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Lending the Federal Circuit a Hand: An Economic Interpretation of the Doctrine of Equivalents

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I. INTRODUCTION

The Court of Appeals for the Federal Circuit was created,[1] in part, to bring uniformity to judicial rulings in the area of patent law.[2] Nowhere in the patent law is such uniformity more needed than in application of the doctrine of equivalents.[3] Since the Supreme Court gave the doctrine modern acceptance in *Graver Tank & Manufacturing Co. v. Linde Air Products Co.*,[4] application of the doctrine has been a source of controversy for courts,[5] scholars,[6] and practitioners.[7]

In *Graver Tank*, the Supreme Court held that where an accused device does not literally infringe the claims of the patentee's device, infringement may be found under the doctrine of equivalents, if the accused device performs *substantially* (1) the same function (2) in the same way (3) to achieve the same result.[8] Judge Plager described judicial frustration with the doctrine of equivalents thusly:

> [One] problem with the doctrine is that appellate review of many of these doctrine of equivalents cases is largely pro

> forma. Federal district judges, perhaps understandably, by and large make little pretense of liking these patent infringement cases, and are quite content to give them, and all the issues in them, to juries to decide. The cases typically come to us on appeal with nothing more than a general verdict finding infringement. There is no explanation by the jury of the rationale behind their verdict, if any exists.[9]

Recently, the Federal Circuit restated the test for infringement under the doctrine of equivalents.[10] In *Hilton Davis*, the court sought to enunciate a formulation of the doctrine of equivalents that is both consistent with the tripartite test described in *Graver Tank* and amenable to proper application by trial courts. Specifically, the Federal Circuit held that "application of the doctrine of equivalents rests on the substantiality of the differences between the claimed and accused products or processes, assessed according to an objective standard."[11] Thus, the standard for equivalency is insubstantial difference between the accused device and the patent claim.[12] Further, the court held that the function/way/result test of *Graver Tank* is but one method of demonstrating insubstantial difference.[13] In addition, the majority resisted the temptation to delimit application of the doctrine of equivalents by, for example, rendering it an equitable remedy[14] or requiring an element of intent.[15] Finally, the *Hilton Davis* court, by stating that "the doctrine of equivalents provides the same protection to the substance of the claim scope provided by the doctrine of literal infringement,"[16] has reaffirmed the proposition that "[a]pplication of the doctrine of equivalents is the exception, . . . not the rule, for if the public comes to believe (or fear) that the language of patent claims can never be relied on, . . . then claims will cease to serve their intended purpose."[17]

This article describes an economic equation, modeled after the Hand Formula,[18] that addresses both the goals of the Patent Act and the purpose of the doctrine of equivalents. In addition to addressing these concerns, the equation, which is referred to in this article as the Economic Doctrine of Equivalents, removes some of the subjectivity of the traditional doctrine of equivalents and provides for greater ease of judicial application. The equation may be used for two different, but related, purposes. First, it may be used to analyze and explain judicial interpretation of the doctrine of equivalents from an economic perspective. Second, the equation serves as a guide to future judicial application of the doctrine of equivalents by providing judges with a framework for evaluating the most important considerations of the doctrine of equivalents and a method for applying those considerations to a particular case.

Part II of this paper examines the Patent Act and its purposes, in order to elucidate the underlying policies and concerns of patent protection. Part III examines infringement in general, and the doctrine of equivalents in particular, in light of the policy goals of the Patent Act. Part IV describes the elements of the Economic Doctrine of Equivalents. Part V discusses the application of the Economic Doctrine of Equivalents and applies it to the facts of *Graver Tank* to demonstrate the consistency of the economic formulation with the aims of the traditional analysis under the doctrine of equivalents. Part VI is the conclusion.

II. PROVISIONS AND PURPOSES OF THE PATENT ACT

Any consideration of the doctrine of equivalents must begin with an examination of the patent system generally. Moreover, proper application of any interpretation of the doctrine of equivalents requires an understanding of the purposes of the Patent Act.[19] In this way, courts, attorneys and scholars may avoid a construction of the doctrine of equivalents that is inconsistent with the Patent Act.

A. Constitutional and Statutory Basis

The Constitution of the United States grants Congress the power "[t]o promote the . . . useful Arts, by securing for limited Times to . . . Inventors the exclusive Right to their . . . Discoveries."[20] This constitutional provision gave rise to the first Patent Act in 1790.[21] While the Patent Act has been revised numerous times since the first act, the patent system has remained substantially the same since 1836.

B. Goals of the American Patent System

In the broadest sense, the American patent system is designed to provide an economic incentive for technological advancement and investment in scientific research.[22] Furthermore, by requiring full disclosure of the subject matter to be patented, the system provides for dissemination of information that is critical to further technological advances. The patent system encourages both invention and investment, and presumes that consequential benefits, in the form of wealth and information, will accrue to society.[23] The patent is an economic reward which allows the inventor to exclude others from manufacturing, using, or selling the invention for a limited period of time. Given the widespread antipathy toward monopolies[24] that existed at the time the Constitution was drafted, the Founding Fathers must have had a strong belief that the patent system, though potentially harmful, would result in an overall benefit to society.[25]

The modern view of the patent system, backed by substantial economic analysis,[26] is not qualitatively different from the views held by the drafters of the Constitution. The basic notion that the patent system provides an incentive to invent and invest, outweighing the

dangers of monopoly, is still the prevailing view.[27] Much recent criticism of the patent system focuses on the inefficient allocation of resources to "block" alternative patentable methods in order to preserve the value of one's patent.[28] Because these efforts contribute nothing substantial to society's technological understanding or aggregate wealth, patent protection is unwarranted. Therefore, the patent system ideal is to provide incentives for invention and investment in areas that will be useful to society, while minimizing the effects of inefficient allocation of resources that result from duplicative, insubstantial research.

III. INFRINGEMENT AND THE DOCTRINE OF EQUIVALENTS

A. Infringement Generally

The Patent Act provides that "whoever without authority makes, uses or sells any patented invention, within the United States during the term of the patent therefor, infringes the patent."[29] In determining whether an accused device[30] infringes a patent, either literally or under the doctrine of equivalents, a court must ascertain the meaning and limits of the patentee's claims and then apply those claims to the accused device.[31] This determination is made for both literal infringement and infringement under the doctrine of equivalents.[32] Literal infringement occurs when an accused device incorporates all of the claims of the patented device.[33]

B. Infringement Under the Doctrine of Equivalents

1. Theoretical basis of the doctrine of equivalents

The doctrine of equivalents is a judicial construction which recognizes the frailties of the written word.[34] Because, as one scholar has noted, "[a]n infringer appropriates an invention, not words,"[35] infringement may occur even though the accused device does not directly infringe upon the literal words of the patentee's claims. To deny recovery for infringement by a device that does not literally infringe upon the claims of a patent, but which nonetheless imitates the patented device, "would be to convert the protection of the patent grant into a hollow and useless thing."[36] A court may consider infringement under the doctrine of equivalents only after it has determined that there is no literal infringement.[37]

2. Application of the doctrine of equivalents

In *Graver Tank*, the Supreme Court established a tripartite test for infringement under the doctrine of equivalents by stating that the doctrine is predicated on the theory that "if two devices do the same work in substantially the same way, and accomplish substantially the same result, they are the same, even though they differ in name, form, or shape."[38] The *Graver Tank* Court considered two electric welding compositions.[39] The patented composition was a combination of alkaline earth metal silicate and calcium fluoride.[40] The accused composition used silicates that were not of an alkaline earth metal.[41] In all other respects, the compositions were identical.[42] The Court relied on the prior art to establish that persons skilled in the art would have understood that the accused composition could be substituted for (i.e., was equivalent to) the claimed composition.[43] Therefore, the doctrine of equivalents was applied to prevent the accused device from fraudulently circumventing the patent.[44] The rationale behind the doctrine, the Court said, is that "one may not practice a fraud on a patent."[45] Simply put, the doctrine prevents a person from circumventing a patent by use of an equivalent means, if that means would have been obvious to one skilled in the art of the patent.

The method for determining equivalency to a claim or limitation of the patented device varies depending on the facts of a specific case.[46] Some cases hold that the focus must be on the combination as a whole,[47] while others indicate that an equivalent of every claim limitation must be found in the accused device.[48] In either case, the appropriate comparison is between the accused device and the patent claim, not simply a comparison of the two devices.[49]

3. Pioneer inventions

In the case of a pioneer invention,[50] the patented device is entitled to broad protection under the doctrine of equivalents.[51] This broad protection arises from the dearth of relevant prior art, rather than an expansive interpretation of the patent claims.[52] Conversely, a patented device that constitutes only a slight improvement in an area of substantial prior art will receive limited protection against infringement under the doctrine.[53]

4. Restrictions on the doctrine of equivalents

The two major restrictions on the doctrine of equivalents are "prosecution history estoppel"[54] and limits imposed by the prior art.[55]

Under prosecution history estoppel, a patentee is estopped from asserting infringement of claims which are embodied in the accused device but were rejected during prosecution of the patentee's patent.[56] The purpose of this doctrine is to prevent the patentee from benefiting from claims that were clearly rejected by the Patent Office and are not within the scope of the patent.[57] The range of equivalents to which a claimed invention is entitled is also limited in that it may not include what was prior art when the patent was prosecuted.[58]

A further restriction on the doctrine of equivalents is the "reverse doctrine of equivalents." As the *Graver Tank* Court noted, if "a device is so far changed in principle from a patented article that it performs the same or similar function in a substantially different way, but nevertheless falls within the literal words of the claim, the doctrine of equivalents may be used to restrict the claim and defeat the patentee's action for infringement."[59] Thus, where an invention relies on the fundamental concept embodied in a patent but is more sophisticated than the patented device due to "a significant advance," the accused device does not infringe by virtue of the reverse doctrine of equivalents.[60] Once a patentee establishes literal infringement, the burden is on the alleged infringer to establish noninfringement under the reverse doctrine of equivalents.[61]

The symmetry of the doctrine of equivalents and the reverse doctrine of equivalents extends to their faults as well. That is, if it is difficult to determine whether a device is not substantially different from a patented device such that there is infringement, it will not be much easier to determine whether a device that falls within the literal words of the claim is so substantially different that infringement does not occur.

