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Patent "Monopolyphobia": A Means of Extinguishing the Fountainhead

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This Article analyzes whether patent property rights confer monopoly power or power over price, being per se "monopolistic" in the antitrust sense. Courts often assume that patent rights (unlike other exclusive property rights) inherently confer the power to charge supernormal prices. This results in a negative presumption surrounding patent rights, providing the impetus for courts to define narrowly and sometimes stifle the promotion of these rights. The early patent misuse cases (1930-1950) are replete with references to patents as anticompetitive monopolies and illustrate how narrowly viewing the patent right led to an increased likelihood of invalidating this right. The latest battle over the survival of the doctrine of equivalents in Warner-Jenkinson Co. v. Hilton Davis Chemical Co. further substantiates the courts' struggle with defining and properly limiting patent rights.

Preliminary statistical analysis also indicates that negative judicial sentiment adversely affects patent filings and negatively impacts economic growth. There is a correlation between the proportion of patents adjudicated not invalid by appellate courts (validity adjudication), patent filings in the Patent and Trademark Office (patents filed) and Gross Domestic Product (GDP). Within a few years following a cycle of judicial hostility, the number of patent applications decreases. Negative judicial sentiment thus adversely affects patent filings (.646 Pearson's, .66 rank correlation). Moreover, there is a strong statistical relationship between patents filed and GDP (.887 Pearson's, .944 rank correlation).

These data powerfully suggest that patent rights provide incentives
for inventors to research and develop new technologies, which in turn strengthens the United States economically. Courts should therefore more favorably view patents as property rights that seldom confer power over price and thus are not inherently monopolistic. By viewing patent rights as property, we can create incentives to innovate, thereby ensuring a fountainhead for technological progress.

INTRODUCTION

Set up standards of achievement open to all, to the least, to the most inept—and you stop the impetus to effort in all men, great or small. You stop all incentive to improvement, to excellence, to perfection. Laugh at Roark and hold Peter Keating as a great architect. You've destroyed architecture.

Throughout the centuries there were men who took first steps down new roads armed with nothing but their own vision . . . . The great creators—the thinkers, the artists, the scientists, the inventors—stood alone against the men of their time. Every great new thought was opposed, every great new invention denounced. . . . But the men of unborrowed vision went ahead. They fought, they suffered and they paid. But they won.

In her first and most controversial novel The Fountainhead, Ayn Rand follows the battle of architectural visionary Howard Roark, who desperately seeks to thrive in a society that rewards mediocrity while stifling creativity. Ellsworth Toohey, the novel’s antagonist, sees the reward of mediocrity and the stifling of the fountainhead of creative genius as the sole means of achieving control and power over the masses. Toohey marginalizes Roark’s creative genius by having new architects substitute Gothic designs for Roark’s modern design of Cortland, a low-income housing project. In the end, the final product bears little resemblance to Roark’s original intellectual property.

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3 Id. at 710 (quoting Howard Roark, protagonist).
4 See id. at 579-99. Through the media, Toohey manages to convince society to reward and applaud the most mediocre writers, artists, architects, etc. He places these people in positions of power and then manipulates them for his own personal enjoyment, all while continuously preaching the theme that all must be done for the good of the collective. Id.
5 Unlike the society depicted in THE FOUNTAINHEAD, federal copyright law in the United States protects intellectual property, including architectural works. See 17 U.S.C. § 102(a) (1994) (including architectural works in definition of subject matter of copyright).
demolition of government property. \textsuperscript{6} While Toohey fears creative genius and the stimulation of free market competition, Roark establishes that the cornerstone of any great society is creativity. "This creative faculty cannot be given or received... That which it creates is the property of the creator." \textsuperscript{7} He warns that further marginalization of an individual's creativity and right to reap the reward for her creativity will stifle the core of the individual, resulting in a slave society. \textsuperscript{8}

The fears espoused in \textit{The Fountainhead} were never realized and we remain a capitalist society. Nevertheless, the novel's underlying message concerning an individual's right to control and commercially exploit her intellectual creation or "property" has an unsettling effect on many. We presently reap the economic benefits of free market competition and readily embrace and enforce real property rights. Unfortunately, however, the intangible nature of intellectual property triggers a reluctance to accept an individual's useful invention or creative work as property. This Article is the second of a series that evaluates whether intellectual property rights are best viewed as property or monopoly. \textsuperscript{9}

The overwhelming majorities of patents do not confer monopoly power on the grantee, \textsuperscript{10} but instead stimulate free market competition by increasing the number of consumer options. Because alternatives or substitutes are frequently available for the patented product, the patentee will rarely be able to extract the type of pricing power that creates a monopoly for her product. For example, if General Electric patents and markets a new energy efficient AC motor, consumers can

\textsuperscript{6} See RAND, \textit{supra} note 2, at 685 ("My act of loyalty to every creator who ever lived and was made to suffer by the force responsible for the Cortland [housing project] I dynamited. To every tortured hour of loneliness, denial, frustration, abuse he was made to spend—and to the battles he won. To every creator whose name is known—and to every creator who lived, struggled and perished unrecognized before he could achieve. To every creator who was destroyed in body or spirit.").

\textsuperscript{7} See id. at 711.

\textsuperscript{8} See id. at 706-18.

\textsuperscript{9} Simone A. Rose, \textit{Will Atlas Shrug?} \textit{Dilution Protection For 'Famous' Trademarks: Anti-Competitive 'Monopoly' or Earned 'Property' Right}, 47 FLA L. REV. 653 (1995). The first article set in the context of Rand's second novel \textit{ATLAS SHRUGGED}, traced the origination of the term "monopoly" as an economically neutral term to define an exclusive right and established that courts fail to refer to intellectual property as economically neutral monopolies. Instead, courts use the term "monopoly" in the antitrust sense to imply that the granting of such rights automatically confers market power on the grantee and impedes free market competition. The first article focused on how this "monopolyphobia" invaded trademark law and inhibited a fair and expansive application of the Lanham Act and dilution doctrine.

\textsuperscript{10} See Nickola \textit{v.} Peterson, 580 F.2d 898, 914 n.25 (6th Cir. 1978) (concluding that a patent "rarely enjoys a dominant share in the relevant market... [because] the patent is limited to a unique form or improvement of the product and the economic power resulting from the patent privileges is slight.") (citing Northern Pac. Ry. Co. \textit{v.} United States, 356 U.S. 1, 10 n.8 (1958)).
choose to pay a slight premium for motors that conserve power, or remain with the older, equally reliable design.\textsuperscript{11}

Moreover, because the patentee has to publicly disclose her invention to obtain the patent, she has contributed another building block for other inventors to design around, develop and market their own novel inventions as improvements on the patented product.\textsuperscript{12} Thus, GE's competitors are motivated to invent and manufacture their own lines of energy-efficient motors. This further enhances free market competition, thereby reducing the likelihood of the patentee possessing monopoly or market power.\textsuperscript{13}

The Antitrust Guidelines for the Licensing of Intellectual Property state that "[t]he Agencies will not presume that a patent, copyright, or trade secret necessarily confers market power upon its owner."\textsuperscript{14} Nonetheless, courts continue to get it wrong. This is partially the fault of intellectual property lawyers and scholars who loosely use the term "monopoly," often in the pejorative antitrust sense. Thus, the judiciary neglects to recognize that patents stimulate technological innovation and economic growth, while characterizing patents as antitrust monopolies that stunt economic growth and free market competition.

\begin{itemize}
  \item \textsuperscript{11} See Walker Process Equip. Inc. v. Food Machinery & Chem. Corp., 382 U.S. 172, 177-78 (1965). The Court noted:
    To establish monopolization or attempt to monopolize a part of a trade or commerce under § 2 of the Sherman Act, it would then be necessary to appraise the exclusionary power of the illegal patent claim in terms of the relevant market for the product involved. Without a definition of that market there is no way to measure . . . [the patentee's] ability to lessen or destroy competition. It may be that the ... [patented] device does not comprise a relevant market. There may be effective substitutes for the device, which do not infringe the patent.

  \item \textsuperscript{12} See Robert P. Merges & Richard R. Nelson, On the Complex Economics of Patent Scope, 90 COLUM. L. REV. 839, 869 (1990) (cautioning against the over-broadening of patent scope since subsequent inventions may not serve as substitutes for the patented invention but improve or build upon it in some way, resulting "in something not simply slightly different but significantly better than the patented technology").

  \item \textsuperscript{13} Cf. Hilton Davis Chem. Co. v. Warner-Jenkinson Co., 62 F.3d 1512, 1531 (Fed. Cir. 1995) (Newman, J., concurring) ("The analytic complexity with respect to the doctrine of equivalents arises because technologic growth benefits not only from the activities of the originators, but also from those who improve, enlarge and challenge.").

  \item \textsuperscript{14} U.S. DEP'T OF JUSTICE, ANTITRUST GUIDELINES FOR THE LICENSING OF INTELLECTUAL PROPERTY § 2.2 (1995) [hereinafter ANTITRUST GUIDELINES].
\end{itemize}
This Article focuses on patent law, the source of intellectual property "monopolyphobia." I explain in Part I why patents are best characterized as property rather than monopolies. Although patents are technically both property and monopolies, the term "monopoly" is frequently used in a pejorative antitrust context and creates an implication of harm to the public. Conversely, the term "property" creates an implication of an earned right to use and exclude without impeding free market competition. Thus, viewing patents as property leads to a positive, more balanced evaluation of the patent right.

In Part II, I provide an empirical demonstration of how patents positively impact the economy. I begin by tracing the various cycles of judicial hostility demonstrated by appellate courts. I analyze select Supreme Court cases from each judicial cycle to illustrate that patents were frequently labeled property when favored by the court and labeled anticompetitive monopolies during cycles of judicial hostility. I analyze the recent conflict over the doctrine of equivalents ("DOE") which illustrates that patent "monopolyphobia" continues to permeate patent infringement cases and threaten technological innovation and economic growth.

15 By legal definition, "property" and "monopoly" are both rights to exclude. The patentee has the right to exclude others from making, using, or selling for the term of the patent. Thus, this right squarely fits both definitions. See Transparent-Wrap Mach. Corp. v. Stokes & Smith Co., 329 U.S. 637, 641 (1947) ("The owner of all property, by withholding it upon any other terms, may, if he can, force others to buy from him; land is the best example and every parcel of land is a monopoly." (quoting Stokes & Smith Co. v. Transparent-Wrap Mach. Corp., 156 F.2d 198, 202 (2d Cir. 1946))); Consolidated Fruit-Jars Mach. Corp. v. Wright, 94 U.S. 92, 96 (1876) ("A patent for an invention is as much property as a patent for land. The right rests on the same foundation, and is surrounded and protected by the same sanctions."); In re Etter, 756 F.2d 852, 859 (Fed. Cir. 1985) ("The patent right is a right to exclude. . . . The essence of all property is the right to exclude, and the patent property right is certainly not inconsequential."); Schenk, A.G. v. Nortron Corp., 713 F. 2d 782, 786 n.3 (Fed. Cir. 1983) ("The right to exclude others is the very definition of 'property.'"); see also Hon. Giles S. Rich, Foreword, in CHISUM ET AL., supra note 11, at iv ("Property rights in general are a form of monopoly. It is simple power that can be put to either good or bad uses. The patent system puts it to good use as an incentive to innovation.").

