Revisiting Injunctive Relief: Interpreting eBay In High-Tech Industries With Non-Practicing Patent Holders

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Abstract
The Supreme Court’s 2006 eBay ruling marked a turning point in injunctive relief policy. Unfortunately, there seems to be considerable confusion about the implications of the decision. Some authors, concerned over patent holdup and excessive royalty rates, interpret the eBay decision as giving a green light to district courts to deny injunctive relief to “non-manufacturing patent owners”. Using an error cost framework, we examine the theory and evidence behind patent holdup concerns as they relate to injunctive relief policy. We find that the holdup theory justifying categorical limitations on injunctive relief rests upon overly narrow assumptions. As a result, categorical limitations are likely to result in substantial “false positives”, where patent holders with no designs of patent holdup are nonetheless denied injunctive relief. Instead of advocating categories of denial, we argue that the majority opinion in eBay can and should be read as a return to a balancing test, where costs and benefits are weighed carefully before granting or denying a patent injunction.

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I. INTRODUCTION

The importance of innovation for the global economy is well understood and commonly agreed.\(^2\) The importance of patent protection, however, is not. In particular, while many scholars maintain that the impact of patent protection is crucial to provide incentives to innovate in a market economy,\(^3\) there is considerable controversy about the appropriate division of the profit from innovation among multiple patent holders when a complex technology involves many innovative components, or when innovation is cumulative. In these circumstances, the effects of changes in the division of profit on the overall incentive to innovate are often ambiguous, since some innovations are encouraged to the detriment of others.\(^4\) Not surprisingly, then, patent policy has been the subject of heated debate for many years.

The patent policy debate entered a new phase in 2006 with the Supreme Court’s *eBay, Inc. v. MercExchange LLC* decision (“the eBay decision”) regarding injunctive relief for patent holders in infringement suits.\(^5\) Prior to 2006, many observers felt that lower courts faced with patent infringement cases frequently granted injunctions as a matter of course to those who sought them.\(^6\) Empirical studies showing high odds for obtaining an injunction support that view. Among district court cases from the early 1980s through the mid 1990s,

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for example, 61% of those seeking an injunction were granted one.7 Among those cases moving on to the Federal Court of Appeals over the same period, 58% of the injunctions granted were affirmed. The percentages vary considerably from year to year, though, ranging from a low of 43% granted in 1989 within federal district courts to a high of 100% (3 out of 3 cases) confirmed by the Court of Appeals in 1990.8 Studies of later years paint a less certain picture for injunctive relief: for instance, analyzing federal district court cases in 1995, 1997, and 2000, Kesan and Ball find only 21% of the trials in which an injunction was requested ended with a ruling for a permanent injunction.9 Regardless of the actual statistics, however, the perception has been that the lower courts did little in the way of assessing in any given case the need for injunctive relief or weighing the harm an injunction might impose on the infringer—establishing that a patent was valid and infringed was often enough.10

In its eBay decision, the Supreme Court called for a stop to this kind of automatic injunction granting. Justice Thomas, writing for the majority, called for the lower courts to adhere to the four part equity test already established in case law.11 Under that balancing test, before a plaintiff may receive injunctive relief it is required to demonstrate that: (1) it has suffered an irreparable injury; (2) remedies available at law are inadequate to compensate for that injury; (3) considering the balance of hardships between the plaintiff and defendant, a remedy in equity is warranted; and (4) the public interest would not be disserved by an injunction.

Instead of following the majority prescription, however, many district courts faced with injunction decisions in the wake of eBay appear to be focused on the minority concurring

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8 Id.
10 See Dauer and Cleffi, supra note 6.
opinion of Justice Kennedy. In his concurring statement in the eBay decision, Justice Kennedy emphasized the problem of patent “trolls” and holdup in patent licensing. According to the holdup argument, once a manufacturer has invested in plant and equipment to produce a particular good, the firms with patents relevant for that good can ask for and receive more than their fair share of the profits, since the manufacturer risks losing its entire investment if it cannot obtain a license to the patent. The leverage that patent holders deploy in these holdup schemes is the threat of closing down the manufacturer. According to injunction-limitation advocates, such a threat is so powerful that the manufacturer will agree to pay excessive licensing fees, i.e., greater than the patent holder’s true economic contribution. Following this reasoning, in his concurring statement Justice Kennedy wrote:

An industry has developed in which firms use patents not as a basis for producing and selling goods but, instead, primarily for obtaining licensing fees. For these firms, an injunction, and the potentially serious sanctions arising from its violation, can be employed as a bargaining tool to charge exorbitant fees to companies that seek to buy licenses to practice the patent.

Concern over the misuse of injunctive relief as a tool for patent holdup is rooted in the academic literature. Recent articles have argued that injunctive relief provides too much negotiation strength for patent holders and thus these articles have called for changes to policy on that basis. The academic analysis centers on denying injunctions to particular categories of patent holders that the authors feel might be more prone to engage in patent

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12 With Justices Stevens, Souter, and Breyer joining.
holdup. That is, the papers have attempted to identify easily observable indications of patent trolls. For example, Lemley and Shapiro advocate

…that one circumstance in which courts should consider denying injunctive relief – or at a minimum delaying it – is when the product that would be enjoined contains multiple components, of which only one is the subject of the patent suit.\textsuperscript{16}

These authors also appear to equate “non-practicing patent holders” with trolls:

Defining a ‘patent troll’ has proven a tricky business, but that does not mean the problem does not exist. ’Non-practicing entities’ account for 30-40\% of all patent suits filed in the computing and electronics industries, for example.\textsuperscript{17}

In a separate paper, Shapiro also calls for limiting injunctions for “non-competing” patent holders.\textsuperscript{18}

Evidently heeding the academic advice, the district courts since eBay are by and large denying injunctive relief when the patent holder does not practice its patents or when it does not compete directly with the accused infringer.\textsuperscript{19} In an analysis of the cases involving a request for injunctive relief that have come to the courts since eBay, Smith finds that:

In place of the former general rule that injunctions must issue is a new emerging consensus that plaintiffs that use their patents to manufacture products and compete with the infringing defendant are likely to obtain injunctive relief, and plaintiffs who simply seek to license their inventions are not. Justice Kennedy's concurrence alluded to the significance of who the plaintiff is – a competitor or a licensor – and district courts seem to be finding the same thing important when performing their analysis. Thus although a majority of the Supreme Court did not recognize such a distinction per se, district courts are certainly doing so in practice.\textsuperscript{20}

\textsuperscript{16} See Lemley & Shapiro, supra note 13, at 39.
\textsuperscript{17} Lemley & Shapiro, supra note 13, at 21.
\textsuperscript{18} Shapiro, supra note 15, at 24.
We understand the concerns over patent holdup. However, the post eBay case law seems to be leaning towards a one-sided approach which favors a manufacturing licensee’s point of view with little consideration given to the impact on firms with other kinds of legitimate business models, such as innovators with limited or no presence in downstream markets (“non-manufacturing” or “non-practicing” patent holders). In fact, at least one practicing lawyer has gone on record recommending that patent holders invest in manufacturing facilities simply to increase their odds of obtaining injunctive relief.\(^21\)

While patent trolls are certainly a possibility, painting all or most non-vertically integrated patent holders as intent upon holdup does a great disservice to the many truly innovative research oriented companies operating in high technology markets today.\(^22\) For example, some biotech firms focus on R&D, leaving drug development or commercialization to the larger pharmaceutical companies.\(^23\) In various industries, certain firms specialize in R&D for particular niche technologies. Still other firms manufacture in one market, but conduct R&D far more broadly than their downstream operations would prescribe. All of these firms, in contrast to patent trolls, invest heavily in research and development, benefit from the broad dissemination of their technologies, and thus have strong incentives to price


\(^{22}\) For a more narrow definition of patent troll, see James F. McDonough III, The Myth of the Patent Troll: An Alternative View of the Function of Patent Dealers in an Idea Economy, 56 Emory L.J. 189 (2007). McDonough argues that patent holding companies can serve a valuable function as intermediaries in an economy, providing liquidity, market clearing, and increased efficiency to technology markets. See also, Brief from Yahoo! Inc. as Amicus Curiae Supporting Petitioners, eBay, Inc. v. MercExchange, L.L.C., 126 S. Ct. 1837 (2006) (No. 05-130), which offers a more tailored definition of patent troll as a firm with low value patents and a history of aggressive litigation with the intent of garnering large settlements. A lack of goods downstream is not synonymous with this definition, as the authors, Joseph K. Siino and Robert Merges, point out. Lemley himself, in another paper, essentially limits the term “troll” to “for-profit licensing shops” that do not develop the innovations behind the patents, nor practice the patents, but instead simply collect the patents and license them. See Mark A. Lemley, Are Universities Patent Trolls? (STAN PUB. L. Working Paper No. 980776, 2007), (available at http://ssrn.com/abstract=980776). Even this definition may be too broad, though, in light of McDonough.

their patents at reasonable levels while still providing an adequate return on their risky investments in R&D.\textsuperscript{24}

We argue in this paper for more balance in the granting and denying of injunctive relief. While we recognize that courts will face circumstances that warrant denying injunctions, we feel that both theory and empirical evidence on patent holdup call for prudence. As for theory, we highlight the benefits of injunctive relief and the need to weigh those benefits against the possible costs, following the four factor equity test affirmed by the Supreme Court majority in the \textit{eBay} decision. We also highlight the restrictiveness of the assumptions required to achieve holdup effects in the models put forth in the literature, including that patent infringement is inadvertent and that the patent could have been circumvented easily if only the manufacturer had been aware of its existence. As for the empirical evidence, we point out the lack of hard evidence that patent holdup and other licensing problems are pervasive, not sporadic. We also note the lack of evidence that those alleged problems have had any significant adverse impact on R&D investment and innovation. From a broader perspective, we argue that there is little theoretical and empirical support for the presumption that non-manufacturing or non-competing patent holders operating in industries with complex, multi-component products are over-rewarded. Since there seems to be no such systematic distortion in the patent system, categorical restrictions on injunctive relief would impose a tax on non-practicing patent holders, favoring different business models that are not necessarily more efficient or more worthy of protection. In short, it appears that advocates of

denying injunction relief to certain patent holders have over-stated the benefits of such a policy and under-stated its costs.

Consequently, we argue that the district courts should follow more closely the majority opinion in the *eBay* ruling, which cautioned against categorical rules. As we illustrate below, non-practicing patent holders can be just as capable of passing an equity test as vertically integrated patent holders and multi-component products do not necessarily signify holdup. Certainly strategies deliberately aimed at creating holdup should not be tolerated. But in attempting to reduce what appears to be a fairly narrow problem we must be careful to avoid the very real danger of under-compensating innovation and, in the process, reducing the incentives to create more of it.

