigation costs. Many, including the FTC and DOJ, have assumed that settlements with no reverse payments will likely set settlement entry dates that equal the probabilistic scope and expected entry date with litigation.[22] However, we prove that this widespread assumption is untrue. Although patent settlements without any reverse payment will not *necessarily* delay entry and exceed the probabilistic patent scope, it turns out that they *usually* will. The magnitude of anticompetitive harm is certainly much smaller without the reverse payments, but that does not alter the fact that those harms are undesirable.

One approach to deal with this problem would be to extend presumptive condemnation to such settlements, but to allow parties to rebut this presumption by showing that their settlement entry date does not delay expected entry or exceed the probabilistic patent scope. Sometimes this inquiry can be limited with a market power screen or by bounding the possible probabilities that could satisfy the relevant benchmarks. However, in some cases, this approach would require courts to directly adjudicate the patent strength in these situations, which is what courts are generally trying to avoid. If direct inquiry into probabilistic patent strength is too unreliable, then the best substantive solution would be categorical condemnation because the proof shows that most such settlements are anticompetitive. However, the better solution in such cases may be procedural. Because the underlying

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[22] *Schering-Plough, supra* note , 136 F.T.C. at 987; Brief for the United States, *supra* note , at *21-22.

problem that allows anticompetitive settlements is that patent law does not ordinarily give buyers standing to challenge dubious patents, one possibility would be to provide that, when such settlements are reached, buyers should have standing to challenge the patent.

Finally, in Part IV, we relate our analysis to prior scholarship. Although some prior commentators had argued that reverse payments that exceed litigation costs usually are anticompetitive, their position has been disputed. We rigorously prove that this position is true and thus help resolve this debate. We also prove that focusing instead on the likelihood of patent victory or a comparison of the reverse payment to entrant profits, as some commentators have advocated, is not a reliable indicator of whether settlements are anticompetitive. Further, our proof allows us to define more precisely the conditions under which reverse payments should be presumptively condemned and the proper grounds for rebuttal. We show that the right benchmark is not all litigation costs, as prior proponents of the presumption have concluded, but only the patentholder's anticipated litigation cost. More important, we disprove the claim by prior proponents of this presumption that courts should allow rebuttal based on the likelihood of patent victory, the expected entry date with litigation, risk aversion, or varying party estimates of patent strength. We also prove that courts need to allow a limited rebuttal for judgment-proof entrants that prior scholarship missed. Finally, we disprove the widespread assumption in prior scholarship that settlements without reverse payments generally do not cause anticompetitive effects.

I. THE TWO RELEVANT BENCHMARKS: EX POST CONSUMER WELFARE AND THE OPTIMAL PATENT REWARD

To determine whether a given patent settlement is anticompetitive, one must focus on two benchmarks: (1) but-for ex post consumer welfare, and (2) optimal patent rewards for ex ante innovation. But-for ex post consumer welfare reflects the level of expected consumer

welfare that would have resulted had the particular patents at issue been litigated rather than settled. It is called "ex post" consumer welfare because it is calculated assuming that the innovation has already occurred. Because the patentholder can charge a significantly higher price while the potential entrant is excluded from the market, a settlement reduces ex post consumer welfare below but-for levels if the settlement excludes the entrant from the market for a larger portion of the patent's remaining life than one would have expected to result from litigation.[23] Thus, any settlement entry date that is later than the expected entry date with litigation necessarily harms ex post consumer welfare.

However, not all things that increase *ex post* consumer welfare above but-for levels are desirable or increase *overall* consumer welfare. For example, refusing to enforce any patent (no matter how valid) would increase *ex post* consumer welfare above but-for levels. But that is only because the ex post perspective assumes the innovation has already occurred, when in reality patent protection is often necessary to encourage the innovation ex ante.[24] If designed optimally, the patent system will maximize overall consumer welfare by giving patentholders the optimal fraction of ex post total surplus created by their innovations.[25] Reducing patent profits below the optimal level will thus

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[23] For example, suppose litigation were instantaneous and we knew the probability that a patent would be found valid and infringed was 75%. With litigation we would expect the entrant to be excluded from the market for 75% of the patent term because 25% of the time the entrant wins and is excluded for none of the remaining patent term, and 75% of the time the entrant is excluded for the rest of the patent term. Consequently, any settlement that excluded the entrant for more than 75% of the remaining patent term would harm ex post consumer welfare.

[24] *See* John H. Barton, *Patents and Antitrust: A Rethinking in Light of Patent Breadth and Sequential Innovation*, 65 ANTITRUST L.J. 449, 450 (1997). ("The patent-antitrust analysis has always had to take into account and balance benefit to consumers by maintaining the competitive structure of existing markets against benefits to consumers by permitting the intellectual property rights system to provide an incentive for research toward new and improved products.").

[25] *See* SUZANNE SCOTCHMER, INNOVATION AND INCENTIVES 100–03 (2004); Partha Dasgupta & Joseph Stiglitz, *Uncertainty, Industrial Structure, and the Speed of R&D*, 11 BELL J. ECON. 1, 18 (1980). Such a system will also maximize overall *total* welfare because competing

result in an inefficiently low amount of innovation. Conversely, increasing patent profits above the optimal level will result in inefficiently excessive development of marginal products and discoveries.[26]

Supreme Court precedent requires courts to assume that Congress has optimally designed patent and copyright law.[27] Although scholars sometimes argue that current patent law upholds too many patents or too few, some balance must be struck. Even if one believes that current patent law does not strike the correct balance, the correct solution is to reform patent law, not to allow antitrust courts to second-guess patent law doctrine and try to offset it imperfectly for the limited set of cases that produce patent settlements that raise antitrust issues. Thus, antitrust analysis of patent settlements should assume the optimality of patent law.

Given that Congress has crafted the substantive doctrines that determine the probability that a patent is found valid and infringed, the amount of exclusion that the patentholder deserves on the merits is equal to the probability that the patent would be found valid and infringed times the remaining patent term. To formalize this, call the probability that the patent will be found valid and infringed θ, and normalize the remaining patent term so that it spans from 0 to 1. (For example, if 100 months remained on the patent term, then 100 months would be 1.0 on the normalized scale, 50 months would be 0.5, 10 months would be 0.1,

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innovators will keep spending on ex ante investments until their investment costs equal their expected ex post profits, so that the profits to patent holders wash out ex ante.

[26] Pankaj Tandon, *Rivalry and the Excessive Allocation of Resources to Research*, 14 BELL J. ECON. 152, 152, 156–57 (1983).

[27] *See, e.g.*, *Sony Corp. of America v. Universal City Studios, Inc.*, 467 U.S. 417 at 429 (1984) ("it is Congress that has been assigned the task of defining the scope of [patent protection]. Because this task involves a difficult balance . . ., our patent and copyright statutes have been amended repeatedly."); *id.* at 431 ("Sound policy, as well as history, supports our consistent deference to Congress when major technological innovations alter the market for copyrighted materials.").

and so forth). According to patent law, the patentholder deserves exclusivity for θ of the remaining patent period, because θ percent of the time it deserves exclusivity for the entire period and $1- \theta$ percent of the time it deserves no exclusivity. This means a settlement entry date T (again on the normalized 0 to 1 timeline) exceeds the probabilistic patent scope, and thus gives the patentholder more exclusivity and patent reward than it deserves, if $T > \theta$. For example, if the remaining patent term is 100 months, and the probability of patent victory is 0.5, then the settlement entry date exceeds the probabilistic patent scope only if $T > .5$, in other words if the settlement entry date is more than 50 months in the future. This measure entitles the patentholder to all the expected profits it would get if patent litigation were instant and costless, and thus enables patentholders to reap any legitimate settlement benefits that come from avoiding the delay and cost of litigation.

Whether a settlement is anticompetitive or procompetitive thus turns both on whether: (a) the settlement harms or benefits ex post consumer welfare, which turns on whether the settlement entry date is later or earlier than the expected entry date with litigation, and (b) the patentholder receives more or less than the optimal patent reward, which turns on whether the settlement entry date does or does not exceed the probabilistic patent scope (i.e., θ). The net effect could be murky if these tests pushed in opposite directions, because that would require us weigh the ex post effect on consumer welfare against the ex ante effect on innovation (which also affects consumer welfare). We avoid this difficulty by proving that both tests point in the same direction for settlements with reverse payments that exceed the patentholder's anticipated litigation costs.

The reason that these tests could in theory point in opposite directions is that the probabilistic patent scope might be less or more than the expected entry date. If the patent is strong enough to deter at-risk entry during litigation, then the probabilistic patent scope would be smaller than the expected entry date. The reason is that entry would be deterred during litigation with 100% probability, even though such entry

would be legal and outside the scope of the patent with probability $1 - \theta$. If the patent is too weak to deter at-risk entry during litigation, then the probabilistic patent scope would exceed the expected entry date. The reason is that entry would occur during litigation with 100% probability, even though such entry would be illegal and within the scope of the patent with probability θ. In either case, the theoretical concern is that a settlement entry date that was between the probabilistic patent scope and the expected entry date could cause the tests to produce conflicting conclusions.

However, we prove that when a settlement has a reverse payment that exceeds the patentholder's anticipated litigation costs, the settlement will *both* (1) delay entry, and thus harm ex post consumer welfare, *and* (b) exceed the probabilistic patent scope, and thus exceed the optimal patent reward for innovation ex ante. Such a settlement is thus unambiguously anticompetitive.

II. REVERSE PAYMENTS THAT EXCEED THE PATENTHOLDER'S ANTICIPATED LITIGATION COSTS

A. The Proof

To begin, we must define some variables. Call M the monopoly profits the patentholder would earn if the patent were fully enforced for the remainder of its term, and call D_P the more competitive duopoly profits the patentholder would earn over that period if it competed with the entrant. We normalize the remaining patent term to extend from time 0 (when the entrant is first capable of entering the market) to time 1 (the patent expiration date), with no discount rate and the assumption that each time slice reflects an equal share of the total profits that could be earned during that period.[28] Call D_E the duopoly profits the entrant

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[28] Altering the model to include discount rates and/or make profitability differ over time would not change any of the conclusions in the proof, but would significantly complicate the mathematical formulas. In fact, adding either of these complications would only strengthen our

would earn if it were in the market for the remainder of the patent term (from time 0 to time 1), and call each party's expected costs of litigation C_P and C_E. The proof does not require one to know M, D_P, or D_E. Instead, the proof holds so long as monopoly profits exceed more competitive duopoly profits (i.e., $M > D_P + D_E$), which is what standard economic models and common observation predict.[29] Call θ_E and θ_P the entrant and patentholder estimates of the probability that the patent will be found valid and infringed.

Absent settlement, the entrant must decide whether to enter during the patent litigation or instead wait and enter only if it wins. Entry during the litigation is commonly referred to as "at-risk" entry because the entrant risks having to pay infringement damages to the patentholder if it loses the litigation. Call L the expected duration of the patent litigation, again on the normalized 0 to 1 timeline.[30] The entrant will

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proof. Adding discount rates would reduce the net present value of the patentholder's anticipated litigation costs but would not reduce the net present value of any reverse payment made at time 0. Discounting future profit streams would only increase the extent to which an entrant would be willing to delay entry in exchange for an upfront settlement payment and reduce the extent to which a patentholder is willing to speed up entry.

[29] To be sure, misestimations could in theory make it conceivable that estimated $M < D_P + D_E$ because the patentholder is estimating M and D_P but the alleged infringer is independently estimating D_E. However, as we prove in the Appendix, adding a reverse payment term can only make settlement *less* likely if estimated $M < D_P + D_E$, so any defendant that argued that $M < D_P + D_E$ would be functionally admitting that the reverse payment was not necessary for settlement. The basic reason is that if $D_E > M − D_P$, then paying the entrant to further delay the settlement entry date increases patentholder profits less than it decreases the entrant profits. In contrast, actual monopoly profits invariably exceed the sum of duopoly profits by a significant amount, so that $D_E << M − D_P$. In this more realistic case, paying the entrant to delay the settlement entry date increases patentholder profits more than it decreases entrant profits, which is exactly the joint gain that the settling parties can share via a reverse payment.

