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ESTIMATING  
DAMAGES  
IN PATENT  
INFRINGEMENT  
CASES:  
AN ECONOMIC  
PERSPECTIVE

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# Estimating Damages in Patent Infringement Cases: An Economic Perspective

## Introduction

In our technology-based economy, many firms recognize that their intellectual property is their most valuable asset. Such firms' corporate strategies often include protecting their intellectual property by aggressive enforcement of patents, copyrights, trademarks and trade secrets through licensing and litigation. Notably, several recent patent infringement damages awards have reached the billion-dollar level.<sup>1</sup>

Given the high stakes involved, it is essential that damage claims be constructed properly. This article focuses on the key economic factors that should be considered when estimating damages in patent matters. Many of the same principles also apply to calculating damages in copyright and trade secret cases and in licensing intellectual property.

The next section describes the legal and economic framework for calculating patent damages. The following two sections discuss the construction of a lost profits claim and the determination of a reasonable royalty. The concluding section summarizes the key economic principles that underlie patent damages.

## The Legal and Economic Framework

The starting point for estimating patent damages is 35 U.S.C. § 284, which states:

Upon finding for the claimant the court shall award the claimant damages adequate to compensate for the infringement, but in no event less than a reasonable royalty for the use made of the invention by the infringer, together with interest and costs as fixed by the court.

The Federal Circuit defines compensatory damages as lost profits caused by the infringement. Lost profits include profits on lost sales as well as profits lost as a result of price erosion. Such a comprehensive definition is designed, as Judge Easterbrook put it: "...to give the patent holder the economic benefits it would have enjoyed had its intellectual property been respected."<sup>2</sup> When lost profits cannot be proven, a reasonable royalty serves as a floor on damages.

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<sup>1</sup> For example, in *Polaroid Corp. v. Eastman Kodak Co.* the damage award was nearly one-billion dollars. In *Litton v. Honeywell* a jury awarded damages of over one-billion dollars, although the judge set aside the award and ordered a new damages trial.

<sup>2</sup> See *Grain Processing Corp. v. American Maize-Products Co.*, 979 F. Supp. 1233 (N.D. Ind. 1997).

A patent is often believed to convey a monopoly on the patent holder. In fact, however, a patent only gives the patent holder the right to exclude others from using the patented innovation, just as property rights for tangible property enable the property owner to exclude others from using his or her property.<sup>3</sup> The value of a patent, therefore, depends on the same factors that determine the value of tangible property: its inherent usefulness and the extent and price of substitutes.

For example, consider the housing market. The property right to my house gives me the right to exclude others from using the house and to charge rent if I desire to “license” its use to others. It does not necessarily give me monopoly power in the housing market or enable me to charge supra-competitive rents. Rather, the rent that I can charge for my house depends on how potential renters value the specific characteristics of my house and what rents other landlords are asking for similar houses. In other words, the rent that I can charge depends on the supply and demand conditions in the housing market.

As in the case of determining the rent I can charge for my house, properly determining patent damages requires an economic analysis of supply and demand conditions which relate to the value of the intellectual property itself. It is not a simple accounting exercise, but rather requires analysis similar to that used to determine damages in antitrust cases:<sup>4</sup> a market must be defined and reconstructed absent the alleged infringement. Such a market analysis includes assessing the degree of competition and potential substitutes, determining the demand elasticity of the product at issue and analyzing the manufacturing, marketing and distribution capabilities and costs of the market participants.

In the next two sections I show how the underlying economic value of the intellectual property at issue affects lost profits and reasonable royalty damages.

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<sup>3</sup> A patent does not even necessarily give the patent holder the right to practice the invention claimed in the patent since the invention may require the use of other patents.

<sup>4</sup> See Judge Easterbrook’s opinion in *Maburkar* in which he states, when referring to a damage calculation, “This procedure fully compensates the patent holder. It is the mirror image of the damages model used in antitrust cases...” *In re Maburkar Patent Litigation*, No. MDL 853, 831 F. Supp. 1354 (N.D. Ill 1993).