IV. ECONOMIC INTERPRETATION OF THE DOCTRINE OF EQUIVALENTS

Patent infringement may be thought of as a federal law tort.[62] Although this analogy is inapposite in some circumstances,[63] similarities between patent infringement and tort law render the former amenable to analysis incorporated in the latter. The level of *mens rea* required, the remedies available and the general economic impact all facilitate infringement analysis by traditional tort law methods.[64] Therefore, the following analysis and transformation of tort law principles, guided by patent law purposes, is a logical extension of economic analysis into the realm of the patent law.

A. The Hand Formula

In 1947, Judge Learned Hand first posited a framework for an economic interpretation of negligence. In *United States v. Carroll Towing*,[65] Judge Hand recognized the economic considerations involved in determining whether a party has acted reasonably.[66] A person's duty to protect against injuries resulting from his behavior is determined by relating: (1) the probability that the injury will occur; (2) the magnitude of the resulting injury; and (3) the burden of taking precautions to prevent the injury from occurring.[67] Judge Hand asserted that liability for injury resulting from certain action attaches when the burden (B) is less than the product of the probability (P) and the magnitude of the injury (L).[68] This relationship is summarized in a simple algebraic formula as $B < P \cdot L$.[69] When the burden of preventing the accident is greater than the product of the probability and magnitude of the injury ($B > P \cdot L$), the actor has not acted negligently and arguably should not be liable for any injury resulting from his actions.

The rationale for this approach is that tort law should encourage economically desirable behavior.[70] As Judge Posner observed:

> When the cost of accidents is less than the cost of prevention, a rational profit-maximizing enterprise will pay tort judgments to the accident victims rather than incur the larger cost of avoiding liability. Furthermore, overall economic value or welfare would be diminished rather than increased by incurring a higher accident-prevention cost in order to avoid a lower accident cost. If, on the other hand, the benefits in accident avoidance exceed the costs of prevention, society is better off if those costs are incurred and the accident is averted, and so in this case the enterprise is made liable, in the expectation that self-interest will lead it to adopt the precautions in order to avoid a greater cost in tort judgments.[71]

Thus, by this view, tort law should not deter activity by attaching liability where the cost of preventing any resulting injury exceeds the cost of the injury itself. In this way, the law promotes economic efficiency.

B. Transformation of the Hand Formula: The Economic Doctrine of Equivalents

By considering the purposes of the patent law in general, and of the doctrine of equivalents in particular, it is possible to design an equation similar in nature to the Hand Formula that may be used to determine infringement under the doctrine of equivalents. Commercial viability, in conjunction with investment and obviousness considerations, may be used directly in considering

infringement under the doctrine of equivalents.[72] These concepts may be related in an equation to facilitate application of the doctrine of equivalents. According to the formulation, an accused device does not infringe under the doctrine of equivalents when its obviousness (O), as measured by investment (reflected in the prior art) in the problem addressed by the accused device,[73] is less than the product of direct investment (I) in the accused device[74] and the commercial viability (Cv) of the accused device, defined as the increased efficiency, measured in dollars, created by the accused device.[75] Thus, where $O < Cv \cdot I$, there is no infringement under the doctrine of equivalents. Conversely, where the obviousness of the accused device is greater than the product of investment and commercial viability ($O > Cv \cdot I$), the device infringes under the doctrine of equivalents.

In *Hilton Davis*, the Federal Circuit emphasized the importance of the substantiality of differences between the accused device and the patent claims.[76] In determining the substantiality of the differences, the factfinder must consider "objective evidence rather than unexplained subjective conclusions."[77] Objective evidence of equivalency is not limited to the function/way/result test of *Graver Tank*, but includes any evidence relevant to the substantiality of the differences between the accused device and the patent claim.[78] In fact, the Federal Circuit stated that "neither the Supreme Court nor this court limits the types of evidence that either party may proffer in support of a factor it considers probative of infringement under the doctrine."[79] The court recognized that "the presence of such factors will depend on the way parties frame their arguments."[80] By incorporating the objective evidence of obviousness, investment in the accused device and commercial viability, the Economic Doctrine of Equivalents examines evidence that is probative of infringement under the doctrine of equivalents. Thus, the Economic Doctrine of Equivalents is a suitable means for determining equivalency under the doctrine of equivalents.

Obviousness, investment and commercial viability, as used in the Economic Doctrine of Equivalents, will next be discussed in some detail. Although the following analysis describes use of the factors in a quantitative sense, the analysis may be conducted qualitatively as well. Like the Hand Formula, the Economic Doctrine of Equivalents may be used as a construct to clarify the criteria that a court will consider in determining infringement under the doctrine of equivalents.

1. Obviousness

Obviousness is an underlying concern of the doctrine of equivalents. Indeed, obviousness is a synonym for the "insubstantial differences" standard enunciated by the Federal Circuit in *Hilton Davis*.[81] The Federal Circuit has described obviousness under 35 U.S. C. § 103 as analogous to infringement under the doctrine of equivalents.[82] The *Graver Tank* Court stated that, when determining equivalence, "[a]n important factor is whether persons reasonably skilled in the art would have known of the interchangeability of an ingredient not contained in the patent with one that was."[83]

The obviousness factor (O) ensures that only significant improvements to a patented device will be found not to infringe under the Economic Doctrine of Equivalents. The concept of obviousness used in the Economic Doctrine of Equivalents might be described as an economic test of obviousness, and differs from the obviousness concept used in determining patentability. It should be clear that I do not advocate the use of the economic test of obviousness as a standard for patent validity. Obviousness with respect to patent validity addresses whether or not patent protection is initially appropriate; the Economic Doctrine of Equivalents, in contrast, is concerned with economic investment and with the economic impact of patents and accused devices. In the following two parts, nonobviousness in the context of patentability and in the Economic Doctrine of Equivalents are each considered.

a. Nonobviousness as a requirement for patentability

The traditional test of nonobviousness is required by section 103 of the Patent Act. Section 103 provides:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.[84]

This language was explicated by the Court in *Graham*,[85] which stated:

> the scope and content of the prior are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or nonobviousness, these inquiries may have relevancy.[86]

According to this test, "[o]bviousness is a legal conclusion based on factual determinations and not a factual determination itself."[87] The necessary factual determinations are: (1) the scope and content of the prior art; (2) the differences between the prior art and the invention; (3) the level of ordinary skill in the art; and (4) objective evidence of nonobviousness.[88] For each of these factual determinations, the inquiry must focus, as the statute requires, on "the time the invention was made."[89] That is, a court must conclude whether the claimed invention *would have been* obvious to a person of ordinary skill at the time the invention was made, not at the time of trial.[90]

Under section 103, determination of obviousness requires an examination of the "art to which [the] subject matter pertains."[91] The pertinent art is determined by examining the nature of the problem confronting the inventor,[92] as well as by considering the type of skill required to understand the patent in question, and the type of art applied to the claims by the Patent Office.[93] Before determining the scope and content of the pertinent prior art, a court must determine whether a reference *is* prior art.[94] Once this legal requirement is met, the court must follow certain legal standards to determine the scope and content of the prior art.[95]

The factfinder must determine whether "the reference is within the field of the inventor's endeavor."[96] If so, the reference is within the scope of the prior art.[97] If not, the factfinder must then determine "whether the reference is reasonably pertinent to the particular problem with which the inventor was involved."[98] According to the Federal Circuit, a "reference is reasonably pertinent if, even though it may be in a different field from that of the inventor's endeavor, it is one which, because of the matter with which it deals, logically would have commended itself to an inventor's attention in considering [the] problem."[99] This consideration requires the factfinder to determine whether a person having ordinary skill in the art[100] would reasonably have expected to solve the problem facing the inventor by considering the reference in question.[101]

Before determining the differences between the prior art and the invention, the court must interpret the meaning and scope of the patent claims at issue.[102] This interpretation is a question of law, incorporating "the objective test of what one of ordinary skill in the art at the time of the invention would have understood the term to mean."[103] The court must consider the claimed "subject matter as a whole," rather than merely compare the claimed subject matter with the prior art.[104] The differences must be evaluated in terms of the whole invention, including whether or not the prior art contains "some teaching, suggestion, or incentive" to make the changes that produce the claimed invention.[105]

In determining obviousness, section 103 requires reference to a hypothetical person of ordinary skill in the art.[106] This person is "presumed to be one who thinks along the line of conventional wisdom in the art and is not one who undertakes to innovate, whether by patient, and often expensive, systematic research or by extraordinary insights."[107] For this reason, the actual inventor's skill is irrelevant: by definition, the inventor is someone with more than ordinary skill.[108] The person of ordinary skill is presumed to have knowledge of all pertinent prior art, the scope and content of which the factfinder has determined.[109] Thus, in light of the foregoing, the appropriate "question is whether what the inventor did would have been obvious to one of ordinary skill in the art attempting to solve the problem upon which the inventor was working."[110]

It is now well settled that "[p]rior art . . . cannot be evaluated in isolation, but must be considered in the light of the secondary considerations bearing on obviousness."[111] Such evidence "may often establish that an invention appearing to have been obvious in light of the prior art was not. It is to be considered as part of all the evidence, not just when the decisionmaker remains in doubt after reviewing the art."[112] Examples of objective evidence of nonobviousness include commercial success,[113] prior failure,[114] unexpected results,[115] long-felt problem or need,[116] copying,[117] and independent development.[118]

b. Nonobviousness and the Economic Doctrine of Equivalents

As used in the Economic Doctrine of Equivalents, obviousness is defined as the net present dollar value of investment directly related to the problem addressed by the accused device.[119] This investment represents the resources allocated to solving a particular problem. It is a monetary representation of what knowledge society would have had without the inventor's contribution. The investment used to determine obviousness is limited to that investment which has a sufficient nexus to the problem addressed by the accused device. This measurement should also be restricted to investment that occurred up to the time that the accused device was developed. These restrictions on the investment determination prevent a wealthy patentee from fraudulently and wastefully throwing money at a problem merely to increase the obviousness factor and, thereby, increase the likelihood that an accused device will infringe under the Economic Doctrine of Equivalents. Moreover, the amount of investment should not include investment by the inventor of the accused device, as it would be unfair to use an inventor's contribution against him.