16 Patents are also labeled monopolies during cycles of judicial favor. However, in these cases the term "monopoly" is not used in a pejorative manner, implying that the patent right is per se anticompetitive. Instead, these courts use the term "monopoly" in an economically neutral sense merely to indicate that the patent right provides a limited right to exclude. In fact, these cases often use the terms "property" and "monopoly" interchangeably. See, e.g., Continental Paper Bag v. Eastern Paper, 210 U.S. 405, 424 (1908) (referring to patents as economically beneficial monopolies as "his absolute property").

17 I concede that the creation of the Federal Circuit has led to far less "monopolyphobia" than in earlier judicial cycles of hostility. Some scholars have gone so far as to characterize the Federal Circuit as pro-patent. See ROBERT L. HARMON, PATENTS AND THE FEDERAL CIRCUIT 684-740 (3d ed. 1994) (reviewing the Federal Circuit's practice in relation to patents); see also Donald R. Dunner et al., A Statistical Look at the Federal Circuit's Patent Decisions: 1982-1994, 5 FED. CIR. B.J. 151, 155 (1995) (noting that federal courts are likely to uphold patent infringement cases). The present controversy concerning the doctrine of equivalents is equally driven by the tension between equitably expanding claims beyond their literal language and the
Part II concludes by evaluating the relationship between the percentage of patents adjudicated valid by appellate courts, the numbers of patents filed in the Patent and Trademark Office ("PTO") and Gross Domestic Product (GDP). Although other scholars have analyzed the relationship between patent procurement and GDP, this paper is the first to evaluate empirically the impact on innovation and economic growth of judicial attitudes toward patents. Because of the various components comprising GDP, it is difficult to substantiate a strong statistical correlation between patents adjudicated and GDP. There is, however, a direct correlation between patents adjudicated and patents filed, and a strong statistical correlation between patents filed and GDP. Thus, we observe that within a short time following a cycle of hostility, the number of patent applications decreased, which ultimately led to a decrease in technological innovation, negatively impacting our economy. Conversely, when appellate courts favored patents, the number of patent applications increased, which then positively impacted our economy.

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18 See generally Edwin Mansfield, Patents and Innovation: An Empirical Study, 32 MGMT. SCI. 173 (1986) (concluding that patent procurement increased the rate of innovation for industries such as pharmaceuticals and chemicals, which rely primarily on patents for intellectual property protection); Francis Narin et al., What Patents Tell You About Your Competition, CHEMTECH, Feb. 1993, at 52 (noting the economic necessity of patents for technological and business growth).

19 The basic statistics used to cross-reference gross domestic product fail to provide conclusive evidence concerning the degree that patent procurement positively or negatively affects the economy. However, I do believe that the data indicates a trend, which should encourage economists to delve further into this area. A more concrete study should contrast patent procurement by industry versus gross domestic product by industry. Unfortunately, we lacked the resources to attempt to categorize the cases by industry and contrast this with the economic data. This will be the subject of a future piece focusing on the pharmaceutical and biotechnological industries.

20 Of course, GDP may drive the analysis: namely, a stronger economy may stimulate patent filings. We are then left with the dilemma of which came first, the chicken or the egg. At a
In Part III, I recommend amending the Patent Act to include language clarifying that patents are property. The proposed amendments include codifying the doctrine of equivalents to give Congressional emphasis on treating patents as property and equitably extending this concept of property beyond the literal language of the claim. Viewing patents as property motivates the Supreme Court, Federal Circuit and district courts to conduct an equitable, balanced evaluation of these rights. This enhances the synergistic relationship between patents and industrial growth, thereby ensuring that we remain a fountainhead of technological innovation in an era of ever-increasing global competition.

I. PATENTS ARE PROPERTY

The term monopoly connotes the giving of an exclusive privilege for buying, selling, working or using a thing which the public freely enjoyed prior to the grant. Thus a monopoly takes something from the people. An inventor deprives the public of nothing which it enjoyed before his discovery, but gives something of value to the community by adding to the sum of human knowledge.

Ownership of patents is no different than the ownership of any other property right necessary as an input, and . . . we minimum, our preliminary analysis establishes that there is a synergy between these three factors. As a result, to avoid creating negative synergy, courts should objectively and positively view patents as property.

Section 261 of the Patent Act presently states that “patents shall have the attributes of personal property.” 35 U.S.C. § 261 (1994). I posit that this language lacks the strength of stating that “patents are property” and is also buried in the Act and easily missed by the lay person. I propose defining patents as property earlier in the Act, perhaps in section 101, which maps out patentable subject matter.

For a description of the doctrine of equivalents, see infra note 138 and accompanying text. I hope, perhaps naively, that codifying the DOE will also lead to a more consistent evaluation of how to draw effective boundaries around a patentee’s right based on what she has claimed, disclosed in her invention and stated during prosecution. I agree with Merges and Nelson that the DOE should not be manipulated by pro-patent courts to inequitably broaden the patent right, because granting patents of overly broad scope, in particular for pioneering patents, inhibits rather than stimulates innovation. See Merges & Nelson, supra note 12, at 916 (noting that “any reduction in patent scope or lessening of the patentee’s potential reward may severely undercut the incentive to invent,” but for pioneering inventions we must carefully apply the DOE to avoid “diminish[ing] incentives for others to stay in the invention game”).

Part III of this piece includes a discussion of factors to be considered when evaluating the DOE, in order to help maintain a proper evaluation of patents as property, while preserving the patent’s notice function and incentive to innovate. I acknowledge the tension between the DOE and section 112’s notice requirements. I agree that the doctrine can not be used to undermine section 112’s provisions that the patent specification and claims define the patent property boundaries as well as what remains in the public domain.

United States v. Dubilier Condenser Corp., 289 U.S. 178, 186 (1933) (citation omitted).
should no more assume that the owner of a patent is a monopolist than we should assume that the owner of particularly fertile land, especially productive skills, or of an advantageous location is a monopolist.Ç

“Property,” like the term “monopoly” in its economically neutral sense, means no more than a granting of a right to exclude.Ç The patent right excludes others from making, using or selling the claimed invention for the term of twenty years after the filing date of the patent application.Ç This squarely fits the definition of property. Indeed, section 261 of the Patent Act expressly refers to patents as having the “attributes of personal property.”Ç Nowhere in the Patent Act is the patent right described as an anticompetitive monopoly. So the question becomes, how did the courts get it wrong?

One answer is that conceptualizing intellectual property as property in the literal sense is difficult and troublesome. Intellectual property is generated by the mind, incorporeal in nature and thus difficult to grasp as something that is earned by its creator. Also, for patents and other forms of intellectual property, the creator has used ideas and principles from the public domain to develop her invention, thereby triggering an instinctual reaction against allowing such creations to become the exclusive right or property of the creator. This tension is illustrated in Article I, Section 8, Clause 8 of the Constitution, which gives Congress the power “[t]o promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors, the exclusive Rights to their respective Writings and Discoveries.”Ç Indeed, the scope and terms of protection outlined in the patent, copyright and trademark actsÇÇ evidence a balance between the creator’s property rights and the public’s right to freely utilize ideas to develop additional creative works. During whatever period Congress

ÇÇ See, e.g., In re Etter, 756 F.2d 852, 859 n.12 (Fed. Cir. 1985); see also CHISUM ET AL., supra note 11, at 5 (distinguishing patent and copyright property from real property because patent property rights are limited to the right to exclude, while real property rights confer the right to use “that carries with it a logically subordinate right to exclude. . . . to ensure the owner’s full enjoyment of the right to use”).
ÇÇ See 35 U.S.C. § 154 (1994) (measuring from the filing date of the application, a patent term is twenty years).
ÇÇ Id. § 261 (1998); see also JOHN W. SCHLICHER, PATENT LAW: LEGAL AND ECONOMIC PRINCIPLES § 1.03 (1996) (“The most direct way of avoiding waste due to external benefits is giving the producer of the benefit the legal benefit the right to exclude others from obtaining or using it. This is the essence of what all property rights do.”).
ÇÇ U.S. CONST. art I, § 8, cl. 8.
ÇÇ Unlike the Patent and Copyright Acts, Congress’s power to enact federal trademark law is derived from the Commerce Clause. See U.S. CONST. art I, § 8, cl. 3.
chooses for the limited time, presently twenty years from the date of application for patents, the inventor has a constitutionally mandated property right to exclusive use of her invention.30

Another answer is the psychological difficulty of categorizing anything intangible as property.31 Psychologically, our ability to touch, feel and observe land development makes us comfortable creating legally enforceable real property rights that are everlasting in duration. The same is true for tangible forms of personal property, such as cars and equipment, which are protected by an elaborate network of common and statutory personal property law.32 Conversely, we cannot touch or feel the inventive process of creating intellectual property, and consequently struggle with defining and protecting these rights. Thus, when inventors attempt to enforce patent rights in court, many judges refuse to evaluate patents as property.33 Instead, courts often erroneously view patents as monopolies in the pejorative antitrust sense, presuming that the granting of patent rights automatically confers market power34 on the grantee that inhibits free market

30 The limited duration of the patent right, unlike real property rights, probably makes it more attractive to the term "monopoly." Limiting the duration does imply that during that period something is being taken away from the public, which is ultimately returned, thereby restoring free market competition. Considering the requirements of novelty and non-obviousness for patents, the better view is that the patentee has contributed new property to society and thus enhances, rather than detracts from, free market competition, even during the patent term.

31 Schlcher points out that this problem can also be termed the problem of public goods. "A public good arises when the nature of the good requires that, to satisfy the demand of one consumer, (1) someone must produce a unit of a good which is capable of satisfying the demands of all other consumers without additional use of resources, and (2) that good will be available to all consumers if it is made available to one." SCHLICHER, supra note 27, § 2.08; see also CHISUM ET AL., supra note 11, at 58 ("The inventor's paradox is due largely to certain features that are shared by all forms of information in general. Information is a special type of economic good, often called a public good, as distinct from so-called private goods. Public goods have two characteristics. They are non-rival (i.e., inexhaustible) and non-exclusive.").

32 See, e.g., U.C.C. art. 9 (1995). Adopted by all 50 states, UCC Article 9 protects security interests in various types of personal property, including intellectual property. States also protect personal property under common law schemes such as conversion.

33 Today, some judges readily point out the positive aspects of patents as property which stimulate innovation. See, e.g., Rich, supra note 15, at iv. Also, Judge Markey, former Chief Judge of the Federal Circuit, criticized labeling patents as anticompetitive monopolies. He acknowledges that "others, particularly those charged with infringement, have long employed the phrase monopoly pejoratively." Nickola v. Peterson, 580 F.2d 898, 914 n.25 (6th Cir. 1978).