The remainder of the paper discusses these points in greater detail in an error-cost framework. In Section II we take a closer look at injunctive relief in theory, both with and without patent holdup. Section III presents an error-cost approach for evaluating categorical denials of injunctive relief, laying out the likely costs of such rules. Section IV then turns to the policy implications associated with injunctive relief, including the inevitable link to reasonable royalty rate adjudications. Section V concludes.

**II. UNDERSTANDING INJUNCTIVE RELIEF**

To put the calls to limit injunctive relief in patent cases into perspective, we begin our analysis by recollecting the benefits it can provide in cases of patent infringement. We then illustrate a simple model of patent holdup taken from the literature that highlights a phenomenon that may justify the denial of injunctive relief in special circumstances.
A. Injunctive Relief without Holdup

The baseline argument for injunctive relief is a very simple one.\textsuperscript{25} Consider a manufacturer M and a patent holder I, which has achieved an innovation of value $v$.\textsuperscript{26} We assume that there is no holdup problem—because the manufacturer faces no cost of switching technologies at any point in time—and that the validity of the patent is not an issue. Following the model laid out by Lemley and Shapiro\textsuperscript{27}, we also assume that had the parties reached a licensing agreement ex ante, the patent holder would have obtained a share $\beta$ of $v$, where $\beta$ reflects its bargaining power (which may depend \textit{inter alia} on the number of manufacturers with whom the patent holder may negotiate).\textsuperscript{28} Suppose, however, that for some reason no such ex ante agreement was reached,\textsuperscript{29} the patent holder alleges that the manufacturer has infringed, and the case goes to court. Our analysis, begins after a court has ruled that the patent is valid and infringed, and is called upon to decide the appropriate remedy.\textsuperscript{30} Following again Lemley and Shapiro, we assume that the courts’ objective in choosing the remedy is simply to re-produce the outcome that would have been agreed upon by the two parties ex ante.\textsuperscript{31}


\textsuperscript{26} It is convenient to imagine that there is a large set of identical consumers, whose mass is normalized to unity, each of whom values the innovation at $v$. Then $v$ is also the total value of the innovation, because of the normalization, and we can use the royalty rate and the aggregate royalty interchangeably.

\textsuperscript{27} Lemley & Shapiro, supra note 13, at 3. The model these authors present is described in more detail Section II.B.

\textsuperscript{28} This is not the only ex ante possibility of course. In fact, we believe it is more natural to assume that the negotiating parties would agree on a license fee of $v$, remunerating the patent holder fully for the value its innovation contributes to the product. Since the $\beta v$ benchmark encompasses this case (when $\beta = 1$), and since it matches the assumptions of the one paper in the literature that presents a model of patent holdup, we follow the $\beta v$ assumption here.

\textsuperscript{29} One could imagine that the manufacturer was not aware of the patent, or else the analysis is concerned with out-of-equilibrium scenarios that are never observed along the equilibrium path, but concur to determine the equilibrium play of the game.

\textsuperscript{30} The analysis that follows can be regarded as determining the disagreement point for the bargaining that may take place after I has detected the infringement but before litigation. If firms anticipate the outcome of litigation, the bargaining surplus at this stage is given by the litigation costs firms can save. Assuming for simplicity that litigation costs are borne by firms proportionally to their respective bargaining power, such bargaining would involve no redistribution of the compensation levels determined by the court.

\textsuperscript{31} This is, indeed, the socially appropriate goal if $\beta v$ is the socially optimal level of the reward for the patentee and patent infringement is always detected with probability one (or retrospective money damages already provide the
The obvious solution to the court’s problem is to choose a “reasonable royalty” equal to the ex ante target, assumed here to be $\beta v$, which manufacturer M must pay to patent holder I. One big problem, however, is that $v$ is typically uncertain, and hence the court’s assessment of $\beta v$ is likely to be imprecise. Perhaps the court observes some (imperfect) signals of the true value $v$, but any remaining uncertainty—even after conditioning upon observable signals—is likely to be substantial.\textsuperscript{32} As a result, errors are inevitable. When it determines the money damages retrospectively, the court may obviously err on either side, setting damages too high or too low.

Things are different, though, when the court decides the prospective reasonable royalty manufacturer M has to pay to I until the patent expires. The key difference is that a finite prospective reasonable royalty provides the manufacturer with an option: if the court sets a prospective royalty $R$ greater than $\beta v$, the manufacturer can simply stop infringing and re-negotiate a license from the patent holder on the same terms as would have been agreed ex ante.\textsuperscript{33} If instead the court-ordered royalty $R$ is lower than $\beta v$, the patent holder is obliged to license on the terms ordered by the courts. Thus, under this model, as regards prospective royalty rates the court may only err in one direction, namely, by under-rewarding the patent holder, since any mistake on the opposite side would be corrected by the subsequent negotiation between the parties.


\textsuperscript{33} Given that there is no holdup problem and the validity of the patent is not at issue, the patent holder’s bargaining power after the court has ruled that its patent is valid and violated by M is the same as its \textit{ex ante} bargaining power. The manufacturer’s threat point \textit{ex ante} and \textit{ex post} is also the same: stop manufacturing. If this threat is credible \textit{ex ante}, it must also be credible \textit{ex post}.
This argument can be illustrated graphically with the help of Figure 1. The figure depicts a possible range of values of \( v \).\(^{34}\) The upward-sloping straight line is the target reward \( \beta v \), and the thick line is the actual reward with a finite prospective court-ordered royalty \( R \) (the horizontal line). The thick line accounts for the re-negotiation that takes place if the prospective royalty rate is above the target.

**Figure 1: Patent Infringement Compensation Levels with No Injunctive Relief**

Clearly, when \( v \) is low the patent holder obtains exactly \( \beta v \), but when \( v \) is high I obtains less than the target reward and is therefore under-rewarded. As a result, to minimize errors the court should set the prospective royalty rate as high as possible (i.e., \( R \) goes to \( \infty \)), so that the thick line coincides with the upward sloping straight line that represents the target reward and, hence, the patent holder is not under-rewarded. Since injunctive relief is effectively equivalent to an infinitely large prospective royalty rate, this means that the court should

\(^{34}\) The underlying probability distribution of \( v \) is not drawn in the figure, but may obviously be important for the computation of the reasonable royalty \( R \).
grant the patent holder an injunction: in this simple setting, that is to say, the property rule is unambiguously superior to the liability rule.\footnote{Under a property rule, patent owners have a right to completely prevent all uses of the patented technology. In contrast, under a liability rule, someone might use the patent without permission, and if caught would then have to pay for that use. See Guido Calabresi & A. Douglas Melamed, \textit{Property Rules, Liability Rules, and Inalienability: One View of the Cathedral}, 85 \textit{Harv. L. Rev.} 1089; Epstein, supra note 25; Burk & Lemley, supra note 15.}

\section*{B. Injunctive Relief in the Presence of a Holdup Problem}

The contribution of Lemley and Shapiro is to demonstrate circumstances in which patent litigation may result in excessively high prospective royalty rates. Their model is quite similar to the one above, but rather than assuming away patent holdup by setting switching costs to zero, they explicitly build holdup into the model. They envision a scenario in which manufacturer $M$ has itself developed an innovative product, the value of which is denoted by $V$,\footnote{A similar argument applies if the innovator is a firm other than $M$ and $I$, which has licensed its innovation to manufacturer $M$.} and patent holder $I$’s innovation is an improved feature that adds value $v$ to $M$’s product. Lemley and Shapiro further imagine that firm $M$ could have commercialized its non-infringing product but, having independently duplicated the improved feature unaware of $I$’s patent, it incorporates the infringing feature into its new product. That is, firm $M$ violates $I$’s IP rights inadvertently and sells a product of value $V + v$, not just $V$. Re-designing the product in a non-infringing way after manufacturer $M$ has been condemned for infringing $I$’s patent (i.e., ex post) is now assumed to be costly: $C$ denotes the cost of re-designing the product ex post, including any profits lost while re-designing the product.\footnote{Lemley and Shapiro distinguish between direct costs of redesigning and lost profits. This allows for a richer set of predictions, but complicates the analysis. Merging the two components of the cost into a single index simplifies matters without altering the logic of the argument.}

If the royalty rate ordered by the court, $R$, is lower than the target reward, $\beta v$, then as before the patent holder is obliged to license and the manufacturer has no incentive to renegotiate. In this case, the patent holder will be under-rewarded with or without holdup. But what happens when $R$ is above the target reward? In the absence of holdup (i.e., when $C$
= 0), the manufacturer renegotiates a license with a $\beta v$ rate. With holdup ($C > 0$), this is no longer the case. To see why, we need to analyze the bargaining between firms M and I that takes place ex post.

The bargaining outcome is determined by the disagreement point (which determines the parties’ payoffs if they fail to reach an agreement) and the parties’ bargaining power (which determines the division of the bargaining surplus, i.e. the difference in joint payoffs between reaching and not reaching an agreement). In case of disagreement, M will get $V - C$, provided that $V > C$, because it can market a non-infringing product only after re-designing it. Therefore, the bargaining surplus is $C + v$ because an agreement will allow the manufacturer to save the redesign cost and also to incorporate the add-on feature, whose value is $v$. As a result, patent holder I gets $\beta (C + v)$, which is greater than the target reward $\beta v$. With respect to the no holdup case, the twist is that when the court-ordered royalty is greater than $\beta v$, manufacturer M may now prefer not to re-negotiate ex post, and even if it does re-negotiate, I will obtain more than $\beta v$. As a result, the patent holder is now over-compensated if $v$ is small. Figure 2 illustrates this possibility.

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38 When $V - C$ is negative, M would prefer to simply stop marketing its product rather than redesign it.
Figure 2: Patent Infringement Compensation Levels Under Holdup

There are two upward sloping straight lines: the lower line represents the target reward $\beta v$, and the upper line accounts for any extra rent the patent holder can extract thanks to the holdup. Thus, the lower line depicts the outcome of ex ante bargaining, whereas the upper line represents the outcome of the ex post bargaining. The thick line again represents the actual reward accruing to the patent holder ex post. Like in the no holdup case, the patent holder is under-rewarded for high values of $v$ (above $v^+$), but now it is over-rewarded for low values of $v$ (below $v^-$). For intermediate values of $v$ (between $v^-$ and $v^+$), firm M prefers to pay the court-ordered rate $R$ and not to re-negotiate, while it will re-negotiate and pay $\beta (C + v)$ for low values of $v$ (below $v^-$).

