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Executive Summary

- Reasonable royalty damages for patent infringement are typically calculated using the *Georgia-Pacific* framework, which contemplates a hypothetical negotiation between a willing licensor and a willing licensee at the time of first infringement. Because damages are based on the agreement an implementer would have made prior to infringement, the implementer has no incentive to initiate licensing. Instead, this grants to the infringer an option to wait, during which time market uncertainty can be resolved.

- The current framework treats this option as costless. The *Georgia-Pacific* framework should be adjusted to expressly price the option to wait. The willing licensor-licensee inquiry should include the amount a rational licensee would have paid at the time of first infringement for the right to defer its decisions until future information became available.

- Pricing the option to wait will encourage earlier licensing, reduce strategic delay, lower the likelihood that licensing occurs only after litigation, and improve the chance of voluntary agreement. This also better aligns damages with innovation incentives. Adequate compensation would increase returns to research and development, reduce free riding on patented technologies, and promote a more coherent relationship between patent remedies and innovation policy.

I. Introduction

The monetary remedy for patent infringement in the United States is frequently a reasonable royalty. For nearly half a century, finders of fact have applied a methodology for calculating reasonable royalties that has changed little. Yet that methodology systematically undercompensates patent holders. To understand why, consider the economic analysis of real options.

A reasonable royalty is typically calculated by estimating what the infringer (that is, the implementer, or potential licensee) would have paid to procure a license before implementation. So, the penalty for not executing a license before infringing is the very same license that the counterparties would have agreed upon before the infringement began. An implementer might ask, Why pay now, when I can pay the same price later and perhaps much later? This framework plainly creates a strong incentive for infringement, where the implementer delays or evades licensing.

In economic terms, under the longstanding approach to calculating a reasonable royalty, the infringer is granted a valuable real option to wait until after infringing the patent to procure a license to the technologies that it practices. And the typical damages calculation prices that valuable option at $0. Pricing the option at $0 undercompensates patent holders, inefficiently allocates market risk, reduces returns to research and development, and increases the frequency of costly patent-infringement litigation. Incorporating that insight into the proper economic analysis of a reasonable royalty does not require Congress to rewrite the Patent Act or U.S. courts to abandon the existing reasonable-royalty framework.

II. Reasonable Royalties Are Calculated Based on a Hypothetical Negotiation at the Time of First Infringement

Section 284 of the Patent Act specifies that damages for patent infringement must be "adequate to compensate for infringement, but in no event less than a reasonable royalty." Courts typically determine a "reasonable royalty" through the application of the *Georgia-Pacific* factors, which frame the analysis in terms of a hypothetical

negotiation between a willing licensor and a willing licensee at the time of first infringement.

This hypothetical negotiation contemplates a single transaction at a single point in time. However, in reality, the infringer has the ability to wait, perhaps for years on end, and then pay the same price as a licensee that negotiated a license up front. The infringing implementer can develop its product, bring it to market, and observe the commercial success of that product, all without paying for a license to the technologies its product practices. If the product fails, the implementer might never be sued and might never license the patented technologies. If, on the other hand, the product succeeds, the reasonable royalty is intended to reflect price formation at the time of first infringement.

Infringement, in other words, functions like a free option: a right to pay later, once uncertainty is resolved, at the upfront price, with the possibility of never having to pay if the product is unsuccessful.

Consumers understand the value of this kind of commercial flexibility. A refundable airline ticket costs more than a non-refundable ticket for the same seat. A hotel room that can be canceled without penalty costs more than one that cannot. In both cases, the buyer is paying for the underlying good and for the right to decide later, once more is known, whether to keep it. The same logic applies to patent licenses, and the traditional approach to determining reasonable royalties, calculating a royalty at the time of first infringement, effectively prices that real option at $0.

III. Granting a Free Option Is Costly to Innovators and Innovation

Consider a firm developing a new product that practices a patented technology. At the time of development, the product's commercial success is uncertain. Suppose, for the sake of example, that each firm faces a 50-percent chance that the product will be highly profitable, and a 50-percent chance that it will fail completely. If a firm's product succeeds, the patent holder will pursue damages for patent infringement, but if the product fails, the patent holder might recover nothing, either because the

infringement goes undetected or because the product's failure renders the firm judgment-proof.

