Component Valuation in Law and in Marketing

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Problems arise in evaluating a given variable when it is one of several that have combined to bring about a result. Imagine that you contract to buy a house and then the beautiful kitchen stove, one of many things that attracted you to the property, is destroyed before you close the transaction or occupy the property. How much should the price now be reduced? The market may provide an answer: here there is an upper limit based on the cost of a comparable replacement appliance. A more precise valuation would also be easy if identical houses, lacking this one feature, had recently been sold. The stove is just a piece of the larger transaction, and with these convenient facts, there is not much of a valuation problem. Additionally, the stove is unlikely to have been of greater value because of its interaction with other items in the house; colors and sizes are fairly standardized. "Conjoint analysis"—a term that usually refers to survey evidence that tries to elicit the value of a component—is therefore unnecessary, or at least uncomplicated, because value does not depend on an interaction among variables in a way that is not directly observed.

In contrast, consider a patent case concerning a company that adds three components, *ABC*, to a product in order to fetch a higher price and capture a larger market share. It turns out that the use of *A* knowingly infringed on the patent of another. What are the damages owed to this patent holder? It would be convenient if the two parties had recently bargained for the right to use *A* and nearly come to an agreement, or if *A* were the only new feature in the product sold, instead of being combined with *B* and *C*. In these cases, we would have a good sense of the value of *A* to the breaching party or to the market. I aim to show that this component valuation problem in patent law is often like the "conjoint analysis" question in marketing research, a topic also discussed presently. I then show that it is also comparable to tort law's

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difficulty in carrying out the doctrine of comparative negligence. Finally, I suggest that some solutions to the problem in one area might be useful, or hint at untried solutions, in another. Be forewarned that it is probably impossible to find a single, perfect solution that fits all cases in these but it is interesting to think that areas of law might be informed by the marketing literature, and *vice versa*.

I. Patent Damages and Combinatorial Value

A good starting point is *Cornell University v. Hewlett-Packard Co.*[1] Cornell had a valid patent on a method for speeding up computer processing. HP infringed on Cornell's patent by (profitably) selling a product that it knew included Cornell's innovation without first acquiring Cornell's consent. HP's product combined the Cornell innovation, which we will call A, with non-Cornell advances in computer processing, which I will summarize as B and C. HP's sale of the combination ABC generated large profits, though the court seemed skeptical that HP's success had much to do with the presence of Cornell's piece. Cornell, of course, objected and sought recovery in the amount of HP's gain.

A reader might imagine recovery aimed at deterring infringement and based on some "entire market value rule." Let us think of it as Option 1, amounting to all the profit HP earned from these sales, nominally attributable to the ABC improvement and advantage over its competitors.[2] In practice, however, patent law can be understood as attempting to recreate the value that the owner would have extracted from the infringer. After all, if Cornell and HP had bargained, it is the value of A to HP that they would have divided.[3] A court might therefore give Cornell: (2) the amount of the profit attributable to the inclusion of A, or (3) an amount reflecting a guess as to how the parties (or perhaps typical parties) would have divided the profit attributable to A through contract negotiation. Option 3 is a fraction of Option 2. While Option 2 aims at the value of A somehow separated from BC, and certainly separated from HP's larger product in which ABC was contained, it plainly

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[1] 609 F. Supp. 2d 279 (N.D.N.Y. 2009); *see also* Elizabeth Bailey, Gregory Leonard & Mario Lopez, *Making Sense of "Apportionment" in Patent Damages*, 22 Colum. Sci. & Tech. L. Rev. 255, 259 (2011) ("In short, Judge [Randall] Rader identified the portion of the revenue of the overall product (the server) that was closely related to the patented technology, namely the processor, and then used that revenue as the royalty base.").

[2] Essentially, the entire market value rule allows compensation for the value of an item as-sold where the value for a patented component part is inseparable from the value of the whole. *Cornell*, 609 F. Supp. 2d at 286 ("When applied, this rule 'permits recovery of damages based on the value of the entire apparatus containing several features, where the patent related feature is the basis for customer demand.'" (quoting State Indus., Inc. v. MorFlo Indus., Inc., 883 F.2d 1573, 1580 (Fed. Cir. 1989)).