In other words, when the costs of re-designing the product to avoid infringing the patent are positive and the incremental value of I’s innovation (i.e., the difference between the value of a technology that includes its patent and the best non-infringing product), $v$, is small, patent holder I will be over-rewarded from an ex ante viewpoint. Furthermore, if $C$ is
sufficiently large, \( \beta (C + v) \) is not just greater than \( \beta v \) but is also greater than \( v \). Since \( v \) represents I’s incremental contribution, in these circumstances patent holder I is over-rewarded by any reasonable standard, and not just the (somewhat arbitrary) ex ante benchmark \( \beta v \).

This simple model illustrates the nature of the holdup problem as presented in the literature: when re-designing the product to avoid infringement is costly ex post but inconsequential ex ante, patent holder I may be able to extract part of the re-designing costs M would have to incur if it stopped negotiating after the infringement has been detected and condemned.

This conclusion relies on several conditions. First, the manufacturer must have infringed inadvertently. Second, infringement must always be detected with certainty. Third, the technology must involve at least two complementary components, and the value of the innovative component covered by the infringed patent, \( v \), must be small in comparison to the value of the product the manufacturer could have commercialized without infringing, \( V \). And fourth, it must be costly to re-design the product in a non-infringing way ex post, in comparison to the manufacturer’s easy circumvention of I’s patent ex ante.

We address all four of these conditions in Section III, but first consider the consequences of the holdup problem for injunctive relief in the presence of the assumptions. Clearly, in this model granting injunctive relief (which is equivalent to setting \( R \) as high as possible) can

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39 To be precise, the condition is \( C > \frac{1 - \beta}{\beta} v \).

40 To see the role of this assumption, suppose that \( V \) were small; more precisely, that \( V < C \) and \( V < \frac{1 - \beta}{\beta} v \). Then M’s disagreement payoff would be zero, and the bargaining surplus would be \( V + v \). Patent holder I would now obtain \( \beta (V + v) \), which is less than \( v \) (since \( V \) is lower than \( \frac{1 - \beta}{\beta} v \)). Thus, when \( V \) is small, I is not over-rewarded relative to its incremental contribution and the extent of the over-compensation is small even relative to the ex ante bargaining standard.
over-reward the patent holder when holdup is a problem (i.e., when $C$ is large). The choice is then between over-rewarding the patent holder if injunctive relief is awarded or under-rewarding it if relief is denied and $v$ is large.\footnote{In fact, the perceived level of $v$ can be used by the courts as a criterion to sort out “real innovations” developed by a non-manufacturing patent holder from dubious patents held by a patent “troll.” This is analogous to the reasoning in Yahoo!’s amicus brief in eBay, Inc. v. MercExchange, L.L.C., supra note 14.}

In principle, when holdup is a problem and $v$ is uncertain from the court’s perspective, the optimal policy is to always set a finite royalty $R$ that balances the risk of under- and over-rewarding the patent holder.\footnote{Such an optimal royalty rate depends on the underlying probability distribution; if high values of $v$ are more probable than low values, for instance, the court should order a relatively high royalty.} In practice, however, if court-ordered royalties are computed conservatively ($R$ not too large), ex post re-designing costs are small (i.e., the distance between the two upward sloping straight lines, $\beta C$, is small, so that the holdup problem is not very serious), and there is a positive probability that infringement goes undetected, denying injunctions would almost surely under-reward the patent holder in expected terms.\footnote{Note that under those circumstances, $v^*$ in Figure 2 will be small and, therefore, the set of values of $v$ for which the patent holder $I$ is under-compensated very large.} Granting injunction relief, by contrast, may cause patent holder $I$ to be slightly over-compensated, which however is preferable to leaving it substantially under-rewarded. Only if the holdup problem is serious enough (i.e., $C$ and $\beta$ are both large) can a court-ordered royalty rate be the most appropriate remedy.

### III. AN ERROR-COST APPROACH FOR EVALUATING POLICY REFORM

In light of the discussion above, what should policy be? In an ideal world, the courts would identify any holdup problem, issue an injunction when there is no holdup or when the holdup problem is not significant, and set a prospective royalty rate that optimally balances
the risk of under- and over-rewarding the patent holder in the presence of a significant holdup problem.

In reality, of course, this optimal policy can never be implemented exactly. All policies and regulations are enforced by people and all people, no matter what their good intentions, make mistakes. So, the courts will not necessarily set the reasonable royalty perfectly and they are likely to make mistakes in discovering holdups. The task, then, is to minimize the damage that such mistakes can cause. On the one side is the risk of denying an injunction to a patent holder in the absence of a significant holdup problem, a type 1 ("false positive") error. On the other is the risk of granting an injunction to a patent holder who is indeed intent on holdup, a type 2 ("false negative") error.

Different policy rules entail different risks of type 1 and type 2 errors. If injunctions were granted routinely, for instance, type 1 errors would be avoided altogether but the probability of type 2 errors would remain. Conversely, with systematic denials of injunctive relief, the risk of type 2 errors would be avoided but a substantial risk of type 1 errors would emerge. Finally, categorical denials of injunctive relief, whereby injunctive relief is denied to certain types of patent holders, can produce both type 1 and type 2 errors if the category of firms for which injunctive relief is denied is not a clean match to the firms actually practicing patent holdup.

Getting a sense of how frequent these two types of errors are in practice is therefore crucial to appropriately designing policies and regulations. In other words, the relevant

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question for evaluating the pros and cons of injunctive relief as well as any categorical limit on its availability is not only whether patent holdups ever occur, but also how frequently they occur and when are they more likely to occur.

Thus, for example, abolishing injunctive relief altogether would be justified only if patent holdup were a common phenomenon in all types of patent cases, so that patent holders are systematically over-rewarded. To the best of our knowledge, however, no one has suggested abolishing injunctive relief outright. Most scholars recognize the benefits injunctions provide in many patent cases, finding “the presumptive right to injunctive relief to be an important part of the patent law.” Instead, the proposals for policy reform are more targeted.

The policy rule proposed by Lemley and Shapiro and others—and evidently guiding the district courts—essentially boils down to denying injunctive relief (or at least granting a stay of injunctions) whenever the holder does not practice the patent or does not license it exclusively and the product at issue contains multiple components only one of which is subject to the infringement suit. If non-manufacturing/non-competing patent holders and complex technologies were necessary and sufficient conditions for a holdup problem to arise, and there was evidence that such patent licensing problems were prevalent when these two conditions are met, this proposal would be compelling. But as argued in the remainder of this section, (a) theory does not justify a presumption against non-manufacturing or non-competing patent holders and there is no evidence that they are systematically over-rewarded, (section III.A); (b) the conditions for a serious holdup problem are much more

46 Lemley and Shapiro recognize that their theoretical model is based on several restrictive assumptions. As we discuss at greater length later on, however, in the process of translating theory into a policy recommendation, the assumptions leading to hold up have been interpreted too broadly. Or at least, such too broad an interpretation seems to have been endorsed by the post eBay case law.
restrictive than those implicit in the policy proposal to limit injunctive relief (section III.B); and (c) there is no empirical evidence that patent holdup and related licensing problems are indeed prevalent in high-tech industries with non-practicing manufacturers (sections III.C).

A. Non-manufacturing, Non-Competing Patent Holders

The archetypical innovative firm many commentators have in mind is a large manufacturer that invested in R&D, patented some inventions, embedded those inventions in its own products, and—if the industry was complex or demanded compatibility—licensed the patents to other downstream firms as well, some of which were also vertically integrated upstream into R&D. But even if this has long been, and still is a prevalent business model, it is by no means the only legitimate one. The division of labor is, in fact, among the founding principles of economics, dating back to Adam Smith’s description of pin manufacture, a far simpler product than the complex technologies at issue today. Smith had in mind the division of labor in 1700s manufacturing, but the concept is the same here. Division of labor, specialization, and comparative advantage are equally applicable to splitting research and development apart from manufacturing as they are to splitting out the various steps of manufacture.

When the modern patent system was created during the era of the Industrial Revolution, firms did not routinely conduct R&D and patents were meant to protect independent inventors who would typically license their innovations. Golden documents that such independent inventors have long continued to account for a significant fraction of innovative activity in the US and elsewhere. Today individual researchers not belonging to corporate teams are less common, but as patents have expanded to cover more kinds of inventions (software, gene sequences, etc), a new breed of research entity has emerged: the upstream

48 See Golden, supra note 19, at 2111.
firm with little or no manufacturing capacity.⁴⁹ Some of these firms come from the early innovative process, such as when university-based research leads to a start-up firm.⁵⁰ Others have formed as patent holding companies representing individual inventors as a means of lowering transaction costs and consolidating the research in a particular field.⁵¹

Langlois argues that “vertical disintegration and specialization is perhaps the most significant organizational development of the 1990s.”⁵² He then catalogs how widespread the development is:

In electronics, firms like Sanmina-SCI, Solectron and Flextronics specialize in assembling on contract electronic systems of all sorts. But they neither design nor distribute nor market the systems themselves. Indeed, in early 2002, IBM—the originator of the dominant personal computer standard—sold its entire domestic assembly operations to Sanmina-SCI. In pharmaceuticals, the major integrated companies are increasingly outsourcing manufacturing and marketing to firms like DSM and clinical trials to contract research firms like Quintiles Transnational and Covance. …Led by Chrysler in the 1990s, US automobile manufacturers began to modularize their product design and supply chain strategies to rely more heavily on subcontractors….The litany could continue.⁵³

Fab-less semiconductors help to illustrate the benefits of specialization.⁵⁴ These firms create and market chip designs, but do not make the chips. Instead, they use patents to protect their designs and outsource the manufacturing to others, typically offshore. Because they enable licensing and contracting, strong property rights allow firms to specialize in

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⁴⁹ Depending on the complexity of the industry, any number of variations is possible. A firm might be upstream (R&D only), downstream (manufacturing only), vertically integrated (both R&D and manufacturing), or some combination of these. For instance, a firm might be upstream for the purposes of the final consumer good but vertically integrated in terms of intermediary products necessary for making the final good.


⁵¹ Acacia Research Corporation claims this as its goal. See About Us – Corporate Profile, (http://www.acaciaresearch.com/aboutus_main.htm) (last visited Aug. 28, 2007). See also the discussion in McDonough, supra note 22, at 193.