Once again, I caution against assuming that the monopoly/property dichotomy understood by patent scholars and judges with patent backgrounds extends to general litigators and district court judges. Thus, many modern opinions (particularly those issued before formation of the Federal Circuit) and legal briefs still refer to patents as monopolies in the pejorative sense. See, e.g., Ashcroft Paper v. Paper Mate Mfg., 434 F.2d 910, 912 (9th Cir. 1970) (arguing that the monopoly effect of patents has led courts to set a "high and exacting standard for patent validity"); see also SCHLICHER, supra note 27, § 2.18 (noting that courts abandoned the patents-as-property theory and moved to viewing patents as economic monopolies).

34 Diane Brinson, in a well-written article analyzing the intersection of intellectual property and antitrust law, points out that courts interchangeably use the terms "monopoly power," "market power" and "economic power." J. Diane Brinson, Proof of Economic Power in a
competition. Consequently, many attempts to enforce patent rights are met with judicial hostility, leading to inconsistent evaluations of both literal patent infringement and infringement under the doctrine of equivalents.

Market power is defined as a seller's capability to exert power over price; in other words, it is "the ability of a firm to raise prices above the competitive level without losing so many sales so rapidly that the price increase is unprofitable and must be rescinded." The term market power is synonymous with economic power and monopoly power. Basically, a seller possessing such power enters the market and commands a premium price for its product above existing competition. The normal market forces for that product are disrupted for the period that the seller maintains the monopoly. Unlike the patent right, monopoly power inhibits free market competition and is evidenced by a negatively sloping demand curve, the social losses of allocative and productive inefficiency, dead weight loss of competitive pricing, and loss of consumer pricing power.

As mentioned above, the patent right confers the right to exclude others from making, using or selling the patented invention for the statutory period of twenty years. Arguably, granting such a right inherently gives the seller some unique capability to dominate the market or control pricing at a competitive disadvantage during the term of the patent. In reality, the majority of patents are not commercialized. Those that are commercialized derive their value from a series of complementary factors such as manufacturing and distribution facilities, workforces, advertising and other items of intellectual property. Thus, the patent right itself does not confer market power


35 Id.

36 With monopolies, as the price of goods drops consumer demand increases, thereby resulting in a downward sloping demand curve. See CHISUM ET AL., supra note 11, at 54. In a competitive market, market forces control or cap the price any given consumer will spend on a product. See id. at 55. Thus, each competitive firm faces a horizontal demand curve indicating a constant price, independent of the quantity produced by that firm. See id. In a monopoly, neither price nor demand is fixed. See id. at 56. The monopolist controls total market demand as evidenced by a downward sloping demand function. See id.

37 Although patents and all types of property rights fit the economically neutral definition of "monopoly" which is merely a right to exclude, the meaning of "monopoly" as used by courts and economists is the condition that creates market power or generates social loss. This condition is present only when the demand curve has a negative slope in the region at which output is occurring.

38 See supra note 26 and accompanying text.

39 See, e.g., ANTITRUST GUIDELINES, supra note 14, § 2.3 ("Intellectual property typically is one component among many in a production process and derives value from its combination with complementary factors."); see also Kenneth W. Dam, The Economic Underpinnings of Patent Law, 23 J. LEGAL STUD. 247, 250 (1994) (noting that "in the great bulk of instances no
or power over price. One must concede, however, that commercialized patents can have an impact on a particular market and may, for certain pioneering inventions, confer market power. Even in these rare instances, however, the patent’s value, in filling a societal need and in the statutory disclosure requirements that enable others to invent additional pioneering devices, outweighs the effects of such monopoly power.

For example, many commercialized inventions were the first to fill a perceived societal need. Pioneering inventions such as the light bulb, telephone or latest generation antibiotic enabled their respective patentees to exert more power over pricing than in cases where substitutes were readily available. Even here however, the patentee’s market power or power over price is not created by the patent grant itself, but by society’s demand and/or need for this unique product and its ultimate commercialization. To fulfill this need and bring a product to market a manufacturer must establish a distribution network, assemble a workforce, select a trademark for source identification and quality assurance, and advertise. It is the combination of the significant market power is granted [from the patent right]. We must bear in mind that leading companies may obtain 1,000 or more patents in a single year, and yet many such firms are unlikely ever to obtain even a single monopoly in any market”) (citing Wesley M. Cohen & Richard C. Levin, Empirical Studies of Innovation and Market Structures, in 2 HANDBOOK OF INDUSTRIAL ORGANIZATION 1059, 1062-64 (Richard Schmalensee & Robert D. Willig eds., 1989)).

This statement may lead one to question the importance of patents to technological progress since many are never commercialized. I posit that patents remain significant to technological progress for a variety of reasons. First, they create an incentive to innovate. Even if Company X chooses not to commercialize certain patents in its portfolio, it continues to work on additional inventions that will create profits for itself. Also, because of the public disclosure requirement, Company Y may use X’s non-commercialized patent as a building block for its own novel product, which it may choose to commercialize, thereby stimulating economic growth. See, e.g., Edmund W. Kitch, The Nature and Function of the Patent System, 20 J.L. & ECON. 265 (1977) (arguing that the patent right creates the incentive to prospect and develop more devices that enhance economic growth); see also Merges & Nelson, supra note 12, at 875 (citing Kitch’s prospect theory of patents but also noting that “[p]roperty rights that are too narrow will not provide enough incentive to develop the asset, while overly broad rights will preempt too many competitive development efforts. Kitch’s prospect theory must be supplemented to take account of this important limitation on the breadth of property rights”).

40 See Kitch, supra note 24, at 37-38 (“A patent can have value like any input that gives a firm a comparative advantage over its competitors, but that does not mean that the owner of the patent owns a monopoly.”); see also infra note 55 and accompanying text.

41 The Patent Act’s disclosure provision requires a writing, which includes the best mode of producing the claimed invention, along with a set of claims that along with the specification defines and notifies the public of the metes and bounds of the invention. See 35 U.S.C. § 112 (1994); see also Kitch, supra note 39, at 286 (“Pursuit of these speculations may clarify the process and conditions under which a monopolist industry will be more efficient than a competitive one”); Merges & Nelson, supra note 12, at 908-09 (proposing that the Patent and Trademark Office could avoid harmful effects of granting patents in pioneering areas by limiting unduly broad patents).
patent right and these complementary factors that give the product value and determine its competitive role in the marketplace. Nonetheless, once the patent property right is commercialized it can be misused by the patentee to create an unlawful monopoly that impedes free market competition. For example, suppose Corporation X misuses its patent rights by tying the sale of its patented salt machine to the purchase of salt, an unpatented product. Corporation X may lose its patent on the salt machine and face liability under federal antitrust law if it is proven that this tying conferred market power on Corporation X in the salt industry. It is the unlawful vertical and horizontal pricing arrangements among competitors and patent misuse that violated federal antitrust law, not the use of the patent right itself. As aptly noted by Judge Markey in Nickola v. Peterson, "[a]bsent demand for product... there can be no commercial success. ... [and] no patent can itself create market demand." Generally, a seller's market power is limited by the consumer's ability to choose an alternative or substitute for the patented product. For example, if our inventor commercializes her patented lightweight, energy-efficient iron, consumers can choose to purchase her technically superior iron or a cheaper iron with more familiar features. Consumer choice thus inhibits the inventor's ability to exert monopoly pricing power. This is particularly true when the inventor is first marketing her device. Consumers often want others to test the waters regarding a new product, thereby giving the older and arguably obso-

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42 See ANTITRUST GUIDELINES, supra note 14, § 2.3.
43 Patent misuse is broadly defined to include any attempt by the patentee "to expand the granted scope or to use the patent as leverage to take advantage outside the scope of the grant is referred to as patent misuse, regardless of whether there is a substantial lessening of competition or other effects necessary to a finding of an antitrust violation." Donald Rupert, The Relationship of Patent Law to Antitrust Law, 49 ANTITRUST L.J. 755, 757 (1980). The two types of patent misuse that rise to the level of antitrust violations are: 1) the improper tying of a patent under license to the purchase of an unpatented item and 2) the use of the patent to control or restrict market prices. See id.
44 See generally Sherman Act, 15 U.S.C. §§ 1-7 (1994); Clayton Act, 35 U.S.C. § 271(d) (1994). Indeed, the hypothetical recites the facts of the two seminal patent misuse and antitrust cases International Salt v. United States, 332 U.S. 392 (1947) and Morton Salt v. G.S. Suppiger Co., 314 U.S. 488 (1942). In both cases, the patentees were held to have violated antitrust laws and have misused their patents by the tying arrangement of the salt machines to the purchase of the patentee's brand of salt. Both cases are criticized by commentators, however, because it was unlikely that either patentee could have gained true market power or power over price in the salt market by having one vendor buy its particular product. There was too much salt available and purchased by others for a negative demand curve to be created in either instance.
45 See Rupert, supra note 43, at 755, 758; see also Kitch, supra note 24, at 39-40 (arguing that courts generally ignored the question of whether patents created monopolies and instead focused on whether the contractual tying agreements violated the antitrust laws).
46 580 F.2d 898 (6th Cir. 1978).
47 Id. at 914.
lete version of the product significant market power. To remain competitive, the inventor must price her iron to reflect the market power of the older products, thereby negating her ability to procure monopoly profits. Also, toward the end of my hypothetical patent term, the inventor must invest significant profits in further research and development to compete with new technology that may displace her patented process. Although the inventor’s patent provides some competitive advantage, since she can temporarily exclude others from copying the device, it does not confer true market power. In fact, the inventor can only occupy the iron market if she prices her iron at “a level which identifies and develops the market that exists at price levels close to cost.” Thus, the patent right itself can not produce the monopoly profits or dead weight loss that are the trademark social costs of monopolies.

In most cases, the patent right actually enhances product efficiency without creating excessive pricing power. For example, providing an enabling disclosure for the latest generation antibiotic patent enables competitors to use this information as building blocks to develop and patent stronger, more effective antibiotics. This prevents any single patentee from gaining monopoly power from its patent portfolio.

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48 See, e.g., Kitch, supra note 24, at 34. Kitch states:

[It is the rare invention indeed which immediately sweeps aside its predecessors. Transistors did not displace vacuum tubes overnight, word processors did not immediately eliminate typewriters. The reason is that there are substantial investment commitments to the old technology. These are not only in special purpose machinery, whose economic value may have fallen to zero, but also investments in specialized human capital which can be used only with the old technology. For the user, the cost of new technology is not only the price, but also the investment required to enable him or his personnel to make use of it.

49 See id. at 38-39 (“Although the technology being displaced may be ‘obsolete’ in an engineering sense, it will often remain as a competitive force for many years, and be priced to reflect the obsolescence of the specialized resources dedicated to its production and use.”).

50 See id. at 39. As Kitch describes:

Then as the patented technology begins to dominate the market, the patent owner must consider the coming end of the patent term, and the ever present possibility that some newer technology may appear to displace his patent. His patent gives him the opportunity to occupy the field, and if he is able to develop an organization that can manufacture and sell the patented product at costs equal to any potential entrant, he may occupy it for many years.

51 Id. (adding that this is why many firms with innovative products seek a quick and expansive entry into their respective markets).