This economic test of obviousness inherently includes some of the considerations of the traditional test of obviousness used to determine patentability. For example, the factfinder must determine what problem the accused device attempted to solve, i.e., what constitutes the pertinent prior art.[120] This may be done by considering investment directed to the nature of the problem confronting the inventor of the accused device, or investment in research reasonably pertinent to the particular problem with which the inventor of the accused device was involved. Furthermore, the investment included in the calculus must have a nexus to the particular problem addressed by the accused device,[121] i.e., the factfinder must determine which investments contribute to the pertinent prior art.[122] This requirement prevents the consideration of investment in research that is too attenuated from addressing the particular problem.[123]

The economic interpretation differs from the traditional nonobviousness test in that the factfinder is not required to consider a hypothetical person of ordinary skill in the pertinent art, or what would have been obvious to that person. Moreover, once the pertinent art is determined and the aggregate investment calculated, the inquiry ends. All that is relevant is the amount of investment by others in the art: the patented device is relevant only to the extent that investment in its development contributes to industrial investment in the particular problem addressed by the accused device. Under the economic test, obviousness is concerned only with the prior art. These differences greatly simplify the determination of obviousness under the Economic Doctrine of Equivalents.

2. Investment

The idea of incorporating research investment into the determination of equivalency was intimated in *Graver Tank*. After deciding that the accused composition (a flux) infringed under the doctrine of equivalents, the Court noted that, without any evidence of independent research, "the trial court could properly infer that the accused flux is the result of imitation rather than experimentation or invention."[124] Thus, the Court indicated that the absence of research investment in a device gives rise to an inference of "practicing 'a fraud on a patent.' "[125]

In *Hilton Davis*, the Federal Circuit reiterated the relevance of evidence of copying.[126] The *Hilton Davis* court relied on *Graver Tank* in asserting that evidence of copying is relevant to a determination of equivalence.[127] However, the court expressly stated that an inference of copying "would not dominate the doctrine of equivalents analysis. Instead, where the inference arises, it must be weighed together with the other evidence relevant to the substantiality of the differences."[128]

This concern with copying is addressed by the investment factor in the equation. Evidence of copying is manifested in the Economic Doctrine of Equivalents as an absence of investment. By relating investment, whether by evidence of copying or otherwise, with other factors of equivalency, the Economic Doctrine of Equivalents satisfies the Federal Circuit's concern that such evidence not dominate the analysis. Moreover, because evidence of copying may not be black or white but may be a matter of degree, using a measure of investment to represent such evidence will allow greater accuracy in attributing the proper weight to such evidence.[129] The equation requires a court to consider *any* investment directly related to the accused device. Thus, the equation facilitates consideration of research investment when such investment is readily quantifiable.

Investment should include only those expenditures that are specifically made for the accused device. For example, purchases of raw materials consumed exclusively in the production of the device are part of the investment. The entire salary of a scientist, however, could be counted toward the investment only if that scientist worked exclusively on the device; otherwise, the portion of the salary credited to investment should be prorated based on the percentage of hours that scientist worked on the device. Thus, if the scientist spent half of his time working on the device, fifty percent of his salary may be counted as part of the investment in the device.

Inadvertent invention provides an interesting illustration of the investment factor. Suppose an inventor in a microbiology laboratory creates an economically desirable strain of bacteria that is novel and nonobvious simply by accidentally leaving the cover off a petri dish. This omission allows another substance used by the scientist to react accidentally with the culture, resulting in the new bacterium. The proper consideration of investment would include overhead investment relating to the scientist's work. By contrast, suppose a person, while rummaging through his garage, accidentally knocks over a can of something, allowing it to mix with another substance. This accident results in the invention of a commercially desirable compound that is novel and nonobvious. In this case, there is no overhead investment in the invention. This example illustrates the meaning of relevant investment in the invention. Of course, the person in the garage, after discovering the compound, could invest in developing the material. However, the length to which one must go to create a situation where the investment factor is inconsequential serves to demonstrate the relevance of this factor in the ordinary course of invention.

By considering investment, combined with commercial viability, in the determination of infringement, the Economic Doctrine of Equivalents protects accused devices which required some effort to develop and which increase efficiency. One possible criticism of this use of investment has been noted by Edmund Kitch: the patent laws should not penalize the low-cost inventor.[130] This criticism is inapposite here. Under the Economic Doctrine of Equivalents, the focus is on whether the accused device infringes the patented

device, not whether or not the accused device is worthy of patent protection. Penalizing the least-cost inventor is less of a concern when the invention is accused of infringing a device which has already been deemed worthy of patent protection.

The investment factor represents competing policies: while it is true that the patent law should not penalize an inventor for developing a device with the most efficient use of resources, neither should the patent law reward an "inventor" who has simply copied other devices and made minor changes at little cost.

3. Commercial viability

Commercial viability is defined simply as the increased efficiency created by the accused device. Increased efficiency may exist in different forms, but the underlying rationale is the same: a difference[131] in the accused device that results in reduction of cost. The commercial viability factor ensures that only devices that do not increase economic efficiency infringe under the Economic Doctrine of Equivalents. This is consistent with the goal of the patent system of providing incentives for inventors to provide society with beneficial products and knowledge. Although the consideration of commercial viability in this context does not concern the patented device, it nonetheless provides the same incentive: patentees are encouraged to claim the most efficient embodiment of their inventions, thereby reducing the likelihood that an improvement on the device will have significant commercial viability. Moreover, the commercial viability factor prevents an extension of patent scope that would preclude dissemination of products and knowledge that do not infringe the literal meaning of the patent claims and increase social welfare.

The use of efficiency as an indication of commercial viability is suggested by Professors Merges and Nelson.[132] The Economic Doctrine of Equivalents takes this use of efficiency of the accused device one step further by requiring that the increased efficiency be quantifiable as cost savings. That is, the efficiency that commercial viability represents must be a measurable reduction in cost (e.g., the cost of production or use of the claimed device). This reduction need not merely be the reduction of production costs of *making* the accused device; any difference that results in increased efficiency is relevant and therefore is included in the calculus of commercial viability.[133] By contrast, a mere inference that efficiency is increased by an alteration in a device would be no more helpful to the courts than the suggestion that only significant improvements in a device will not infringe under the doctrine of equivalents.[134]

The Federal Circuit noted that "[e]vidence of 'designing around' the patent claims is also relevant to the question of infringement under the doctrine."[135] Not only does designing around a patent require investment, but:

> [t]he ability of the public successfully to design around-to use the patent disclosure to design a product or process that does not infringe, but like the claimed invention, is an improvement over the prior art-is one of the important benefits that justify awarding the patent owner exclusive rights to his invention. Designing around "is the stuff of which competition is made and is supposed to benefit the consumer." When a competitor becomes aware of a patent, and attempts to design around its claims, the fact-finder may infer that the competitor, presumably one of skill in the art, has designed substantial changes into the new product to avoid infringement.[136]

Commercial viability is a more objective, tangible measure of designing around a patent. It is a measure, not merely an inference, of competition resulting in social benefit.

Commercial viability is expressly distinguished from commercial success.[137] Professor Merges has argued that reliance on commercial success as an indication of nonobviousness in determining patentability may lead to undesirable consequences.[138] However, there may be situations where some degree of commercial success is, at least in part, indicative of commercial viability. For example, suppose a drug accused of infringement has greater efficacy than the patented drug, but has the same production cost as the patented drug. In this case, commercial success, as measured by the greater sales of the accused drug, may be the only economic measurement of commercial viability. In cases where commercial success is a proxy for commercial viability, Professor Merges' suggestion that the underlying reasons for the commercial success be considered is applicable.[139]

As a practical matter, it is worth noting that the value of commercial viability may be less than, or equal to, zero. Given the mathematical relationship, either of these situations requires judgment as a matter of law for the patentee. Where commercial viability of the accused device is nil, i.e., there is no increased efficiency resulting from the accused design, the obviousness factor will necessarily be greater and infringement can be found. Similarly, where the commercial viability of the accused device is negative, i.e., there is a decrease in efficiency resulting from the accused device, the obviousness factor will again be necessarily greater.

C. Criticisms and Strengths of the Economic Doctrine of Equivalents

Initially, it may appear that the Economic Doctrine of Equivalents incorporates criteria that examine the accused device without reference or comparison to the patented device. However, application of the Economic Doctrine of Equivalents inherently accounts for the patented device. For example, the commercial viability of an accused device must be made with reference to the patented device: an increase in efficiency will be determined by comparison to the patented device. Similarly, the obviousness factor must be calculated by including the contribution of the patented device to the prior art, to the extent that such contribution is relevant.