[3] *See* 35 U.S.C. § 284 (damages awarded for infringement shall be "in no event less than reasonable royalty for the use made of the invention by the infringer, together with interest"). In *Cornell*, damages were based on "the smallest salable infringing unit." *Cornell*, 609 F. Supp. 2d at 287–88.

discourages patent infringements. This is because if HP had bargained for the right to use *A*, as reflected in Option 3, it would presumably have done better than giving all the marginal profit away. Such an intermediate recovery avoids giving Cornell undeserved credit for HP's unobjectionable use of *BC*.[4]

It must be noted that finding the amount attributable to the inclusion of *A* is even harder than already suggested. Courts might want to reward the company that thought of *combining* the three elements, *ABC*. At times that innovator will be a patent holder like Cornell, but it is more interesting when it is a company like HP which might have taken *A* but never used *A* on its own, always ingeniously combining it with *BC*. For our purpose, it will be sufficient to recognize that Option 2 may be closer to Option 1 than it first seems, because courts might (learnedly or intuitively) upgrade Option 2 to a level we can designate as Option 4, at least when it seems appropriate to reward the innovative step taken by the apparent infringer in combining the patented element with other elements, whether they are patented or freestanding. Option 4 thus blends the conventional idea of marginal value (of *A*) with the value of combining it with other elements.

In the litigated case, the court eventually imagined a royalty based on Option 2.[5] Nevertheless, it is easy to be attracted to something approaching Option 1. There are several reasons for this sort of generosity to the infringed upon party. First, there is the difficulty of extracting *A* from *ABC*. Second, there is the difficulty of recreating the bargain that would divide the gain from innovation between Cornell and HP. And, most important, the prospect of high damages might be certain to deter the intentional taking of patented inventions. Still, it is important to see the danger of over-deterrence, which threatens a party like HP with disaster if it innovates. HP may well have known of Cornell's patent claim on *A*, but HP might have been uncertain about the legal viability of this patent, given that it could have considered Cornell's contribution to be an unprotected idea rather than a process, machine, or article of manufacture.[6] It is for this reason that I

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[4] A reader interested in additional information on damages in patent law, such as the "reasonable royalty" standard and infringement damages, might look to the analysis provided by Greg Allenby, Jeff Brazell, John Howell & Peter Rossi, *Valuation of Patented Product Features*, 57 J.L. & ECON. 629 (2014).

[5] The decision is analyzed in Drew Voth, *Patent Damages Apportionment and the Cornell Case*, COUNSELOR @ LAW (Oct. 4, 2010), https://web.archive.org/web/20161013125619/http://www.wac6.com/wac6/2010/10/patent-damages-apportionment-and-the-cornell-case.html. For some excellent discussion of the component valuation problem, see Allenby, Brazell, Howell & Rossi, *supra* note 4; J. Gregory Sidak & Jeremy O. Skog, *Using Conjoint Analysis to Apportion Patent Damages*, 25 FED. CIR. B.J. 581 (2016); Gregg Allenby, Peter E. Rossi, Lisa Cameron, Jeremy Verlinda & Yikang Li, *Calculating Reasonable Royalty Damages Using Conjoint Analysis*, 45 AIPLA Q.J. 233 (2017). An innovation in this literature is the idea that when people are surveyed, they should compare an offering not just to an enhanced or narrowed item but also to items offered by other sellers. Another insight focuses on the difference between asking about the future compared to what would have happened in the past.