52 See, e.g., 35 U.S.C. § 112 (1994) (requiring a written, enabling disclosure that includes the best mode of producing the claimed invention and a set of claims, which along with the specification, defines and notifies the public of the metes and bounds of the invention); see also State Indus., Inc. v. A.O. Smith Corp., 751 F.2d 1226, 1236 (Fed. Cir. 1985) (noting that the patent system assures the steady flow of innovations to the marketplace, providing an incentive via the doctrine of equivalents to develop one’s own pioneering product).
Instead, each firm in a high-technology market must remain cost-effective and invest profits in research and development in order to remain profitable.

In fact, the alleged rent seeking costs that result from others initially duplicating the same research are dwarfed by the overall benefit of competitors utilizing the disclosed information to build new and better pioneering inventions. These products will be available at lower production costs and prices for consumers. Thus, any perceived dead weight loss fails to outweigh the overall benefit to society, and this market power does not create a monopoly in the antitrust sense.

To be sure, the patent right does provide the inventor of a pioneering invention with cost advantages that provide an opportunity to reap extraordinary profits, which may exceed those normally recycled into research and development. However, a recent article by Kenneth Dam exploring the economics of patent law suggests that rather than labeling these profits as monopolistic, they are better characterized as “economic rent.”

Dam defines economic rent as the difference between the patentee’s per-unit costs and competitors’ per-unit costs (to the extent attributable to the patented innovation) multiplied by the patentee’s volume. Economic rents are found throughout the economy wherever “an economic actor has a cost advantage that competitors can-

53 See generally Dam, supra note 39, at 252-53 (noting that as a result of “the relentless advance of its own technology” the computer industry caused prices to fall, measured in terms of millions of instructions per second, from $250,000 to $2,500 between 1980 and 1990) (quoting Andrew S. Rappaport & Shmuel Halevi, The Computerless Computer Company, HARV. BUS. REV., Jul.-Aug. 1991, at 69, 70); Merges & Nelson, supra note 12 (discussing the economic theories underlying the American patent system, including the incentive to design around).
54 See ANTITRUST GUIDELINES, supra note 14, § 2.2 (“If a patent or other form of intellectual property does confer market power, that market power does not by itself offend the antitrust laws. As with any other tangible or intangible asset that enables its owner to obtain significant supracompetitive profits, market power (or even a monopoly) that is solely ‘a consequence of a superior product, business acumen or historic accident’ does not violate the antitrust laws.”) (citing United States v. Grinnell, 384 U.S. 563 (1966)); see also United States v. Aluminum Co. of America, 148 F.2d 416, 430 (2d Cir. 1945) (stating that the Sherman Act is not violated by the attainment of market power solely through “superior foresight and industry”).
55 However, I concede that in certain areas, such as pharmaceuticals, the overwhelming need and desire to obtain the fastest and most efficient cure enable drug patents to confer monopoly power on the patentee. This market power often lasts until a more effective next-generation drug is patented. This is clearly illustrated in the antibiotic market, where premium prices are paid for the newest drug that cures bacteria X in a short time period.
56 See Dam, supra note 39, at 250; see also CHISUM ET AL., supra note 11, at 66-68 (“[T]he dead weight loss associated with the patent’s potential monopoly effects is analytically analogous to transaction costs of building a fence around the prospect and of the sign designating ownership. Both are merely indispensable costs of using the system to allocate resources.”).
57 See Dam, supra note 39, at 251.
not match, for legal or other reasons.” Thus, one's superior research abilities, like one's superior athletic skills, may set one above the competition and create rights (legal or natural) that lower costs and provide a competitive advantage.

For pioneering inventions, Dam's economic rent paradigm appears more suited to analyzing the patent right than does the concept of monopoly power. Here, the superior skill of the inventor has solved a pressing societal need. Clearly, the exclusive right to exclude others from making, using and selling the claimed invention provides the pioneering inventor with a cost advantage that allows her to reap greater profit—i.e., economic rent—than her competition.

There remains the argument that pioneering inventions are indeed monopolies, for without the patent right, innovation and cutting-edge technology would be available to all. This availability minimizes cost and increases productivity. Thus, arguably, for pioneering patents in particular (since there are no substitutes), the patent right restricts production and creates dead-weight loss, a trademark of monopolies.

Dead-weight loss notwithstanding, the term “monopoly” still fails to fully capture the economics of patentable inventions. The patent right stimulates competitive research and development (R&D) and brings pioneering inventions to fruition. Without this exclusive right, corporations and private investors would not expend the R&D dollars necessary to develop such devices. From a pricing perspective, the inventor would be unable to recoup its R&D costs if competitors could copy the claimed invention, manufacture it without incurring R&D expenses and undercut the inventor's price. Without the patent right, the inventor must rely on trade secret pro-

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58 Id. at 250 (including examples of regulatory constraints or subsidies stemming from some form of industrial policy, natural causes, such as superior location in real estate, or superior talent in the arts and professional sports).

59 Although technically both the terms “monopoly” and “economic power” concede certain losses associated with pioneering patents, use of the term “monopoly power” fails to acknowledge the acceptability of these losses when factoring in the social benefits of patents providing incentives to invent, commercialize and design around. Use of the term “monopoly” or “market power” places pioneering patents in a negative light. To avoid this casting, I prefer using Dam's economic rent paradigm. See id. at 251-53.

60 See Merges & Nelson, supra note 12, at 896 (conceding that pooling and cross-licensing will mitigate the negative effect of unduly broad patents).

61 See id. at 916 (“When a broad patent is granted or expanded via the doctrine of equivalents, its scope diminishes incentives for others to stay in the invention game, compared to a patent whose claims are trimmed more closely to the inventor’s actual result.”).

62 See Dam, supra note 39, at 251-52.

63 I concede that this proposition fits strongest in industries that rely heavily on patent protection, such as the pharmaceutical, biotechnology and, to a lesser degree, automotive industries. See generally Mansfield, supra note 18 (evaluating role of patent procurement on economic growth in these specific industries).
tection that may permanently keep pioneering information away from the public domain. Trade secrets arguably give inventors far more monopoly power than does the patent right, and without the quid pro quo of public disclosure.\textsuperscript{64} Also, the pioneering invention has placed something in the market that was previously unavailable, thereby enhancing productive efficiency rather than inhibiting it. Thus, “it would be more useful to restrict the concept of monopoly to circumstances where . . . patent licenses are used, as in certain classic antitrust cases, as a device for implementing anticompetitive agreements.”\textsuperscript{65} Moreover, “[s]ince competitive forces which act upon a patent holder are readily identifiable, the patent holder cannot be assumed to have monopoly power.”\textsuperscript{66}

If patents are not monopolies in the pejorative sense of the word,\textsuperscript{67} and do not inherently confer market power, why do many courts and scholars view patents as limited monopolies, which during the life of the patent presumptively confers market power on the patentee?\textsuperscript{68} This characterization persists despite indications to the contrary. For example, as mentioned earlier, the Justice Department in its antitrust guidelines expressly provides that “[t]he agency will not presume that a patent, copyright, or trade secret necessarily confers market power upon its owner.”\textsuperscript{69} Similarly, section 271(d) of the Patent Act states

\begin{footnotes}
\textsuperscript{64} See Dam, supra note 39, at 251-52. To the extent that certain trade secrets can be reverse engineered, the information is disclosed to the person or entity that discerns it via this process. Nonetheless, the enabling disclosure remains unavailable to the public at large when protected by trade secret. Without an enabling disclosure, competitors are unable to build upon the existing product to create new products that may compete with the original. See also Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470 (1974) (stressing the importance of patent protection to economic growth and noting that patent protection acts like a barrier, while trade secret acts like a sieve); CHISUM ET AL., supra note 11, at 1437 n.3 (noting that despite the language of Kewanee Oil, trade secrets arguably give broader protection since information remains within the scope of a trade secret forever, as long as there is no disclosure or reverse engineering).

\textsuperscript{65} Dam, supra note 39, at 251 (citing SCM v. Xerox Corp., 645 F.2d 1195, 1205 (2d Cir. 1981)).

\textsuperscript{66} Kitch, supra note 24, at 31.

\textsuperscript{67} See id. at 47 (“The basic distinction adopted in this paper is between a right which confers a comparative advantage in production which is sold into a market where the demand curve facing the firm has a slope of zero, and a right which confers the advantage of being able to sell into a market where the demand curve facing the firm has a negative slope. Both kinds of rights have value. Patents are almost always examples of the first rather than the second class.”).

\textsuperscript{68} See, e.g., Standard Oil Co. v. U.S., 337 U.S. 283, 307 (1949) (stating that a patent “is at least \emph{prima facie} evidence of \emph{market} control” despite the presence of competing substitutes for the patented article); see also Fortner Enterprises, Inc. v. U.S. Steel Corp., 394 U.S. 495, 505 n.2 (1969) (“Uniqueness confers economic power only when other competitors are in some way prevented from offering the distinctive product themselves. Such barriers may be legal as in the case of patented or copyrighted products.”).

\textsuperscript{69} ANTITRUST GUIDELINES, supra note 14, \S 2.2. This is the agency’s way of attempting to negate the per se rule against tying. Under the per se tying rule, if a seller tied a product with market power to a regular product offered in free market competition, it was presumed to be a per se tying violation of the Sherman and Clayton Acts. See, e.g., Jefferson Parish Hosp. Dist. No. 2 v. Hyde, 466 U.S. 2, 17 (1984) (“[T]he Court has held that the likelihood that market
that in patent misuse cases it will not be presumed that the patent conferred market power on the patentee.\(^7\)

Courts err because litigators and scholars are reluctant to make economic arguments that patent procurement positively stimulates technological innovation, without inhibiting economic growth and free market competition.\(^7\) Yet, economists have analyzed the relationship between intellectual property rights and economic growth for several years.\(^7\) Recent studies indicate that patent procurement stimulates the economy and countries failing to adequately protect intellectual property are lagging in industrial growth and development.\(^7\) The development of this relationship occupies the next Part of this Article.

II. PATENTS POSITIVELY IMPACT THE ECONOMY

\[\text{T}h\text{e courts have many ways to manipulate the effects of the patent system. . . . Moreover, the judicial power to interpret}\]

\(^7\) See 35 U.S.C § 271(d) (1994).


\(^7\) As noted by Judge Newman in Hilton Davis, Joseph A. Schumpeter was one of the first economists to argue that inventions alone produce “no economic effect, while patent-based innovation has a positive impact on the economic system as new industries and new goods displace the old.” Hilton Davis, 62 F.3d at 1529 n.1 (citing JOSEPH A. SCHUMPETER, CAPITALISM, SOCIALISM, AND DEMOCRACY (3d ed. 1950)). In recent years, Zvi Griliches has argued that the results are inconclusive that patents stimulate economic growth, while Francis Narin has argued that patent procurement positively impacts the economy and that patents are indicators of corporate technical strength. Compare Zvi Griliches, Patents: Recent Trends and Puzzles, BROOKINGS PAPERS: MICROECONOMICS 291, 316-19 (1989), with Francis Narin & Elliot Noma, Patents as Indicators of Corporate Technological Strength, 16 RES. POL’Y. 143 (1987) (presenting data of study involving patents and company profits of 17 pharmaceutical companies).