Strictly speaking, the Economic Doctrine of Equivalents requires a change in the traditional doctrine of equivalents paradigm which compares the accused device with the patent claims. But the new paradigm posited by the Economic Doctrine of Equivalents results from consideration of the purposes of the Patent Act and the underlying reasoning of the traditional doctrine of equivalents. This new paradigm manifests itself in an economic context. Judge Newman recognized this context by stating that "[t]he patent law is directed to the public purposes of fostering technological progress, investment in research and development, capital formation, entrepreneurship, innovation, national strength and international competitiveness. Our review of the doctrine of equivalents takes place in this context, not as an abstraction insulated from commercial reality."[140] Thus, the essential problem with the doctrine of equivalents is not the purpose behind the doctrine but the application of it.[141] Failure to recognize the economic context will only result in further frustration with the doctrine.

The Economic Doctrine of Equivalents emphasizes both the prior art and the accused device. On one side of the equation, the obviousness factor is concerned with investment in the prior art. On the other side, commercial viability and investment are concerned with the accused device itself. This lesser reliance on the patented device itself decreases a court's ability to expand the claims of a patent in litigation beyond what was granted by the Patent Office.

The strength of the Economic Doctrine of Equivalents is that it focuses a court's analysis on criteria that best serve the purposes of both the Patent Act and the traditional doctrine of equivalents. First, the commercial viability factor represents the goal of the Patent Act to promote the invention, development and marketing of products that are useful to society. It thus encourages development of devices where there is no literal or fraudulent infringement and where commercial viability is great. Second, the investment factor serves to ensure that the alleged infringer does not practice a fraud on a patent. This factor also brings a tangible meaning to the notion of practicing fraud on a patent.

Some may argue that simply reducing a concept to an algebraic equation does not eliminate the uncertainty inherent in the concept of equivalence. The Economic Doctrine of Equivalents, however, reduces uncertainty as compared to the traditional doctrine of equivalents because: (1) it focuses courts on the most important considerations of the doctrine and the Patent Act; and (2) it provides a method for introducing quantitative analysis into the doctrine of equivalents. But even if the formulation provided no greater certainty than the traditional methods, it does furnish courts with a more familiar manner of analysis. This will serve to overcome any apprehension judges or juries may feel when considering highly technical matters involving infringement.

The Economic Doctrine of Equivalents may also be criticized as a simple mechanical calculation where a more flexible approach is needed. This criticism mischaracterizes the Economic Doctrine of Equivalents. The Economic Doctrine of Equivalents is an almost purely objective test; but like most rules of law, it requires some interpretation for implementation. For example, the obviousness determination requires some discretion as to whether certain investment addresses the same problem addressed by the accused device. The significant increase in objectivity achieved by the Economic Doctrine of Equivalents is not strained by the possible subjectivity of the obviousness factor. Any subjectivity introduced by the obviousness factor is more than counterbalanced by the objectivity of the overall formulation. Thus, the Economic Doctrine of Equivalents is not merely a mathematical formula applied perfunctorily by courts, but is a flexible guideline for promoting the goals of the Patent Act in accordance with the true purpose of the traditional doctrine of equivalents.

One concern raised by the use of investment in the Economic Doctrine of Equivalents is that, taken together, the investment and commercial viability factors could allow a device with little commercial viability which was backed by substantial investment to evade an infringement finding. A devious inventor could obtain insurance against an infringement finding by driving up investment in a device, irrespective of any increase in commercial viability.[142] Assuming for the moment that the overinvestment is the type in which a rational investor would engage, such overinvestment does not defeat application of the Economic Doctrine of Equivalents. First, if the accused device offers no increased efficiency whatsoever, i.e., the commercial viability equals zero, then no amount of investment will avoid a finding of infringement under the Economic Doctrine of Equivalents. Second, any investment which rises to the level of fraudulence may be so identified and discounted by the factfinder.[143]

The Economic Doctrine of Equivalence is also likely to be criticized for requiring quantitative analysis where it is not always possible to do so. For example, while major corporations may be able to produce the information required for the analysis, a single inventor conducting research in her garage may not be able to provide detailed information, particularly where market analysis is required. It is

important to emphasize that, more than anything else, the Economic Doctrine of Equivalents is a paradigm for understanding infringement under the doctrine of equivalents. The Hand Formula has been subject to similar criticism. But even critics of the Hand Formula will recognize that the formula is helpful in understanding the underlying considerations of negligence. So it is with the Economic Doctrine of Equivalents. Even where a quantitative analysis is not appropriate or possible (for whatever reason), the formulation provides assistance in understanding the underlying considerations of the doctrine of equivalents and the Patent Act.

As courts[144] and scholars[145] increasingly incorporate economic analysis into legal thought and interpretation, it is not surprising that traditional legal doctrines will be revised and reformulated. Where revision and reformation through economic analysis results in a more cohesive legal doctrine, courts should not hesitate to adopt new interpretations. Given the economic nature of patent law, this particularly applies to the doctrine of equivalents.[146] The Economic Doctrine of Equivalents does not contravene the law as it exists: it merely serves to clarify the existing analysis in a manner more accessible to courts, inventors and investors.

V. APPLICATION OF THE ECONOMIC DOCTRINE OF EQUIVALENTS

A. Application Generally

A patentee establishes a prima facie case of infringement under the Economic Doctrine of Equivalents by introducing evidence of obviousness, investment and commercial viability which demonstrates $O > Cv \cdot I$.[147] Once this burden is satisfied, the alleged infringer may dispute the patentee's calculus by introducing evidence to refute the patentee's case.[148] As explained below, the Economic Doctrine of Equivalents should be applied in any case where infringement is alleged, whether or not literal infringement is found.

The Economic Doctrine of Equivalents places less emphasis on the protection of pioneer inventions than the traditional doctrine.[149] Because a pioneer invention has virtually no prior art, the obviousness factor will be relatively small. Thus, *ceteris paribus*, infringement will be more difficult to prove in the case of a pioneer invention. This is not a fundamental flaw, however, because the Economic Doctrine of Equivalents will still function to protect only socially beneficial improvements. The purpose of the pioneer invention doctrine is to afford greater protection to those inventions that are uniquely innovative. The purpose of the Economic Doctrine of Equivalents is to protect those inventions that do not literally infringe and increase efficiency. The broad protection afforded pioneer inventions becomes unwarranted where another inventor makes an improvement, as opposed to an imitation, that is truly beneficial to society, as determined by the Economic Doctrine of Equivalents. This is especially so considering that the pioneer inventor presumably has a competitive advantage. Where the pioneer inventor has the opportunity to improve upon his own invention, but another succeeds first, the doctrine of equivalents should not protect the pioneer invention at the expense of a valuable improvement. Indeed, to do so would be contrary to the purpose of the patent law.

The advantage in applying the Economic Doctrine of Equivalents is that it inherently accounts for the uniquely innovative aspects of pioneer inventions. There is no need for a court to determine whether or not an invention should receive pioneer status. Where a pioneer invention has a greater adverse effect on the commercial viability of an accused device than a non-pioneer invention, the calculus itself will account for an invention deserving of pioneer status. Moreover, the Economic Doctrine of Equivalents does not require a court to determine whether a particular patent describes a pioneer invention; rather, by measuring a device according to its particular commercial viability, the Economic Doctrine of Equivalents recognizes that pioneer status is a matter of degree.[150] In cases where an accused device has little or no commercial viability because the patented device is simply the most efficient embodiment of the patent, that patent will, in effect, enjoy pioneer status. But where the accused device is more efficient as a result of the defendant's effort (i.e., investment), the patented device will receive a lesser degree of protection.

In a related manner, application of the Economic Doctrine of Equivalents also accounts for the reverse doctrine of equivalents. There is no need for a court to determine whether "a device is so far changed in principle from a patented article that it performs the same or a similar function in a substantially different way"[151] so that the reverse doctrine of equivalents applies. By applying the Economic Doctrine of Equivalents even when the accused device literally infringes the patent, the defendant has the opportunity to demonstrate, in a meaningful way, that the accused device *is* a substantial change from the patented device. This ensures that all the purposes of the doctrine of equivalents, in light of the goals of the patent system, are served.

B. Application to *Graver Tank*

Applying the Economic Doctrine of Equivalents to the facts in *Graver Tank* yields the same result as reached by the Supreme Court. This case also illustrates that it is unnecessary to have a strict numerical basis in order to apply the formulation. In other words, it is not necessary to know the absolute value of a factor if its relative value is known. Thus, the following interpretations of obviousness, commercial viability and investment will be made by reference to the investment in the patented device.

1. Obviousness

Although the Graver Tank opinion does not provide detailed information regarding investment in the relevant prior art it is possible to draw inferences from the facts given. Certainly the investment in development of the patented composition is included in the obviousness calculus. In a case such as this, where actual figures are not available, the relative magnitude of the factor is essential. Given the insubstantial change in the accused composition, the obviousness factor in *Graver Tank* is relatively great.[152]

2. Commercial Viability

The facts of *Graver Tank* give rise to certain inferences that may be used to determine commercial viability. First, the fact that the accused and patented compositions were "identical in operation and produce the same kind and quality of weld"[153] suggests that the accused device did not result in anything more than a negligible increase in efficiency. Second, the similarity between the two compositions-one using silicates of calcium and magnesium, the other using silicates of calcium and manganese[154]-gives rise to the inference that the difference in production costs of the two compositions is not great. Therefore, it is likely that commercial viability is relatively insignificant.

It is worthwhile to recognize that if the facts were such that the substitution of manganese silicates for magnesium silicates resulted in a dramatic cost savings, it is possible that there would be no infringement under the Economic Doctrine of Equivalents. Under the current doctrine of equivalents analysis, a similar noninfringement finding would be possible. Such a finding would be predicated on the substantial cost savings created by the accused device-the same criterion that the Economic Doctrine of Equivalents emphasizes.