[30] For example, if the remaining patent term is 100 months, and the parties expect the patent litigation to last 10 months, then L = .1. We assume both parties share the same expected litigation entry date L because it makes the mathematical model easier to understand but does not change any of the relevant conclusions. If we instead assumed that the entrant was relatively pessimistic about litigation length (so that $L_E > L_P$), that would only widen the range of possible settlement entry dates that (without any reverse payment) can provide settlement payoffs to both the entrant and patentholder that exceed their litigation payoffs. If we instead assumed the entrant was relatively optimistic about litigation length (so that $L_E < L_P$), that would only

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enter at-risk if its expected profits during at-risk entry, LD_E, exceed its expected infringement liability, which is equal to θ_E (its expected probability of losing) times the patentholder's lost profits during at-risk entry $L(M-D_P)$.[31] This means the entrant will enter at-risk only if $\theta_E < D_E/(M-D_P)$. As shorthand, define $\theta^* = D_E/(M-D_P)$, and call a patent "strong" if it deters at-risk entry ($\theta_E > \theta^*$) and "weak" if it does not ($\theta_E < \theta^*$).[32]

We assume the settlement does two things: it sets a settlement entry date of T (on the normalized 0 to 1 time scale) and gives the entrant a reverse payment amount of R. Thus, the entrant's settlement payoff is $(1-T)D_E + R$ because the entrant earns nothing during the T time while it is excluded from the market, earns duopoly profits during the remaining time until the patent expires (i.e., during 1-T), and gets the reverse payment R. Conversely, the patentholder's settlement payoff is $TM + (1-T)D_P - R$ because it earns monopoly profits from time 0 until the agreed-upon entry date T, earns duopoly profits for the remainder of the time until the patent expires (1-T), and pays R to the entrant.

The parties' joint payoff from settlement is thus $TM + (1-T)D_P - R + (1-T)D_E + R$, which simplifies to $D_P + D_E + T(M-D_P-D_E)$. Because monopoly profits exceed the sum of duopoly profits, $M-D_P-D_E$ is positive. Thus, the parties' joint payoff is thus clearly maximized by choosing the maximum T of 1, that is, by setting the settlement entry date to equal the patent expiration date. At this T, the joint settlement payoff is M, that is, monopoly profits throughout the patent period. This is the result we can expect if the *formal* scope of the patent test were

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increase the extent to which a settlement entry date that exceeds the patentholder's expected entry date will exceed the entrant's expected entry date.

[31] This formula assumes the entrant has sufficient assets to pay damages; i.e., that it is not judgment proof. We discuss below the case of a judgment-proof entrant. *See infra* Section Section II.B.2.

[32] Our model assumes firms are risk neutral, but as we show below, our conclusions do not depend on this assumption.

adopted, and the settling parties were free to choose any settlement date as long as it did not exceed the patent expiration date, because it maximizes their joint profits. Because θ_E and θ_P are both less than 1, a settlement entry date of $T = 1$ means that the settlement entry date necessarily exceeds both the probabilistic patent scope and the expected entry date.

However, if the *formal* scope of the patent test were not adopted, we might hope that the threat of antitrust liability would cause the parties to choose a settlement entry date of $T < 1$. Even then, however, neither party would ever enter into a patent settlement that leaves it worse off than it would be if it litigated. We prove next that this unwillingness to approve a settlement that leaves them worse off suffices to assure a settlement is anticompetitive if the reverse payment exceeds the patentholder's anticipated litigation costs.

1. Strong Patent

With a strong patent, the entrant would not enter at risk during the litigation. Thus, expected entry would be delayed by at least the length of litigation L, and also delayed with probability θ for the remainder of the patent term, $1 - L$. Accordingly, the expected entry date is $L + \theta(1-L)$, which can be rearranged as $\theta + (1-\theta)L$.

The patentholder's expected litigation payoff is $LM + (1-L)[\theta_P M + (1-\theta_P)D_P] - C_P$ The first term reflects the fact that the patentholder earns M during the litigation period no matter how that litigation turns out. The next two terms reflect the fact that it earns M if it wins the patent litigation and D_P if it loses. The last term reflects its litigation costs. Given a reverse settlement payment that exceeds the patentholder's anticipated litigation costs by E, the patentholder's settlement payoff is $TM + (1-T)D_P - E - C_P$. Thus, the patentholder will accept the settlement only if $TM + (1-T)D_P - E - C_P > LM + (1-L)[\theta_P M + (1-\theta_P)D_P] - C_P$. Rearranging, this is true only when $T > \theta_P + (1-\theta_P)L + E/(M-D_P)$.

Thus, the minimum settlement entry date that the patentholder will demand is $\theta_P + (1-\theta_P)L + E/(M-D_P)$. According to the patentholder's own probability estimate, the probabilistic patent scope is θ_P and the expected entry date with litigation is $\theta_P + (1-\theta_P)L$. Thus, the minimum settlement date will, by its own estimate, always exceed the probabilistic patent scope by $(1-\theta_P)L + E/(M-D_P)$ and the expected entry date by $E/(M-D_P)$. These terms are all positive because by definition $E > 0$, $M > D_P$, $L > 0$, and $\theta_P \leq 1$. Moreover, the more the reverse payment exceeds the patentholder's anticipated litigation costs, the more the minimum settlement entry date will exceed both benchmarks.

Thus, according to the patentholder's own probability estimate, a settlement with a reverse payment that exceeds its anticipated litigation costs will always delay expected entry and exceed the probabilistic patent scope, even though the patent is strong enough to deter at-risk entry. This is true no matter what the entrant's estimate of the patent strength is.

If the patentholder and the entrant disagree about the patent strength θ, there are two possibilities. One possibility is that $\theta_P > \theta_E$, meaning that the patentholder's estimate of patent strength exceeds the entrant's, so that we can say the entrant is relatively optimistic. If so, then all the above propositions will also be true according to the entrant's probability estimate. Indeed, according to the entrant's lower probability estimate, the settlement will delay entry and exceed the probabilistic patent scope by even more.

The other possibility is that $\theta_E > \theta_P$, meaning that the entrant's estimate of patent strength exceeds the patentholder's, so that we can say the entrant is relatively pessimistic. If so, then the parties will always be able to reach a settlement without any reverse payment. Without any reverse payment, $E = -C_P$, so the above analysis shows that the patentholder will agree to such a settlement if $T > \theta_P + (1-\theta_P)L - C_P/(M-D_P)$, which can be rearranged as $L + \theta_P(1-L) - C_P/(M-D_P)$. The entrant

will agree as long as its settlement payoff exceeds its expected litigation payoff. Without a reverse payment, the entrant's settlement payoff is $(1-T)D_E$. The entrant's expected litigation payoff given litigation delays and no at-risk entry is $(1-L)(1-\theta_E)D_E - C_E$ because the entrant earns nothing during the litigation period, earns D_E after the litigation period if it wins, and must pay litigation costs of C_E. Thus, the entrant will agree to such a settlement if $(1-T)D_E > (1-L)(1-\theta_E)D_E - C_E$. Rearranging, this is true if $T < L + \theta_E(1-L) + C_E/D_E$. Thus, a settlement without any reverse payment will be possible for a strong patent as long as $L + \theta_E(1-L) + C_E/D_E > L + \theta_P(1-L) - C_P/(M-D_P)$. This can be rearranged as $(\theta_E-\theta_P)(1-L) + C_E/D_E + C_P/(M-D_P) > 0$. This inequality is always satisfied because $\theta_E > \theta_P$, given that the entrant is relatively pessimistic, and all the other terms are positive.

Thus, when the entrant is relatively pessimistic, a reverse payment is never necessary to reach settlement, even if the patent is strong. Further, because adding a reverse payment can only increase the entrant's willingness to agree to a later settlement entry date, the settlement they would have reached without the reverse payment would provide an earlier entry date less harmful to consumer welfare, while still exceeding the probabilistic patent scope according to the patentholder's own estimate.

2. Weak Patent

With a weak patent, the entrant would enter at risk immediately during the litigation because the entrant thinks that its expected profits during entry exceed its expected infringement liability. The patentholder's expected litigation payoff would thus be $M\theta_P + D_P(1-\theta_P) - C_P$. The first term reflects the fact that, if the patentholder wins the litigation, the patentholder receives monopoly profits throughout the residual patent period; it gets monopoly profits during the litigation period by recovering damages for lost profits, and it gets monopoly

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profits after the litigation ends because its rival is excluded.[33]   The second term reflects the fact that if the patentholder loses the litigation it will receive only competitive profits. The last term reflects its litigation costs.   Given a reverse settlement payment that exceeds the patentholder's expected litigation costs by E, its settlement payoff is $MT + D_P(1-T) - E - C_P$. Thus, the patentholder will agree to a settlement if $MT + D_P(1-T) - E - C_P > M\theta_P + D_P(1-\theta_P) - C_P$, which simplifies to $T > \theta_P + E/(M-D_P)$.

Thus, the minimum settlement entry date that the patentholder will demand is $\theta_P + E/(M-D_P)$. Accordingly, the earliest possible settlement entry date will exceed the probabilistic patent scope, θ_P, by $E/(M-D_P)$. Although (given at-risk entry) the entrant would otherwise have entered at time 0, an expected entry date of 0 does not accurately convey the expected entry value to consumers because if the entrant loses, it will be precluded from the market after the litigation. One should thus define a constructive expected entry date equal to the expected portion of the patent period for which entry will be precluded, which is $\theta_P(1-L)$, or $\theta_P - \theta_P L$. The minimum settlement entry date of $\theta_P + E/(M-D_P)$ will thus exceed the constructive expected entry date by $\theta_P L + E/(M - D_P)$.

Thus, according to the patentholder's own probability estimate, a settlement with a reverse payment that exceeds its anticipated litigation

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[33] The formula in text assumes the entrant has sufficient assets to pay any patent damages. If the entrant does not, then it is judgment proof to some extent, which does provide a possible ground for rebuttal that we discuss below in Section II.B.2. The formula in text also assumes that damages are not trebled for willful infringement. Because we are here talking about a weak patent, where by definition the odds are relatively low a court would sustain the patent claims, it is very unlikely willful infringement would ever be found, especially because willful infringement is only found in 2.1% of all patent disputes. Kimberly A. Moore, *Empirical Statistics on Willful Patent Infringement*, 14 FED. CIR. B.J. 227 (2004-2005). In any event, the prospect that damages might be trebled would either: (1) raise damages high enough to deter entry, in which case the strong patent proof would apply or (2) raise the patentholder returns from litigation if the patent remained too weak to deter entry, which would make the patentholder demand an even later settlement entry date, worsening all the effects predicted by the model.

costs will always delay expected entry and exceed the probabilistic patent scope. Again, the more the reverse payment exceeds the patentholder's anticipated litigation costs, the more the minimum settlement entry date will exceed both benchmarks.

If the entrant is relatively optimistic, then we can also say that the patentholder's probability estimate θ_P exceeds the entrant's probability estimate θ_E, and thus all the above propositions will also be true according to the entrant's probability estimate. Indeed, according to the entrant's lower probability estimate, the settlement will delay entry and exceed the probabilistic patent scope by even more.