## Lost Profits Damages

### The Panduit Test

The Panduit<sup>5</sup> test is usually the starting point for determining whether profits have been lost as a result of the infringement. The Panduit test requires the plaintiff to establish:

- Demand for the patented product;
- Absence of acceptable noninfringing substitutes;
- Manufacturing and marketing capability to exploit the demand;
- The amount of profit that would have been made.

Below, I discuss each of these factors in turn, showing how economic analysis of market conditions relates to each factor.

#### *Demand for the Patented Product*

There is usually some demand for the patented product; otherwise there would be no product sold, no infringement and no lawsuit. Consequently, one interpretation of the first Panduit factor is not whether there is demand for the product at issue but whether there is demand for the patented feature of the product. Absent demand for the patented feature of the product, the patent has no value and there are no lost profits damages.

To assess the demand for the patented feature of the product, one must ask what the invention accomplishes and how users value the accomplishment. For example, does the patent improve the product, allow the product to be produced at a lower cost or make possible the production of a new product altogether? Such a patent may have economic value.

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<sup>5</sup> See *Panduit Corp. v. Stablin Bros. Fibre Works, Inc.*, 575 F.2d 1152 (Sixth Circuit 1978).

### *Absence of Acceptable Noninfringing Substitutes*

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Economics teaches that the value of a patented product is determined to a large extent by the availability and cost of substitute products and production technologies. The second Panduit factor thus requires an evaluation of the degree of substitution on both the demand and supply sides. This exercise is similar to that followed in antitrust cases where a relevant market is defined based on the degree of substitution on both the demand and supply sides.

On the demand side one must look to what substitute products, if any, the purchasers of the product at issue would turn to if its price were higher or it were unavailable. If a new patented product has many substitutes in the marketplace, the invention will have little value. For example, suppose a new way of lighting is invented but offers neither cost advantages over extant methods of lighting nor any different esthetic benefits to consumers. The fact that there are many competing lighting products implies that such a patent has little or no value. Should the patent holder try to license the patent, it would find no takers since consumers would be unwilling to pay a premium for the patented product (and therefore manufacturers would be unwilling to pay a royalty). Likewise, there would be no lost sales or profits resulting from infringement of the patent since in this example the patent did not lead to any additional sales.<sup>6</sup>

On the supply side, one must examine what alternative technologies could be used by producers of the infringing products if the patent holder raised its license fee or made its technology unavailable. For example, suppose that forty different paint makers each had a different patented formula for making red paint that results in a \$5.00 per gallon cost savings over an older, unpatented method. In this situation, each of the forty patents alone has value compared to the unpatented method. But none of the forty patents has economic value. Competition will cause the paint makers to drive the price of red paint down to a level commensurate with their lower production costs, thereby competing away the potential value of their patents. As a result, there would be no demand to license any of the patents since a license holder who paid a per unit royalty would be unable to compete with the other patent holders who did not have to pay license fees. Furthermore, in this example, a particular patent holder would suffer no lost profits or lost sales resulting from the infringement because the patent itself does not lead to additional sales.<sup>7</sup>

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<sup>6</sup>One might ask why anyone would infringe a patent that had no inherent value. One reason is that it may be difficult to determine whether one is infringing a patent. In some patent cases, infringement may be inadvertent: the infringer does not know that he or she has potentially infringed until after production and sales have occurred. And even after a suit is filed, there is usually dispute about whether infringement has occurred and whether the patent is valid.

<sup>7</sup>Moreover, in a perfectly competitive market with identical firms, such as that assumed above, a firm's sales do not depend on the sales of any one competitor. Thus, even if the infringer's sales were assumed to be zero, the patent holder's sales would be the same.

In most cases, determining the patent's value is not as clear cut as in these two examples. For example, noninfringing substitutes may exist, yet not be perfect substitutes as assumed above. In such situations, it may be necessary to measure the degree of substitution and hence the magnitude of lost profits damages.