3. Investment

Certain inferences about the degree of investment in the accused device may be drawn from the facts given. The Court noted that there was no "explanation or indication that [the accused composition] was developed by independent research . . . [and] is the result of imitation rather than experimentation or invention."[155] Therefore, it is apparent that investment in research of the accused composition is practically nil and, thus, relatively insignificant.

4. $O > Cv \cdot I$

Both the commercial viability and investment factors are small; obviousness, however, is relatively great. Thus, the product of investment and commercial viability is less than the obviousness factor. Even though this may not be proven quantitatively, the facts of the case allow a court to make inferences that substantiate this conclusion. Therefore, the accused composition infringes under the Economic Doctrine of Equivalents.

VI. CONCLUSION

Arising out of the Supreme Court's admonition that "[e]quivalence, in the patent law, is not the prisoner of a formula,"[156] the Economic Doctrine of Equivalents provides a concise, yet comprehensive, means for applying what has proved to be a troublesome doctrine. Given all the rhetoric about protecting the virtuous inventor from the scurrilous imitator who evades infringement with minor modifications, the time has come to recognize an interpretation of the doctrine of equivalents that addresses economic impact.

The rationale behind the Economic Doctrine of Equivalents reflects the legal reasoning behind both *Graver Tank* and *Hilton Davis*. These opinions provide three fundamental principles underlying the doctrine of equivalents. First, only insubstantial, obvious changes come within the purview of the doctrine. Second, where there is evidence of copying, or conversely, no evidence of investment in the accused device, application of the doctrine of equivalents is more appropriate. Third, where there is evidence that the defendant sought to design around the patent claim, application of the doctrine of equivalents is less appropriate. These principles are adequately represented in the Economic Doctrine of Equivalents by the obviousness, investment and commercial viability factors, respectively. The relation of these factors in the equation provides a rationale for the factfinder to use in the determination of infringement under the doctrine of equivalents. Thus, the Economic Doctrine of Equivalents provides a structure for determination of infringement under the doctrine of equivalents.

Equally important is the fact that the Economic Doctrine of Equivalents uses measured quantities, not inferences, to determine equivalency. The test enunciated in *Hilton Davis* describes important considerations used to draw inferences. The test enunciated in this article describes quantification of the same considerations used to make determinations. In *Hilton Davis*, Judge Newman assessed the doctrine of equivalents:

> [T]he major contribution of the doctrine of equivalents is now, and always has been, to the idea of a fairer, less technocratic, more practical patent system; one that is oriented toward encouraging technologic innovation and discouraging free riding; one that is not at the "mercy of verbalism," in the words of *Graver Tank*. In this way the doctrine of equivalents can contribute a degree of added investment confidence to the inherently risky environment of new technology. However, it will not serve that function if its application is so unpredictable that it cannot be relied upon. Indeed, the determination of technologic equivalency should be reasonably predictable by not only the innovator but also the competitor. When applied to a particular patented invention, it should be reasonably predictable whether a specific device will be found "equivalent."[157]

Because the Economic Doctrine of Equivalents relies on measurements, rather than inferences, it is more predictable than the current test for equivalency.[158] The formulation provides more certainty for patent attorneys in advising their clients, as well as providing commercial actors with a legal doctrine expressed in cognizable terms. As Judge Newman concluded, "[i]t is not the doctrine of equivalents, but the uncertainty of its application, that causes the uncertainty in commercial relationships."[159] The Economic Doctrine of Equivalents should remove the uncertainty in the application of the doctrine.

While affording the opportunity to rein in the doctrine of equivalents, the Economic Doctrine of Equivalents remains faithful to the purposes of the traditional doctrine of equivalents, as well as the patent law in general. As Judge Newman further observed, "[n]ot all improvements are equal, and neither are their implications for technological growth."[160] The Economic Doctrine of Equivalents takes notice of this observation and seeks to reflect it in a manner that is consistent with the traditional doctrine of equivalents. In short, the Economic Doctrine of Equivalents provides a feasible rationale for a troublesome doctrine.

It is, perhaps, appropriate that a modification of the Hand Formula be devised to clarify and apply the doctrine of equivalents. Before the *Graver Tank* opinion issued, Judge Hand had eloquently expressed the essence of the doctrine of equivalents: "after all aids to interpretation have been exhausted, and the scope of the claims has been enlarged as far as the words can be stretched, on proper occasions courts make them cover more than their meaning will bear."[161] The doctrine of equivalents must be preserved: it ensures that protection of an inventor's ideas is not circumvented by mere words. But equally important is the ability of inventors and investors to allocate economic resources with confidence that a court will not deprive them of the benefits of their efforts. The Economic Doctrine of Equivalents satisfies both concerns.

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1. The U.S. Constitution, Article III, § 1, provides for the creation of "such inferior Courts as the Congress may from time to time ordain and establish."

2. Federal Courts Improvement Act of 1982, Pub. L. No. 97-164, 96 Stat. 25; *see also* S. REP. NO. 275, 97th Cong., 2d Sess. 11 (1982), *reprinted in* 1982 U.S.C.C.A.N. 11, 11 (stating that the statute is "part of a comprehensive program designed to improve the quality of our Federal court system.") The Act withdrew the jurisdiction of the twelve regional Courts of Appeals.

3. The veracity of this statement is partially due to the Federal Circuit's efficacy in clarifying other areas of the patent law. *See generally* Rochelle Cooper Dreyfuss, *The Federal Circuit: A Case Study in Specialized Courts*, 64 N.Y.U. L. REV. 1 (1989); Douglas A. Strawbridge et al., *Patent Law Developments in the United States Court of Appeals for the Federal Circuit During 1986*, 36 AM. U. L. REV. 861 (1987).

4. Graver Tank & Mfg. Co. v. Linde Air Prods. Co., 339 U.S. 605 (1950).

5. *See, e.g.*, Hilton Davis Chem. Co. v. Warner-Jenkinson Co., Inc., 62 F.3d 1512, 1545 (Fed. Cir. 1995) (en banc) (Plager, J., dissenting) (stating that the majority failed "to bring a consistent and rationalized practice to the doctrine of equivalents"); Pennwalt Corp. v. Durand-Wayland, Inc., 833 F.2d 931, 939 (Fed. Cir. 1987) (en banc) (Bennett, J., dissenting) (accusing the majority of "contraven[ing] Supreme Court precedents . . . [and] rewrit[ing] the doctrine of equivalents without regard for stare decisis principles"); *Graver Tank*, 339 U.S. at 613 (Black, J., dissenting) (stating that the majority opinion "steriliz[es] . . . Acts of Congress and prior decisions ").

6. *See, e.g.*, Martin J. Adelman & Gary L. Francione, *The Doctrine of Equivalents in Patent Law: Questions that* Pennwalt *Did Not Answer*, 137 U. PA. L. REV. 673, 728-29 (1989) (arguing that justice would best be served if the doctrine of equivalents were abandoned); Timothy L. Tilton, *The Doctrine of Equivalents in Patent Cases*, 32 J. PAT. OFF. SOC'Y 861 (1950) (predicting that the Supreme Court would use *Graver Tank* to abolish the doctrine of equivalents).

7. *See, e.g.*, Rudolph P. Hofmann, Jr., *The Doctrine of Equivalents: Twelve Years of Federal Circuit Precedent Still Leaves Practitioners Wondering*, 20 WM. MITCHELL L. REV. 1033, 1060 (1994) ("uncertainty remains in every issue of the doctrine of equivalents as currently applied"). Tom Arnold, of Arnold, White & Durkee, observed that different panels of the Federal Circuit "have gone off on frolics of their own in an effort to render the doctrine narrower and more specific. And they have generated one hell of a turmoil, with opinions that don't reconcile with each other." Victoria Slind-Flor, *Rethinking Protection: Software Patents, Copyright Issues Shaped the IP Landscape in '93*, NAT'L L.J., Jan. 24, 1994, at S27.

8. 339 U.S. at 608-09.

9. *Hilton Davis*, 62 F.3d at 1538 (Plager, J., dissenting).

10. *Id.* at 1516.

11. *Id.* at 1518.

12. *Id*.

13. *Id*.

14. *Id*. at 1521.

15. *Id*. at 1519.

16. *Id.* at 1528.

17. London v. Carson Pirie Scott & Co., 946 F.2d 1534, 1538 (Fed. Cir. 1991).

18. United States v. Carroll Towing, 159 F.2d 169 (2d Cir. 1947).

19. The current patent statute is 35 U.S.C. §§ 1-376 (1988).

20. U.S. CONST. art. I, § 8, cl. 8.

21. An Act to promote the progress of useful Arts, ch. 7, 1 Stat. 109 (1790) (repealed 1793).

22. *See, e.g.*, Robert P. Merges & Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839 (1990) (detailing the economic benefits that result from the patent system).

23. *But see* FRIEDRICH A. VON HAYEK, THE FATAL CONCEIT: THE ERRORS OF SOCIALISM (1989); Jack Hirshleifer, *The Private and Social Value of Information and the Reward to Inventive Activity*, 61 AM. ECON. REV. 561 (1971).

24. A patent, of course, is not a monopoly. As then-Chief Judge Markey observed, "[i]t is but an obfuscation to refer to a patent as 'the patent monopoly' or to describe a patent as an exception to the general rule against monopolies." Schenck, A.G. v. Norton Corp., 713 F.2d 782, 786 n.3 (Fed. Cir. 1983). However, given the development of the patent law from the English law of monopolies, the tradition of mischaracterizing a patent as a monopoly is understandable. The Case of Monopolies, Darcy v. Allin, 77 Eng. Rep. 1260 (K.B. 1602), was the first English case to declare a royal patent grant void as contrary to the common law and in violation of many acts of Parliament. Later, in The Clothworkers of Ipswich, Godbolt, 252, 78 Eng. Rep. 147 (K.B. 1615), the court recognized that while the Crown did not have power to grant a monopoly in a specific trade, it could grant an exclusive right for a limited time to an inventor who introduced a new discovery. Later, in 1623, Parliament enacted the Statute of Monopolies, 21 Jam. ch. 3, which served

both to codify the common law and provide a statutory basis for the British patent law. *See generally* Edward C. Walterscheid, *The Early Evolution of the United States Patent Law: Antecedents* (pts. 1 & 2), 76 J. PAT. & TRADEMARK OFF. SOC'Y 697, 849 (1994).