If the entrant is relatively pessimistic, then the parties will be able to reach a settlement without any reverse payment. Without any reverse payment, $E = -C_P$, thus the above analysis shows that the patentholder will agree if $T > \theta_P - C_P/(M-D_P)$. The entrant will agree as long as its settlement payoff exceeds its litigation payoff. Without any reverse payment, the entrant's settlement payoff is $(1-T)D_E$. The entrant's litigation payoff with at-risk entry is $L[D_E - \theta_E(M-D_P)] + (1-L)(1-\theta_E)D_E - C_E$ because during the litigation period it earns D_E but must pay the infringement damages of $M-D_P$ if it loses, after the litigation period it earns D_E if it wins, and it must pay litigation costs C_E either way. With a weak patent the entrant will therefore agree to such a settlement if $(1-T)D_E > L[D_E - \theta_E(M-D_P)] + (1-L)(1-\theta_E)D_E - C_E$. Rearranging, this is true if $T < \theta_E + (1/D_E)[\theta_E L(M-D_P-D_E) + C_E]$. Thus, a settlement without any will be possible for any weak patent as long as $\theta_E + (1/D_E)[\theta_E L(M-D_P-D_E) + C_E] > \theta_P - C_P/(M-D_P)$, which can be rearranged as $\theta_E - \theta_P + (1/D_E)[\theta_E L(M-D_P-D_E) + C_E] + C_P/(M-D_P) > 0$. This inequality is always true because $\theta_E > \theta_P$, given that the entrant is relatively pessimistic, and the other terms are all positive given that monopoly profits exceed duopoly profits.

Thus, when the entrant is relatively pessimistic, a reverse payment is never necessary to reach settlement. Further, because increasing the reverse payment amount beyond the patentholder's anticipated litigation

costs can only increase the entrant's willingness to agree to a later settlement entry date, the settlement they would have reached without a reverse payment above this level would provide an earlier entry date less harmful to consumer welfare, while still exceeding the probabilistic patent scope according to the patentholder's own estimate.

3. Implications

In sum, if the reverse payment exceeds the patentholder's anticipated litigation costs, the following propositions hold true, whether the patent is weak or strong. **First,** the settlement must delay entry and exceed the probabilistic patent scope according to the patentholder's own estimate of the patent strength. This is true whether the entrant is relatively optimistic or pessimistic. Further, the higher the reverse payment, the worse these effects are.

Second, if the entrant is relatively optimistic, then both benchmarks are exceeded even further according to the entrant's own estimate of the patent strength. Such a settlement thus anticompetitively delays entry and exceeds the probabilistic patent scope according to *both* the patentholder's *and* the entrant's estimates of the patent strength. This means that both the entrant and patentholder knew the settlement was anticompetitive.

Third, if the entrant is relatively pessimistic, the parties could always settle without any reverse settlement payment at all. In this case, a reverse payment that exceeds the patentholder's anticipated litigation costs is not only *unnecessary* to reach settlement, but also means that the settlement entry date *must* delay entry and exceed the probabilistic patent scope, according to the patentholder's *own* probability estimate. There is thus no reason to tolerate a reverse payment of this size because without it the alternative settlement the parties could have reached would have provided an earlier entry date less harmful to consumer welfare, while still exceeding the probabilistic patent scope according to the patentholder's own estimate. Because the patentholder's own

estimate is the only estimate that can affect its incentives to invest in innovation, it is the key estimate to consider in determining whether the settlement exceeds the optimal patent reward.

Defenders of reverse payments often stress that they may sometimes be necessary to reach settlement. But the above analysis proves that a reverse payment that exceeds the patentholder's anticipated litigation costs is never necessary to secure a *desirable* settlement. Instead, such a reverse payment can be necessary to reach settlement only when both the patentholder and entrant know the settlement is anticompetitive. Thus, courts can safely condemn settlements with reverse payments of this size because doing so will only deter unnecessary or anticompetitive reverse payments.

To put it another way, when a reverse payment exceeds the patentholder's anticipated litigation costs, a court can be confident that the settlement entry date will exceed the optimal patent reward, while anticompetitively reducing consumer welfare compared to either litigation or an alternative settlement without a reverse payment of that size. This conclusion does not rely on any particular level of patent strength θ or any assumption that the parties agreed on that level. Nor does it require knowledge of the parties' varying estimates of patent strength, or which is greater. It does not even require us to assume the parties picked the settlement that maximized profits or to make any particular assumption about the extent to which the parties considered the risk of antitrust liability. It simply requires us to assume that neither party to the patent dispute would agree to a settlement that made it worse off.

The proof above nowhere needed to assume the existence of anything like the Hatch-Waxman Act's 180-day period, when only the first-filing generic entrant is permitted to enter. That generic exclusivity period is often cited as the main culprit, because it allows the patentholder and first-filing generic to settle in a way that delays the entry of other generic entrants. Because our proof does not rely on this

effect, it shows that the problem with reverse payment settlements extends well beyond the Hatch-Waxman Act and the pharmaceutical industry regulated by it.

B. Presumption and Limited Grounds for Rebuttal

The above proof assumes that at-risk entrants are not judgment proof and that the reverse payment does not have some other procompetitive justification. The proof thus suggests that courts should presumptively condemn settlements when the reverse payment exceeds the patentholder's litigation costs, unless the defendant can rebut this presumption by showing either: (1) that the entrant would have entered at risk and is judgment proof to a sufficient effect to change the results; or (2) that some other procompetitive justification exists and offsets the anticompetitive effect. Absent such rebuttal, the proof shows that a settlement with a reverse payment of this size always has anticompetitive effects. In particular, absent such rebuttals, a reverse payment of this size precludes the possibilities: (1) that the settlement entry date is actually earlier than the expected entry date or within the probabilistic patent scope; and (2) that the patentholder lacks market power. Defendants thus should not be permitted to rebut the presumption by trying to prove that either of those possibilities is true.

1. Establishing Presumption by Comparing Reverse Payment to Anticipated Litigation Costs

To apply the presumption indicated by our proof, a court need only determine whether the reverse payment amount exceeded the patentholder's anticipated litigation costs. The amount of the reverse payment is easy to ascertain if the settlement just specifies a monetary payment to the entrant. Sometimes, however, a payment to the entrant consists of consideration other than money, such as a business license, in which case the reverse payment amount equals the expected value (at the time of settlement) of that consideration. Other times there is also some return consideration, in which case the reverse payment amount is the

difference between the expected value of the consideration flowing to and from the entrant, leaving aside the value of setting the entry date and avoiding litigation costs.

One must also estimate anticipated litigation costs. This can be tricky because the settlement means that those litigation costs have not actually occurred. Thankfully, there are three, easily administrable ways that a court can determine whether the reverse payment amount exceeded the patentholder's anticipated litigation costs. We present them in order from least costly to most costly.

First, the reverse payment amount may sometimes exceed the patentholder's own estimate of litigation costs in its documents. This is a sufficient, but not necessary condition for finding that the reverse payment exceeded its anticipated litigation costs because, if this presumption were adopted, patentholders would predictably start to inflate their recorded estimates of litigation costs in order to evade antitrust liability. Thus, courts should move onto the next method if this first method does not indicate that the reverse payment exceeded the patentholder's anticipated litigation costs.

Second, a court could compare the reverse payment amount to the upper bound of litigation costs from similar cases. The largest publicly documented amount spent on patent litigation that we could find was $15 million, which was in a case where the patented product had over $1 billion in annual sales.[34] Empirical literature confirms that this $15 million market is an upper bound. Surveys of intellectual property lawyers indicate that the 75th percentile for patent litigation costs through trial for cases with more than $25 million in controversy was around $7.5 million in 2011.[35] This 75th percentile is $10 million for

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[34] *See* Richard D. Margiano, *Cost And Duration of Patent Litigation* (published online at Managing Intellectual Property, Feb. 1, 2009), *available at* http://www.managingip.com/Article/2089405/Cost-and-duration-of-patent-litigation.html.

[35] 2011 AIPLA Report of the Economic Survey at 35-36.

cases in New York,[36] but even that figure is only two-thirds of the $15 million upper bound. A court could therefore be confident that any reverse payment settlement in excess of the $15 million upper bound exceeded the patentholder's anticipated litigation costs.

The reverse payments in past cases have often far exceeded $15 million, including $66.4 million in *Tamoxifen*, $123 million in *Valley Drug,* $264-372 million in *Watson*, and $324-425 million in *Arkansas Carpenters*.[37] These past cases show that in many situations, including those arising in the past key appellate cases, applying this test should not require significant fact finding.

If neither of the above tests is dispositive, then the parties could call patent lawyers as experts to estimate the patentholder's anticipated litigation costs. For several reasons, this method of objectively measuring the patentholder's anticipated litigation costs is significantly more desirable than trying to objectively measure the patent strength, as one would do under the objective probabilistic patent scope approach. First, because large firms that try large patent cases almost exclusively bill by the hour, one need only know the average amount of time that was expected to be necessary for patent litigation in order to estimate the patentholder's anticipated litigation costs; one need not estimate the probability that the patentholder would win or lose, which is far more difficult. Second, hindsight bias is not a concern because most firms' hourly billing structures mean that patent litigation costs do not depend

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[36] *Id.* at I-154. The reports from previous years have similar figures, with the highest 75th percentile reported in any year being $11.5 million for cases in the Los Angeles region in 2009. *See* 2009 AIPLA Report of the Economic Survey at I-29.

[37] In re Tamoxifen Citrate Antitrust Litig., 466 F.3d 187, 190, 194 (2d Cir. 2006) ($66.4 million total to two generics); Valley Drug Co v. Geneva Pharmaceuticals, Inc., 344 F.3d. 1294, 1300-01 (11th Cir. 2003) ($123 million total to two generics); FTC vs. Watson Pharmaceuticals, 677 F.3d. 1298, 1305 (11th Cir. 2012) ($60 million to one generic and $19-30 million annually to another generic for the 10.75 years from January 2006 to September 2015); Arkansas Carpenters Health and Welfare v. Bayer AG, 604 F.3d 98, 102 (2d Cir. 2010) (payment of $49.1 million plus quarterly payments of $12.5 to $17.125 million 22 quarters).

on whether the patentholder wins or loses. Third, firms that honestly were trying to keep their settlement payments below the patentholder's anticipated litigation costs could easily insulate themselves from being second-guessed by a court by soliciting arms-length estimates of their litigation costs from law firms prior to the settlement.

2. Rebuttal by Showing At-Risk Entrant Is Sufficiently Judgment Proof

Whether an entrant is judgment proof can affect whether or not the patentholder expects it to enter at risk, although the effects are mixed. On the one hand, if the entrant is judgment proof, then it pays only a fraction of damages if it loses, which makes it more likely to enter at risk. On the other hand, being judgment proof also means that if it loses, the entrant will go bankrupt and the managers will lose their jobs, which will make the entrant's managers risk averse, which makes it less likely that the entrant will enter at risk.

If the patent holder concludes that the net effect is that the entrant will not enter at risk, then our proof for strong patents continues to apply without any modification. The reason is that if the patentholder does not expect at-risk entry, then whether the entrant is judgment proof is irrelevant to assessing the patentholder's litigation payoff because it does not expect to sue for damages anyway.

However, if the patentholder concludes that the net effect is that the entrant will enter at risk, then it becomes relevant that our model for weak patents assumes that the entrant is not judgment proof, that is, that it has sufficient assets to fully pay any patent damages. If we instead assume that an at-risk entrant would be judgment proof, then a patentholder could suffer an uncompensated loss of patent profits from such at-risk entry. This would reduce the expected litigation payoff to the patentholder, and thus would make it willing to accept a settlement with an earlier settlement date than our proof predicted with at-risk entry.