⁵³ Id. at 373-374. Internal citations omitted.

various functions, such as chip design, testing, and production—analogous to separating the various stages of pin manufacture described in a famous passage of the Wealth of Nations. Without such property rights, firms are generally reluctant to share their intellectual property for fear that others will expropriate it. By eliminating the necessity of a huge upfront capital outlay for developing a chip production plant (about $6 billion in 2007), strengthened property rights lowered barriers to entry and thus increased competition in semiconductors by opening the doors to many new entrants able to capitalize on the efficiencies of specialization.

“Upstream” firms, with little or no manufacturing capacity but with R&D functions, have strong incentives to license their patents. With no product sales to generate revenues, licensing forms a core element of revenues and provides the primary route to earning a return on R&D investments. Moreover, because these firms have no downstream product market to protect, they do not have incentives to discriminate in their licensing practices, as can be the case for vertically integrated firms licensing to pure downstream manufacturers.

At the same time, however, these R&D-focused firms have complicated the existing licensing regime. When most firms in the high technology sector are vertically integrated, holding patents and manufacturing goods, they can negotiate cross licensing deals with one another, perhaps even a royalty-free swap of portfolios. Other downstream players, with no

patents to exchange, could be charged considerable royalty rates, which tend to keep entry relatively low. Looking at measures like cumulative or average royalty rates disguises the highly skewed nature of the rates. A good example here is GSM, the 2G mobile telecom technology standard in Europe, which has been controlled by a relatively small group of vertically integrated firms. The traditional cross licensing scenario is not possible with non-manufacturing patent holders, however. Upstream firms do not take profits in the downstream market and instead rely on royalty earnings.

The point of profit taking, however, does not define the social benefits of a firm’s presence in the marketplace. R&D focused firms can be a welfare enhancing addition to an industry. As noted above, these firms intensified competition in the semiconductor industry, and appear to have done the same for 3G cell phone handsets and perhaps for biotechnology as well. Moreover, as already explained, diversity in firm structure fits nicely with other economic theories, like comparative advantage. Some firms will find their strengths lie in developing technologies, others in making products. Profit taking occurs at different points in the production chain for these two approaches, but this suggests looking at end user prices rather than comparing one cost element like royalty rates.

The key question, then, is whether industry profits remunerate innovation appropriately. In general, recent work suggests that patent holders are more likely to be under- than over-

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60 We focus on R&D firms. See McDonough, supra note 22, for arguments on the benefits of patent holding companies.
compensated.\textsuperscript{65} Is there any reason to believe that non-integrated patent holders are over-compensated while vertically integrated companies are not? True, under the vertically integrated model aggregate royalty rates may be held down through cross licensing, but so is competition, which means that the integrated firms’ price-cost margins could be relatively high. With more diversity in business models we may (though not necessarily) see cumulative royalty rates increase—and royalties are certainly an input price for final goods—but we also tend to see lower price-cost margins downstream.\textsuperscript{66} Thus, there is no reason to believe that the price to the final consumers will be higher in the presence of non-manufacturing patent holders and, hence, no reason to suspect that over-compensation is more likely for non-practicing entities.

Categorically denying injunctions to non-manufacturing patent holders therefore casts far too wide a net, increasing the likelihood of false positives. The proposed reform may also increase the likelihood of false negatives, since holdup problems may also arise when the IP holder is practicing the patent. To see why, contrast the following two scenarios. In both scenarios, there are two competing manufacturers, M1 and M2, which supply differentiated products. Manufacturer M2’s product is non-infringing, while M1’s product inadvertently infringes a patent that ex ante could have been circumvented easily. In the first scenario, the one envisioned by Lemley and Shapiro, the patent infringed by M1 is owned by non-manufacturing, non-competing patent holder I. In the second scenario, instead, it is owned by rival manufacturer M2. The apparent district court policy and that advocated by Lemley and Shapiro would grant an injunction to M2, but not to I.

\textsuperscript{65} For example, after a careful review of available evidence, Denicolò concludes that “a preponderance of the empirical evidence suggests that in the aggregate patents do not over-compensate innovators”. See Vincenzo Denicolò, \textit{Do patents over-compensate innovators?}, 22 ECON. POL’y 679 (October 2007), and the references therein.

\textsuperscript{66} Pandey & Carlaw, \textit{supra} note 59, at 25.
Is there any economic ground for the proposed different treatment? No, economic theory implies that in both cases there is a risk the patent holder is over-compensated and, as a consequence, that M1’s incentives to innovate are disrupted. In fact, the holdup problem may be even more serious when M1 is held up by its direct competitor M2, since non-manufacturer I must perforce reach an agreement with M1 to earn a positive reward on its R&D investment, whereas M2 can profit by shutting M1’s activity down and thereby obtaining a full monopoly. As a consequence of its stronger bargaining position, competing manufacturer M2 will most probably be able to charge a greater royalty than I. Of still greater concern, however, is the fact that if the two products are relatively undifferentiated, shutting down firm M1 is not only a credible bargaining threat for manufacturer M2, it can indeed be the most profitable strategy to carry out. In this case, any specific investment made by M1 is entirely lost—and consumers are harmed by higher prices and lower product variety. So, the non-manufacturing, non-competing category may result in numerous false positives (I may be denied an injunction incorrectly) and false negatives (M2 may be granted an injunction when it should not be).

B. Restrictive Assumptions

As noted in section II.B above, Lemley and Shapiro’s theoretical model of holdup makes four assumptions: (i) the manufacturer infringed inadvertently; (ii) all infringements are detected with certainty; (iii) it is costly to re-design the product in a non-infringing way ex post, even though the manufacturer could have easily circumvented the patent ex ante; and (iv) the technology involves several complementary components and the value of the innovative component covered by the infringed patent is small relative to the value of the

67 It could be argued that differently from I, manufacturer M2 may not really want to enforce its IP rights, because its product may in turn infringe on some of M1’s patents and M2 may fear M1’s retaliation. But here we are concerned with remedies for patent infringement, a problem that can only arise after M1 has been sued and found to have infringed. At this stage, it is irrelevant that ex ante M2 may have been relatively less likely to sue than I.
product. All four conditions are important and should not be overlooked or oversimplified when moving from theory to policy.

In the policy recommendations for denying injunctive relief, however, these assumptions are either dropped or substantially weakened. Assumption (i) is reduced to “no explicit copying”, a much easier hurdle to clear. Condition (ii), which is implicit in the theoretical model, is largely ignored, although it is crucial for obtaining the holdup results. Moreover, in the policy recommendation the important distinction between ex ante and ex post re-design costs is blurred. Finally, conditions (iii) and (iv) embed an additional assumption regarding the particular type of complementarity between components: while the stand-alone value of the technology owned by M is positive, that of the technology owned by I is zero. If all the multiple innovative components of a product are indispensable, however, the logic of the holdup problem, and hence the appropriate remedies, can be significantly different. We address these four points in turn.

1. Inadvertent Infringement

Inadvertent infringement means that at the time of designing the product the manufacturer was unaware of the patent, or else it genuinely believed its product to be non-infringing. To see why inadvertent infringement is crucial to the holdup result, assume manufacturer M was aware of I’s patent ex ante. If it knew that the patent was valid (and maintaining the assumption that all infringements are detected), M would have bargained with I for a license before making any irreversible investments. In such ex ante bargaining, patent holder I would not obtain more than the target reward $\beta v$—i.e., patent holder I would not be over-compensated.

Suppose, however, that I’s patent is valid only with probability $\theta < 1$. Shapiro argues that in this case of probabilistic patents, a holdup problem can arise even if M is aware of I’s
patent rights before making any investments.\textsuperscript{68} That is, inadvertent infringement is no longer a necessary assumption. Here, I’s ex ante (target) compensation is $\theta \beta v$ and $\theta v$ is the incremental contribution in expected terms. Firm M, according to this argument, now has two options. First, it can negotiate with firm I ex ante, as if the patent was valid ($\theta = 1$). Such bargaining will result in a payoff for firm I equal to $\beta v$, which exceeds the benchmark $\theta \beta v$, and so I is over-rewarded.\textsuperscript{69} Alternatively, firm M could infringe on the patent and face litigation, but this second option would be costly. Hence, provided that the litigation cost is sufficiently large, M will choose to negotiate ex ante and firm I will be over-rewarded.

However, this result is based on the strong assumption that manufacturer M cannot contest the validity of the patent before designing its product, even though it is aware that I’s patent is “weak.” If the model is extended to allow M to litigate before designing its product, e.g. after having signed a licensing agreement or simply in response to I’s threat of an infringement suit, there is no over-compensation. This result is clearest if litigation does not entail any cost, but similar conclusions also hold with costly litigation. In this case, M will always contest the validity of I’s patent after signing a licensing agreement but before designing its product.\textsuperscript{70} In the ensuing litigation, with probability $1 - \theta$ the patent is ruled to be invalid and manufacturer M can incorporate the add-on feature freely. As a result, I’s

\textsuperscript{68} Shapiro recognizes that inadvertent infringement is necessary if the patent is ironclad, with $\theta = 1$. Shapiro, \textit{supra} note 4, at 13.

\textsuperscript{69} Note, however, that even in this case the extent of the overcompensation is at most a fraction of $v$, and so the problem cannot be significant when the value of the add-on feature is small. When infringement is inadvertent, by contrast, the patent holder can obtain a share of $C$, which can greatly exceed $v$. Indeed, the holdup problem is most serious precisely when the technology owned by the patent holder has a very low intrinsic value.

\textsuperscript{70} Before signing a licensing agreement, a potential infringer like M may face restrictions in meeting the U.S. Constitution’s “case-or-controversy requirement” for bringing a suit. But patent holder I by assumption can obtain nothing in the absence of a licensing agreement, and so such an agreement must sooner or later be reached. After the Supreme Court’s decision in \textit{MedImmune, Inc. v. Genentech, Inc.}, 127 S. Ct. 764 (2007), M can sue even without breaching the licensing agreement. (It is unclear whether bargaining with patent holder I without reaching any agreement may suffice to sue.) If any policy reform were needed to allow M to better enforce its right to litigate before designing, such a reform would be a much more tailored and appropriate remedy to the problems created by weak patents than denying I injunctive relief once the patent is upheld by a court. More generally, we would welcome reforms that make it easier to litigate before designing, such as allowing patents to be contested even in the absence of any affirmative act by the patent holder.
payoff is zero. With the complementary probability $\theta$, the patent is ruled valid and M must compensate I, with I’s payoff equal to $\beta v$. Therefore, I’s expected payoff is $\theta \beta v$. Thus the award equals the ex ante target and there is no over-compensation.

Therefore, the appropriate criterion for denying injunctive relief is that the defendant infringed inadvertently, not merely that it did not explicitly copy. The difference is not a minor one: re-developing an innovative technology without mechanically copying it can be a relatively easy task, especially when the infringer knows that the innovative technology already exists.