\(^7\) See, e.g., David M. Gould & William C. Gruben, The Role of Intellectual Property Rights in Economic Growth, 48 J. DEV. ECON. 323, 333 (1996) (examining the role of intellectual property rights and determining increased economic growth with greater protection, utilizing cross-country data on patent protection, trade regime and country-specific characteristics); Narin & Noma, supra note 72, at 143, 155 (noting the limitations of their study, but predicting studies in other industries). See generally Francis Narin, Parallelism, Leads and Lags Between National Papers, Corporate Patents and GNP, Presentation at the Paris Technology and Competitiveness Conference (June 24-27, 1990) (on file with author).

There are also studies that question whether patent procurement stimulates technological innovation and economic growth. See Griliches, supra note 72, at 303 (crediting decreases in innovation to deteriorating economic conditions during certain periods); Merges & Nelson, supra note 12, at 878-79 (discussing the widely accepted idea that more inventions yield more productivity).
the generally worded patent statutes can dramatically alter the economic effects of a patent scheme.\textsuperscript{74}

This section empirically demonstrates that any market power conferred by patents positively impacts economic growth, and therefore is not anticompetitive or contrary to the public interest. First, select Supreme Court cases from each judicial cycle are analyzed to illustrate that patents were frequently labeled property when favored by the Court and labeled anticompetitive monopolies during cycles of judicial hostility. I also graphically document the various cycles of judicial hostility by counting the number of patent validity adjudications by appellate courts. I conclude by establishing a positive synergy between patent validity adjudications, the proportion of patent applications filed and economic growth.

A. Cyclical Judicial Patent "Monopolyphobia"

The power to exclude which is the essence of every patent is monopoly power, hence, "[a]ny action to enforce a patent is in a very explicit sense 'exclusionary,' both in purpose and, if unsuccessful, in effect."\textsuperscript{75}

The difficulty is that "monopoly" is used in different senses in patent and antitrust law, hence its ambiguity. Because of its antitrust connotations and association with illegality in connection therewith, it often evokes negative reactions inappropriate to a dispassionate analysis of patent law problems.\textsuperscript{76}

These quotes illustrate the complexity in tracing patent "monopolyphobia." Improper categorization of intellectual property rights as monopolies in the negative sense is traceable to the ambiguity surrounding the term "monopoly."\textsuperscript{77} This ambiguity has its roots in English common law, antitrust law and the cyclical judicial hostility


\textsuperscript{75} Handgards, Inc. v. Ethicon, Inc., 601 F.2d 986, 992 n.10 (9th Cir. 1979) (citing \textit{Lawrence Anthony Sullivan, Handbook of the Law of Antitrust} § 181 (1977)), \textit{aff’d}, 743 F.2d 1282 (9th Cir. 1984).

\textsuperscript{76} \textit{In re Kaplan}, 789 F.2d 1574, 1577 n.3 (Fed. Cir. 1986).

\textsuperscript{77} "Monopoly," by its economically neutral definition, is nothing more than an exclusive right, encompassing patent and other property rights. However, commentators note that the "meaning of monopoly that is of concern to the scientific student of economic behavior is the condition that generates social loss," thereby impeding free market competition. \textit{See} Kitch, \textit{supra} note 24, at 33; \textit{see also} Rose, \textit{supra} note 9, at 665-72; Rupert, \textit{supra} note 43, at 755.
toward patents. 78 It has created confusion that has resulted in courts’ crossing the line from ambiguously using the term “monopoly” to affirmatively labeling patent rights as anticompetitive and contrary to the public interest. 79 This judicial mindset increases the likelihood of patents being held invalid during infringement litigation, which negatively impacts patent filings, thereby inhibiting technological innovation and economic growth. 80

Donald Chisum, in his leading treatise on patents, notes that the Supreme Court periodically shifted its view toward patents, going from cycles where patents were under fire to cycles where patents were in favor. 81 When patents were in favor, more patents were held valid and enforced by the courts. 82 Conversely, when patents were under fire, courts narrowly applied the Patent Act and often held patents invalid or misused. 83 For example, during the period 1892-1930, courts broadly applied the Patent Act, labeling patents pro-competitive monopolies having the attributes of property. 84 During the second cycle of judicial hostility (1930-1950), however, courts described patents as anticompetitive monopolies, narrowly applied the Patent Act and often held patents invalid. 85

78 See Rose, supra note 9, at 665-72 (providing a brief history of the English common law approach and an economically neutral definition of “monopoly”).


80 See, e.g., J. THOMAS McCARTHY, TRADEMARKS AND UNFAIR COMPETITION § 2:5[A] (1973) (“[T]he court’s attitude toward patents, by a sort of intellectual osmosis, affected their rulings concerning trade symbols. When more recently, the older, stricter, judicial views about patents reemerged, this strictness, in part at least, seems to have carried over into the trade-name decisions.”) (quoting Standard Brands, Inc. v. Smidler, 151 F.2d 34, 41-42 (2d Cir. 1945) (Frank, J., concurring)).

81 See 1 DONALD S. CHISUM, CHISUM ON PATENTS §§ OV-9 to OV-12 (1993) (arguing that patents were “under fire” from 1880-1892, “in favor” from 1892-1930, “renewed fire” from 1930-1950 and “in favor” again with the passing of the 1952 Patent Act).

82 See id.

83 See id.

84 See, e.g., Crown Die & Tool Co. v. Nye Tool & Mach. Works, 261 U.S. 24, 36 (1923); McAlene v. United States, 150 U.5. S. 424, 429-32 (1893); Amer. Steel Foundries v. Laughlin, 30 F.2d 139 (7th Cir. 1928).


During the modern era (post-1950), courts have vacillated between a positive and a negative use of the term “monopoly,” but generally have been less likely to condemn patents as anticompetitive. This is particularly true in recent cases. See, e.g., Glaxo, Inc. v. Novopharm Ltd., 52 F.3d 1043 (Fed. Cir. 1995) (upholding validity of drug patent). Many recent decisions
H.R. Mayers, former counsel to General Electric, was the first to argue a connection between the various cycles of judicial hostility towards patents and public sentiment towards industry and innovation. Mayers evaluated the percentage of patents held valid as part of the infringement analysis by the Supreme Court and courts of appeals from 1850-1958. He analyzed the intersection of patent and antitrust law noting that the "passage of the Sherman Act in 1890 coincides roughly with the first point of major severity in the action of the courts with respect to patents." Figure 1 in the Appendix incorporates Mayers's data, Federal Circuit case data, as well as my own appellate court case data, to illustrate that the cyclical judicial hostility towards patents went well beyond 1958, into the modern era of patent law.

do not describe patents in terms of monopolies at all. See, e.g., U.S. Philips Corp. v. Sears, Roebuck & Co., 55 F.3d 592 (Fed. Cir. 1995) (using the doctrine of judicial estoppel to preclude antitrust claims); Vollrath Co. v. Sammi Corp., 9 F.3d 1435, 1460 (9th Cir. 1993) (stating certain criteria necessary for a monopolization claim); Information Exchange System v. First Bank Nat'l Ass'n, 994 F.2d 478, 484 (8th Cir. 1993) (dismissing antitrust claims against bank).

See H.R. Mayers, The United States Patent System in Historical Perspective, 3 PAT. TRADEMARK & COPYRIGHT J. RES. & EDUC. 33 (1959). "Through the period 1850 to 1958, the action of the appellate courts on patents coming before them for determination of validity has varied radically." Id. at 34. Mayers cites several theses for the cyclical validity holdings, including the quality of American inventions, public opinion and judicial sentiment. He further cites secondary factors such as introducing the reissue era and the creation of the courts of appeals, which did not occur until 1891. See id. at 37-45.

The Federal Circuit data from 1982-1994 was graciously supplied by Donald Dunner and is excerpted from his leading article, which takes a statistical look at the Federal Circuit's patent decisions from 1982 through 1994. See Dunner et al., supra note 17, at 179-80. We counted cases utilizing the Mayers approach, which took a decision holding any claim of a patent valid as an overall validity count favorable to the patentee, even though other claims may have been held invalid and not infringed. See Mayers, supra note 86, at 34 (detailing this method).

See also Sergei S. Zlinkoff, Monopoly Versus Competition: Significant Trends in Patent, Anti-Trust, Trademark, and Unfair Competition Suits, 53 YALE L.J. 514, 518-25 (1944) (providing an excellent statistical analysis of the trend of the Supreme Court to limit patent rights based on "monopolyphobia"). Zlinkoff statistically documents a fundamental theme running throughout the Supreme Court's decisions during this period, namely "an insistence that the 'public interest' shall be considered the dominant interest in these matters and that this interest is best served by a freely competitive economic system from which have been removed as many monopolistic restrictions as possible." Id. at 516.
I. Patents in Favor (1892-1930)

During the first cycle of judicial favor toward patents (1892-1930), several opinions used "monopoly" in its economically neutral sense and often linked this term to property. For example, in Continental Paper Bag Co. v. Eastern Paper Bag Co., the Court refers to the patent monopoly as economically beneficial and opines that the inventor has created or discovered something of value. As a result, "[i]t is his absolute property, [h]e may withhold the knowledge of it from the public, and he may insist upon all the advantages and benefits which the statute promises to him who discloses to the public his invention." Similarly, in General Electric Co. v. Wise, the District Court of New York expressly refers to patents as property, then notes in the same paragraph:

"[i]n a sense, the granting of a patent confers a monopoly on the inventor or owner of such patent, but such a monopoly is granted in the interest of the public as well as of the grantee of the patent, and is an encouragement to the development of inventive skill and genius." And in Crown Die & Tool v. Nye Tool & Machine Works, the Court refers to patent rights as unique statutory property. These cases illustrate that during times when patents were in favor, courts were more likely to use "monopoly" in the economically neutral sense and equate it with a property right to exclude. Most importantly, during this era, patent rights were not presumed to be anticompetitive devices.

90 From 1880 to 1892, the first cycle of judicial hostility towards patents occurred. Although these cases contain numerous pejorative references to the patent "monopoly," this cycle was relatively short-lived. Outright patent "monopolyphobia" did not occur until the second cycle of judicial hostility (1930-1950). See, e.g., CHISUM ET AL., supra note 11, at 22-23; Zlinkoff, supra note 89, at 518-25 (providing a historical overview of patent right limitations imposed by the Supreme Court).
91 210 U.S. 405 (1908).
92 Id. at 424.
93 119 F. 922 (C.C.N.D.N.Y. 1903).
94 Id. at 924.
95 261 U.S. 24 (1923).
96 See id. at 35.
97 See, e.g., Atlantic Works v. Brady, 107 U.S. 192, 200 (1883). The Court cautioned:

The design of the patent laws is to reward those who make some substantial discovery or invention, which adds to our knowledge and makes a step in advance in the useful arts. Such inventors are worthy of all favor. It was never the object of those laws to grant a monopoly for every trifling device, every shadow of a shade of an idea, which would naturally and spontaneously occur to any skilled mechanic or operator in the ordinary progress of manufacture. Such an indiscriminate creation of exclusive privileges tends rather to obstruct than to stimulate invention.