This effect could mean that, even with a reverse payment that exceeds litigation costs, the patentholder might accept a settlement entry date within the probabilistic patent scope. To see why, call J the share of damages (between 0 and 1) that a judgment-proof entrant will be unable to pay. To simplify, assume here that both the patentholder and entrant perceive the same patent strength of θ. Then, assuming at-risk entry, we must subtract $JL\theta(M-D_P)$ from the previously predicted litigation payoff because the patentholder no longer expects to collect that share of its lost profits damages during litigation if it wins. Thus, its litigation payoff is now $M\theta + D_P(1-\theta) - C_P - JL\theta(M-D_P)$. If this litigation payoff is exceeded by its settlement payoff, $MT + D_P(1-T) - E - C_P$, the patentholder will agree to settlement. This simplifies to saying the patentholder will agree to a settlement entry date of $T > \theta + E/(M-D_P) - JL\theta$. The minimum settlement entry date of T that the patentholder would accept could thus be within the probabilistic patent scope if $JL\theta > E/(M-D_P)$, which we can rearrange as when $JL\theta(M-D_P) > E$. That is, the minimum settlement entry date might be within the probabilistic patent scope if (1) the expected amount of uncollectable lost profits exceeds (2) the difference between the reverse settlement payment and the patentholder's anticipated litigation costs.

However, this is just the minimum settlement entry date. The actual settlement entry date could also be larger. The at-risk entrant's litigation payoff would be $L[D_E - \theta(M-D_P)] + (1-L)(1-\theta)D_E - C_E$ plus the $JL\theta(M-D_P)$ in damages it expects to avoid because it is judgment proof. If this is exceeded by its settlement payoff, $(1-T)D_E + R$, it will accept settlement. This can be rearranged to conclude that the at-risk entrant will accept settlement if $T < \theta + (1/D_E)[R + C_E + L\theta(M-D_P-D_E) - JL\theta(M-D_P)$. The maximum settlement the at-risk entrant would accept can thus exceed the probabilistic patent scope where the sum of the reverse payment, avoided entrant litigation costs, and joint profits from excluding at-risk entry for a valid patent exceed the expected amount of uncollectable lost profits. Because the settlement could be reached anywhere between the minimum T the patentholder would accept and the maximum T the entrant would accept, one cannot know in such a

case whether the settlement entry date will or will not exceed the probabilistic patent scope. On the other hand, where the defendants can show that the expected amount of uncollectable lost profits do exceed the sum of the reverse payment, avoided entrant litigation costs, and joint profits from excluding at-risk entry for a valid patent, then we do know that the settlement entry date must have been within the probabilistic patent scope.

However, even in such a case, the settlement entry date will still exceed the expected entry date if the reverse payment exceeds litigation costs. As shown above, the (constructive) expected entry date without litigation is $\theta(1-L)$. The settlement entry date will always exceed this if $\theta + E/(M-D_P) - JL\theta > \theta(1-L)$, which rearranges to if $(1-J)L\theta + E/(M-D_P) > 0$. This is always true because $J \leq 1$, E is positive, and monopoly profits exceed duopoly profits. The extent to which the minimum settlement entry date will exceed the constructive expected entry date will thus increase the higher the reverse payment, and the higher the length of litigation, odds of patent victory, or share of damages the judgment proof entrant will pay.

In sum, even if the defendants can show that at-risk entry would have occurred by a judgment-proof entrant, that showing will mean only that the settlement entry date *could* be within the probabilistic patent scope *only* if they also show that expected amount of uncollectable lost profits exceeds the difference between the reverse payment and the patentholder's anticipated litigation costs. It will mean the settlement entry date necessarily *will* be within the probabilistic patent scope *only* if the defendants can also show that the expected amount of uncollectable lost profits exceeds the sum of the reverse payment, avoided entrant litigation costs, and joint profits from excluding at-risk entry for a valid patent. Further, even in such a case, the settlement will clearly delay entry, thus creating at most a murky tradeoff between harming ex post consumer welfare (through that delayed entry) and benefiting ex ante consumer welfare (by increasing the patent reward to a level still within the probabilistic patent scope).

3. Rebuttal by Proving Other Procompetitive Justifications

Leaving aside cases of judgment-proof entrants, the proof above shows that when a settlement does nothing else other than set an entry date and provide reverse payments that exceed the patentholder's anticipated litigation costs, then the settlement cannot be justified as necessary to reach a settlement that: (a) speeds entry (which would increase ex post consumer welfare); or (b) increases the patent reward to a level still within the probabilistic patent scope (which would increase ex ante consumer welfare). The reason is that our proof precludes those procompetitive justifications.

However, in some cases, settlements might have unique features that create *other* procompetitive justifications that can offset any anticompetitive effects.[38] For example, one of us was a defense expert in the *In re Cardizem* case and found that the settlement there had the unique feature that it allowed the generic to bring a *re*formulation of its generic drug on to the market more quickly than otherwise possible. The entry in that case was governed by the Hatch-Waxman Act, which allows a patentholder to automatically delay entry by a reformulated generic by an additional 30 months. The settlement prevented this additional delay by providing that the reformulated generic would be treated like the original generic. The reverse payment was then used to fund the reformulation, which the patentholder ultimately conceded was outside the patent. It thus resulted in earlier generic entry. Further, in that case, the evidence indicated that the generic was judgment proof to a significant extent. It was thus a particularly strong case to rebut a presumption that reverse payment settlements have anticompetitive effects.[39]

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[38] The Third Circuit has recognized the need to allow this sort of rebuttal for other procompetitive justifications. *In re* K-Dur Antitrust Litigation, 2012 WL 2877662, at *16 (3rd Cir. 2012).

[39] Aiding this sort of rebuttal evidence was other evidence that minimized the possible anticompetitive effects that needed to be rebutted in that case. The Cardizem settlement differed from the sort we model in this paper because it did not end the patent litigation and set a fixed

4. *No Rebuttal by Showing Lack of Market Power*

For linguistic simplicity, the model above assumed a monopolist patentholder facing an entrant. However, the only necessary condition for our proof is that the joint profits of the patentholder and entrant would be higher without entry than with it. This condition will hold as long as the patent holder has any degree of market power, even if it falls well short of monopoly power.

Further, the fact that the reverse payment exceeds litigation costs itself proves that the patentholder has the requisite market power. If the patentholder lacked market power, then by definition its sales profits would be identical no matter when the entrant entered the market, because other firms would constrain the patentholder to price at cost regardless of when this entrant entered. If so, the patentholder would earn the same business profits whether it won the patent litigation, lost the patent litigation, or settled and excluded the entrant for some period. The only effect of settlement would thus be that it would save its anticipated litigation costs and incur the cost of making the reverse payment. Thus, if the reverse payment amount exceeds the litigation costs, the settlement would always make the patentholder worse off if it lacked market power. Accordingly, the patentholder's willingness to make a reverse payment that exceeds its anticipated litigation costs necessarily means that it believes it has market power.

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settlement entry date. Rather, it was an interim settlement that required the parties to continue the patent litigation, precluded entry only during the litigation and only if the litigation did not last too long, and allowed the generic to keep the reverse payment only if it won the litigation. Further, in that case anticompetitive effects were undermined by strong evidence that: (1) the entrant would not have entered at-risk anyway, so that such a purely interim settlement did not preclude any entry by the settling generic; and (2) no other generic entry was delayed because (a) under the rules that then prevailed, the settling generic had to win the patent litigation to preclude other generics, and (b) no other generic received FDA approval in time to enter any earlier anyway. Given this evidence, the FTC concluded that the settlement had not actually delayed any generic entry. *See* FTC Analysis to Aid Public Comment at 4, *available at* http://www.ftc.gov/os/2001/04/hoechstanalysis.pdf.

Given this, if the reverse payment exceeds litigation costs, courts should not allow defendants to rebut the presumption by arguing that the patentholder lacked market power. Instead, a reverse payment of that size itself proves market power, and obviates any need to establish market definition or market power.

This same analysis also rebuts the claim that anticompetitive effects could be eliminated because non-settling entrants can still challenge the patent.[40] Even though that possibility generally exists, our analysis proves that the patent holder would never make a reverse payment of this size if non-settling entrants could – through entry or patent litigation – create the same constraint on its market power. The patent holder would only make a reverse payment that exceeds its anticipated litigation costs if excluding the settling entrant confers an enhanced market power on the patentholder that it otherwise would not enjoy.

5. No Rebuttal by Showing Risk Aversion

Our model assumes firms are risk neutral. This assumption generally holds, but even if it did not, it would not alter our conclusions.

Entrants are typically public corporations with a market capitalization that exceeds the potential patent damages from the case at hand. In those circumstances, the entrant's managers and shareholders have incentives to behave in a risk-neutral manner that maximizes expected profits. In other situations, entrants might be risk averse, in which case they might not enter at risk even though a risk-neutral entrant would. But this would merely expand the set of cases for which the proof for strong patents applies, which proved anticompetitive effects. Thus, whether or not risk aversion would deter at-risk entry, a reverse

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[40] *See* FTC vs. Watson Pharmaceuticals, 677 F.3d. 1298, 1315 (11th Cir. 2012).

payment that exceeds anticipated litigation costs would be anticompetitive.

Risk aversion is unlikely to be a serious issue for the patentholder. Because the patentholder does not face the risk of patent damages, aversion to loss is not relevant to it. Although individuals might sometimes prefer to avoid variation in profits by accepting certain profits with lower expected value, this is unlikely to be relevant for a publicly held corporation, which generally has incentives to maximize expected profits on behalf of a diversified set of shareholders. Managers who do not maximize expected profits increase the risk that their conduct will be punished by product markets, capital markets, labor markets, takeover threats, shareholder voting, and lower valuation of their stock options. Further, because the issue for patentholders is merely variation in the degree of profits, decisions to litigate are unlikely to create a risk that the corporation will go out of existence that could override those ordinary managerial incentives. In any event, to the extent that risk aversion could cause managers to enter into settlements that fail to maximize expected corporate profits, that effect reflects an undesirable agency cost that can only be exacerbated by reverse payments that make such settlements more likely. Considering patentholder risk aversion would thus only strengthen the case for invalidating reverse payments that exceed the patentholder's litigation costs.

III. SETTLEMENTS WITHOUT REVERSE PAYMENTS THAT EXCEED LITIGATION COSTS

If the reverse payment does not exceed the patentholder's anticipated litigation costs, then we can no longer be sure that a settlement that sets an entry date will *necessarily* delay entry and exceed the probabilistic patent scope. But we prove below that such a settlement *usually* will have these anticompetitive effects. We do so by modeling the simple case of a settlement that sets an entry date but has no reverse payment. The FTC, DOJ, and many prominent antitrust and

patent scholars have assumed that such settlements will likely produce settlement entry dates that equal the probabilistic patent scope and expected entry date.[41] We prove that this widespread assumption is incorrect; instead such settlements are usually anticompetitive. This necessarily means that settlements are also usually anticompetitive if they have a positive reverse payment that is lower than anticipated patentholder litigation costs, because a positive reverse payment can only increase the settlement entry date that the patentholder would demand and that the entrant would accept.

Because this subset of settlements is not susceptible to proofs showing that they are necessarily anticompetitive, it may make sense to allow rebuttal through direct inquiry into the probabilistic patent scope and expected entry date. Although that inquiry is difficult, it can be bounded in various ways. To the extent those bounds do not apply and a court concludes that such a direct inquiry is too unreliable, then the best substantive solution would be to preclude rebuttal because most such settlements are anticompetitive. However, the better method for resolving these cases might be procedural. The underlying problem that makes it possible for patentholders and entrants to collude in settlements that benefit themselves at the cost of buyers is the fact that patent law does not give buyers standing to challenge dubious patents. Thus, a possible procedural solution would be to provide that, when patent settlements preclude entry until a settlement entry date, the law should recognize an exception that gives buyers that standing.