[6] Patents are limited to "any new and useful process, machine, manufacture, or composition of matter," to the exclusion of abstract ideas. *See* 35 U.S.C. § 101; *see also* Diamond v. Chakrabarty, 447 U.S. 303, 309 (1980). Cornell's patent was not clearly viable under the case law. In *Gottschalk v. Benson*, the Supreme Court

downplay the importance of the intentionality of HP's behavior. It may have been intentional, but I describe HP as simply *knowing* of Cornell's claim, but perhaps thinking that the patent would eventually be found invalid. Another over-deterrence concern has already been noted; HP might have figured out the value of the *ABC* combination, and Cornell might have held out in negotiations in order to extract the value of the combination of its patented piece with *BC*. Law must not discourage a party from innovating with its combinatory insight.

It is apparent that if HP must pay very little when it is sued for using patented material, inventors will learn that their outputs can be taken, and they may invest too little in inventive behavior. A less apparent problem is that users like HP may strategically mix in material under patent with other things in order to *create* a component valuation problem. *ABC* may actually be an inefficient way to build something, but HP will have an incentive to put these three things together in order to pay very little for the patented *A*, which would have been costlier for HP had it been used on its own or obtained through a proper bargain with Cornell. In short, it is reckless to allow anyone to avoid paying for the "value" of a patent by setting things up in order to benefit from a component valuation issue, but we should not unthinkingly prefer high damages in order to penalize the apparent misbehavior and discourage potential inefficient strategizing by HP. It would be nice to get the payment to Cornell just right with or without a sweetener to deter knowing violations or court tests.

In the case of HP's knowing violation of Cornell's patent, how *should* damages be calculated? An attractive rule might call for a search for competitor firms, as suggested by Gregory Sidak and neighboring authors,[7] that sold a product with *BC* but not with *A*. If there is such a set of sales, and especially a large set (in order to set aside the two-party bargaining game), then we could compare the prices with HP's in order to get at the value of *A*.[8] Law could then use Option 2 or 3. In short, information can be provided by add-ons in similar markets. If there is a great deal of money at stake, as there was in the Cornell case, we could even imagine a firm creating a market for a computer

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denied the patentability of a binary code conversion process, stating that "[t]he mathematical formula involved here has no substantial practical application except in connection with a digital computer" and that its patent would in essence be "a patent on the algorithm itself"—something the Court deemed an abstract idea. 409 U.S. 63, 71 (1972). HP might have believed there was a reasonable argument for overturning Cornell's patent as too abstract and unconnected from application to be a "process" in the sense of 35 U.S.C. § 101.

[7] *See supra* note 5; *see also* J. Gregory Sidak & Jeremy O. Skog, *Hedonic Prices and Patent Royalties*, 2 Criterion J. on Innovation 601 (2017); J. Gregory Sidak & Jeremy O. Skog, *Hedonic Prices for Multicomponent Products*, 4 Criterion J. on Innovation 301 (2019).

[8] Patent law does on occasion use information from other sellers to assess values. *See, e.g.*, Grain Processing Corp. v. Am. Maize-Prods. Co., 185 F.3d 1341, 1351 (Fed. Cir. 1999) ("[O]nly by comparing the patented invention to its next-best available alternative(s) . . . can the court discern the market value of the patent owner's exclusive right.").

with *BC* but not *A*, and then another in the same market with *ABC*, in order to see how much consumers would pay for the addition of *A*. The idea is to estimate a bargain between the infringer and the patent holder by looking for information in comparable markets and then awarding the differential value, or perhaps one half of this value.

There will be markets in which the innovation does not generate higher prices. The market price may be dictated by first-time users who will simply search for the lowest price or best location near their destination. If users appreciate the added features, the innovator will benefit from more sales. In this case, the damages for a wrongful taking of patented inputs are a function of the profit per customer times the increase in the number of patrons or the occupation rate. Meanwhile, it is sufficient to note that there are a number of ways of properly assessing damages in a patent law case like *Cornell v. Hewlett-Packard,* and they all involve assessing the value of a component, whether through price, profit, or volume. Cornell insisted on a version of Option 1, claiming that billions earned by HP should be turned over to the patent holder, Cornell, because of a single component, wrongfully used by HP, and contributing to its profit. At the very least, Cornell needed to show evidence of the incremental impact on HP's profits from the inclusion of the patented and unlicensed component, simplified here as *A*. But Cornell might also have pointed to an increase in sales, which might seem to suggest something close to a fraction of Option 1, but this ignores the fact that any increase likely comes from the combination of *ABC*, and presents the (now familiar) decoupling problem.