Id.
2. The First Patent “Monopolyphobia” (1931-1950)

As illustrated in Figure 1 and Table 1 in the Appendix, the Court’s “monopolyphobic” trend heightened during the second cycle of judicial hostility toward patents (1930-1950). For example, between 1927-1931, 50.4% of patents adjudicated were held valid; by 1944, the percent adjudicated valid had fallen to 21.6%. Indeed, Chisum notes that the Supreme Court’s “anti-patent bias was so pronounced that Justice Jackson would complain in dissent, that the only valid patents were those that the Court had not been able to get its hands on.” Interestingly, this cycle parallels the general anti-monopoly sentiment fostered by the Court’s implementation of the Sherman Act in cases involving tying the sale of a patented product to an unpatented product readily available in the public domain. Similarly, the most common defense in patent infringement cases during this period was that

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98 See CHISUM ET AL., supra note 11, at 22-23 (“From 1890-1930 patents were viewed favorably by the Court; but from about 1930 to 1950, the Court approached patents with a great deal of suspicion, emphasizing the monopolistic and social-cost aspect of patents.”).

99 Although the Sherman Antitrust Act was passed in 1890, it took several years for fear of restraint of trade to permeate the intellectual property infringement or antitrust analysis. As noted by Willard Tom and Joshua Newberg of the Federal Trade Commission (FTC):

In the first twenty years after the enactment of the Sherman Act in 1890, antitrust was no match for intellectual property in the perceived “conflict” between the two bodies of law. When faced with competition law challenges to the exercise of intellectual property rights, courts tended to resolve disputes by deferring to the prerogatives of the intellectual property holder.

Willard K. Tom & Joshua A. Newberg, Antitrust and Intellectual Property: From Separate Spheres to Unified Field, 66 ANTITRUST L.J. 167, 168 (1997); see also Bement v. National Harrow Co., 186 U.S. 70, 91 (1902) (“[T]he general rule is absolute freedom in the use or sale of rights under the patent laws of the United States.”).

100 CHISUM ET AL., supra note 11, at 22 (citing Jungersen v. Ostby & Barton Co., 335 U.S. 560, 571-72 (1949) (Jackson, J., dissenting)).

101 Abuse of the term “monopoly” to manipulate public sentiment against patent rights did not originate in the United States. The anti-patent movement had a stronghold in Europe during the mid-19th century. Anti-patent scholars and economists cleverly linked their movement to the rising ideological tide against tariff protection. See Fritz Machlup & Edith Penrose, The Patent Controversy in the Nineteenth Century, 10 J. ECON. HIST 1, 9 (1950).

The strength in nineteenth century Europe of the movements against privilege and monopoly and for free international trade was such that the ideological linking of patent protectionism with tariff protectionism and of patent monopoly with monopoly privileges in general tended to help the opponents and to weaken the defenders of the patent system. It was strategically essential for the latter [patent advocates] to separate as far as possible the idea of patent protection from the monopoly issue and from the free trade issue.

Id. The authors state that by 1873 the patent advocates had triumphed by presenting “the case of patent protection as one of natural law and private property.” Id. They further note that “[t]he arguments for patents, formulated in these terms . . . are still used today [in the United States] whenever the patent system is debated.” Id. As I will establish in Part III of this Article, the property rights argument is indeed the strongest argument to advocate a broad base of intellectual property rights, including patent rights.
the patentee had misused the patent right by illegally tying the patented product to a second unpatented product\textsuperscript{102} (recall that tying arrangements that restrain competition are in direct violation of section 1 of the Sherman Act\textsuperscript{103}).

The courts' use of "monopoly" in patent antitrust cases during the second cycle of judicial hostility ultimately permeated the opinions in patent infringement cases. This in turn created a negative presumption or "monopolyphobia" concerning patent rights, causing courts more often than not to invalidate or restrict the patent rights at issue.\textsuperscript{104} The patent misuse cases most illustrative of judicial hostility toward patents were decided during the 1940s, the decade of heightened judicial activism on the Supreme Court.\textsuperscript{105}

In Morton Salt Co. v. G.S. Suppiger Co.,\textsuperscript{106} the patentee was accused of patent misuse for restraining the sale of unpatented salt tablets by requiring licensees to use only tablets sold by the patentee

\textsuperscript{102} Today, section 271(d) of the Patent Act expressly provides that patent misuse will not be presumed simply because the patentee has "conditioned the license of any rights to the patent or the sale of the patented product on the acquisition of a license to rights in another patent or purchase of a separate product, unless, in view of the circumstances, the patent owner has market power in the relevant market for the patent or patented product on which the license or sale is conditioned." 35 U.S.C. § 271(d) (1994); \textit{see also} Dawson Chemical Co. v. Rohm & Haas Co., 448 U.S. 176 (1980) (evaluating how the enactment of section 271 affected the doctrines of contributory infringement and patent misuse).

\textsuperscript{103} \textit{See} 15 U.S.C § 1 (1994) ("Every person who shall make any contract or engage in any combination or conspiracy hereby declared to be illegal shall be guilty of a felony."); \textit{see also} United States v. Loew's Inc., 371 U.S. 38, 44-51 (1962) (reverting to pre-1892 anti-patent attitudes and expanding the patent misuse doctrine by holding that a patent was unenforceable if the patentee attempted to extend its patent monopoly through tying arrangements or other improper practices). Tying is found when the seller of one product, most often the patented product, conditions the sale of the product on the buyer purchasing a second product (the tied product), generally unpatented, from a seller or a designated third party. Tying is in direct violation of the Sherman or Clayton Acts if (1) the "seller has appreciable economic power" in the tying product, or (2) "the arrangement affects a substantial volume of commerce in the tied market." Eastman Kodak Co. v. Image Technical Services, 504 U.S. 451, 461-62 (1992); \textit{see also} Northern Pac. Ry. v. United States, 356 U.S. 1, 10-11 (1958) (stating that the problem with tying arrangements lies with the use of market power rather than whether or not it is a monopoly).

\textsuperscript{104} Although the ambiguous and often anticompetitive use of "monopoly" is found during the first cycle of judicial hostility toward patents (1880-1982), it is during the second cycle that we observe a true germination of patent "monopolyphobia." In fact, Zlinkoff points out:

[i]n the year 1943 alone, the various circuit courts of appeals in thirty-four cases ruled the patent claims involved to be entirely invalid for lack of invention or prior anticipation, or found no infringement. In the eight cases where the Supreme Court was petitioned to review these decision, certiorari was denied.

Zlinkoff, \textit{supra} note 89, at 520. This was also the zenith for antitrust cases in general, since the Supreme Court composition tipped toward justices who zealously protected the public interest. \textit{See id.} at 516.

\textsuperscript{105} \textit{See} CHSUM ET AL., \textit{supra} note 11, at 22.

\textsuperscript{106} 314 U.S. 488 (1942).
with its patented salt machines. In holding the patent unenforceable due to tying, the Supreme Court stated:

The grant to the inventor of the special privilege of a patent monopoly carries out a public policy adopted by the Constitution and laws of the United States. . . . But the public policy . . . forbids the use of the patent to secure an exclusive right or limited monopoly not granted by the Patent Office and which it is contrary to public policy to grant.

The Court further opined that "[w]here the patent is used as a means of restraining competition with the patentee’s sale of an unpatented product, the successful prosecution of an infringement suit . . . is a powerful aid to the maintenance of the attempted monopoly of the unpatented product, thwarting the public policy underlying the grant of the patent." By distinguishing the special privilege of the patent monopoly from the unlawful limited monopoly that takes place with tying, the Court established that the tying arrangement alone unlawfully extended the patentee’s monopoly, in violation of the public interest. Thus, one could infer that during this period the Supreme Court acknowledged that patent rights lawfully exercised by the patentee were not anticompetitive monopolies. Nevertheless, in later patent cases, the same Court blurs the line between antitrust/anticompetitive monopolies and the patent privilege.

107 The Morton Salt facts are illustrative of the typical tying arrangement, in which a seller makes the purchase of a second product a prerequisite to obtaining the first or desired product. In patent cases, the desired product is often the patented product, and the tied product is an unpatented product that is freely available on the market. A tying arrangement is per se illegal "wherever a party has sufficient economic power with respect to the tying product to appreciably restrain free competition in the market for the tied product and 'not insubstantial' amount of interstate commerce is affected." Northern Pac. Ry. v. United States, 356 U.S. 1, 6 (1958); see also Brinson, supra note 34, at 35-36 (discussing which tying arrangements are legal and which are illegal).

108 Morton Salt, 314 U.S. at 492.

109 Id. at 493.

110 The Court took great pains in distinguishing how tying arrangements adversely affect the public interest and are in restraint of trade. See id. at 493.

111 See Zlinkoff, supra note 89, at 516 (suggesting that this pattern emerged because seven of the nine Supreme Court justices appointed between 1937 and 1944 were appointed as "champion[s] of free competition as the fundamental characteristic of our economic structure"); see also United States v. Masonite Corp. 316 U.S. 265, 280 (1942) (illustrating how the Court exhibited true patent "monopolyphobia," by expressly characterizing the patent privilege itself as being "restrictive of a free economy"). The Court’s opinion establishes that patents are lawful anticompetitive monopolies that become unlawfully extended and unenforceable when used in violation of the Sherman or Clayton Antitrust Acts. See id. at 280; see also United States v. Line Materials Co., 333 U.S. 287, 310 (1948) ("The monopoly granted by the patent laws is a statutory exception to this freedom for competition and consistently has been construed as limited by the patent grant"). As in Masonite, the Court goes on to distinguish that "[i]t is not the
In *Mercoid Corp. v. Mid-Continent Investing Co.*, the Supreme Court openly declared war on patent rights. The patentee in *Mercoid* alleged contributory infringement and the Defendant counter-claimed, alleging conspiracy to extend the patent monopoly in violation of antitrust laws. The Supreme Court held that the patentee’s tying of an unpatented stoker switch to a combination patent for heating systems was beyond the patentee’s monopoly, although the unpatented article was designed solely for the product covered by the combination patent. The Court combined antitrust and patent monopoly concepts in balancing the patentee’s rights against the public interest, stating that “[t]he necessities or convenience of the patentee do not justify any use of the monopoly of the patent to create another monopoly... The instant case is a graphic illustration of the evils of an expansion of the patent monopoly by private engagements.”

Later in the opinion, the Court weakly attempted to distinguish antitrust monopolies from the patent right, stating that “[i]f a limited monopoly over the combustion stoker switch were allowed, it would not be a monopoly accorded inventive genius by the patent laws but a monopoly born of a commercial desire to avoid the rigors of competition fostered by the antitrust laws.” Nonetheless, this distinction appears to be one of degree only, with patents being lawfully anti-
competitive, and antitrust monopolies unlawfully anticompetitive. Indeed, Mercoid's pervasive holding is that patent rights are narrowly defined anticompetitive monopolies that operate as secondary to the public interest.\footnote{See id. at 665.}

Interestingly, during this period, some judicial decisions did make efforts to objectively evaluate the patent right as property.\footnote{During the second cycle of judicial hostility the Court occasionally, like a voice in the wilderness, stated that the patent right was indeed an earned property right. See, e.g., United States v. Dubilier Condenser, 289 U.S. 173, 183-86 (1933) ("The government has no more power to appropriate a man's property invested in a patent than it has to take his property invested in real estate. . . . [someone] may exercise his inventive faculties in any direction he chooses, with the assurance that whatever invention he may thus conceive and perfect is his individual property."). This case was decided at the beginning of this judicial cycle (1933) and as noted by Zlinkoff, it was decided by the later appointees to the court (Justices Black, Reed, Douglas, Frankfurter, Murphy, Jackson and Rutledge), who were known as the champions of free competition. See Zlinkoff, supra note 89, at 516 n.5.}

What the early line of patent misuse cases left unresolved, however, was whether the limited monopoly granted under the patent right automatically conferred market power.