In sum, it is usually necessary to consider substitutes on both the demand and supply sides when determining whether the patent has value and thus whether the patent holder has suffered lost sales and lost profits as a result of infringement. Some patents represent minor technical changes on well-known ideas, and there may be many ways of achieving the same economic results through substitute processes. Other patents make possible new industries or ways of doing things and may have significant value.<sup>8</sup>

#### *Manufacturing and Marketing Capability to Exploit the Demand*

The third Panduit factor recognizes that a firm may not have the manufacturing or the marketing capacity to exploit its patent fully. As such, it requires both an economic analysis of the firm's existing production processes and an extrapolation of these processes and their associated costs into a range where production has not yet occurred. It is also necessary to investigate the firm's marketing practices and the nature of the marketplace to assess whether the firm had the marketing capability to make the additional sales.<sup>9</sup> Economics teaches that in many markets more is required to sell a product than simply producing it.

#### *The Amount of Profit That Would Have Been Made*

Finally, assuming the firm had the manufacturing capacity and marketing capability to meet the additional demand, the fourth Panduit factor requires economic analysis of the incremental costs the firm would have incurred in meeting that demand. This relates to the third Panduit factor, "manufacturing and marketing capability." Because incremental costs often rise as a firm nears capacity, historical incremental costs could understate projected incremental costs, thereby overstating profits. On the other hand, if the firm had sufficient excess capacity, it might be able to achieve economies of scale at higher production levels so that projected incremental costs would be lower than historical incremental costs.

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<sup>8</sup> Economic evidence that a patent has transformed or created a new industry is compelling evidence of the non-obviousness of the patent. Such economic evidence of commercial success can play a crucial role in defeating arguments that the patent is invalid because it was obvious.

<sup>9</sup> The patent holder might license its patent if it lacked the capacity to exploit it itself or if the licensee had lower manufacturing, distribution or marketing costs.

## Calculating Lost Profits Damages

Assuming the four Panduit conditions are met, calculating lost profits requires one to model how the market would have evolved absent the infringement and to compare the “but-for” behavior of both the infringer and the patent holder to their actual behavior. The difference between the patent holder’s but-for and actual profits represents the patent holder’s lost profits damages. Constructing a but-for world is not unique to patent cases: it is an element of virtually every damage case in which it is necessary to determine what would have happened but for, say, anticompetitive conduct or a breach of contract.

### *The But-For Behavior of the Infringer*

The patent holder is entitled only to profits it lost *by reason of the infringement*. Thus, the first step is to determine what the infringer’s behavior would have been absent the infringement. This in turn depends on the nature of the patent. With a patent for which there are no noninfringing substitutes, a reasonable assumption is that absent the infringement the infringer would have made no sales of substitute products.

However, when there are alternative noninfringing substitute technologies available to the infringer (at the time of infringement), this assumption is not appropriate. In such a situation, economic theory as well as the logic of the Panduit test indicate that one should assume the infringer would use the next-best noninfringing technology. A firm that (in the but-for world) does not have access to the patented technology will still produce a competing product if it has an opportunity to earn profits using a substitute technology.

By assuming that the infringer would have used the next-best available noninfringing technology, lost profits patent damages will equal those that actually result from the infringement. To assume the converse—that the infringer would not use the available alternative technology and not make any sales—leads to an overstatement of the sales the patent holder would have captured and thus damages. Yet this assumption underlies the mechanical calculation of lost sales and lost profits often seen in patent damages estimation, wherein the patent holder’s but-for sales are assumed equal to its share of the market of noninfringing sales times the infringer’s sales. Such an approach overstates the lost sales resulting from the infringement because it implicitly allows the patent holder to capture the value of the patent relative to the absence of any alternative technology, as opposed to the absence of only the infringing technology.