It should be clear, however, that an inadvertent infringement criterion may create perverse incentives. As has aptly been said, “Any party that did not use due diligence to find out whether its conduct constituted infringement would be in the advantageous position of using its own neglect to undermine the legal protection otherwise available to a patentee. Potential infringers would have a palpable incentive to decrease inquiry into existing patent rights, which would in turn increase the number of infringement disputes.”\(^\text{71}\) To avoid those risks, and hence avoid encouraging even greater false positives, it is important that injunction policy require a defendant to establish not only that it infringed inadvertently, but also that it exercised due diligence in searching for any IP right its product might have violated.

2. Uncertain Detection

In Lemley and Shapiro’s theoretical model, infringement is always detected with certainty and hence in equilibrium manufacturers never infringe voluntarily.\(^\text{72}\) In reality, companies may choose to infringe just to save royalty payments, hoping that patent holders


\(^{72}\) Even when the patent is probabilistic and M’s best strategy in the model would be to “infringe and litigate”, what actually happens in equilibrium is that M and I reach a licensing agreement whose terms reflect their best alternative strategies (i.e., the disagreement point).
do not have the will or the resources needed to detect or pursue each and every instance in which their patents are infringed. We therefore introduce the far more realistic assumption that some infringements go undetected. To deter deliberate infringement, the patent holder must still obtain its target reward \( \beta v \) on average even after accounting for the possibility of no detection.\(^{73}\)

Suppose that firm M deliberately infringes I’s patent and that the infringement is found only with probability \( \sigma < 1 \) (i.e., \( \sigma \) denotes the probability that I detects the infringement and files a suit). Assume that if the infringement is found and injunctive relief is granted, M is forced to re-design its product incurring a cost equal to \( C \). Then, with probability \( 1 - \sigma \), firm I receives a payoff of 0, while its payoff equals \( \beta (C + v) \) with probability \( \sigma \theta \)—i.e., the probability that I detects the infringement multiplied by the probability that the patent is found valid and infringed.\(^{74}\) Firm I’s expected payoff therefore equals \( \sigma \theta \beta (C + v) \), which can be less than \( \theta \beta v \), the target reward with probabilistic patents and perfect detection, even if \( C \) is positive and fairly large provided that \( \sigma \) is sufficiently small.

\(^{73}\) Here we focus on prospective damages. Some deterrence can also be provided by retrospective money damages; for instance, for firms that are determined to have willfully infringing a patent, judges can assess treble damages and oppositions’ lawyers’ fees. Nevertheless, the possibility of facing this punishment does not appear adequate to completely prevent purposeful infringement, especially when “rational ignorance” in conducting patent searches is included. See, e.g., Edwin H. Taylor & Glenn E. Von Tersch, *A Proposal to Shore Up the Foundations of Patent Law that the Underwater Line Eroded*, 20 Hastings Comm. & Ent. L.J. 721 (1998); Mark Lemley and Ragesh K. Tangri, *Ending Patent Law’s Willfulness Game*, 18 Berkeley Tech. L.J. 1085 (2003); William F. Lee & Lawrence P. Cogswell, *Understanding and Addressing the Unfair Dilemma Created by the Doctrine of Willful Patent Infringement*, 41 HOUS. L. REV. 393, 399 (2004); Ira V. Heffan, *Willful Patent Infringement*, 7 FED. CIR. B.J. 115, 115 (1997). Furthermore, the U.S. Court of Appeals for the Federal Circuit recently raised the standard for establishing willful infringement, making treble damages less of a threat. See Re Seagate Tech., LLC, No. 830, (Fed. Cir., Aug 20, 2007). For simplicity, we assume that retrospective damages guarantee to the patent holder an expected compensation exactly equal to \( \beta v \) until the courts makes a decision, so that the problem of guaranteeing the same expected reward for the subsequent period remains.

\(^{74}\) Blair and Cotter present a similar model of detection. The ex post redesign costs \( C \) can be thought of to include a penalty for infringement, \( F \) in Blair and Cotter’s model. See Roger D. Blair & Thomas F. Cotter, *Intellectual Property: Economic and Legal Dimensions of Rights and Remedies*, ch. 3 (CAMBRIDGE UNIV. PRESS 2005).
Figure 3: Patent Infringement Compensation Levels with Naked Infringement

The relative importance of the potential over-compensation and under-compensation problems in this case is illustrated in Figure 3. The figure shows that even in the presence of a holdup problem, granting injunctive relief may not necessarily over-compensate patent holders. Over-compensation requires that \( C \) is large relative to \( v \) if \( \sigma \) is small. The smaller is the probability of detection \( \sigma \), the more likely it is that we have an under-compensation problem. Clearly, then, policy should be concerned not only with the possibility of holdup, but also with manufacturers’ incentives to behave opportunistically, purposefully infringing a known patent or failing to adequately search for patents.

3. Complex Technologies and Multi-component Products

Lemley and Shapiro argue that injunctions should be denied in “situations in which a downstream firm produces a complex product that potentially or allegedly infringes many patents.”\(^{75}\) Their model, however, implies that a patent holder can extract significant extra rent only if the patented technology is a minor component of a product that is predominantly

\(^{75}\) Lemley & Shapiro, supra note 13, at 1994.
non-infringing. That is, the assumption in the model is that the manufacturer could have marketed a non-infringing product of positive, and relatively large, value $V$. When the infringed patent is essential for the innovative product, however, the logic of the holdup problem changes significantly.

To see this, consider the case of two innovative components that are both indispensable for creating a new product (i.e., two-way complementarity). One component is owned by firm M, and the other by firm I. Now the stand-alone value of the technology owned by either firm—M as well as I—is zero and the marginal contributions of both firms equal the entire value of the new product, say $W$. Moreover, it is now impossible (i.e., it is infinitely costly) to design the product in a non-infringing way both ex ante and ex post since both inventions are required in combination for either to earn any positive return. Consequently, once both innovative components have been invented, there is no reason why the outcome of the bargaining between manufacturer M and patent holder I should be different after the product has been designed than before.

One might counter that $C$ can now be interpreted as the cost M must pay to develop its innovative component. With this interpretation, in the ex ante bargaining, i.e. before M has sunk this cost, the bargaining surplus is $W - C$ and so I would obtain $\beta (W - C)$. But ex post, once M’s cost is sunk, I can obtain $\beta W$. As a result, firm I is again over-rewarded by $\beta C$. This argument, however, is one-sided: it emphasizes the R&D costs borne by firm M but neglects entirely those borne by firm I to develop its own innovative component.

To arrive at a more balanced conclusion, let $c$ denote the R&D cost I must bear to develop its innovative component. We can now distinguish three bargaining stages. First consider ex ante, i.e., before both firms sink their R&D expenditures. Here, the bargaining surplus is $W - C - c$ and so I’s gross reward is $c + \beta (W - C - c)$, while M’s gross reward is
\[ C + (1 - \beta)(W - C - c). \] In practice, such ex ante bargaining would occur very rarely, because it is often very difficult, if not impossible, to identify in advance which firm is going to develop which technology. Yet, according to the logic of Lemley and Shapiro’s analysis, these ex ante rewards are the appropriate benchmarks for market outcomes.

Second, consider the interim stage, i.e., after I has sunk \( c \) but before M sinks \( C \). Here, I would obtain \( \beta (W - C) \) while M would obtain \( C + (1 - \beta)(W - C) \). Patent holder I is actually under-rewarded by \( (1 - \beta)c \), because it is now held up by manufacturer M. The possibility that I is also held up is not taken into account in Lemley and Shapiro’s analysis, which focuses exclusively on what happens after the innovative technologies have been achieved.

Finally, consider the ex post stage, i.e., after both firms have sunk their R&D expenditures. Here, I would obtain \( \beta W \) and M \( (1 - \beta)W \). The difference between these ex post rewards and the target rewards is \( (1 - \beta) c - \beta C \), which can be either positive or negative depending on parameter values. That is, since both firms must sink a specific investment before they can contract, both may actually be subject to a hold up problem.

If R&D costs are approximately of the same size and the two firms have symmetric bargaining power, the difference \( (1 - \beta) c - \beta C \) will be small and the ex post bargaining solution will approximately re-produce the ex ante solution. To implement this outcome, however, both firms must be able to credibly threaten to shut down production. Manufacturer M can obviously do so irrespective of patent policy, but patent holder I can credibly threaten to shut down production only if injunctive relief is an available option. This means that injunctive relief is needed to re-produce the “ideal” solution, at least approximately, in this benchmark case.

Clearly, any deviation from a policy that offers I injunctive relief can be desirable only if I’s R&D costs relative to its bargaining power, \( c/\beta \), is significantly lower than M’s, \( C/(1 - \beta) \).
\( \beta \). In this case I would be over-rewarded ex post, because the hold up is less of a problem for I than it is for M. But when \( c/\beta \) is greater than \( C/(1 - \beta) \), I would be under-rewarded even with injunctive relief, and denying injunctions would further exacerbate this under-compensation problem.

With two-way complementarity innovators are more likely to be under-compensated and hence denying injunctions can be especially harmful. Intuitively, when both innovations 1 and 2 are needed to develop a product,\(^{76}\) a firm racing for innovation 1 exerts a positive externality on the firms racing to achieve 2, and vice versa. This positive externality is a source of distortion that tends to reduce investment in R&D as compared to the social optimum: the firm that first achieves innovation 1 will only benefit from its invention if component 2 is achieved as well. Thus the expected payoff of each successful innovator is the reward in case of success multiplied by the probability (a fraction less than one) that both inventions are created. In view of this additional distortion, the optimal degree of patent protection is larger than in the stand-alone innovation case.\(^{77}\)

Another issue is what happens when the number of complementary innovative components required for the new technology increases. Turning back to the model in which M can market a stand alone non-infringing product of positive value, \( V \), and I’s innovative component has an additional value of \( v \), Lemley and Shapiro claim that “As a first approximation, the magnitude of the [hold up] problem is multiplied by the number of patents that read on the product.”\(^{78}\) This, however, depends on how the costs of re-designing the product ex post relate to the number of infringed patents—a relationship that is not necessarily linear. Suppose, for example, that manufacturer M inadvertently infringes two

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76 Each innovative component has zero stand-alone value and both must be obtained in order to operate a new technology.
77 Denicolo shows that with two innovative symmetric components the optimal aggregate degree of patent protection is twice as large as in the stand-alone case. Denicolo, supra note 65, at §5.
78 Lemley & Shapiro, supra note 13, at 2016.
patents, owned by I1 and I2, respectively, which it could easily have circumvented ex ante. Clearly M was particularly unlucky or perhaps not careful enough, but is the magnitude of the problem really doubled? To answer this question, make the simplifying assumption that each additional component raises the value of the new product by the same amount, $v$. If it was really easy for M to design the new product without infringing I1’s and I2’s patents ex ante, then it seems reasonable to assume that the cost of redesigning the product, $C$, is the same as when only one patent is infringed. In the three-party bargaining that takes place once the courts have ruled that M infringed I1’s and I2’s patents, the disagreement point is $(V - C, 0, 0)$, where the numbers in brackets denote the payoffs to firms M, I1 and I2, respectively. The bargaining surplus is now $C + 2v$, and with symmetric bargaining power it will be divided evenly between the parties. Thus, both I1 and I2 will get $\frac{1}{3}(C + 2v)$. When $C > v$, that is, when an over-compensation problem arises, each patent holder in fact obtains less than it would have in the single-holdup case, $\frac{1}{2}(C + v)$. Manufacturer M’s payoff is now $V - \frac{3}{5}(C - v)$, as compared to the payoff of $V - \frac{1}{5}(C - v)$ it would have obtained if it had infringed only one patent. Thus, when $C > v$, M is harmed by multiple holdups, but the magnitude of the problem is clearly less than doubled.