II. Component Valuation in Marketing

Anyone schooled in marketing research will see both similarities and distinctions between "conjoined analysis" in marketing and the component valuation difficulty in assessing damages in patent law. Imagine an automobile manufacturer deciding whether to add a back-up mirror, two, four, or eight more airbags, and an auto-lane keeper to next year's model of one of its popular vehicles. The manufacturer knows the production cost of each feature but not the willingness of consumers to pay. Unlike innovations in many other industries, it is too costly to simply try out combinations and observe customer reaction. The decision-making problems are exacerbated by the fact that there is likely to be interplay among options, and this is what makes the problem interesting. For example, consumers will value a rear-seat airbag differently if the vehicle already has two of these safety features. A noise-absorbing fabric affects the value of an improved sound system, and so forth. The problem would be hard enough with five unrelated items in play, but they are generally related and five items make for 120 possibilities. Even

if the airbag choices are not interactive (one cannot have four as well as six airbags), there are plenty of possible combinations. Moreover, even when there is no physical connection among features, there is a price interaction, as some consumers might pay more for a feature so long as the entire price of the vehicle does not exceed budgetary constraints. Given the cost and time of production, manufacturers turn to marketing experts, and their most popular approach is to survey a population resembling likely buyers.

The marketing literature recognizes that survey respondents will not have the patience to evaluate 120 combinations and so it focuses statistical techniques on asking a manageable number of questions of the type "what would you pay for *x*" (where *x* contains a combination of features) or "please rank the importance to you of the following three features." The survey expert then estimates based on an assumption of linear functions and other ways of reasoning from several aggregated responses to creating a map of likely preferences for all combinations of the variables.[9] If we see that survey respondents will pay between $100 and $1,200 more for eight airbags than for two, but barely more if there is also a lane-keeper function in the package, then it is possible to interpolate to the demand for four additional airbags—assuming a linear, or other correctly specified, demand curve.[10]

Patent lawyers and judges could learn from marketing, and engage in extrapolation, especially when there are no comparable firms to study.[11] If Cornell does not see other firms charging more because they provide *BC* (so that the value of *A* can be deduced), it could survey actual or likely buyers about the value of *BC* or *ABC*, and present this evidence in court. Following an idea advanced earlier, Cornell might also ask actual customers what attracted them to HP's product, and with this tactic discover the importance of *A* compared to *B* and *C*. It would be surprising to find that customers had paid HP a substantial premium and yet could not even identify *A*, but stranger things have happened, and the cost of such an inquiry is low.[12]

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[9] David Bakken & Curtis L. Frazier, *Conjoint Analysis: Understanding Consumer Decision Making*, *in* The Handbook of Marketing Research: Uses, Misuses, and Future Advances 288, 290–92, 295 (Rajiv Grover & Marco Vriens eds., Sage 2006).

[10] The linearity assumption is common in the literature and probably uncalled for, but I leave that objection for another day.

[11] Inter-disciplinary learning is possible but unnecessary where firms and their lawyers have figured things out on their own. For example, marketing experts, and indeed run-of-the-mill business owners, regularly check out what competitors and their customers are doing, just as HP's gain from *A* is easily deduced if a competitor firm incorporates *BC* without *A*.

[12] After writing this article, I was fortunate enough to run across a related, but perhaps even more unlikely, idea of using tax law (or really imagined transfer prices) to estimate hypothetical bargains in patent law, and then also to use patent law to estimate transfer prices for tax law's purposes. This is quite similar to the cross-discipline strategies advanced here. See Susan C. Morse, *Seeking Comparable Transactions in Patent and Tax*, 37 Rev. Litig. Brief 201 (2018), for a thoughtful and insightful discussion of borrowing in both directions.