A.   *Proof That Even Settlements With Zero Reverse Payment Are Usually Anticompetitive*

Because we are just trying to get a rough sense of likelihood, rather than prove necessary effects, we adopt the simplifying assumption that the entrant and patentholder perceive the same patent strength of θ and

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[41] *See supra* note __; *see infra* Part IV.

same anticipated litigation cost C. If their perceptions vary, that could increase or decrease the likelihood of anticompetitive settlements, and thus has no clear effect on overall likelihood. Otherwise, we use the same model as in Part II.

1. Strong Patent

Take first the case of a strong patent. As shown above, the patentholder's expected litigation payoff is $LM + (1-L)[\theta M + (1-\theta)D_P] - C$. Without a reverse payment, its settlement payoff is $TM + (1-T)D_P$. It will accept a settlement only if the latter is greater than the former, which one can rearrange to show that the minimum settlement entry date it will accept is $T_{min} = \theta + L(1-\theta) - C/(M-D_P)$. Thus, T_{min} will exceed the probabilistic patent scope whenever $L(1-\theta) > C/(M-D_P)$, which can be rearranged as $(1-\theta)L(M-D_P) > C$. In words, the minimum settlement entry date will exceed the probabilistic patent scope whenever the patentholder's anticipated litigation costs are less than the additional monopoly profits it expects to make because the strong patent deters entry during litigation even when in fact the patent would have lost. Thus, there are some cases where the minimum settlement entry date will necessarily exceed the probabilistic scope of a strong patent, but other cases when it will not.

With a strong patent, the expected entry date is $L + \theta(1-L)$, which is the same as $\theta + L(1-\theta)$. Thus, T_{min} is always lower than the expected entry date by $C/(M-D_P)$, that is by the ratio of its anticipated litigation costs divided by lost monopoly profits if the entrant had entered throughout.

However, T_{min} just tells us the bottom edge of the bargaining range. To get the full bargaining range, one needs to also know the maximum settlement date the entrant would accept. The entrant's expected litigation payoff is $(1-L)(1-\theta)D_E - C$. Without a reverse payment, its settlement payoff is $(1-T)D_E$. It will accept a settlement only if the latter is greater, which one can rearrange to show that the

maximum settlement entry date it will accept is $T_{max} = \theta + L(1-\theta) + C/D_E$. This maximum thus always exceeds the probabilistic patent scope by $L(1-\theta) + C/D_E$. It also always exceeds the expected entry date by C/D_E. Because bargaining can produce a settlement anywhere between T_{min} and T_{max} this shows that, for strong patents, settlements without any reverse payment can produce settlement entry dates that exceed both the probabilistic patent scope and the expected entry date.

Given that any settlement between T_{min} and T_{max} is possible, it makes some sense to assume that all such settlements are equally likely, so that the middle of this settlement range equals the average expected settlement entry date, T_{avg}. Given the above, $T_{avg} = \theta + L(1-\theta) + C/2D_E - C/2(M-D_P)$. T_{avg} will thus exceed the expected entry date, $\theta + L(1-\theta)$, whenever $C/2D_E > C/2(M-D_P)$, which is true if $M-D_P-D_E > 0$, which is always true because monopoly profits exceed duopoly profits. T_{avg} will exceed the probabilistic patent scope by this amount plus $L(1-\theta)$.

Thus, even with zero reverse settlement payment and a strong patent, the middle of the settlement range always both delays entry and exceeds the probabilistic scope of the patent. This rebuts the prevailing view that settlements without reverse payments will do neither. To the contrary, the above proof establishes that, if we assume all settlements in the bargaining range are equally likely, settlements without reverse payments are usually anticompetitive.

To get some sense of just how likely these anticompetitive effects are, we need to estimate some of these parameters. Given the data summarized above, $10 million appears to be a good high end estimate of average litigation costs, so we will use that as our average estimate of C. The lion's share of reverse payment settlements have occurred in pharmaceutical markets, where on average, the residual patent term is

90.2 months and monthly pre-entry sales are \$72.6 million.[42]   This means average total sales for a monopolist during the remaining patent term would be \$6.548 billion. The average length of patent litigation after the end of the automatic Hatch-Waxman stay is about 18 months.[43] We can thus estimate that on average L = 18/90.2 = .1774.

On average, a single generic entrant prices at 70-88% of the pre-entry price charged by the incumbent.[44] To get a single average, we average these to estimate the generic price is 79% of the patentholder's pre-entry price. (With multiple generic entrants, the drop in price is much higher, so the results with the assumption here of only one generic entrant are quite conservative.) Empirical studies show that incumbent drug prices remain fairly constant in response to entry.[45] Costs are

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[42] This data is drawn from Professor Scott Hemphill's invaluable survey of 143 patent settlements from 1984 to 2008. *See* Hemphill, *An Aggregate Approach To Antitrust*, 109 COLUM. L. REV. 629, 653 (2009); Hemphill, *Drug Patent Settlements Between Rivals: A Survey* (working paper 2009). I use the date of the settlement agreement, rather than the expiration of the 30 month Hatch-Waxman stay, as the best indicator of when generic entry was first possible because sometimes the Hatch-Waxman stay gets extended for other reasons, like pediatric exclusivity. If one instead used the expiration of the 30 month stay, the residual patent period would be 93.2 months. Because our focus is on the prospective issue of how likely it is that settlements that set an entry date would be anticompetitive if no reverse payment were allowed, we combine results from settlements that did and did not have a reverse payment. If one instead wanted to ask about the likelihood that past settlements without any reverse payment were anticompetitive, then the residual patent period for only those settlements was 75.4 months and the average monthly sales figure would be \$42.4 million. This would not alter our qualitative conclusions. *See infra* Section III.A.3 (showing shows that with cutting the residual patent period and annual profit level in half would actually make it a bit more likely that settlements without reverse payments are anticompetitive).

[43] *See* RBC Capital Markets, Pharmaceutical Industry Comment, Jan. 15, 2010, Appendix C.

[44] Frank, R. G. & Salkever, D. S., Generic entry and the pricing of pharmaceuticals. 6(1) J. Econ. & Mgmt. Strategy, 75, 84 (1997) (70%); David Reiffen and Michael R. Ward, *Generic Drug Industry Dynamics,* 87(1) *Review of Economics and Statistics* 37, 43 (Feb. 2005) (88%).

[45] In fact, incumbents increase their drug prices slightly in response to generic entry, but because the price increase is only 0.7% with one generic entrant, we treat it as unchanged. Frank & Salkever, supra note at 87. Apparently, the incumbent makes more money by keeping its price high to price-insensitive customers, and ceding the price-sensitive customers to the generic, than the incumbent would make it is tried to compete for the latter by lowering its price.

around 20% of the monopolist's pre-entry price,[46] which suggests that on average M = 80% of \$6.548 billion = \$5.238 billion. Generic producers get 40-50% of the market.[47] To get a single average, we average these to estimate a 45% generic market share. Because the empirical evidence indicates that generic entry does not alter total market volume,[48] this means that on average D_P = \$2.881 billion and D_E = \$1.732 billion.[49]

Given these numbers, the average threshold probability to have a strong patent $\theta^* = D_E/(M-D_P) = 47.2\%$. Thus, the patentholder's odds of winning the patent would on average have to exceed 47.2% to be a strong patent that deters at-risk entry.

For such a strong patent, if we plug the above values into the equation for T_{min}, we get that $T_{min} = 0.1732 + 0.8226\theta$. Thus, the minimum settlement entry date exceeds the probabilistic scope of a strong patent whenever $0.1732 + 0.8226\theta > \theta$, which is true whenever $\theta < 97.6\%$. Thus, even without any reverse payment, the minimum settlement entry date exceeds the probabilistic scope of a strong patent unless the patentholder is all but assured of winning the patent litigation.

We can also ascertain the portion of the settlement range that exceeds the probabilistic scope of a strong patent. Given the above, this portion is 100% for patent strengths between 47.2% and 97.6%. For

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[46] Reiffen & Ward, *supra* note , at 43.

[47] Frank & Salkever, supra note at 89.

[48] *See* Gautier Duflosa & Frank R. Lichtenberg, *Does competition stimulate drug utilization? The impact of changes in market structure on US drug prices, marketing and utilization,* 32 INT'L REV. L. & ECON. 95, 96 (2012) (showing that net volume is unchanged by entry into drug markets because entry leads to a decline in both prices and marketing expenditures, which offset each other).

[49] Because the patent holder profit per sale is unchanged, D_P = 55% of M. The generic who is a single entrant has a price that is 79% of the monopolist's with the same marginal cost of 20%, so earns 59% of the monopolist gross sales for 45% of volume, so has average monthly profits of 59% of 45% of \$72.46 = \$19.2 million. Thus, if it could obtain those profits for the entire residual patent period, it would get \$1.732 billion.

extremely strong patents with strengths from 97.6% to 100%, the portion of the settlement range above $\theta = (T_{max}-\theta)/(T_{max}-T_{min})$. Plugging in the values into the equation for T_{max}, we get that $T_{max} = 0.1832 + 0.8226\theta$. Inserting that into the prior equation, we find that (given average numbers) the portion of the settlement range that exceeds the probabilistic patent scope is $18.29 - 17.71\theta$. Over this range of extremely strong patents, this portion drops from 99% to 58% as the patent strength goes from 97.6% to 100%.

For a strong patent, the expected entry date is $L + \theta(1-L) = 0.177400 + 0.8226\theta$. The portion of the settlement range above the expected entry date is $(T_{max} - 0.177400 + 0.8226\theta)/(T_{max} - T_{min}) = 58\%$ for all patent strength levels that constitute a strong patent.

In sum, even with zero reverse payment and a strong patent, the middle of the settlement range always exceeds both the expected entry date and the probabilistic patent scope. Assuming parties are equally likely to reach any settlement in the bargaining range, this means that settlements without reverse payments are usually anticompetitive. Further, using actual average numbers for such settlements, a settlement is 100% likely to exceed the probabilistic patent scope for a strong patent unless the patent is extremely strong (more than 97.6% certain to win). Even for extremely strong patents whose patent strength ranges from 97.6-100%, the settlement is still 58-99% likely to exceed the probabilistic patent scope. Further, the settlement entry date is 58% likely to exceed the expected entry date for all levels of patent strength that qualify as a strong patent.

2. Weak Patent

Next consider a weak patent. As shown above, the patentholder's expected litigation payoff is $M\theta + D_P(1-\theta) - C$. It will accept a settlement without a reverse payment if this is exceeded by its settlement payoff of $TM + (1-T)D_P$. Thus, $T_{min} = \theta - C/(M-D_P)$. Accordingly, a settlement entry date that is lower than the probabilistic scope of a weak

patent is always possible without a reverse payment. Indeed, T_{min} is always lower than the probabilistic scope of a weak patent by $C/(M-D_P)$, that is by the ratio of its anticipated litigation costs divided by lost monopoly profits if the entrant enters throughout. The constructive expected entry date for a weak patent is $\theta(1-L)$. Thus, T_{min} will exceed the expected entry date if $\theta L > C/(M-D_P)$, which can be rearranged as $\theta L(M-D_P) > C$. Accordingly, there are some cases where the minimum settlement entry date will necessarily exceed the expected entry date. It will do so for a weak patent whenever the patentholder's anticipated litigation costs are less than the lost monopoly profits it suffers from at-risk entry in cases where its patent would have won.