In \textit{International Salt Co. v. United States},\footnote{332 U.S. 392 (1947).} the Supreme Court held that tying the sale of unpatented salt products to a lease for patented salt machines restrained trade in violation of section 1 of the Sherman Act.\footnote{See id. at 395-96.} The court opined that "[b]y contracting to close this market for salt against competition, International has engaged in a restraint of trade for which its patents afford no immunity from the antitrust laws."\footnote{Id. (citing Morton Salt and Mercoid).} Although the Justices' arguments fail to link the patent right with market or economic power, \textit{International Salt} was later cited by the Court in \textit{United States v. Loew's Inc.}\footnote{371 U.S. 38 (1962). This case is discussed \textit{infra} at text accompanying notes 146-52.} for this very proposition.


The 1952 Patent Act was enacted largely in response to the "monopolyphobia" that permeated the Court between 1930-1950.\footnote{See CHISUM \textit{et al.}, supra note 11, at 22-23, 532-33 (noting that the "flash of creative genius" test articulated by the Supreme Court in \textit{Cuno Engineering Corp. v. Automatic Devices Corp.}, 314 U.S. 84 (1941), was the last straw for members of the Patent Bar). Chisum notes that the Patent Bar perceived the \textit{Cuno} standard as raising "the hurdle of patentability above and beyond the 'requirement for invention.'" CHISUM \textit{et al.}, supra note 11, at 532. In 1948, President Roosevelt appointed a National Patent Planning Commission that eventually proposed that Congress "declare a national standard whereby patentability of an invention shall be determined by the objective test as to its advancement of the arts and sciences." Id. at 533 (citing H.R. DOC. No. 78-239, at 6, 10 (1943)). Its report, along with a second "monopolyphobic" opinion, \textit{Great Atlantic Tea & Pac. Tea Corp. v. Supermarket Equip.}, 340 U.S. 147 (1950), prompted Judge}
The 1952 Patent Act ushered in a new era where patentability requirements and infringement were more equitably defined.\textsuperscript{125} For example, section 261 expressly gave patents the "attributes of personal property."\textsuperscript{126} Section 103 of the Act codified the non-obviousness requirement\textsuperscript{127} from case law.\textsuperscript{128} Section 112 overturned the Court's decision in \textit{Halliburton}\textsuperscript{129} and reinstated the use of "means plus function" claims.\textsuperscript{130} Section 271(a), (b) and (c) formally defined direct infringement, inducement of infringement and contributory infringement, while also overturning the Court's broad reading of patent misuse and contributory infringement in \textit{Mercoid}.\textsuperscript{131}

Although the 1952 Act strengthened the concept of patents as property, courts continued struggling with claim interpretation and enforcement of patent rights.\textsuperscript{132} In patent appeals, there was great disparity among the circuits.\textsuperscript{133} Some circuits viewed patents favorably, while others "displayed a distinct patent bias."\textsuperscript{134}

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\textsuperscript{125} See \textit{CHISUM ET AL}, supra note 11, at 533.

\textsuperscript{126} For decisions indicating how the Supreme Court, prior to the 1952 Act, made patentability much harder to attain, see \textit{CHISUM ET AL}, supra note 11, at 22.


\textsuperscript{128} Section 103 presently states:

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. Patentability shall not be negatived by the manner in which the invention was made.


\textsuperscript{129} \textit{Halliburton Oil Well Cementing Co. v. Walker}, 329 U.S. 1 (1946). In \textit{Halliburton}, the Court abolished the "means plus function" to include all means disclosed in the specification, plus equivalents known at the time. \textit{See Halliburton}, 329 U.S. at 8-11. A simplified example of a "means plus function" claim is a widget, comprising X, Y, and a means of fastening X to Y.

\textsuperscript{130} \textsuperscript{35 U.S.C. § 112} (1994). ("An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.").

\textsuperscript{131} \textit{Mercoid Corp. v. Mid-Continent Inv. Co.}, 320 U.S. 661 (1944); \textit{see 35 U.S.C. § 271} (1994).

\textsuperscript{132} \textit{See CHISUM ET AL.}, supra note 11, at 23 ("The 1952 Act did a great deal to strengthen our patent system, but problems, mainly procedural in nature remained.").

\textsuperscript{133} Prior to 1982 and the formation of the Federal Circuit as the mandatory court for patent appeals, regional circuit courts heard patent appeals from their respective circuits. \textit{See CHISUM ET AL}, supra note 11, at 23-24.

\textsuperscript{134} \textit{Id.} at 23.
struggle between viewing patents as property or anticompetitive monopolies. This floundering is illustrated throughout the judicial opinions of this era.

a. Graver Tank (1950): A Return to Favoring Patents

In *Graver Tank & Manufacturing Co. v. Linde Air Products Co.*, the Court retreated from its “monopolophobic view” and expansively evaluated patents as property. The *Graver Tank* court established the modern standard for infringement under the doctrine of equivalents (“DOE”) where literal infringement is absent, yet the alleged infringing device “performs substantially the same function in substantially the same way, to obtain the same result.” The Court held that the patentee’s electric welding composition was the equivalent of the accused device which substituted a non-alkaline earth metal, manganese, for the patentee’s alkaline earth metal, magnesium. It opined that the accused device “and the composition of the patent in suit are substantially identical in operation and in result.”

As might be expected, the term “monopoly” is conspicuously absent from the majority’s opinion. The dissent, however, used the term in its public interest argument against applying this equitable doctrine to broaden the claim for alkaline earth metal to include manganese, when the patent claim was “free from ambiguous language.” Justice Black noted:

"The way specific problems are approached naturally has much to do with the decisions reached. A host of prior cases... have treated the 17-year monopoly authorized by valid patents as a narrow exception to our competitive enterprise system. For that reason, they have emphasized the impor..."

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136 See id. passim.
137 Id. at 608. The doctrine of equivalents is considered an equitable doctrine because it goes beyond the plain language of the Patent Act, which requires that the infringer literally copy each claimed element before literal infringement can be found under section 271 of the Patent Act. See id. at 607-08. The majority’s view, affirming this equitable expansion of patent rights, was fairly controversial because it came at the tail end of the second cycle of judicial hostility toward patents. At this time, the Supreme Court was more likely to limit a patentee’s rights than find an equitable basis to establish these rights. See Zlinkoff, supra note 89, at 518 (“In the patent field during the past ten years, the Supreme Court has invalidated approximately twenty important patents dominating portions of industries as diverse as the motion picture, telegraph, radio, chemical, and machinery fields.”).
138 See *Graver Tank*, 339 U.S. at 610-12.
139 Id. at 611. The Court was persuaded by expert testimony and other patents indicating that “alkaline earth metals are often found in manganese ores in their natural state and that they serve the same purpose in fluxes...” [thus,] “[I]n the sense of the patent,” manganese could be included as an alkaline earth metal.” Id. at 610-11.
140 Id. at 613 (Black, J., dissenting).
tance of leaving business men free to utilize all knowledge not preempted by the precise language of a patent claim.\textsuperscript{141}

Inherent in the Black dissent is an acknowledgment of the section 112 notice requirement.\textsuperscript{142} That is, the doctrine of equivalents can not be used in a manner that undermines the public's reliance on the patent specification and claims defining the "metes and bounds" of the invention.\textsuperscript{143} Arguably, the majority considered this tension when opining that "what constitutes equivalency must be determined against the context of the patent, the prior art, and the particular circumstances of the case."\textsuperscript{144} Moreover, even though prior cases labeled patents as a narrow exception to a competitive economic system, this characterization does not negate the reality that patents are not per se anticompetitive. Thus, Justice Black needed to remind the majority of the balance at stake, without resorting to terminology implying that patents impede free market competition and should be strictly, rather than equitably, evaluated.

\textbf{b. United States v. Loew's (1962)}: The Court-Created Presumption that Patents Confer Market Power

In \textit{United States v. Loew's, Inc.},\textsuperscript{145} the Court rotated back to the "monopolyphobia" era by holding that patents were anticompetitive monopolies that conferred market power. Here, the tying of the sale or lease of the blockbuster copyrighted film "Gone With the Wind" to the sale or lease of lesser-known copyrighted films was held to be a violation of the Sherman Antitrust Act.\textsuperscript{146} The Court erroneously

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\item \textsuperscript{141} \textit{Id.} at 617 (Black, J., dissenting) (emphasis added); \textit{see also} Lackner v. Quehl Sign Co., 145 F.2d 932, 934 (6th Cir. 1944) (using the term "monopoly" and holding that the patentee's rights are secondary to the public interest).
\item \textsuperscript{142} \textit{See} 35 U.S.C. § 112 (1994) (outlining four distinct disclosure requirements: 1) a written description; 2) an enabling disclosure; 3) disclosure of the best mode; and 4) a set of claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention).
\item \textsuperscript{143} \textit{See}, e.g., London v. Carson Firie Scott & Co., 946 F.2d 1534, 1538 (Fed. Cir. 1991) (noting that the purpose of section 112 requirements are to give the public "fair notice of what the patentee and the Patent and Trademark Office have agreed constitute the metes and bounds of the claimed invention").
\item \textsuperscript{144} \textit{Graver Tank}, 339 U.S. at 609. Arguably, the majority's subsequent analysis was flawed in including within the patent's scope information that was already disclosed in the prior art. \textit{See} Paul M. Janicke, \textit{Heat of Passion: What Really Happened in Graver Tank}, 24 AIPLA Q.J. 1, 6 (1996) (arguing that a close examination of the facts surrounding \textit{Graver Tank} indicates that "the courts, moved by passions that drove the case and particularly by the perceived justice of Linde's cause, misapplied the doctrine, inadvertently causing the Linde patent to cover the prior art"). \textit{But see} Leon Chasan, \textit{A Valid Patent—Graver v. Linde}, 5 INTRAMURAL L. REV. N.Y.U. 70 (1950) (applauding the \textit{Graver Tank} decision as "halting the Supreme Court's tendency to 'attenuate' patent rights").
\item \textsuperscript{145} 371 U.S. 38 (1962).
\item \textsuperscript{146} \textit{See id.} at 51.
\end{itemize}
cited *International Salt Co. v. United States*\(^{147}\) as holding that economic power is presumed when the tying product is patented or copyrighted.\(^{148}\) The Court argued that patent law intersects with antitrust law, such that "the existence of a valid patent establishes a distinctiveness sufficient to conclude that any tying product would have anticompetitive consequences."\(^{149}\) Ironically, there is little in the plain language of *International Salt* or any other patent misuse case supporting this Court-created presumption of market power. The *Loew's* presumption ultimately wreaked havoc in patent infringement and antitrust cases for the next two decades. Today, section 271(d) of the Patent Act expressly overrules the *Loew's* presumption, but its application is limited to patent infringement cases.\(^{150}\) Yet, courts have continued to resist expressly overruling *Loew's* in antitrust cases involving intellectual property.\(^{151}\)


In recent years there have been cases in which the courts have broadly and equitably viewed patent rights.\(^{152}\) In *Diamond v. Chakrabarty*,\(^{153}\) the Supreme Court broadened the statutory interpretation of patentable subject matter\(^{154}\) to include human engineered microorganisms, without a single reference to the patent monopoly.\(^{155}\) Instead, the majority's historical analysis of patents included language which affirmed patents as economically beneficial property rights: "The authority of Congress is exercised in the hope that '[the] pro-

\(^{147}\) 332 U.S. 392 (1947).