Thus, for holdup to be a significant threat not only must the patent cover a single component of a larger complex product, but that one component must be minor ($v$ small) and a standalone product excluding $v$ must have been commercially and technically feasible ex ante.\(^{79}\)

\(^{79}\)In practice many complex products involve not one or two components, but hundreds. The issue is the same however: is a product viable ex ante without the contested component(s) or not? If not, the difference between the ex ante and ex post redesign costs will be small to zero as both are quite large, and thus holdup will be minimal or non-existent, except for the issue of R&D costs discussed above.
4. Costly Redesign

As the discussion above should make clear, the important aspect of redesign cost ($C$) is not simply that it is high relative to the value of the patent ($v$), but also that it is considerably higher ex post than it would have been ex ante. This follows because the holdup problem is a consequence of the greater difficulty of making later what could easily have been done early on.

In Lemley and Shapiro’s model, the cost of designing a non-infringing product is zero ex ante. Thus, $C$ denotes both the ex-post cost and the difference between the two. When they move to their policy recommendation, however, they simply posit that “the court should evaluate the cost that the infringing firm would have to incur to redesign its product to avoid infringing the patent. If this cost is high relative to the value that the patented technology has added to the infringing firm’s product, no permanent injunction should be issued.”

This policy recommendation is overly broad in relation to the model’s findings. If the suggested criterion were taken to mean that injunctive relief should be denied (or stays of injunctions routinely granted) whenever it is very costly or even impossible to design the product in a non-infringing way ex ante, this injunction policy would penalize the most valuable patents—precisely those that are most difficult to circumvent even with full knowledge of the patent. Instead, to be consistent with the theory, the policy should indicate that to avoid injunctive relief an infringer must show not only that it is costly to redesign the product in a non-infringing way ex post, but also that it could easily have designed the product in a non-infringing way ex ante if only it had been aware of I’s patent (which again emphasizes the importance of the inadvertent infringement assumption).

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80 Lemley & Shapiro, supra note 13, at 2037.
C. Evidence of Patent Holdup

The discussion above makes clear the theoretical circumstances under which patent holdup can occur are fairly narrow. The next important question is whether those circumstances are narrow in practice as well.

It is very difficult, if not impossible, to find systematic evidence on the holdup phenomenon. Strictly speaking, establishing a patent holdup would require comparing the royalty rate that would have been agreed by the parties ex ante with that determined ex post, when the manufacturer had already designed its product and started to commercialize it. But most of the time this comparison is counterfactual, since almost by definition either the ex ante or the ex post royalty rate can be observed, but not both. For the same reason, even anecdotal evidence on patent holdup and related licensing problems is at best circumstantial, and hence inevitably controversial.

1. Patent Holdup

Lemley and Shapiro cite two cases as evidence of holdup: Rambus charging “a 0.75% royalty rate for patents that do not cover industry standards and 3.50% for patents that do cover industry standards” and RIM’s settlement with NTP for $612.5 million in the case over BlackBerry email wireless service. As a matter of fact, however, the claim concerning Rambus’ licensing policy is incorrectː81 both royalty rates concerned standardized products, and the difference in royalty rates was due to the fact that the latter incorporated more patented components.82

81 To be sure, there seems little doubt that Rambus tried to holdup its licensees, but its attempt was struck down by the FTC. There are indeed several reported cases in which patent holders unsuccessfully threatened to holdup manufacturers, suggesting the effectiveness of available remedies, such as antitrust policy, the traditional equitable doctrine of laches and estoppel, or the mere fact that manufacturers often take care of designing their products in a non-infringing way if they can.
82 Initial Decision, In the Matter of Rambus, Inc., FTC Docket No. 9302, Finding of Facts Nos. 502, 1546, 1558 (Feb. 23, 2004). The royalty rates are 0.75 for SDRAM (see p1262) and 3.5 for DDR SDRAM (see p1390), both of which are covered by JEDEC standards. The DDR SDRAM royalty was higher due to more patented
As for the BlackBerry case, Lemley and Shapiro note that “the settlement was eighteen times the jury award”\(^{83}\). Assuming the jury award corresponds precisely to the ex ante royalty rate, however, “the damages the jury awarded were only for six of fifteen remaining years of the patent, […] and there is reason to believe RIM will sell more BlackBerries in the future than in the past”.\(^{84}\) At the time of the jury’s award (November 2002), the email wireless service was still early in its lifecycle. Thus, in the absence of a careful empirical analysis of the product lifecycle and the evolution of the industry it seems difficult to conclude with any certainty that there is a significant holdup problem even for this infamous case.

2. Royalty Stacking

Royalty stacking is a related licensing problem where the multi-component nature of a product leads to an aggregate royalty rate that is excessive even though individual rates may be reasonable (i.e., the many individual royalties stack up to a high total). The empirical evidence that royalty stacking is common is also quite weak, as some of us demonstrate in a separate paper.\(^{85}\) To summarize those findings here, we find that the empirical literature testing the validity of the royalty stacking theories in the real world is sparse and typically inconclusive. The few studies presenting empirical evidence report decidedly mixed results. Researchers have found a possible but limited royalty stacking effect in the software industry,\(^{86}\) a possible effect in the semiconductor industry that is apparently mitigated

\(^{83}\) Lemley & Shapiro, *supra* note 13, at 2014 n.35.
\(^{84}\) Lemley & Shapiro, *supra* note 13, at 2014 n.35.


through market mechanisms (primarily cross-licensing), no measurable effect in the mobile telecom industry, and no systematic evidence in the biomedical industry.

The case studies that Lemley and Shapiro present do little to advance the question. They start by discussing patenting in 3G cellular (WCDMA—Wideband Code Division Multiple Access) and Wi-Fi technologies. In both of these sectors, patenting is extensive, with hundreds of patents relevant for each technology. Moreover, in both instances the patents are held by a large number of firms. These two points suggest that royalty stacking could occur, but do not prove that it has in fact occurred. From patent proliferation and a fragmentation of IP rights, however, Lemley and Shapiro claim that there is an overcompensation problem due to royalty stacking. We cannot make that connection without more information, though. Royalty stacking requires that the asking prices for a group of complementary patents exceed in the aggregate their objectively determined “fair” value. The only conclusive evidence of royalty stacking, therefore, comes from comparing actual licensing terms against an objective estimate of patent value.

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87 See Hall & Ziedonis, supra note 54; Rosemarie Ham Ziedonis, Don’t Fence Me In: Fragmented Markets For Technology And The Patent Acquisition Strategies Of Firms, 50 MGMT. SCI. 804 (2004).
88 Anne Layne-Farrar and Jorge Padilla, “Royalty Stacking In High Tech Industries: Testing The Theory”, working paper on file with the authors.
90 Interestingly, some of the empirical evidence quoted by Lemley & Shapiro does not rely on actual market data but rather on experimental simulations. See Lemley & Shapiro, supra note 13, at 2019 n.53. While we recognize the value of experimental economics to the understanding of complex economic phenomena, we do not believe that this sort of analysis constitutes empirical proof of the importance and prevalence of royalty stacking in the marketplace.
91 They offer their case studies as “examples of the royalty stacking problem outside the litigation context, in the development of new technologies within a standard setting organization.” Lemley & Shapiro, supra note 13, at 30.
92 Patent valuation is not a cut and dried science. It typically requires a close read of the patents at issue, from both a legal and technical perspective. Moreover, “value” is in the eye of the licensee as it depends on the uses that the patent will be put to. For a sampling of the literature on patent valuation methods, see Lynda M. Applegate & Gavin Clarkson, Intellectual Asset Valuation, HARV. BUS. SCH. Case Study No. 9-801-192 (2000); F. Russell Denton & Paul Heald, Random Walks, Non-Cooperative Games, and the Complex Mathematics of
admit that for their case studies “It is not clear what the total cost of these stacked royalties is.”\(^{93}\) Nor do they report any objective estimates of patent value to benchmark the aggregate royalty rates for each of these technologies.

For 3G, Lemley and Shapiro note that “We have seen estimates as high as 30% of the total price of each phone, but those were based on summing royalty demands before any cross-licensing negotiations began.”\(^{94}\) They report sources that suggest the cumulative royalty rate for WCDMA may lie somewhere between 15% and 22%.\(^{95}\) These figures do not appear to be in line with the aggregate royalty rates reported by market participants. For example, Hakan Eriksson, Ericsson’s CTO, recently noted that “[d]ifficulties with WCDMA and HSPA are exaggerated [...] The IPR rate for these technologies is typically 4-5%, and WiMAX will end up at the same level. On only a few occasions the IPR rate for WCDMA and HSPA is higher than 4-5%.”\(^{96}\) Further, Ericsson’s CEO, commenting that many analysts exaggerated the level of royalties paid on WCDMA, stated that “You will find hardly anyone that pays more than high single digits.”\(^{97}\)

But suppose for the sake of argument that the cumulative royalty rate was between 15-22%, \textit{quod non}, would these rates be “too high”? There is no absolute scale for judging royalty rates. For a downstream implementer that has itself contributed significantly to the 3G standard, 15 – 20% might perhaps be too high. But a firm of this type will have patents of its own to cross-license and so it is quite unlikely that these high end aggregate royalty estimates apply to such vertically integrated firms. If the proffered cumulative rates apply only to pure manufacturing firms with no intellectual property of their own relevant for the

\footnotesize{\textsuperscript{93} Lemley & Shapiro, \textit{supra} note 13, at 31.}
\footnotesize{\textsuperscript{94} Ibid.}
\footnotesize{\textsuperscript{95} They cite, in particular, Bekkers & West, \textit{supra} note 61, at 22, and Michael W. Thelander, \textit{The IPR Shell Game}, 2 SIGNALS AHEAD 1, 7 (2005).}
\footnotesize{\textsuperscript{96} Interview by InformaTM with Hakan Eriksson, CTO, Ericsson (Feb. 21, 2007).}
\footnotesize{\textsuperscript{97} Interview for Reuters by Lucas van Grinsven with Carl-Henric Svanberg, CEO, Ericsson (Dec. 3, 2006).}
product, then 15 – 20% may be entirely appropriate, or perhaps even too low: after all, most of the value of a cellular phone seems to lie in its technology—the designs, the chips, and so forth. We do not mean to suggest that 30%, 20%, or even 15% cumulative royalty rates should be considered reasonable. The point is that determining what is and what is not reasonable requires an adequate benchmark. Discussions of rates in the abstract neither prove nor disprove royalty stacking.