If a firm and patent holder were to negotiate a license at the time of first infringement, they might settle on a royalty of roughly $18 per unit. In this example, that $18 per-unit royalty reflects a division of the surplus generated by the licensing of the patented technologies, relative to each party's outside alternative, with the surplus from the bargain divided on the basis of each party's bargaining power. Courts applying the *Georgia-Pacific* framework traditionally would calculate this figure, representing the royalty that the parties would have agreed upon at the time of first infringement, using only the information available at that time.

But that $18 figure is only ever actually collected from at most the half of infringers whose products succeed. So, although the royalty that the *Georgia-Pacific* framework calculates is $18, the royalty that patent holders can actually expect to collect, given the probability that they will ever be paid at all, is $9. In real negotiations, the expected value could in many instances fall well below the patent holder's minimum willingness to accept in exchange for a patent license.

A damages rule that produces that result does not compensate patent holders adequately. Instead, it compensates them for only half of what an actual up-front negotiation would have secured. If, instead, the parties had negotiated over the right to delay, the expected payment from both the option and the royalty would be sufficient to place the patent holder in a position consistent with what a genuine bargain would have produced. The process requires explicitly pricing the option to wait, similar to the way an airline prices the premium above a regular fare for a refundable fare. The court should ask what a willing licensee and a willing licensor would have agreed at the time of first infringement for a license to the patented technology in which payment is delayed for a set period of time, and perhaps entirely forgone in the event of commercial failure. It is the value of the option that the current application of the law confers on infringers for free.

IV. The Free Option Distorts Incentives for Infringers

The consequences of pricing this option at zero extend beyond the magnitude of damages. A zero price also affects whether a firm has any incentive to negotiate a license in the first place. Borrowing an analogy from economist Gary Becker's classic work on the economics of crime, imagine a parking meter where the fine for not feeding it is exactly equal to the price of feeding it. Under those terms, no rational driver would ever put money in the meter. There is no penalty for waiting to see whether a parking officer detects the violation, because the penalty is identical to the fee necessary to avoid that penalty.

The same logic applies to a firm deciding whether to seek a patent license before or after developing or marketing its product. If the firm expects that that the reasonable royalty ultimately awarded after litigation will equal the royalty that it would have negotiated up front, and if there is a nontrivial chance that the patent holder will never enforce its patents against a given infringer, then a rational implementer has little reason to negotiate early or at all.

It is not necessarily the case that a firm that is infringing a patent is doing so willfully. Many firms might infringe simply because a product's research and development causes it to practice patented technologies not anticipated or known at the beginning of the development process. Regardless of the reason for the initial infringement, the incentives created by a free option discourage firms from negotiating even after infringement is observed. The legal system, without intending to, subsidizes delay.

By pricing the option at $0, the traditional approach to calculating a reasonable royalty is almost certainly misallocating risk in the market. The option will have different value to different infringers. All implementers are granted the option at the time of infringement, and the option expires only when the patent holder begins enforcing its patents. The patent holder does not necessarily observe the value of the option, and consequently the option is likely to be allocated inefficiently. By setting the price at $0, rather than rationing the option to its highest-value user, the traditional approach places the rationing indirectly in the hands of the patent holder, the party that might have the least information on the value of waiting to different infringers.

V. Simulation Results

To demonstrate the effects of licensing with and without the option value as a part of the hypothetical negotiation, I use a simulation of the bargaining process between a patent holder and a prospective licensee. The results of that simulation show that excluding option value systematically lowers the probability of observing a negotiated royalty.

When the option value is priced into the negotiation, the average royalty payment increases. More strikingly, licenses are agreed upon earlier and more often. The probability that the parties reach an agreement in the very first period of bargaining rises from about 58 percent to about 73 percent. Firms facing more aggressive patent holders and firms with lower borrowing costs are especially likely to negotiate sooner when the price of delay is no longer zero. In short, when the law prices the option honestly, both parties get to the table faster, and fewer disputes are left to fester until litigation forces the issue.

Part of the increase in royalties is due to the direct inclusion of the option. However, for firms that immediately agree to a license, the option value is zero. In those instances, the increase in the royalty does not reflect the option value, but instead how the inclusion of the option encourages firms to execute licenses earlier that otherwise would have chosen to delay. When waiting is no longer free, the demand for delay decreases.

That outcome is consequential for two distinct policy reasons. First, earlier and more frequent licensing results in less litigation, which will lead to a direct saving in judicial and private resources. Second, and more fundamentally, that earlier, increased licensing will allow the innovation system to function more nearly as intended, with technology transferred through voluntary licensing rather than compensated only after infringement. Parties bargain over technology before putting it to use, rather than treating a court judgment years later as an acceptable substitute for a market transaction.