The entrant's expected litigation payoff given a weak patent is $L[D_E - \theta(M-D_P)] + (1-L)(1-\theta)D_E - C$. It will accept a settlement without a reverse payment if this is exceeded by its settlement payoff of $(1-T)D_E$. Thus, $T_{max} = \theta(1-L) + (1/D_E)[\theta L(M-D_P) + C]$. This maximum thus always exceeds the expected litigation entry date by $(1/D_E)[\theta L(M-D_P) + C]$. This maximum also exceeds the probabilistic patent scope if $(1/D_E)[\theta L(M-D_P) + C] > L\theta$. This can be rearranged as $\theta L(M-D_P-D_E) + C/D_E > 0$. This is always true because monopoly profits are greater than duopoly profits and litigation costs are positive. Thus, the maximum settlement entry date always exceeds both the probabilistic patent scope and expected entry date. Accordingly, for weak patents as well as strong, settlements without any reverse payment can produce settlement entry dates that exceed both the probabilistic patent scope and the expected entry date.

Given the above, $T_{avg} = \theta + \theta L(M-D_P-D_E)/2 + C/2D_E - C/2(M-D_P)$. The second term is positive because monopoly profits exceed duopoly profits, so T_{avg} will always exceed the probabilistic patent scope, θ, if $C/2D_E > C/2(M-D_P)$. This is true if $M-D_P-D_E > 0$, which is always true because monopoly profits exceed duopoly profits. Thus, T_{avg} will always exceed the probabilistic of a weak patent. The constructive expected entry date for a weak patent is $\theta(1-L)$, thus T_{avg} will exceed this expected entry date by this amount plus θL.

Thus, even with zero reverse settlement payment and a weak patent, the middle of the settlement range always both delays entry and exceeds the probabilistic scope of the patent. If we assume all settlements in the bargaining range are equally likely, settlements without reverse payments are usually anticompetitive for weak patents as well as strong.

Using the numbers above, we can get a sense of just how likely these anticompetitive effects are. Given those numbers, a weak patent exists if $\theta < 47.2\%$. For such a weak patent, if we plug the above values into the equation for T_{min}, we get that $T_{min} = \theta - .00424$. Plugging in the values into the equation for T_{max}, we get that $T_{max} = .005774 + 1.064\theta$. The portion of the settlement range above $\theta = (T_{max}-\theta)/(T_{max}-T_{min}) = (.005774 + .064\theta)/(0.010016 + .064\theta)$. This ranges from 58-89% for weak patents. Thus, if we assume parties are equally likely to reach any settlement in the bargaining range, a settlement with no reverse payment is 58-89% likely to exceed the probabilistic patent scope even for a weak patent that cannot deter at-risk entry.

The constructive expected entry date for a weak patent is $\theta(1-L) = 0.8226\theta$. The minimum settlement entry date $T_{min} = \theta - .00424$. Thus, the minimum settlement entry date exceeds the constructive expected entry date if $\theta - .00424 > 0.8226\theta$, which is true if $\theta > 2.4\%$. Accordingly, even without any reverse payment, the minimum settlement entry date exceeds the constructive expected entry date other than for a very weak patent that is less than 2.4% likely to win the patent litigation.

We can also ascertain the portion of the settlement range that exceeds the expected entry date. Given the above, this portion is 100% for patent strengths between 2.4% and 47.2%. For patent strengths less than 2.4%, the portion of the settlement range that exceeds the expected entry date is $(T_{max}-0.8226\theta)/(T_{max}-T_{min}) = (.005774 + 0.2414\theta)/(0.01002$

+ .064θ). Over this range of extremely weak patents, this portion ranges from 58-99%.

Accordingly, for a weak patent like a strong one, a settlement with no reverse payment still results in a settlement range whose midpoint always exceeds both the expected entry date and the probabilistic patent scope. Assuming parties are equally likely to reach any settlement in the bargaining range, this means that settlements without reverse payments are usually anticompetitive. Further, using actual average numbers for such settlements, a settlement is 100% likely to exceed the expected entry date unless the patent is extremely weak (less than 2.4% likely to win). Even for extremely weak patents whose patent strength ranges from 0-2.4%, the settlement is still 60-99% likely to exceed the expected entry date. Further, the settlement entry date is 58-89% likely to exceed the probabilistic patent scope.

3. Summary

We have thus proven that, even with zero reverse payment, a settlement that sets an entry date will produce a settlement range whose midpoint exceeds both the probabilistic patent scope and the expected entry date at *any* level of patent strength and for *any* level of market profits, residual patent period, litigation length, and litigation costs. Because we have no particular reason to assume that some settlements in the possible range are any more likely than others, it makes some sense to assume all of them are equally likely. If so, then we can say that all settlements that set an entry date with no reverse payment are usually anticompetitive, regardless of the market particulars.

If we do use typical numbers for such settlements, we can go further and estimate the likelihood that they are anticompetitive. The graph below combines the above analysis to depict the portion of the bargaining range that exceeds the probabilistic patent scope (vertical axis) at each level of possible patent strength (horizontal axis).

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Figure 1

**Portion of Bargaining Range Above θ
with No Reverse Payment**
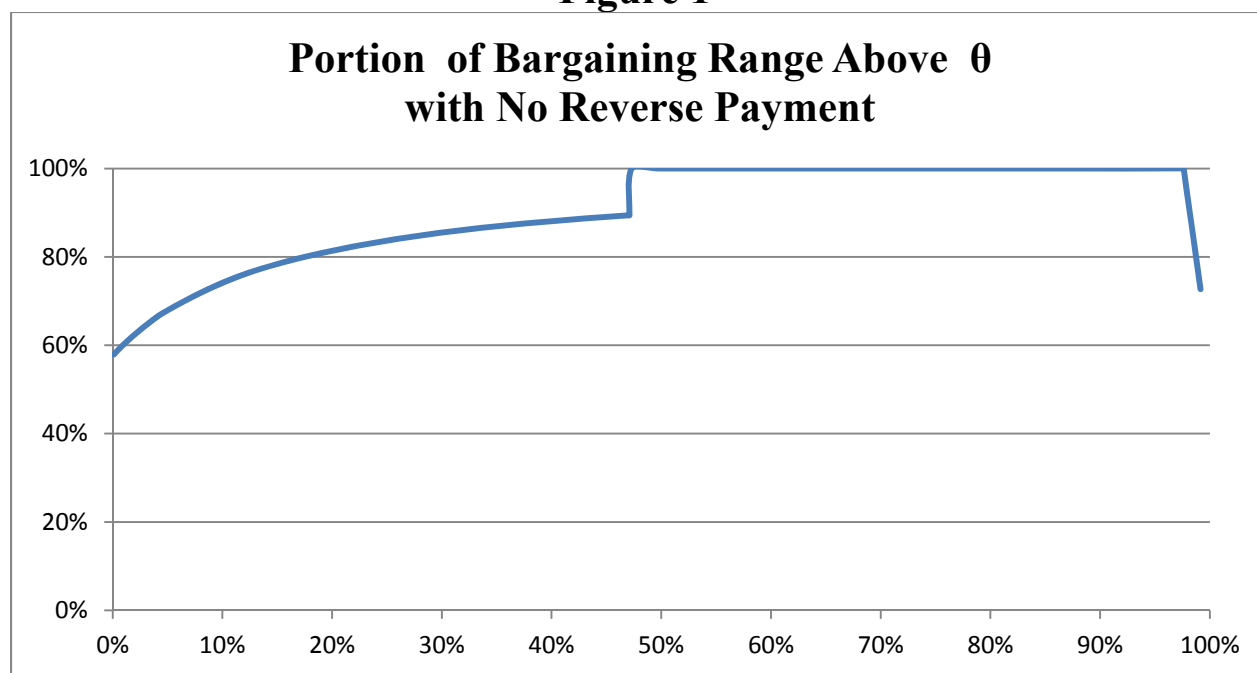
As Figure 1 shows, this proportion exceeds 50% for all levels of patent strength. It ranges from 58-89% for weak patents (for which patent victory is less than 47.2% likely), but rises to 100% for strong patents (above this 47.2% threshold), unless the patent is extremely strong, in which case the proportion declines from 99% to 58% as the patent strength goes from 97.6% to 100%. It is thus at least 58% likely that the probabilistic scope is exceeded at all patent strength levels, and usually the likelihood is much higher than that. Further, if the evidence shows that the patent was strong enough to deter at-risk entry, then the settlement will certainly exceed the probabilistic scope unless patent victory was a slam dunk.

The next graph below combines the above analysis to depict the proportion of the bargaining range that exceeds the expected entry date at each level of possible patent strength.

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Figure 2

Portion of Bargaining Range Above Expected Entry Date With Litigation with No Reverse Payment
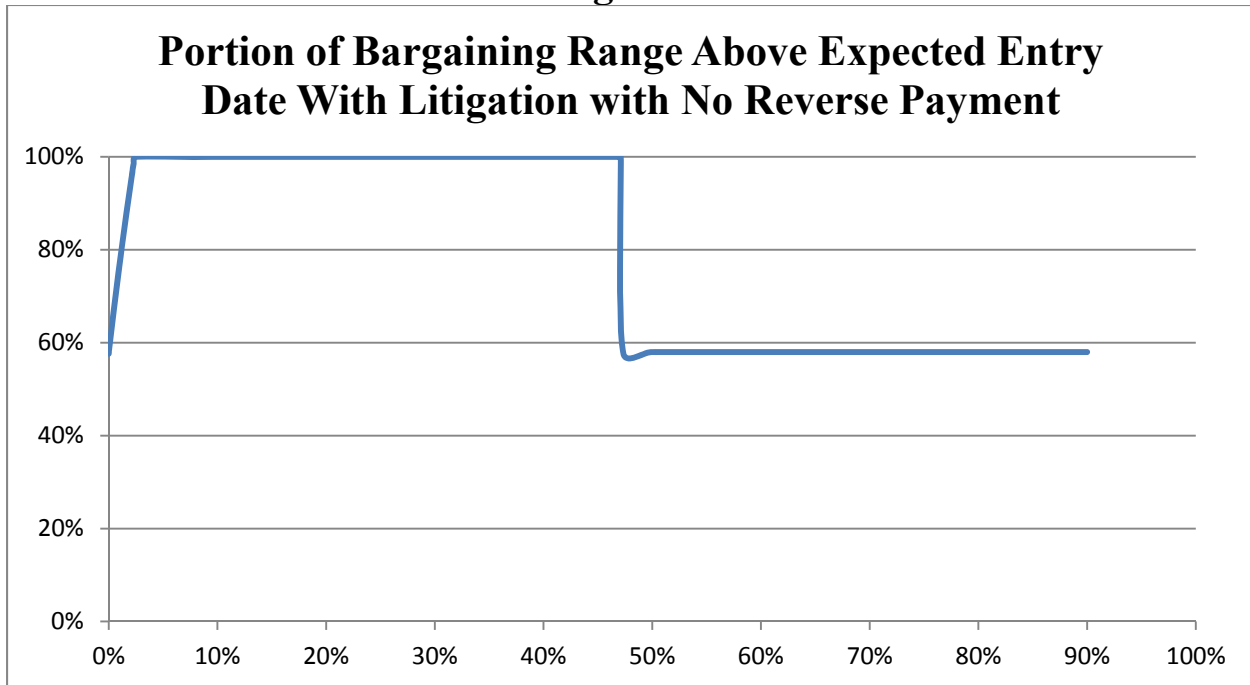
This portion exceeds 50% for all levels of patent strength. It ranges from 60-99% for extremely weak patents (which are less than 2.4% likely to prevail), is 100% for all other weak patents (those 2.4-47.2% likely to win), and then drops back to 58% for strong patents. Thus, it is at least 58% likely that expected entry date is exceeded at all patent strength levels. Further, if the evidence indicates that the patent was weak enough that the entrant would have entered at risk, then the settlement will certainly exceed the expected entry date unless a patent loss was virtually assured.

Further, the portion of possible settlement entry dates that will exceed *both* standards can be depicted by the following graph, which puts together the graphs above. The bottom edge of the range of likelihood is 58% with the likelihood increasing to 89% for some patent strength levels. In short, even without any reverse payment, the bulk of possible settlement entry dates will exceed both the expected entry date and the probabilistic patent scope at every possible level of patent strength.