3. Summing Up

Taking all of the evidence together, we find the proof of prevalent, recurring patent holdup and royalty stacking in high-tech industries to be extremely weak. Proponents of categorical injunction limitations might counter that it is the absence of the data needed to truly assess how common holdup and royalty stacking are—licensing contracts and patent valuations—that drives the dearth of evidence. If we were to look at appropriate (but publicly unavailable) measures, we might see how often these problems occur. This is, however, a rather speculative basis on which to ground significant policy reform.

IV. POLICY IMPLICATIONS

The appeal of categorical denials for injunctive relief is easy to understand. If it were always the case that firms fitting into well defined boxes were the ones, and the only ones, most likely to be engaged in holdup, then categorical denials would spare the court the messy

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98 An additional consideration for pure manufacturing firms paying relatively higher royalty rates is that costs of this sort provide incentives for such firms to move beyond manufacturing. Two firms in the ICT sector that appear to be taking this evolutionary path are Samsung & Huawei. These firms began as manufacturing outsourcers, making other companies’ products. They are now investing in R&D of their own and have begun to patent their inventions. As they begin to contribute to the development of cellular products (and the standards defining them), their royalty burden will likely fall through cross licensing arrangements. Thus, it is only those manufacturing firms that decide not to innovate, or simply prove unable to do so, that continue to pay the highest royalty rates. See Shane Greenstein, Outsourcing and Climbing a Value Chain, IEEE Micro, Sept.–Oct. 2005 at 84. Also see Craig Simmons, China’s Telecom Giant: The Huawei Way, NEWSWEEK INT’L, Jan. 16, 2006, available at http://www.msnbc.msn.com/id/10756804/site/newsweek/page/0/.
and costly task of evaluating the particulars of each case. The risk of false positives would be
minimized, as would the risk of false negatives, and we would meet our goal of error cost
minimization. Unfortunately, as just shown, the categories proposed in the literature and
evidently being deployed currently by district courts, while certainly clear, could capture far
more than the handful of potential bad actors sought after. Instead a great many innocent
parties, in that holdup was not their goal, could be boxed in as well. In other words, when the
tests are either flawed and/or imprecise, as the tests discussed above are, policy relying on
them can create a large number of errors. An error cost approach would therefore lead us to
reject categorical limits on injunctions.

A. Guidance for Injunctive Relief

What should guide injunctive relief? The obvious answer is that the four-pronged equity
test already established in the case law and reaffirmed by the majority in the *eBay* decision
should be the proper guide. While some authors have focused on Justice Kennedy’s
concurring option as giving a green light to district courts to deny injunctive relief to “non-
manufacturing patent owners”, we see the majority statement as more of a call for district
courts to return to a balancing test from a course of nearly automatic granting of injunctive
relief.

While Justice Kennedy’s admonition to keep a watchful eye for holdup is sage advice,
we find that the *eBay* decision does not lend support to broad categorical limitations on
injunctive relief for non-manufacturing patent holders, even when multiple complementary

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99 For a similar line of reasoning applied to patents in the software industry, see Ronald J. Mann, “Do Patents
Facilitate Financing in the Software Industry?”, 83 Tex. L. Rev. 961.
100 See, e.g., Lemley & Shapiro, *supra* note 13; Doug Licthman & Mark A. Lemley, *Rethinking Patent Law’s
MercExchange, L.L.C.: Permanent Injunctions For Patent Infringement Are No Longer Automatic*, The
Metropolitan Corporate Counsel, Nov., 2006.
components comprise the product. The majority opinion, written by Justice Thomas, explains

But traditional equitable principles do not permit such broad classifications [as assuming all non-practicing patent holders do not qualify for an injunction]. For example, some patent holders, such as university researchers or self-made inventors, might reasonably prefer to license their patents, rather than undertake efforts to secure the financing necessary to bring their works to market themselves.

The main gist of the Supreme Court opinion, as we read it, is rather a call for the lower courts to adhere to the four-factor test already established. We see no reason why non-manufacturing or non-competing patent holders could not meet this test.

In relation to the first factor of irreparable injury, most scholars agree that injunctions are critical tools for patent holders in achieving the rights legitimately granted by a patent. Thus one author writes that “limiting a patent holder’s ability to stop the infringing activity will severely diminish the value of the patents because the only right inherent in a patent is the right to exclude others from its use.” An R&D focused firm has little other leverage in achieving fair payment, as explained above, and does not have the option of employing the patent itself. Nor would we want to encourage R&D focused firms to make inefficient investments in downstream operations merely to pass an injunction test. Moreover, when a court denies an injunction the firm’s ability to attain fair remuneration from other (future) potential licensees will be weakened as well, as those firms will look to the public terms


103 As Justice Kennedy observed in his concurring statement, “[t]he Court is correct, in my view, to hold that courts should apply the well-established, four-factor test—without resort to categorical rules—in deciding whether to grant injunctive relief in patent cases.” *See, Ebay Inc., et al. v. MercExchange, LLC* 126 S. Ct. 1837, 1848 (2006).

104 McDonough, *supra* note 22, at 197. See also Rob Merges, writing about the importance of the injunctive threat in creating a patent pool stating that “[w]ithout the property rights—backed by the threat of production-choking injunctions—the advantages conveyed by the pool would never have been realized.” Robert P. Merges, *Contracting into Liability Rules: Intellectual Property Rights and Collective Rights Organizations*, 84 CAL. L. REV. 1293, 1343 (1996).

105 In fact, this is just the advice of some practitioners. *See, e.g.*, Cote, *supra* note 23.
settled on in the court dispute. These injuries do not rest on the in-house practice of the patent or on direct competition with the licensee.

In terms of the second factor, the inadequacy of other remedies, note that the option of injunctions can aid in more complete contracting. Negotiations frequently cover entire patent portfolios, including all intellectual property issues between two companies. Cross licensing can be a part of the talks even for upstream firms, for example when follow on research relies in part on complementary patents held by others. The courts, however, do not have the authority to order a defendant infringer to grant a cross-license of the infringer’s patents to the successful patent holder plaintiff, nor to impose any other terms. In other words, all that the patent holder can recover in adjudication is cash royalties, not all of the other terms and conditions available during bilateral negotiations. If shifting bargaining power reduces the ability of the parties to reach agreement on these terms, patent holders cannot be made whole through reasonable royalty awards alone.

Regarding the third factor, the balance of hardships, because patents have expiration dates, timing issues must be considered when weighing harm. The literature has largely assumed away timing issues. For instance, Lemley and Shapiro argue that107

It is true that stays will allow the infringing party to keep infringing for some period after the patent is found valid and infringed, but we do not see this as terribly unfair to the patent holder, since the infringing party will owe reasonable royalties for those infringing sales, so any adverse impact on the patent holder is no greater than the impact caused by the infringement during the pendency of litigation.

If court proceedings moved at a quick pace, ignoring delays might be reasonable. But this is far from reality. Patent infringement cases can take years to wend their way through

106 Ashish Arora, Contracting for tacit knowledge: The provision of technical services in technology licensing contracts, 50 J. DEV. ECON. 233 (1996).
107 Lemley & Shapiro, supra note 13, at 41.
the courts, and the average case takes approximately 15 months.\(^\text{108}\) Meanwhile, any delay in payment benefits the infringer and harms the patent holder since a dollar today is always worth more than a dollar tomorrow. This is doubly true for R&D focused firms who rely on licensing for their revenues.\(^\text{109}\) Nor is there any guarantee that the courts will apply an appropriate interest rate to account for the lost time. Thus, infringers tend to have strong incentives to drag out proceedings while patent holders generally have incentives to settle.

Furthermore, when courts finally do force payment, patent holders face considerable dangers in a court setting its royalty rates. Specifically, in the absence of ex post holdup a court-set royalty rate acts as a “cap”, not a floor, on licensing terms, as illustrated in Figure 1 above. Furthermore, if a court sets a rate too low, it will not only cost the patent holder in that one transaction but will hinder the firm’s future negotiations with other potential licensees, as no other party will pay more than the publicly noted court rate. This dynamic reinforces patent holders incentives to settle on a license, even when it appears that they will win a court case, just to avoid court set rates.

It is therefore easy to imagine circumstances where hardship arguments could favor either side in a patent dispute. Patent holders face substantial delays in receiving payment, delays that might jeopardize their operations; they also face the risk of inadequate royalty rates set by a court, and the long term repercussions that entails. On the other side are the potential losses to a manufacturer from shutting down its plant and the impact this might have on customers or the industry. It is the case particulars under the test that should decide this question and not the business model of the patent holder or its competing status with the alleged infringer.


\(^{109}\) In fact, scholars have commented on the possibility of “financial predation” associated with denying a rival access to needed capital. See, e.g., Patrick Bolton, Joseph F. Brodley & Michael H. Riordan, Predatory Pricing: Strategic Theory and Legal Practice, 88 GEO. L.J. 2239 (2000).
Finally we come to the most important issue, factor four on public interest. The main point here is how the granting of an injunction would affect incentives for innovation. While in the short-term limiting injunctions may protect the investments of manufacturing firms, long-term innovation might be chilled. In particular, if injunctions are granted on the basis of whether the patent holder actually practices its invention or whether the product incorporates multiple patented inventions, the viability of a worthy business model would be hindered and incentives for innovation would be reduced. For all of these reasons, we agree with the majority opinion in the eBay decision: categorical limits on injunctive relief are not needed and could do much harm; instead careful application of the existing four-factor test is the best approach.