With the exception of a decision by Judge Easterbrook,<sup>10</sup> courts have been reluctant to adopt the idea that substitutes available to the infringer should be taken into account when estimating damages, arguing that it is only the substitutes available from noninfringers that are relevant, and that it is not proper to assume the infringer would have sold a noninfringing product. The courts reason that an infringer would not choose to employ an infringing technology and risk a patent infringement suit when a noninfringing substitute technology was available to the infringer.<sup>11</sup>

While the courts' logic may be fine in the context of willful infringement, not all patent cases involve willful, deliberate infringement. In many instances, without litigation, it is difficult to know whether a patent is valid and infringed. Further, a firm is often accused of infringement after it decides which technology to adopt and actually produces a product. Had the firm known the technology was infringing it might have used a noninfringing technology. But after production decisions have been made it may be costly to reverse the choice and use a noninfringing technology. Such uncertainty about the validity and infringement of patents is probably more common in cases where the patent represents a minor technical change on an extant technology. It is in these situations that it is most important to avoid mechanical calculations of lost profits.

### *The But-For Behavior of the Patent Holder*

Once the infringer's behavior in the but-for world has been assessed, it is necessary to model the but-for effect on the patent holder, which depends on the nature of market supply and demand. Three key issues need to be addressed: the effect of the infringement on the price of the patent holder's product; the extent to which the infringement reduced the patent holder's sales; and the effect of the infringement on the patent holder's profits.

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<sup>10</sup> See *Grain Processing Corp. v. American Maize-Products Co.*, 1236. Judge Easterbrook states: "This rule calls for a reconstruction of the way the market would have developed in the absence of infringement. Reconstruction takes account not only of substitutes actually produced but also what would have been produced, had it been economically advantageous to do so." As Judge Easterbrook notes, the only limitation is that "...to be an acceptable noninfringing substitute, the product or process must have been available or on the market at the time of infringement."

<sup>11</sup> The courts apparently assume that willful infringement would not occur unless the gains from infringement over the substitute technology exceeded the costs of defending a patent infringement suit, including both legal costs and damages times the probability of the infringement being detected. Since the costs of litigation are presumed high and the probability of infringement being detected is presumed high, courts apparently infer that the next-best technology must not be a very close substitute or the firm would have adopted it instead of the infringing technology.

Patent holders may suffer price erosion resulting from unlawful competition by the infringer. For example, in a two-firm market absent noninfringing substitutes, an infringing competitor may force prices to be lower than they would have been absent its infringing competition. How much higher the price would have been absent the infringement depends on the characteristics of the demand function for the patented product.<sup>12</sup> What is often not recognized, however, is that this higher but-for price implies, according to fundamental economic principles, that the total quantity of product sold in the but-for world usually will be lower than in the actual world. Higher prices typically cause lower sales. Thus, to calculate price erosion damages it is usually necessary to account for the effect of higher prices on quantity demanded.

In some cases, experts testify that they can ignore the decrease in quantity demanded caused by the higher price because demand is (perfectly) inelastic. That is, quantity demanded is not responsive to price. However, this argument contradicts a basic economic proposition: a firm does not usually price in the inelastic portion of its demand curve. The reason is simple. If demand is inelastic at the current price, the firm can improve profits by increasing price. A profit-maximizing firm will increase price until it is no longer in the inelastic portion of its demand curve.

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<sup>12</sup> Economists call this the price elasticity of demand. Elasticity is defined as the percentage change in quantity resulting from a percentage change in price. The larger the elasticity (in absolute value), the greater the responsiveness of quantity to price. Econometric techniques can be used to estimate the price elasticity of demand. Note that elasticity varies along the demand curve, with demand becoming more elastic at higher prices.