25. Thomas Jefferson, an inventor and member of the commission created by the 1790 Patent Act to oversee the patent system, observed that only those "things which are worth to the public the embarrassment of an exclusive patent" deserve patent protection. Graham v. John Deere Co., 383 U.S. 1, 10-11 (1966). James Madison concluded that the public good resulting from a patent grant coincided with the inventor's right to the invention and that the individual states could not effectively regulate the matter. THE FEDERALIST NO. 43, at 288 (James Madison) (Jacob E. Cooke ed., 1961).

26. *See, e.g.*, Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 J.L. & ECON. 265 (1977); WILLIAM D. NORDHAUS, INVENTION, GROWTH, AND WELFARE: A THEORETICAL TREATMENT OF TECHNOLOGICAL CHANGE (1969); Yoram Barzel, *Optimal Timing of Innovations*, 50 REV. ECON. & STAT. 348 (1968); John S. McGee, *Patent Exploitation: Some Economic and Legal Problems*, 9 J.L. & ECON. 135 (1966); F.M. SCHERER ET AL., PATENTS AND THE CORPORATION (2d ed. 1959); Arnold Plant, *The Economic Theory Concerning Patents for Inventions*, 1 ECONOMICA 30 (1934).

27. For an excellent discussion of intellectual property generally and government incentives to technological progress, see Edmund W. Kitch, *Property Rights in Inventions, Writings and Marks*, 13 HARV. J.L. & PUB. POL'Y 119 (1990).

28. *See, e.g.*, SUBCOMMITTEE ON PATENTS, TRADEMARKS AND COPYRIGHTS, SENATE COMM. ON THE JUDICIARY, 85TH CONG., 2D SESS., AN ECONOMIC REVIEW OF THE PATENT SYSTEM 15 (Comm. Print 1958) (Fritz Machlup).

29. 35 U.S.C. § 271(a) (1988).

30. As used in this article, the word "device" means any patentable subject matter under 35 U.S.C. § 101 (1988).

31. Key Mfg. Group, Inc. v. Microdot, Inc., 925 F.2d 1444, 1448 (Fed. Cir. 1991); Palumbo v. Don-Joy, 762 F.2d 969, 974 (Fed. Cir. 1985); Texas Instruments, Inc. v. United States Int'l Trade Comm'n, 805 F.2d 1558, 1568-70 (Fed. Cir. 1986) [hereinafter *Texas Instruments I*].

32. *Texas Instruments I*, 805 F.2d at 1568-70; SRI Int'l v. Matsushita Elec. Corp. of Am., 775 F.2d 1107, 1121 (Fed. Cir. 1985); Martin v. Barber, 755 F.2d 1564, 1567 (Fed. Cir. 1985).

33. Laitram Corp. v. Rexnord, Inc., 939 F.2d 1533, 1535 (Fed. Cir. 1991); Johnston v. IVAC Corp., 885 F.2d 1574, 1580 (Fed. Cir. 1989); Julien v. Zeringue, 864 F.2d 1569, 1571 (Fed. Cir. 1989).

34. *See* Winans v. Denmead, 56 U.S. (15 How.) 330, 343 (1853) (observing that "where the whole substance of the invention may be copied in a different form, it is the duty of courts and juries to look through the form for the substance of the invention"); Zeigler v. Philips Petroleum Co., 483 F.2d 858 (5th Cir.), *cert. denied*, 414 U.S. 1079 (1973) (recognizing the doctrine of equivalents as a safeguard against the elevation of form over substance); *cf.* Cabell v. Markham, 148 F.2d 737, 739 (2d Cir. 1945) (Judge Hand noting that "it is one of the surest indexes of a mature and developed jurisprudence not to make a fortress out of the dictionary"). *But cf.* White v. Dunbar, 119 U.S. 47, 51 (1886) (warning that a patent claim is not "like a nose of wax which may be turned and twisted in any direction").

35. 1A LESTER HORWITZ, PATENT OFFICE RULES AND PRACTICE § 111.6 (1992).

36. Graver Tank & Mfg. Co. v. Linde Air Prods. Co., 339 U.S. 605, 607 (1950).

37. *Id.* at 607-08. However, there is no equitable threshold for application of the doctrine of equivalents. "The doctrine of equivalents has no equitable or subjective component." Hilton Davis Chem. Co. v. Warner-Jenkinson Co., Inc., 62 F.3d 1512, 1523 (Fed. Cir. 1995) (en banc).

38. *Graver Tank*, 339 U.S. at 608 (quoting Machine Co. v. Murphy, 97 U.S. 120, 125 (1877)).

39. *Graver Tank*, 339 U.S. at 610.

40. *Id.*

41. *Id*.

42. *Id*.

43. *Id*. at 611-12.

44. *Id*. at 612.

45. *Id*. at 608.

46. Malta v. Schulmerich Carillons, Inc., 952 F.2d 1320, 1326 (Fed. Cir. 1991) ("How equivalency . . . is met necessarily varies from case to case due to many variables such as the form of the claim, the nature of the invention defined by it, the kind of limitation that is not literally met, etc.").

47. *Texas Instruments I*, 805 F.2d 1558, 1568-70 (Fed. Cir. 1986).

48. Pennwalt Corp. v. Durand-Wayland, Inc., 833 F.2d 931, 934-36 (Fed. Cir. 1987) (en banc).

49. Read Corp. v. Portec, Inc., 970 F.2d 816, 822 n.2 (Fed. Cir. 1992). The court provided the example of the comparison between a pencil and a pen: while the two "may for many purposes or uses be generally equivalent, . . . claim limitations drawn to a pen would not under the doctrine of equivalents cover a pencil and vice versa." *Id*.

50. The Supreme Court defined a pioneer invention as "a wholly novel device, or one of such novelty and importance as to mark a distinct step in the progress of the art, as distinguished from a mere improvement or perfection of what had gone before." Westinghouse v. Boyden Power Brake Co., 170 U.S. 537, 562 (1898). More simply, a pioneer invention is an invention without significant prior art. *Texas Instruments I*, 805 F.2d at 1572.

51. Morley Sewing-Mach. Co. v. Lancaster, 129 U.S. 263, 272-84 (1889); Perkin-Elmer Corp. v. Westinghouse Elec. Corp., 822 F.2d 1528, 1532 (Fed. Cir. 1987) (citing Sealed Air Corp. v. United States Int'l Trade Comm'n, 645 F.2d 976, 984 (C.C.P.A. 1981)).

52. Texas Instruments v. United States Int'l Trade Comm'n, 846 F.2d 1369, 1370 (Fed. Cir. 1988).

53. Hughes Aircraft Co. v. United States, 717 F.2d 1351, 1362 (Fed. Cir. 1983).

54. This is alternatively known as file wrapper estoppel. Amstar Corp. v. Envirotech Corp., 730 F.2d 1476, 1485 (Fed. Cir. 1984).

55. Stewart-Warner Corp. v. City of Pontiac, Mich., 767 F.2d 1563, 1572 (Fed. Cir. 1985).

56. Schriber-Schroth Co. v. Cleveland Trust Co., 311 U.S. 211, 220-21 (1940); Black & Decker, Inc. v. Hoover Serv. Ctr., 866 F.2d 1285, 1295 (Fed. Cir. 1989).

57. Mannesmann Demag Corp. v. Engineered Metal Prods. Co., 793 F.2d 1279, 1284 (Fed. Cir. 1986).

58. *Stewart-Warner*, 767 F.2d at 1572.

59. *Graver Tank*, 339 U.S. at 608-09.

60. Mead Digital Sys., Inc. v. A.B. Dick Co., 723 F.2d 455, 464 (6th Cir. 1983).

61. SRI Int'l v. Matsushita Elec. Corp., 775 F.2d 1107, 1123-24 (Fed. Cir. 1985).

62. *See, e.g.*, Beverly Hills Fan Co. v. Royal Sovereign Corp., 21 F.3d 1558, 1570-71 (Fed. Cir. 1994) (for purposes of a state's long-arm statute, the situs of the tort of patent infringement is not the domicile of the patentee but the place where the allegedly infringing activity takes place); A.C. Aukerman Co. v. R.L. Chaides Constr. Co., 960 F.2d 1020, 1031 (Fed. Cir. 1992) (laches is an appropriate defense to continuing torts, such as patent infringement); Orthokinetics, Inc. v. Safety Travel Chairs, Inc., 806 F.2d 1565, 1579 (Fed. Cir. 1986) (infringement is a tort for purposes of corporate liability); Carbice Corp. v. Am. Patents Dev. Corp., 283 U.S. 27, 33 (1931) ("[i]nfringement, whether direct or contributory, is essentially a tort").

63. *See, e.g.*, North Am. Philips Corp. v. Am. Vending Sales, Inc., 35 F.3d 1576, 1579 (Fed. Cir. 1994) ("[W]hile it may be appropriate to speak loosely of patent infringement as a tort, more accurately the cause of action for patent infringement is created and defined by statute.").

64. *See generally* RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW (4th ed. 1992); WERNER Z. HIRSCH, LAW AND ECONOMICS (2d ed. 1988).

65. 159 F.2d 169 (2d Cir. 1947).

66. *See generally* Richard A. Posner, *A Theory of Negligence*, 1 J. LEGAL STUD. 29, 32 (1972).

67. *Carroll Towing*, 159 F.2d at 173.