B. The Related Issue of Reasonable Royalties

Clearly, the two decisions the courts must make in a patent infringement case—whether to grant an injunction and, if not, how to set the prospective royalty—are strictly related, as we explained in section II above. In most of this paper we have focused on the first of these two decisions. And the issue of the optimal royalty is, indeed, of lesser importance if the courts grant injunctions relatively frequently. Nonetheless, given the link between the two, we end our analysis with a discussion of reasonable royalty rates.

Look again at Figure 2. If the court-ordered royalty is sufficiently large, the cost of denying injunctive relief is limited, but if the royalty is low, then innovators can be seriously under-compensated. Conversely, if injunctive relief is denied rarely, only in the presence of big holdup problems, then it is approximately optimal to set the reasonable royalty at the rate that would have been agreed by the parties ex ante, in the spirit of Georgia-Pacific.\textsuperscript{110} But if injunctions are denied even in the absence of a significant holdup, things are different: if the

\footnote{\textsuperscript{110} Georgia-Pacific Corp. v. U.S. Plywood Corp., 318 F. Supp. 1116 (D.N.Y. 1970)}
courts set the prospective royalty rate at the unconditional mean of $\beta v$, patent holders will be under-compensated on average. This is explained in Figure 4.

**Figure 4: Patent Infringement Compensation Levels Under Holdup with Georgia-Pacific Royalties**

Suppose, for simplicity, that all values of $v$, the incremental contribution of patent holder I, were equally likely.\textsuperscript{111} Then, the area of the right-hand-side triangle (defined for $v$ between $v^+$ and the maximum $v^*$) would give the expected under-compensation associated with the Georgia-Pacific royalty rate, $R_{GP}$. Likewise, the area of the left-hand-side triangle (defined for $v$ lower than $v^+$) would give the expected over-compensation associated with $R_{GP}$, provided that patent holder I received $R_{GP}$ for all values of $v$ lower than $v^-$. By definition, the Georgia-Pacific royalty rate, $R_{GP}$, is such that the areas of the two shaded triangles in Figure 4 coincide. So if patent holder I received $R_{GP}$ for all values of $v$, its compensation would be fair. However, as explained in section II.B above, for low values of $v$ (when $v$ is lower than $v^-$) the infringer will renegotiate a lower royalty. Once this renegotiation possibility is taken into account we have that the expected over-compensation for $R_{GP}$ is reduced to the area

\footnote{\textsuperscript{111} Formally, assume that $v$ was uniformly distributed in a finite interval $[0, v^*]$.}
It follows that when the royalty rate is equal to $R^{GP}$, patent holder I is undercompensated on average.

When determining the prospective royalty rate, if the courts really want to reproduce, at least in expected terms, the outcome of ex ante bargaining, they should target an inflated benchmark. As a result, any move toward denying injunctive relief more broadly should be accompanied by a move towards computing reasonable royalties more generously, and vice versa. Surprisingly, Lemley and Shapiro argue simultaneously for limiting injunctions and reducing reasonable royalties. It seems difficult to reconcile these combined proposals, unless there are reasons to believe that currently the courts are systematically inflating reasonable royalties, thereby over-compensating patent holders.

The evidence that Lemley and Shapiro present to this effect is, however, problematic. They make two main empirical claims. First, they note that the average royalty rate granted by courts in all reasonable royalty cases contained in their sample (which is 13.13% of the price of the infringing product) is “surprisingly high”. To support this claim they refer to an estimate from the *Licensing Economics Review* finding an average royalty rate of 6.7% for patent licenses negotiated without litigation. Second, they argue that “reasonable royalty rules do in fact accommodate component products, but only to a limited extent”. In support of this claim, they first compare the average royalty rate for component inventions in their sample with the average royalty rate for all inventions and for integrated product claims. They also compare the average royalty rate for electronic inventions (where allegedly royalty stacking is likely to be a problem) with the corresponding figure for mechanical inventions (somewhat immunized from that problem). They find that the average royalty rate for component inventions is 30% lower than the average royalty rate for integrated product

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112 Lemley & Shapiro, *supra* note 13 at 36.
113 Lemley & Shapiro, *supra* note 13, at 38.
claims and that the average royalty rate for electronic inventions is approximately 60% lower than the average royalty rate for mechanical inventions, but these discounts are regarded as insufficient.

A closer look at the claims demonstrates that they are not reliable. Consider each claim in turn. One problem with the evidence presented to support the first claim is that the data sample is not a random extraction from the *Licensing Economics Review* sample. As a consequence, the patents considered to calculate the two averages are likely to differ in many dimensions, as Lemley and Shapiro recognize. For example, patents might differ in terms of their net contribution to the value of the products embedding those technologies, or in terms of the bargaining skills of licensees and licensors. To the extent that these features are correlated with the probability of patents being litigated, the comparison of the two averages is systematically biased. It is widely recognized, for instance, that more valuable patents are the ones most likely to be litigated.

Another problem is that the first, larger average royalty rate is derived from patents that have been ruled valid, whereas the second, lower average only corresponds to patents that may or may not be valid (i.e., probabilistic patents). Assume, for the sake of argument, that the patents in Lemley and Shapiro’s court sample and those in the sample of the *Licensing Economics Review* were identical in all dimensions except for the fact that the latter are probabilistic, with a probability $\theta$ of being ruled valid if litigated. Then, the ratio between the reasonable royalty for a probabilistic patent with strength $\theta < 1$ and the royalty rate for an ironclad patent ($\theta = 1$) should be $\theta$. If we calculate that ratio using the values Lemley and

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114 Others agree: see Golden, supra note 19, at 2116 (“There are significant reasons to suspect that Lemley & Shapiro’s empirical data is unrepresentative. Further, such data cannot by itself indicate what the proper level of compensation is.”)


Shapiro report, we find that $\theta$ is approximately equal to 0.5, which is close to the probability that a patent was ruled to be valid in all patent cases in federal court that were litigated to final judgment in the year 2000.\textsuperscript{117} That is, this factor alone can explain the difference between the average royalty rate granted by the courts in Lemley and Shapiro’s sample and the average royalty rate for patent licenses negotiated without litigation.

Turning to the claim that the courts do not adequately accommodate component inventions, Lemley and Shapiro’s discussion implicitly presupposes that the reasonable aggregate royalty rate for component inventions is the same as the reasonable rate for stand-alone inventions.\textsuperscript{118} But theory suggests that the appropriate aggregate reward for complementary innovations is generally higher than for stand-alone innovations.\textsuperscript{119} As a result, no discounting at all may be appropriate in some circumstances, and even when some discounting is indeed appropriate, it is generally less than division by the number of patents reading on a product. If the court-ordered reasonable royalty rate for component innovations is half that for stand-alone innovations, for instance, the courts did not necessarily mean that there are only two components in a multi-component product on average. Perhaps the courts are well aware that complex technologies involve more than two components on average, but also recognize the need to increase the aggregate reward with multi-component inventions and to allow for variations in patent value.

To sum up, we are unaware of any reliable evidence that the courts systematically overcompensate patent holders when setting reasonable royalty rates. On the contrary, theory

\textsuperscript{117} See Moore, supra note 6, at 365, 386.

\textsuperscript{118} Lemley & Shapiro, supra note 13, at 2044.

\textsuperscript{119} Denicolo shows that with complementary innovations and fragmented property rights, each innovator should be rewarded as if he contributed the whole technology if there are enough profits to do so; otherwise, there is no equilibrium with positive, simultaneous investments in R&D due to the externality innovators investing in one innovative component exert on those investing in the other, complementary components. See Denicolo, supra note 65. When firms invest in the separate innovative components sequentially, the optimal reward policy is more complicated; however, the optimal aggregate reward with complementary innovations is always greater than in the stand-alone case.
suggests that the *Georgia-Pacific* factors, whose goal is to re-produce the royalty rate that would have been agreed by the parties, may under-compensate innovators inasmuch as they do not account for the possibility of re-negotiation ex post.

**IV. CONCLUSIONS**

Providing balance in the assessment of patent injunctions is critically important, with more than an academic inquiry at stake as real world policy decisions are often guided by proposals first set forth in scholarly journals.\(^{120}\) With such high stakes at issue, we argue that a more thorough and balanced understanding of the threat of patent holdup is needed to better guide court decisions. The literature has made clear the potential costs resulting from patent holdup. What it has not made clear is whether the problem is widespread, but this key question must be answered before categorical limitations on injunctions are justified. If holdup is infrequent—as the available evidence suggests—then limiting injunctions to protect against holdup is itself a dangerous course. It might stop a case or two of patent holdup, but along the way it could catch a number of false positives as well. This would reduce the expected cost of willful infringement and, consequently, could lead to under compensation for innovation in high technology industries.

Moreover, courts faced with injunctive relief decisions already have a well-functioning mechanism to rely on. The Supreme Court appears to believe that the existing four-factor test is flexible enough to accommodate the increasing ranks of non-manufacturing patent

\(^{120}\) The current trend in district court rulings highlights this point. The recent *Rambus* opinion issued by the FTC also emphasizes the link, as that opinion cites a number of academic papers making theoretical points. For instance, when discussing Rambus’ royalty rates the opinion quotes Swanson & Baumol, in saying that “a reasonable royalty ’is or approximates the outcome of an auction-like process appropriately designed to take lawful advantage of the state of competition existing ex ante . . . between and among available IP options.’” Swanson & Baumol, *supra* note 58. See also, U.S. DEP’T OF JUSTICE & FED. TRADE COMM’N, Antitrust Enforcement and Intellectual Property Rights: Promoting Innovations and Competition (2007).
holders. At a minimum, then, any substantial policy shift should be supported by evidence that the four-factor test is inadequate or has failed in some important way.

If the district courts are indeed following the policy prescription laid out in the literature and apparently advocated by Justice Kennedy, taking patent holdup as commonplace and as justifying broad categorical restrictions on the granting of injunctions, in particular among non-manufacturing patent holders or in cases involving multiple component products, they are risking serious harm to the innovative process. That policy could well lead to undercompensation and underinvestment for innovation. Furthermore, it could hinder a legitimate and welfare enhancing business model built around a comparative advantage for R&D as opposed to manufacturing. And it could consolidate the market power of entrenched vertically integrated companies, to the detriment of entry and competition within the high technology sector.

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121 Opinion of Justice Thomas in *ebay Inc., et al. v. MercExchange, LLC* 126 S. Ct. 1837, 1841 (2006). (“Such patent holders may be able to satisfy the traditional four-factor test, and we see no basis for categorically denying them the opportunity to do so.”)