VI. How Courts Could Incorporate Option Value Analysis Without New Legislation

My proposal requires neither a change to the patent statute nor a new judicial

doctrine, merely two adjustments within the application of the existing *Georgia-Pacific* framework.

First, when *Georgia-Pacific* Factor 15 asks what royalty the hypothetical negotiation would actually have produced, that analysis should account for the fact that the infringer, by virtue of having infringed rather than licensed, obtained the ability to delay payment until commercial success or patent enforcement was observable. That flexibility has a value that can be calculated using the same option-pricing tools that courts and expert witnesses already use in other financial contexts. That option value should be added to the royalty rather than ignored, so that it is considered in the hypothetical negotiation at first infringement. Until now, damages analysis has simply ignored this option or not assigned it a positive value.

Second, when comparable licenses are considered evidence probative of a reasonable royalty, the finder of fact should consider whether those comparable licenses were negotiated under the same timing conditions as the hypothetical negotiation at issue. A license signed voluntarily, before any infringement occurred, for immediate payment, is not an apples-to-apples comparison to a royalty owed only after years of undetected, unlitigated use. Where the comparison is not apples to apples, either an upward adjustment is warranted before the comparable license is used to set the royalty rate or, in some cases, an otherwise "comparable" license might not be comparable after all for the purpose of establishing a reasonable royalty.

VII. Policy Implications of Pricing Options at $0

Although consideration of the option value could be reduced to a technical dispute among damages experts of interest only to litigants, its effects extend well beyond litigation. Inadequate patent damages function as a subsidy to whoever uses a technology without paying for it, and as a tax on whoever invests in developing that technology. Systematically undercompensating patent holders, which is what a damages rule does when it prices the infringer's option to wait at zero, lowers the expected return to research and development across the economy, not only in the specific cases that reach trial. Most infringement is never litigated. The

royalty adjudicated in a hypothetical case nevertheless sets the backdrop against which every real-world licensing negotiation takes place. If that backdrop systematically favors delay, the effect extends across every industry in which patents play a key role in protecting the rights of innovators, from pharmaceuticals to semiconductors to telecommunications.

The use of real-options valuation need not come at the expense of downstream consumers or raise concerns about so-called patent holdup. Pricing the option accurately does not provide patent holders with a windfall. Instead, it restores them to the position that a real, voluntary negotiation would have produced. By encouraging earlier licensing and reducing the incentive to litigate rather than negotiate, it might well reduce the very transaction costs and legal uncertainty that critics of the patent system most often cite as evidence that the system is not working as intended.

A damages framework can look rigorous, be applied by courts consistently, and still leave a persistent gap between what the law promises and what it delivers. Closing that gap does not require new legislation. It requires only that the hypothetical negotiation that courts have been reconstructing for fifty years be refined to include the value of the one thing every infringer gets that an upfront licensee never does, the freedom to decide later.

About the author

Dr. Andrew P. Vassallo a Senior Scholar at IPPI: The IP Policy Institute with The University of Akron School of Law and an Associate Professor of Economics and the Chair of the Economics Department at Shippensburg University of Pennsylvania. He is also a Senior Consultant to Criterion Economics, Inc. Previously, he served as a research economist at Princeton Economics Group.

His research focuses on the analysis of mergers, antitrust and competition law, regulated industries, and patent damages and royalties. He has extensive experience in the economic analysis of standard-essential patents (SEPs) and of the valuation of patents, patent portfolios, and patent pools generally. He also has extensive experience in antitrust litigation, economic analysis in regulatory matters, and the valuation and analysis of complex financial instruments. He has analyzed fair, reasonable, and non-discriminatory (FRAND) royalty rates for patents and patent portfolios essential to standards related to cellular communications, Wi-Fi communications, video and audio compression, and memory modules.

Professor Vassallo earned a Ph.D. in Economics from Rutgers University and a J.D. from the George Mason University School of Law, where he was a Robert A. Levy Fellow in Law and Liberty. He also earned an M.S. in Economics from Carnegie Mellon University, and a B.A. in Economics and Mathematics from La Salle University.

About IPPI: The IP Policy Institute

IPPI: The IP Policy Institute is a Washington, D.C.-area based intellectual property law research center founded in early 2025 with The University of Akron School of Law. The IPPI team comes from the former Center for Intellectual Property x Innovation Policy (C-IP^2), which operated at George Mason University Antonin Scalia Law School from 2012 to early 2025.

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