### *Lost Sales*

After one determines the but-for price and the quantity of but-for sales, one must determine which firms would make those sales. In a multi-firm market, clearly the patent holder should not expect to capture all of the infringer's sales. In a two-firm market, it might seem that the patent holder would make all of the sales of the infringer, but this is still not necessarily the case. First, the patent holder must have the manufacturing and sales capability to make the infringer's sales (one of the Panduit factors). Second, all of the infringer's customers must sufficiently value the patented feature that they would buy the patent holder's product rather than some product without the infringing feature. In some cases only some of the infringer's customers (or possibly none at all) may value the patented feature of the patent holder's product sufficiently that they would buy it if the infringer's product were not available.<sup>13</sup>

In some cases it can be difficult to prove that the infringer's customers value the patented feature enough to cause them to purchase the patent holder's product. To address this problem, a market-share approach has been used in which the market includes similar products that do not contain the patented feature.<sup>14</sup> If the patented feature does have value, such an approach is conservative since a larger share of the infringer's customers would choose to purchase the patent holder's product than would purchase products without the patented feature. However, in a market comprised of products containing noninfringing acceptable substitutes (that is, close substitutes) for the patented feature, the market-share approach is not appropriate.<sup>15</sup>

### *Lost Profits*

Once lost sales are determined, total lost profits can be calculated by measuring the incremental profits on the lost sales plus profits lost due to price erosion. As mentioned above, when lost profits cannot be proven, a reasonable royalty serves as a floor on damages.

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<sup>13</sup> See *BIC Leisure Products, Inc. v. Windsurfing International, Inc.*, 1 F.3d 1214, 1218 (Federal Circuit 1993) in which the court found that the infringer's and patent holder's products were sufficiently different that the infringer's customers would have been unlikely to purchase the patent holder's product, a much more expensive, high-end product.

<sup>14</sup> See *State Industries, Inc. v. Mor-Flo Industries, Inc.*, 883 F.2d 1573 (Federal Circuit 1989).

<sup>15</sup> In such a situation, as discussed above, there is no causal link between the infringement and the patent holder's sales.

## Reasonable Royalty

The economic factors that determine the value of a patent and thus determine lost profits damages also influence the determination of a reasonable royalty. The presence of substitutes on the demand side limits what consumers would pay for the patented feature and thus what manufacturers would pay to license the patent. Similarly, if there are competing technologies available on the supply side, a licensee would pay no more for a license of the patent in suit than the incremental profits it could earn over and above the profits it would earn using the next-best available technology.<sup>16</sup>

The Georgia-Pacific factors<sup>17</sup> serve as a starting point for determining a reasonable royalty. Many of the Georgia-Pacific factors are influenced to a large degree by the presence or absence of substitutes on either the demand or supply side:

*Factor 1:* “The royalties received by the patentee for the licensing of the patent in suit, proving or tending to prove an established royalty.”

*Factor 2:* “The rates paid by the licensee for the use of other patents comparable to the patent in suit.”

*Factor 8:* “The established profitability of the product made under the patent; its commercial success; and its current popularity.”

*Factor 9:* “The utility and advantages of the patented property over the old modes or devices, if any, that had been used for working out similar results.”

*Factor 10:* “The nature of the patented invention; the character of the commercial embodiment of it as owned and produced by the licensor; and the benefits to those who have used the invention.”

The availability of close substitutes for the patent will keep royalties and license fees described in the first and second factors low (or nonexistent); conversely, the absence of close substitutes would suggest high license fees. Likewise, a product made under a patent that has close substitutes will tend not to be highly profitable, as it will convey few benefits to its users relative to those available from competing products or technologies (factors 8, 9 and 10). Thus, much like the Panduit factors, the Georgia-Pacific factors highlight the importance of substitutes in determining a patent’s value.

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<sup>16</sup> If the next-best technology required a license, the licensee would pay no more for the patent in suit than the license fee for the next-best technology plus the incremental profits it could earn by using the technology covered by the patent in suit.

<sup>17</sup> See *Georgia-Pacific Corp. v. United States Plywood Corp.*, 318 F. Supp. 1116 (S.D.N.Y. 1970).

Assuming that an established royalty does not exist,<sup>18</sup> the legal framework for estimating a reasonable royalty is to construct a hypothetical negotiation between a willing licensor and willing licensee. What this means in economic terms is that both the licensor and licensee should benefit from the licensing arrangement—there must be gains from trade. To determine the limits of the potential licensing arrangement it is necessary to examine the alternatives available to both the licensor and licensee.