Figure 3
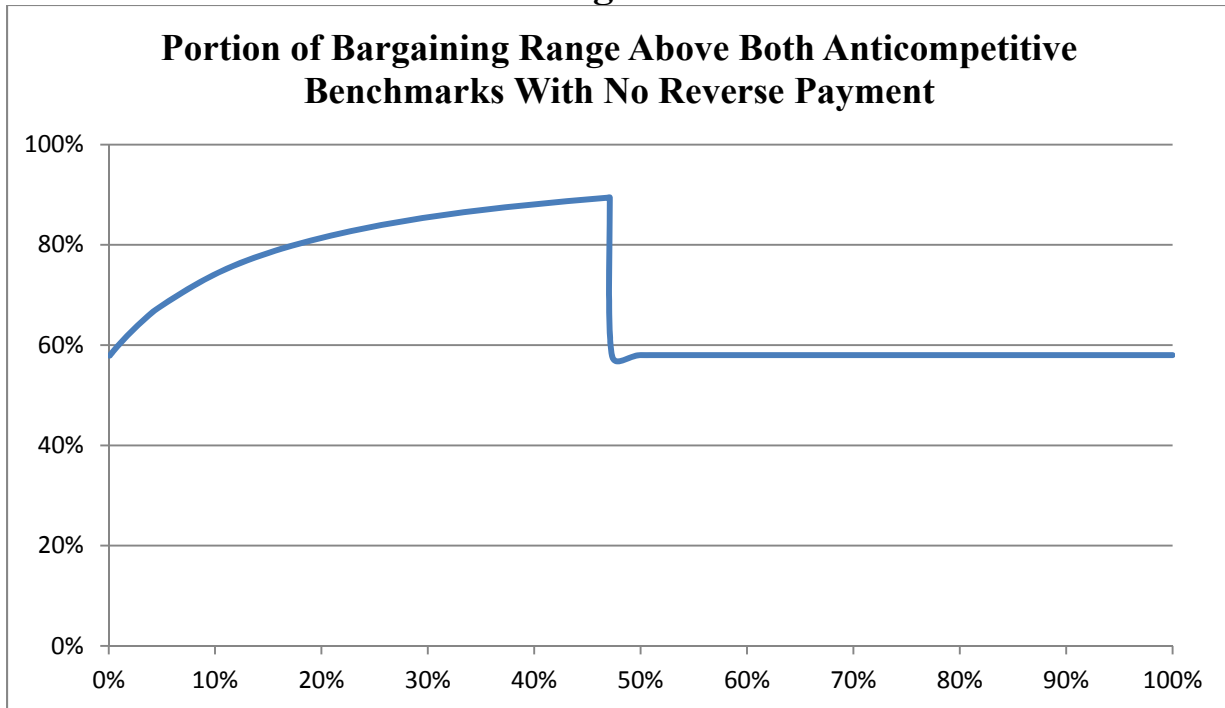
The above proofs showed that these portions will exceed 50% regardless of the particular assumptions we make about market factors. To illustrate, suppose we cut in half our estimates of both the monopoly profits per month and the residual patent period, so that the total monopoly profits at stake are only one-fourth of what we estimated. Using the same analysis as above, we get the following graph for the portion of the bargaining range that is above both anticompetitive benchmarks for a settlement with zero reverse payment.

Figure 4

Portion of Bargaining Range Above Both Anticompetitive Benchmarks With No Reverse Payment -- Assuming Half the Estimated Monopoly Profits and Residual Patent Period
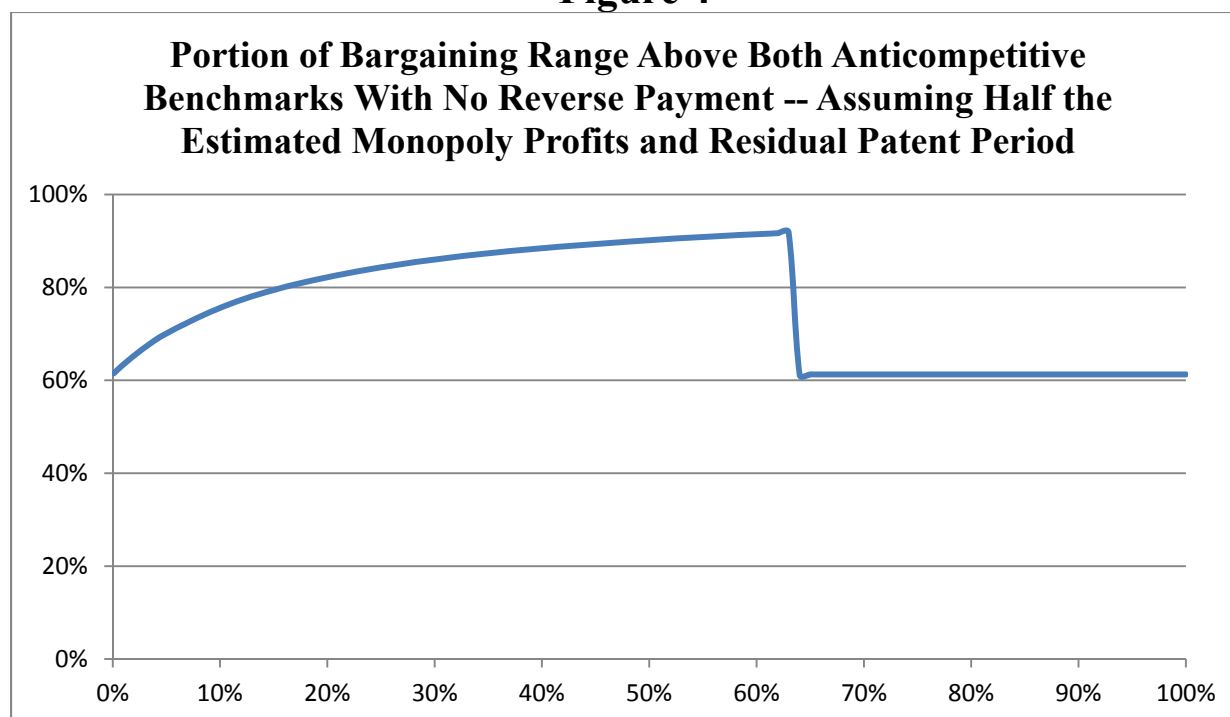
With lower monthly profits and a smaller residual patent period, the threshold for a strong patent is higher (now 63.2%), but the portion of settlements that are above both anticompetitive benchmarks remains above 50% at each patent strength level. Indeed, the bottom of the range of likelihood is now higher, at 61%, as is the top of the range, now at 92%.

B. Grounds for Rebuttal and Possible Procedural Solution

The above analysis demonstrates that, even when a patent settlement has no reverse payment and only sets an entry date, it is likely to both delay entry and exceed the probabilistic patent scope. Because adding any reverse payment will only further delay the settlement entry date, then settlements with a reverse payment that is smaller than the patentholder's anticipated litigation costs are even more likely to both delay entry and exceed the probabilistic patent scope.

However, we cannot exclude the possibility that some such settlements might not be anticompetitive. This proof thus suggests that courts should in these cases also adopt a presumption of illegality, but allow it be rebutted by direct proof that the settlement did not delay entry or exceed the probabilistic patent scope. The problem is that such a rebuttal would require the sort of direct case-by-case inquiry into probabilistic patent strength that many antitrust courts seek to avoid.

One way to narrow the inquiry would be to add a market power screen. Here such a screen makes sense because one cannot exclude the possibility that no market power exists if the reverse payment has not exceeded the patentholder's anticipated litigation costs. Further, there can be no harm to consumer welfare without market power. However, this will not help in the typical patent settlement case where such market power can be proven.

Nonetheless, the above analysis can help bound the probabilistic analysis in a way that makes it more tractable. For example, suppose a court concludes that the relevant standard is whether the settlement exceeds the probabilistic scope of the patent and that there is good evidence that at-risk entry would not have occurred. Then, if the case at hand matched average numbers for things like market profits and residual patent period, we know that the relevant standard must have been violated unless it was an extremely strong patent whose patent strength exceeded 97.6%. Even if courts would have difficulty assessing the precise probability of patent victory, it may be easier for courts to decide whether that lower bound seemed likely to be exceeded. In an actual case, the experts would simply plug in the case-specific values for market profits, residual patent term, expected litigation length, and anticipated costs, to reach the appropriate lower bound for that case. Those issues are easier to ascertain that the probability of patent victory.

Similarly, suppose a court concludes that the relevant standard is whether the settlement exceeds the expected entry date and that there is good evidence that at-risk entry would have occurred. Then it can

conclude that the relevant standard must have been violated unless it was an extremely weak patent, with the upper bound being 2.4% with typical numbers but using another upper bound based on case-specific numbers.

However, a court will not be able to set upper and lower bounds that guarantee that both standards are violated in the same case. Thus, if it wants to allow rebuttal under both standards at once, then it cannot avoid a direct inquiry into probabilistic patent strength. Given the difficulty with this sort inquiry, this might be unattractive but there may be no better alternative.

If courts do not think they can reliably assess probabilistic patent strength, one solution would be not to allow rebuttal at all. This would reach the wrong result in some cases, but by hypothesis the problem is that courts cannot distinguish those cases. Thus, their substantive choices are to either condemn all such settlements or allow them all. Given our proof that most settlements without reverse payments are anticompetitive, allowing all such settlements would produce worse results than condemning them all. To be sure, the magnitude of anticompetitive harm is much smaller without a reverse payment, but that does not make such harms desirable, and antitrust law generally has no exception for small anticompetitive harms.

Given the problems with these possible substantive responses, the better solution in such cases might be procedural. The underlying problem that allows anticompetitive patent settlements is that patent law does not allow buyers to sue to prevent the anticompetitive exclusion of rivals through invalid patents. If patent law did allow such buyer standing, then patentholders and entrants could not collude in settlements that bar patent scrutiny of dubious patents at the expense of buyers. Those buyers would have a strong interest in challenging dubious patents.

There may well be good reasons to change this patent rule against buyer standing generally. But at a minimum, one could lift this bar on

buyer standing in patent cases when the only rival or rivals that could have challenged the patent have settled in a way that prevents them from entering immediately. This sort of procedural remedy would sharply lessen the incentive for a patent settlement that excludes rivals because it could not preclude a buyer class action seeking to invalidate the patent. When the patent is not dubious, then plaintiff attorneys would have little incentive to lose money by funding a class action to challenge the patent. But when the patent is dubious, they would have incentives to bring such a buyer class action, and courts could directly address the issue of whether the patent is valid, rather than adjudicate the difficult issue of the probability with which the court thinks another court would have held the patent valid.

IV. RELATIONSHIP TO PRIOR SCHOLARSHIP

Some leading antitrust and patent scholars have reached a conclusion similar to ours that reverse payments that exceed litigation costs should be presumptively illegal.[50] However, they have so far presented no general proof to support this presumption.[51] By providing this proof, we not only help resolve the debate about whether this position is true, but we also are able to better specify the conditions under which this presumption holds and what sort of rebuttals should be permitted.

To begin with, while these scholars word their presumption as applying when the reverse payment exceeds all litigation costs, our proof shows that the payment need only exceed the patentholder's litigation costs. More important, their presumption would differ significantly from ours because they would allow rebuttal on very different grounds

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[50] *See* Herbert Hovenkamp, Mark Janis, and Mark Lemley, *Anticompetitive Settlement of Intellectual Property Disputes*, 87 MINN. L. REV. 1719, 1720, 1759 (2003); Carl Shapiro, *Antitrust Limits to Patent Settlements,* 34 RAND J. ECON. 391, 408 (2003); Michael A. Carrier, *Unsettling Drug Patent Settlements,* 108 MICH. L. REV. 37, 75-76 (2009).