68. *Id*.

69. While the formula may be simple, the conceptual and practical application may not be. Judge Hand himself recognized the problems that may arise in applying the test: "The difficulties are in applying the rule, . . . they arise from the necessity of applying a quantitative test to an incommensurable subject matter; and the same difficulties inhere in the concept of 'ordinary' negligence." Moisan v. Loftus, 178 F.2d 148, 149 (2d Cir. 1949).

70. Posner, *supra* note 66, at 32-33.

71. *Id*. at 33.

72. One author has suggested that commercial viability could distinguish a recombinant protein from the naturally occurring isolate by creating a legal fiction whereby a recombinant protein would be "coupled" to its method of production. Michael S. Greenfield, *Recombinant DNA Technology: A Science Struggling with the Patent Law*, 44 STAN. L. REV. 1051, 1082 (1992). The Economic Doctrine of Equivalents gives greater meaning to the concept of commercial viability so that it may be applied in all cases where the issue of infringement under the doctrine of equivalents is raised.

73. The definition of the term "obviousness," as used in this article, is discussed in greater detail *infra* text accompanying notes 81-123.

74. The definition of the term "investment," as used in this article, is discussed in greater detail *infra* text accompanying notes 124-130.

75. The definition of the term commercial viability, as used in this article, is discussed in greater detail *infra* text accompanying notes 131-139.

76. Hilton Davis Chem. Co. v. Warner-Jenkinson Co., Inc., 62 F.3d 1512, 1518 (Fed. Cir. 1995) (en banc).

77. *Id*. at 1519.

78. *Id*. at 1518.

79. *Id*. at 1522.

80. *Id*.

81. *Id*. at 1520. The court further explained that "those who make only insubstantial changes to a patented product or process are liable for infringement, regardless of their awareness of the patent and its disclosure." *Id*.

82. In explaining the difference between the definition of "anticipation" before and after the 1952 amendment of the Patent Act, Judge Nies observed that "[a]ll infringements of a device do not 'anticipate' [the device] . . . . Some may be infringements under the doctrine of equivalents which, if one wished to draw a parallel, is somewhat akin to obviousness." Lewar Marine, Inc. v. Barient, Inc., 827 F.2d 744, 748 (Fed. Cir. 1987).

83. *Graver Tank*, 339 U.S. at 609.

84. 35 U.S.C. § 103 (1988).

85. Graham v. John Deere Co., 383 U.S. 1 (1966).

86. *Id.* at 17-18.

87. Aktiebolaget Karlstads Mekaniska Werkstad v. United States Int'l Trade Comm'n, 705 F.2d 1565, 1575 (Fed. Cir. 1983) (citing General Motors Corp. v. United States Int'l Trade Comm'n, 687 F.2d 476, 480 (Fed. Cir. 1982), *cert. denied*, 459 U.S. 1105 (1983)).

88. *See* Stratoflex, Inc. v. Aeroquip Corp., 713 F.2d 1530, 1535-40 (Fed. Cir. 1983).

89. 35 U.S.C. § 103 (1988).

90. *See* Panduit Corp. v. Dennison Mfg. Co., 810 F.2d 1561, 1570-71 (Fed. Cir.), *cert. denied*, 481 U.S. 1052 (1987).

91. 35 U.S.C. § 103 (1988).

92. *See* Shatterproof Glass Corp. v. Libbey-Owens Ford Co., 758 F.2d 613, 620 (Fed. Cir.), *cert. dismissed*, 474 U.S. 976 (1985).

93. *See* Orthopedic Equip. Co., Inc. v. United States, 702 F.2d 1005, 1008 (Fed. Cir. 1983).

94. *See Panduit*, 810 F.2d at 1568. What the prior art comprises, as contrasted with what it teaches, is a question of law. General Motors Corp. v. United States Int'l Trade Comm'n, 687 F.2d 476, 482 n.10 (C.C.P.A. 1982), *cert. denied*, 459 U.S. 1105 (1983). Sources of prior art are mentioned in 35 U.S.C. § 102 and include prior knowledge or use, prior patents, prior publications, description in a prior copending patent application that ripens into a patent, prior invention, and derivation from another. 2 CHISUM, PATENTS § 5.03[3] (1994). However, "section 102 is not the *only* source of section 103 prior art." *In re* Fout, 675 F.2d 297, 300 (C.C.P.A. 1982).

95. *See Panduit*, 810 F.2d at 1568. For example, when the prior art reference is a patent, the "patent must be considered in its entirety, i.e., as a *whole*, including portions that would lead away from the invention in suit . . . ; elements of separate prior patents cannot be combined when there is no suggestion of such combination anywhere in those patents . . . and a court should avoid hindsight" *Id*. (citations omitted).

96. Bausch & Lomb, Inc. v. Barnes-Hind/Hydrocurve, Inc., 796 F.2d 443, 449 (Fed. Cir. 1986).

97. *See, e.g., In re* Deminski, 796 F.2d 436, 442 (Fed. Cir. 1986).

98. *Bausch & Lomb*, 796 F.2d at 449.

99. *In re* Clay, 966 F.2d 656, 659 (Fed. Cir. 1992). The court further observed:

> Thus, the purposes of both the invention and the prior art are important in determining whether the reference is reasonably pertinent to the problem the invention attempts to solve. If a reference disclosure has the same purpose as the claimed invention, the reference relates to the same problem, and that fact supports use of that reference in an obviousness rejection. An inventor may well have been motivated to consider the reference when making his invention.

If it is directed to a different purpose, the inventor would accordingly have had less motivation or occasion to consider it.

Id.

100. The concept of a "person with ordinary skill in the art" is discussed in greater detail *infra*, text accompanying notes 106-110.

101. *Clay*, 966 F.2d at 660.

102. Markman v. Westview Instruments, 52 F.3d 967, 979 (Fed. Cir. 1995) (en banc). *See* Lemelson v. Gen. Mills, Inc., 968 F.2d 1202, 1206 (Fed. Cir. 1992), *cert. denied*, 113 S. Ct. 976 (1993). When the accused device is not patented, the court may construct hypothetical claims that describe the accused device. *See* Wilson Sporting Goods v. David Geoffrey & Assoc., 904 F.2d 677 (Fed. Cir. 1990). According to this test, a court should "visualiz[e] a *hypothetical* patent claim, sufficient in scope to *literally* cover [sic] the accused product." *Id*. at 684.

103. *Markman*, 52 F.3d at 986. In determining the meaning of the claim to one skilled in the art, the court will consider the claim language, the specification, the prosecution history and extrinsic evidence, including expert testimony. *Id.* at 979.

104. *See In re* Kaslow, 707 F.2d 1366, 1374 (Fed. Cir. 1983).

105. Northern Telecom, Inc. v. Datapoint Corp., 908 F.2d 931, 934 (Fed. Cir. 1990).

106. *See* Standard Oil Co. v. Am. Cyanamid Co., 774 F.2d 448, 454 (Fed. Cir. 1985). The Federal Circuit has enunciated several criteria to consider in determining the level of ordinary skill in the art. The factfinder may consider: "(1) the educational level of the inventor; (2) type of problems encountered in the art; (3) prior art solutions to these problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) educational level of active workers in the field." Envtl. Designs v. Union Oil Co. of Cal., 713 F.2d 693, 696 (Fed. Cir. 1983).

107. *Standard Oil*, 774 F.2d at 454.

108. *Id*.

109. *Id*.

110. *In re* Wright, 848 F.2d 1216, 1219 (Fed. Cir. 1988) (citing *In re* Rinehart, 531 F.2d 1048, 1055 (C.C.P.A. 1976)).

111. Alco Standard Corp. v. Tenn. Valley Auth., 808 F.2d 1490, 1499-1500 (Fed. Cir. 1986).

112. *See* Stratoflex, Inc. v. Aeroquip Corp., 713 F.2d 1530, 1538-39 (Fed. Cir. 1983).

113. *See* Akzo N.V. v. United States Int'l Trade Comm'n, 808 F.2d 1471, 1481 (Fed. Cir. 1986) ("Commercial success is, of course, a strong factor favoring nonobviousness.").

114. *See* Panduit Corp. v. Dennison Mfg. Co., 774 F.2d 1082, 1099 (Fed. Cir. 1985), *vacated on other grounds*, 475 U.S. 809 (1986). Prior failure to achieve the solution accomplished by the device in question may, where a sufficient showing has been made, be "virtually irrefutable evidence that . . . [the invention] would not have been obvious to those skilled in the art when it was invented." *Id*. *But cf. In re* Sneed, 710 F.2d 1544, 1550 (Fed. Cir. 1983) (evidence of prior failure is less persuasive where prior party had no motivation to succeed due to satisfaction with the status quo, or where prior party was unaware of the most advanced art).

115. *See* Specialty Composites v. Cabot Corp., 845 F.2d 981, 991 (Fed. Cir. 1988) (citing United States v. Adams, 383 U.S. 39, 51-52 (1966)). Where an inventor proceeds "contrary to the accepted wisdom" and succeeds, there is strong evidence of nonobviousness. *In re* Hedges, 783 F.2d 1038, 1041 (Fed. Cir. 1986) (citing W.L. Gore & Assoc., Inc. v. Garlock, Inc., 721 F.2d 1540 (Fed. Cir. 1983)). In another case, one expert, upon learning of the invention, found the results so unexpected that he conducted further tests over the course of three months to confirm the results. Burlington Indus. Inc. v. Quigg, 822 F.2d 1581, 1583 (Fed. Cir. 1987). Others skilled in the art merely dismissed the inventor as "crazy." *Id*. at 1584.

116. *See* Northern Telecom, Inc. v. Datapoint Corp., 908 F.2d 931, 935 (Fed. Cir. 1990) (nature of problem persisting in the art and the inventor's solution are factors to be considered when determining obviousness).