III. Component Valuation in Tort Law

Consider next the application of the doctrine of comparative fault in tort law. *S* drives too fast and is unable to stop in time to avoid hitting *T*, who is backing out of a driveway without pausing and taking due care. For many years, a wrongdoer like *S* was absolved of tort liability because *T* was contributorily negligent. Over time, however, and perhaps because most people's ethical intuition was that *S* should not be completely absolved, especially where *S*'s behavior was intentional, the law in most jurisdictions switched to the rule of comparative negligence. Under this rule, the jury or judge is asked to "compare" *S* and *T*'s fault, and thus divide the loss between them. There are many ways to interpret this instruction, but almost every one of these promotes (at least in theory) efficient behavior, because once one driver is induced to take proper care, the others will also be motivated in order to avoid being left to pay the entire loss.

Comparative negligence is especially attractive when an innocent victim is injured by multiple wrongdoers. Imagine for instance that *J*, *K*, and *L* operate grossly polluting factories on a river's banks, and the combination of their pollutants damages downstream parties. Law wants the wrongdoers to pay, but how should payment be divided among *JKL*? Again, we wish we knew the marginal contribution of each, but these are interconnected. Perhaps we are harder on *J* if *K* and *L* were already on the river, and their wastes were absorbed harmlessly. After all, it was the third set of discards that "caused" harm. This is an interesting problem, because a single owner of all three factories might find it most efficient to clean up the second or first factory. The marginal wrongdoer is easy to misidentify, just as denying recovery to one who "comes to a nuisance" is often inefficient. Here, there are increasing returns to scale, for the whole is greater than the sum of the parts.

The torts problem is analogous to the vexing problem in patent law where we tried to reward the inventor but also not to inhibit innovation. In both settings, the word "marginal" is misleading whether for gains (as in the patent cases) or losses (in the tort cases). In tort law, one possibility is to allocate liability in proportion to how much the wrongdoers saved by polluting, rather than behaving non-negligently and investing in scrubbers or taking waste products to designated dump locations. Another is to penalize intentional torts more severely than miscalculations.[13] But however this question is resolved, there is again the problem of component valuation.

It may be that tort law has little to offer patent law and even less to give marketing and, in turn, tort law has little to learn from these other areas, even

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[13] *See generally* William Landes & Richard Posner, *An Economic Theory of Intentional Torts*, 1 Int'l Rev. L. & Econ. 127 (1981).

though the three fields have component valuation problems in common. An important difference between torts and marketing begins with the observation that so long as the downstream victims are not over-compensated, there is little risk of over-deterrence. If J pays more than its fair share, whatever that might be, it can try to bargain with K and L in order to reduce their pollution and, consequently, the downstream losses. More importantly, if J's expected liability causes J to take precautions, K and L will then learn that they will be entirely responsible for any downstream injury. After all, so long as liability is linked to law's usual negligence principle, J will be absolved, leaving the others to pay. Bargaining of the kind just described is even easier in patent law, where parties can bargain even if they have different estimates of the likelihood of a patent's viability, but bargaining means nothing to an automobile manufacturer struggling with a decision about improvements. It is tempting to say that patent law and marketing have more to learn from one another because the component problems they share are about dividing gains, while the comparative negligence setting is about dividing losses.

It is apparent that law could require the polluters to make buy-sell offers about these prices. It could also ask each polluter what it would pay for the others to reduce pollution, or what it would pay for their factories. Honest answers would be encouraged by the fact that the law could require the parties to follow through and carry out the transaction at the specified price.

Conclusion

The problems referred to in the title of this article concern evaluating a given variable when it is one of several that have combined to bring about a result. When there is no easy market solution, by noticing the presence of component valuation problems in a few areas—namely, damages for patent infringement, the marketing literature, and tort law—and observing the ways in which they are or might be handled, we can improve our understanding of how to proceed in a variety of seemingly unrelated fields.