[51] Professor Shapiro does present proofs on other issues but not on this presumption.

than our proof indicates would be appropriate. None of them provide for rebuttals based on judgment-proof entrants or procompetitive justifications, which we show above are necessary. Further, they would all allow rebuttal based on grounds that our proof precludes.

Professors Hovenkamp, Janis, and Lemley would allow rebuttal only by proof that (a) there was some "legitimate" likelihood of patent victory and (b) the settlement entry date was in the "range" of possible expected litigation entry dates.[52] We reject this possible rebuttal because our proof shows that the fact that a reverse payment exceeds the patentholder's anticipated litigation costs itself precludes the possibility that the settlement is within the probabilistic scope and does not delay expected entry. Nor, even if it could be made, would we find such rebuttal sufficient because: (1) the fact that the odds of patent victory are "legitimate" does not mean that the settlement entry date did not exceed those odds and thus over-reward innovation; (b) the fact that the settlement entry date is within the "range" of the expected entry date does not mean it did not exceed that expected entry date and thus harm consumer welfare.

Professor Shapiro would allow the presumption to be rebutted by proof of varying estimates or risk aversion, and Professor Carrier would similarly allow rebuttal based on informational asymmetries.[53] We would not because our proof indicates anticompetitive effects despite varying estimates, and we show that risk aversion would not alter our conclusions. Moreover, Shapiro's ultimate test is that patent settlements should be illegal if the settlement entry date exceeds the expected entry

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[52] Hovenkamp, Janis & Lemley, *supra* note , at 1734-35.

[53] Shapiro, *supra* note , at 408; Carrier, *supra* note , at 77. Professor Carrier would also allow rebuttal if a cash-strapped generic needs cash quickly. *Id.* To the extent he means to rely on varying risk aversion, we would not allow rebuttal. To the extent he means that the generic might be judgment-proof, we agree with that possible ground for rebuttal, as limited by the condition we prove are necessary to establish it.

date.[54]   He thus uses only one of the two benchmarks we use, and applies it as the case-by-case standard rather than a benchmark by which to assess a more administrable test.   One problem with Shapiro's approach is that a settlement could fail his benchmark and still be within the probabilistic patent scope and thus help provide the patentholder with the appropriate reward for innovation.[55]   Such a settlement might thus benefit ex ante consumer welfare more than it harms ex post consumer welfare, and his test would not allay the courts' concern about denying patentholders their full patent reward. The other problem is that his test requires a case-by-case inquiry into the patent merits,[56] which is precisely the inquiry that the patent settlement was trying to avoid and that the antitrust courts have been reluctant to undertake.

Finally, while we prove that even settlements without any reverse payment are generally anticompetitive, these prior scholars assumed that a settlement with no reverse payment will produce a settlement entry date that equals the expected entry date. Hovenkamp, Janis, and Lemley thus favor a presumption of legality for such settlements, with the only rebuttal being proof that the patent was a sham.[57] Shapiro concludes that settlements without reverse payments should be per se legal.[58] Carrier also seems to advocate per se legality if there was no reverse payment, or if the reverse payment is less than litigation costs.[59] Because we have disproved their underlying assumption, we show that presumptive or conclusive legality is inappropriate even without any reverse payment.

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[54] Shapiro, *supra* note , at 396.

[55] Shapiro mistakenly conflates the expected entry date test with the probabilistic scope test, *id.* at 396, but as we showed above, the former can be less than the latter when at-risk entry would have occurred without settlement.

[56] *Id.* at 397.

[57] Hovenkamp, Janis & Lemley, *supra* note , at 1762-63. Their other rebuttal is that a reverse payment was actually made, but that means the presumption does not apply.

[58] Carl Shapiro, *Antitrust Analysis of Patent Settlements Between Rivals,* ANTITRUST MAGAZINE 70, 72 (Summer 2003).

[59] Carrier, *supra* note , at 76-77.

Other professors have not focused on the relationship between reverse payments and litigation costs at all. Professors Daniel Crane and Thomas Cotter have instead focused on the absolute odds of patent victory. Crane argues that one should allow reverse payment settlements when the ex ante probability of patent victory is high but not when it is low.[60] But even if the probability of patent victory is high, a settlement entry date that is higher would be undesirable, and even if the probability of patent victory is low, a settlement entry date that is lower would still be desirable. Thus, his test does not correspond to social desirability of the patent settlement, and also requires the sort of case-by-case inquiry into the patent merits that patent settlements and many antitrust courts seek to avoid. Moreover, our proof shows that inquiry into the patent merits is unnecessary when the reverse payment exceeds the patentholder's anticipated litigation costs.

Cotter shows that it can be rational for a patentholder to offer the entrant a reverse payment even if the odds of patent victory are high, and concludes from this that reverse payments should be presumptively unlawful, but that this presumption should be rebuttable by proving the odds of patent victory are high, with "high" meaning at least 50% and certainly being provable by showing 75% odds.[61] However, the fact that a patentholder finds it rational to make a reverse payment tell us nothing about whether the settlement is desirable, especially because a settlement that delays entry funds that reverse payment with other people's money – namely the money of buyers. Moreover, whether the probability of patent victory exceeds 50% or 75% also tells us nothing about settlement desirability. Even if the probability were 75%, a settlement that excludes entry for more than 75% of the residual patent period would still be anticompetitive, and even if the probability were

[60] Daniel A. Crane, *Exit Payments in Settlement of Patent Infringement Lawsuits: Antitrust Rules and Economic Implications,* 54 FLA. L. REV. 747, 779-96 (2002).

[61] Thomas F. Cotter, *Refining the "Presumptive Illegality" Approach to Settlements of Patent Disputes Involving Reverse Payments: A Commentary on Hovenkamp, Janis & Lemley,* 87 MINN. L. REV. 1789, 1797, 1804-07, 1812 & n.92 (2003).

10%, a settlement entry date that covers less than 10% of the residual patent period would still be procompetitive. Further, his test also requires a difficult case-by-case inquiry into the probability of patent victory. Our proof shows that whether a reverse payment exceeds litigation costs provides a more reliable indicator of desirability by indicating when the settlement entry date exceeds the probability of patent victory, without requiring any such case by case inquiry into what the probability may be.

Professor Blair argues that one should simply apply a rule of reason to reverse patent settlements to determine if their net effects are procompetitive.[62] But his rule would presume legality, which our proof shows is unwarranted, especially if the reverse payment amount exceeds anticipated litigation costs. Nor does he provide clear guidance to how courts could conduct the suggested rule of reason analysis. Further, he suggests that one should not infer likely illegality unless the reverse payment is close to the amount of entrant profits from entry.[63] We prove that the key comparison is instead to anticipated patentholder litigation costs.

Professors Willig and Bigelow argue that reverse payments may sometimes be necessary for desirable patent settlements, and conclude from this that patents with reverse payments thus should not be presumptively unlawful.[64] However, when one examines the details, one sees that their argument applies for a desirable settlement only when the reverse payment amount is "less than the incumbent's litigation costs."[65] Our proof shows this possibility goes away when the reverse

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[62] Roger D. Blair & Thomas F. Cotter, *Are Settlements of Patent Disputes Illegal Per Se?*, 47 ANTITRUST BULLETIN. 491, 533-34 (2002) (reporting the views of just Professor Blair).

[63] *Id.*

[64] *See* Robert D. Willig & John P. Bigelow, *Antitrust policy toward agreements that settle patent litigation*, 49 ANTITRUST BULLETIN 675, 659-662, 667-677 (2004).

[65] *Id.* at 671. Much of their analysis actually addresses a different question: whether a reverse payment might be necessary for patent settlement *without* showing that settlement would

payment amount exceeds those litigation costs, which fully justifies the presumption.

Further, Willig and Bigelow consider only whether desirable settlements are possible, not whether they are likely. We proved that even without *any* reverse payment, the lion's share of settlement entry dates the parties could reach would be anticompetitive. This justifies presumptive condemnation even without a reverse payment, and thus even more strongly justifies it with a positive reverse payment amount, which only increases the share of possible settlements that are anticompetitive. Finally, in the end Willig and Bigelow simply argue that courts should sustain patent settlements if the settlement entry date is lower than the expected entry date.[66] Their test thus, like Shapiro's ultimate test, both (1) ignores the potential disjunction between expected entry and probabilistic scope and (2) requires the case-by-case inquiry into the patent merits that patent settlements and many antitrust courts seek to avoid.

CONCLUSION

In assessing whether patent settlements are anticompetitive, it is relevant to use two benchmarks that are often conflated: (1) whether the settlement harms ex post consumer welfare by delaying entry; and (2) whether the settlement harms ex ante welfare by exceeding the probabilistic patent scope and thus the optimal reward for innovation. However, courts have been reluctant to apply such benchmarks in a case by case way because it would require the sort of inquiry into the patent merits that settlement aims to avoid, with the addition of a probabilistic twist that is administratively difficult.

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actually be desirable. Our proof shows that although this is true, a reverse payment that exceeds litigation costs is necessary only for undesirable settlements.

[66] *Id.* at 662, 677.

Our proof avoids this administrative difficulty by proving that, under ordinary conditions, a patent settlement with a reverse payment that exceeds the patentholder's anticipated litigation costs is *always* anticompetitive under both benchmarks. We show this is true even if the patentholder and alleged infringer differ in their estimates of patent victory. We also show that this claim should not be defeated by claims that market power was lacking, that the parties were risk averse, or that the particular settlement entry date did not violate the two benchmarks. On the other hand, we show that rebuttal is appropriate when the entrant would have entered at risk and is judgment proof to a sufficient extent. We also show that rebuttal is appropriate when there are other procompetitive justifications.

We also show that, contrary to widespread assumption, patent settlements that set an entry date without any reverse payment are also usually anticompetitive. However, they are not always anticompetitive, so a broader array of rebuttal would be advisable. To the extent that those rebuttals require a probabilistic inquiry into the patent merits that is too difficult for the courts, then the best solution may be the procedural one of giving buyers standing to challenge the patent.

APPENDIX

Proof That Reverse Payments Cannot Be Necessary for Settlement if Estimated Duopoly Profits Exceed Monopoly Profits

1. Weak Patent

$T_{Max} = \theta_E (1-L) + [\theta_E L(M-D_P)+C_E+R]/D_E$
$T_{Min} = \theta_P - (C_P+R)/(M-D_P)$
Can settle only if
$\theta_E(1-L) + [\theta_E L(M-D_P)+C_E+R]/D_E > \theta_P - (C_P+R)/(M-D_P)$
Thus, if R increases by ∂ from 0 or any positive number, the left side (T_{Max}) will increase by ∂/D_E and the right side (T_{Min}) will increase by $\partial/(M-D_P)$.

Therefore, if $M-D_P<D_E$ (just $M < D_P + D_E$ rearranged) then $\partial/D_E < \partial/(M-D_P)$, meaning that increasing a settlement payment by ∂ can only make it less likely that $T_{Max}>T_{Min}$. A corollary is that that if $M-D_P<D_E$ but the parties nevertheless settled, the parties must have necessarily been able to settle without any reverse settlement payment.

2. Strong Patent

$T_{Max} = \theta_E + L(1-\theta_E) + (C_E+R)/D_E$
$T_{Min} = \theta_P + L(1-\theta_P) - (C_P+R)/(M-D_P)$
Increasing R by ∂ from 0 or any positive number can only reduce $T_{Max} - T_{Min}$ if $M-D_P<D_E$ because then T_{Max} would increase by only ∂/D_E and T_{Min} would increase by the greater $\partial/(M-D_P)$. Therefore, if $M-D_P<D_E$ but the parties nevertheless settled, the parties must have necessarily been able to settle without any reverse settlement payment.