### **The Licensee's Considerations**

As discussed above, the maximum amount a licensee would be willing to pay for a license is the benefit it receives compared to its next-best alternative. If perfect substitutes are available at no cost, then the licensee would be willing to pay nothing and the patent would be of no value. On the other hand, if the substitutes are not perfect or have costs, the maximum amount the licensee would be willing to pay is the incremental profits it could make by selling the patented product compared to the next-best alternative plus the cost (if any) of acquiring the next-best technology.

### **The Licensor's Considerations**

Like the licensee, the licensor must consider the opportunity costs of granting a license. Depending on market conditions, the patent holder may make fewer sales, and prices may decline, due to competition by the licensee. To avoid price erosion, the licensor could charge the licensee a sufficiently high per unit royalty to ensure that the licensee did not price below the optimum level. (A per unit license fee increases the licensee's marginal cost which would cause it to raise its price.) Assuming the licensee had the same marginal cost function as the licensor, charging such an optimal royalty rate would ensure that the market price with licensing equaled the market price absent licensing. Likewise, to the extent that the license caused the patent holder to lose sales, the patent holder would want to ensure that the royalty rate was set so that the license revenue equaled at least the incremental profits it would have earned had it made the sale itself.

Any license revenue would be pure incremental profit if the licensor does not expect to lose sales or suffer price erosion, because, for example, the licensee would not compete directly with it. This could happen if, for example, the licensee served different geographic areas or targeted different types of customers. Thus, the same supply and demand considerations that go into computing a lost profits claim also figure into estimating a royalty that would be acceptable to both the licensor and licensee.

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<sup>18</sup>If a license exists, it is necessary to consider the competitive effect of that license in the marketplace. A potential licensee will not be willing to pay a high royalty rate unless it can compete with the existing licensee.

## The Bargaining Space

Assuming the licensee is willing to pay the same or more than the amount the licensor is willing to receive, it is possible to determine a range of reasonable royalty rates that will satisfy the willing licensor/licensee test. Economics has little to say about how such gains from trade will be allocated between licensor and licensee in any particular bargaining situation. The most that can be said is that in repeated bargaining situations, where bargaining power is evenly distributed between licensor and licensee, the gains will be split 50–50, on average.

## Conclusions

Properly estimating patent damages requires an economic analysis of both the actual market and what the market would be absent the infringement. Such an analysis requires the application of economic principles to the facts and data available about the case at hand. Estimating patent damages requires more than a simple accounting tabulation. The key economic concepts that underlie the correct evaluation of patent damages can be summarized as:

1. The presence (or absence) of close substitutes on both the demand and/or supply sides tends to diminish (increase) the value of the patent and hence lost profits and reasonable royalty damages. A key issue is identifying the next-best alternative to the patented product and/or technology.
2. Opportunity costs, not accounting costs, determine the value of the patented technology and thus patent damages.
3. Typically, a smaller quantity will be sold at higher (but-for) prices.
4. Reasonable royalty damages and lost profits damages are influenced by the same factors; they are not independent concepts.



## About the Author

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For more than twenty years Michael Keeley has consulted and served as an expert witness on liability and damage issues in a variety of legal disputes, including intellectual property, antitrust and general business litigation. He has testified in federal court on a number of occasions. In addition to litigation issues, he has consulted on non-litigation business, economic and public policy issues.

In the intellectual property area, he has consulted or served as an expert in a number of cases involving lost profits and reasonable royalties in patent matters, including some prominent cases, such as *MCI v. AT&T*. He has also worked on a number of other intellectual property cases, including *AMD v. Intel* and *Lotus v. Borland*. He is a member of the Licensing Executives Society.

Before joining Cornerstone Research he was an officer of the Federal Reserve Bank of San Francisco, and before that he founded and managed Stanford Research Institute's Antitrust Economic Consulting Group.

His research has been published widely in economics and finance journals. Based on citations of his research he was selected for inclusion in *Who's Who in Economics*. He was also awarded the Garn prize for his research on bank risk-taking and has served as a referee for many of the major economics and finance journals.

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