117. Windsurfing Int'l, Inc. v. AMF Inc., 782 F.2d 995, 1000 (Fed. Cir.), *cert. denied*, 477 U.S. 905 (1986) ("Copying the claimed invention, rather than one in the public domain, is indicative of unobviousness.").

118. Hybritech Inc. v. Monoclonal Antibodies, Inc., 802 F.2d 1367, 1380 n.4 (Fed. Cir. 1986), *cert. denied*, 480 U.S. 947 (1987) ("[S]imultaneous development may or may not be indicative of obviousness . . . ." Moreover, as the court noted, problems regarding simultaneous development may be resolved in an interference proceeding).

119. Anyone who has enjoyed science historian James Burke's documentary series "Connections" will immediately recognize one of the problems with this definition: the complex relationship of one technological development to another (and, thus, the relationship of investment in one device to the development of another). For example, Burke described how a seemingly simple development hundreds of years ago led to a chain of developments resulting in the development of the atomic bomb. *Connections* (B.B.C. T.V. & Time-Life Television broadcast, Sept. 29-Dec. 29, 1979). This problem is addressed in the Economic Doctrine of Equivalents by requiring a nexus between the investment and the problem addressed.

120. For example, suppose the accused device is a television with an improved picture tube. The pertinent art is limited to picture tube technology, not televisions generally.

121. This is analogous to the current requirement that any commercial success proffered as objective evidence of nonobviousness be a result of the merits of the claimed invention. *See* Sjolund v. Musland, 847 F.2d 1573, 1582 (Fed. Cir. 1988). Where commercial success is due to an unclaimed aspect of the invention, the factfinder cannot infer that the commercial success is due to the merits of the claimed invention. *Id*. Similarly, where investment is not directed at the specific problem addressed by the accused device, the investment cannot be included in the calculus of the Economic Doctrine of Equivalents.

122. To continue the analogy of note 121, investment is limited to development of picture tubes and picture tube technology. Thus, investment in electrical circuitry in general, for example, is too attenuated to be included.

123. For example, it is undeniable that the invention of television depended upon the successful development of electricity; however, investment in the development of electricity would not be included because that development addresses a different problem from the problems addressed by the invention of television. The point is simply this: it is not enough for a technology to be related to the accused device; rather, the technology must address the same problem as the accused device. This blatant example demonstrates that courts will have to determine what investment may be included in the obviousness calculus: this determination, far from simple addition, will require judicial interpretation as to what constitutes relevant prior art.

124. *Graver Tank*, 339 U.S. at 612.

125. *Id*. at 618. Obviously, investment would not include, in the extreme case, expenditures for industrial espionage in order to gain information as this is a blatant example of "practicing a 'fraud on a patent.' " *Id*.

126. *Hilton Davis*, 62 F.3d at 1519.

127. *Id*.

128. *Id*.

129. For example, suppose an accused device comprising five components. If four of the components are copied from a patent, only the investment (if any) in developing the fifth component is included in the calculus.

130. Kitch, *supra* note 26, at 281. The salient distinction is that Kitch was discussing the least-cost inventor in terms of issuing a patent, rather than infringing a patent.

131. The word "difference" in this sense means one or more alterations in the accused device that preclude the literal infringement of

the patentee's claims, such as an aspect of the accused device that was in the public domain.

132. Merges and Nelson, *supra* note 22, at 859. The authors analyze *Texas Instruments I*, 805 F.2d 1558 (Fed. Cir. 1986), and emphasize the added increased efficiency of the accused device. *Id*. at 857-59. The authors then suggest that application of the doctrine of equivalents should include consideration of "[c]hanges in the number of components; [g]reatly improved efficiency in individual components; [and i]ncreased efficiency in the way components work together, i.e., overall design components." *Id*. at 910.

133. For example, again suppose a simple patented device of ten components. The accused device also has ten components, five of which are identical to components in the patented device and five of which are not. The accused device performs exactly the same function in exactly the same way as the patented device. The production cost of each device is the same. But the accused device performs the task in half the time taken by the patented device. If this difference manifests itself as a cost savings to the end-user, the savings represents a cost reduction, i.e., increased efficiency and thus, commercial viability.

134. For example, suppose a simple patented device comprising ten components. The accused device performs exactly the same function, in exactly the same manner, but incorporates only five components. On the surface, the accused device appears to increase efficiency. However, if the cost of making the accused device equals the cost of making the patented device (for whatever reason), then there is no increase in economic efficiency. Therefore, commercial viability is defined as increased efficiency as measured by lower cost.

135. Hilton Davis Chem. Co. v. Warner-Jenkinson Co., Inc., 62 F.3d 1512, 1520 (Fed. Cir. 1995) (en banc).

136. *Id*. (citation omitted).

137. In part, this distinction arises from the requirement that any commercial viability, i.e., increased efficiency, arise from an improvement in the device. This excludes any cost savings from other sources, such as lower labor wages. Although production of a device by cheaper labor will result in lower cost, this is not the type of economic impact to which the Patent Act is directed.

138. Robert P. Merges, *Commercial Success and Patent Standards: Economic Perspectives on Innovation*, 76 CAL. L. REV. 803 (1988). Professor Merges argues that by blindly accepting evidence of commercial success as evidence of nonobviousness, courts run the risk of rewarding nontechnical achievements, such as superior marketing techniques, distribution systems and service networks, rather than rewarding technological invention.

139. In brief, Professor Merges recommends coupling commercial success with prior failure of others or, alternatively, scrutinizing evidence of commercial success to ensure that it is probative of invention, rather than qualities that the patent system is not designed to reward, e.g., superior advertising efforts. *Id*. at 874-75. Apparently courts are able to distinguish between commercial success resulting from invention and that resulting from other factors: in determining obvious *vel non* under § 103, the Federal Circuit stated that "while there is evidence that marketing and financing played a role in the success of [the patentee's invention], as they do with any product, it is clear to us on the entire record that the commercial success here was due to the merits of the claimed invention." Hybritech, Inc. v. Monoclonal Antibodies, Inc., 802 F.2d 1367, 1383 (Fed. Cir. 1986), *cert. denied*, 480 U.S. 947 (1987).

140. *Hilton Davis*, 62 F.3d at 1536.

141. The fact that the Federal Circuit's decision in *Hilton Davis* was 6-1-5 is justification enough for a new approach to the doctrine of equivalents.

142. It is possible to dismiss the extreme case by simply stating that rational actors would not invest in this manner. Rational actors do, however, purchase insurance, so that some overinvestment to guard against potential infringement litigation is possible.

143. For example, where an inventor purchases supplies that are readily obtained at one-third the price, the factfinder would consider only the lower price.

144. *See, e.g.*, Carlson v. Bic Corp., 840 F. Supp. 457, 464 (E.D. Mich. 1993). In applying the Michigan state law of negligence, the district court noted that the risk-utility test used by the state courts is "a detailed version of Judge Learned Hand's negligence calculus . . . ."

145. *See, e.g.*, Richard H. McAdams, *Relative Preferences*, 102 YALE L.J. 1 (1992). Professor McAdams elucidated what had confounded many adherents of economic analysis: an economic model which demonstrates the efficiency of taxation and antidiscrimination laws.

146. *See generally* Kenneth W. Dam, *The Economic Underpinnings of Patent Law*, 23 J. LEGAL STUD. 247 (1994); Yusing Ko, Note, *An Economic Analysis of Biotechnology Patent Protection*, 102 YALE L.J. 777 (1992); John W. Schlicher, *If Economic Welfare is the Goal, Will Economic Analysis Redefine Patent Law?*, 4 No. 6 J. PROPRIETARY RTS. 12 (1992).

147. The patentee may gain access to relevant information under the rules of discovery. Any concerns regarding confidential information may be handled by the court on a case by case basis; a court may grant a protective order to prevent dissemination of critical information.

148. For example, the alleged infringer may challenge a portion of the amount included in the obviousness calculation as being outside the scope of the prior art.

149. *See supra* text accompanying notes 51-53.

150. This is consistent with the current application of the doctrine of equivalents to pioneer inventions: "the 'pioneer' is not a separate class of invention, carrying a unique body of law. The wide range of technological advance between pioneering breakthrough and modest improvement accommodates gradations in scope of equivalency. . . . The place of a particular invention in this spectrum depends on all the circumstances . . . ." Sun Studs, Inc. v. ATA Equipment Leasing, Inc., 872 F.2d 978, 987 (Fed. Cir. 1989) (citation omitted).

151. Graver Tank & Mfg. Co. v. Linde Air Prods. Co., 339 U.S. 605, 608 (1950).

152. The Court accepted the trial court's findings that the differences in the accused device were obvious to those skilled in the art, in light of the prior art. *Id.* at 611.

153. *Id.* at 610.

154. *Id.*

155. *Id.* at 612.

156. *Id.* at 609.

157. *Hilton Davis*, 62 F.3d at 1534 (Newman, J., concurring); *see also* Thomas K. Landry, *Certainty and Discretion in Patent Law: The On Sale Bar, The Doctrine of Equivalents, and Judicial Power in the Federal Circuit*, 67 S. CAL. L. REV. 1151, 1202 (1994) (concluding that "[n]o one should expect the court to achieve certainty in the doctrine of equivalents").

158. This is not to say that parties working independently of each other will arrive at the same exact measurements. Like any economic model, accuracy in the result depends on accurate information. However, the Economic Doctrine of Equivalents allows for better prediction of infringement, as well as better litigation risk assessment.

159. *Hilton Davis*, 62 F.3d at 1532 (Newman, J., concurring).

160. *Id.*

161. Royal Typewriter Co. v. Remington Rand, Inc., 168 F.2d 691, 692 (2d Cir.), *cert. denied*, 335 U.S. 825 (1948).