\(^{148}\) *Loew's*, 371 U.S. at 45. The *Loew's* Court also erroneously cites *United States v. Paramount Pictures*, 334 U.S. 131 (1948), for the market power presumption. See id.

\(^{149}\) Id. at 46 (noting that "[e]ven absent a showing of market dominance, the crucial economic power may be inferred from the tying product's desirability to consumers or from uniqueness in its attributes"); *see also* Brinson, *supra* note 34, at 41 (noting that using the flexible *Loew's* standard, one would be hard pressed to find any type of tying arrangement which "logically could not be found to be illegal") (quoting Richard E. Day, *Exclusive Dealing, Tying and Reciprocity—A Reappraisal*, 29 Ohio St. L.J. 539, 547 (1968)).


\(^{151}\) See Eastman Kodak v. Image Technical Servs. Inc., 504 U.S. 451, 466-67 (1992) (attempting to distinguish *Loew's* by reasoning that "[l]egal presumptions that rest on formalistic distinctions rather than actual market realities are generally disfavored in antitrust law"); *see also* Atari Games v. Nintendo of America, Inc., 897 F.2d 1572 (Fed. Cir. 1990) (involving the tying of home video game machines to video cartridges that were both patented and copyrighted; in this case the Federal Circuit completely ignored the *Loew's* presumption with respect to the copyrighted material and merely stated that patents do not presumptively confer market power).

\(^{152}\) See CHISUM ET AL., *supra* note 11, at 23-25.

\(^{153}\) 447 U.S. 303 (1980).


\(^{155}\) See *Chakrabarty*, 447 U.S. at 317.
ductive effort thereby fostered will have a positive effect on society through the introduction of new products, increased employment and better lives for our citizens."\textsuperscript{156} The Court further noted, "[t]he Committee Reports accompanying the 1952 Act inform us that Congress intended statutory subject matter to include anything under the sun that is made by man."\textsuperscript{157} Similarly, in \textit{Nickola v. Peterson},\textsuperscript{158} the Sixth Circuit commented that the "statutory, and therefore proper, characterization [of the patent right] is not ‘patent monopoly,’ but patent property."\textsuperscript{159}


The formation of the Federal Circuit in 1982 as the mandatory appellate court for patent cases greatly increased inventor confidence in the ability of the judiciary to properly adjudicate patent procurement and infringement.\textsuperscript{160} The creation of this Circuit meant that there

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\textsuperscript{156} Id. at 307 (citing Kewanee Oil v. Bicron, 416 U.S. 470, 480 (1974)). The dissent also emphasized that the "patent laws attempt to reconcile this Nation’s deep seated antipathy to monopolies with the need to encourage progress. . . . [T]he absence of legislative direction, the courts should leave to Congress the decisions whether and how far to extend the patent privilege into areas where the common understanding has been that patents are not available." Id. at 319 (Brennan, J., dissenting) (citing Graham v. John Deere, 383 U.S. 1, 7-10 (1966) and Deepsouth Packing Co. v. Laitram Corp., 406 U.S. 518, 530-31 (1972)).

Fortunately, other courts have echoed the majority’s view of patents as economically beneficial exclusive rights. \textit{See, e.g., U.S.M. Corps. v. S.P.S. Techs., 694 F.2d 505, 511 (7th Cir. 1982) (arguing for a view of patents as monopolies that may not be anticompetitive); United States v. Westinghouse Electric Corp., 648 F.2d 642, 646-67 (9th Cir. 1981) (acknowledging tension between antitrust and patent laws by noting that "one body of law creates and protects monopoly power while the other seeks to proscribe it"); Mannington Mills, Inc. v. Congoleum Corp., 395 F.2d 1287, 1295-96 (3d Cir. 1979) (establishing that one must conduct market analysis before determining that obtaining patent via fraud is an "attempt to monopolize in violation of the antitrust laws"); W.L. Gore v. Carlisle Corp., 529 F.2d 614, 622 (3d Cir. 1976) (distinguishing patents from antitrust/anticompetitive monopolies).}

\textsuperscript{157} \textit{Chakrabarty}, 447 U.S. at 309 (quoting S. REP. No. 1979, at 5 (1952) and H.R. REP. No. 1923, at 6 (1952)).

\textsuperscript{158} 580 F.2d 898 (6th Cir. 1978).

\textsuperscript{159} Id. at 914 n.25. The court stated:

The term monopoly connotes the giving of an exclusive privilege for buying, selling, working or using a thing which the public freely enjoyed prior to the grant. . . . [b]ut the] inventor deprives the public of nothing which it enjoyed before his discovery, but gives something of value to the community by adding to the sum of human knowledge.

\textit{Id.; see also In re Kaplan}, 789 F.2d 1574, 1578 (Fed. Cir. 1986) (citing \textit{Nickola} for Markey’s patent-as-property view); \textit{Schenk v. Nortron Corp.}, 713 F.2d 782, 786 n.3 (Fed. Cir. 1983) ("It 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.’").

\textsuperscript{160} \textit{See Dunner et al., supra} note 17, at 151-55 (1995) (noting that many viewed the Federal Circuit as pro-patent). Dunner’s statistical analysis refutes these views by analyzing Federal Circuit cases for this 11-year period and observing that although there was a high percentage of validity affirmances (88% for section 103 and 85% for section 112) the court affirmed the
would be uniform patent review and elimination of forum shopping.\textsuperscript{161} Also, because certain judges possessed patent and/or other intellectual property backgrounds, patentees anticipated increased consistency in patentability and infringement evaluations.\textsuperscript{162} Nevertheless, the Federal Circuit has not been without its own periods of "monopolyphobia,"\textsuperscript{163} as demonstrated by its cyclical attitude toward the doctrine of equivalents; this issue came to a head in \textit{Hilton Davis Chemical Co. v. Warner Jenkinson Co.}\textsuperscript{164}

\textit{Hilton Davis} epitomizes the competing policies frequently at war in the patent system. Generally, federal patent law adequately balances the property right of an inventor against the public's right to the free dissemination and use of information. In the area of patent infringement, however, there remains tension between an inventor's right to protect against a competitor making mere insubstantial changes to an invention—changes which would be beyond the literal language of the claims—and a competitor's right to rely on a claim's providing adequate notice of the scope of an invention. Unfortunately, section 271 of the Patent Act merely covers literal infringement of patent claims, and patentees seeking protection against non-literal infringement must rely on the doctrine of equivalents, a court-created remedy.\textsuperscript{165} \textit{Hilton Davis} provided the catalyst for a hotly

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\textsuperscript{161} See \textit{H.R. REP. NO. 97-312, at 20-21 (1981)} ("[S]ome circuit courts are regarded as 'pro-patent' and others 'anti-patent', and much time and money is expended in 'shopping' for a favorable venue.").

\textsuperscript{162} See CHISHOLM ET AL., supra note 11, at 31-32.

\textsuperscript{163} See Dunner et al., supra note 17, at 155-56. Although not expressly using the term "monopolyphobia," Dunner documents the cyclical response of even the Federal Circuit toward infringement cases. For example, he notes that in the last five years of his study, the court affirmed non-infringement as often as it affirmed infringement. From 1982-1988, the Federal Circuit found infringement 56% of the time and no infringement about 35% of the time. From 1988-1994, the percentage declined to 48% for infringement, while the percentage for non-infringement increased to 45%. \textit{Id.}


\textsuperscript{165} See 35 U.S.C. § 271(a) (1994) ("Except as otherwise provided in this title, whoever without authority makes, uses, offers to sell, or sells any patented invention, within the United States or imports into the United States any patented invention during the term of the patent therefor, infringes the patent."). Since the claims define the metes and bounds of an invention, literal infringement under section 271 requires literal copying of every element in a particular patent claim. \textit{See, e.g., Zenith Lab., Inc. v. Bristol-Myers Squibb Co.}, 19 F.3d 1418, 1424 (Fed. Cir. 1994) ("It is the claim that sets the metes and bounds of the invention entitled to the protection of the patent system."). Courts have held that restricting the enforcement of patent rights to only those cases where the patent was literally infringed would allow copyists to unfairly limit
contested debate over the use and viability of the doctrine of equivalents. It is no accident that scholars and jurists who view patents as merely creating limited monopolies also advocate narrowing or eliminating this equitable doctrine.166

Hilton Davis and Warner-Jenkinson manufactured dyes used in the food, drug and cosmetic industries.167 Although both simultaneously worked on a dye purification process that eliminated the expensive salting-out step, Hilton Davis was first to patent an ultra-filtration process. In its patent, Hilton Davis claimed a process to be operated at a pH of approximately 6.0-9.0. The upper pH limit was added in a patent amendment to overcome prior art, but there was no explanation in the patent specification or file concerning the lower limit.168 Unaware of the Hilton patent, Warner-Jenkinson implemented its own ultra-filtration process that operated at a pH of five. Hilton Davis immediately sued Warner-Jenkinson for patent infringement. Acknowledging that a pH of 5.0 went beyond the literal language of the claims, Hilton Davis’s claim went forward solely under the doctrine of equivalents.169

The district court case resulted in a jury finding the patent valid and infringed under the doctrine of equivalents.170 The jury also found there was no willful infringement and accordingly adjusted the damage award.171 The federal circuit, sitting en banc, reviewed the infringement issue only. In its appeal, Warner-Jenkinson argued that the doctrine of equivalents was an equitable remedy available only upon a suitable showing of the equities and an issue of law for the court.172 A fractured bench issued a majority opinion with one concurring opinion and three separate dissents.173

the patentee’s right to protect against insubstantial changes. Thus, the doctrine of equivalents evolved to find infringement in the instance of such insubstantial changes. The case most frequently cited for establishing the doctrine is Winans v. Denmead, 56 U.S. (15 How.) 330 (1853). Graver Tank modernized the doctrine by articulating the function, way and result rule. See Graver Tank & Mfg. Co. v. Linde Air Products Co., 339 U.S. 605, 608 (1950) ("[A] patentee may invoke this doctrine to proceed against the producer of a device if it performs substantially the same function in substantially the same way to obtain the same result.").


167 See Hilton Davis, 62 F.3d at 1515.

168 See id.

169 See id. at 1515-16.

170 See id. at 1516.

171 See id. at 1516.

172 See id. at 1525. This argument is based on the scholarly view that the doctrine of equivalents is an equitable rather than legal doctrine and should be reserved for those compelling circumstances where “unclean hands” or other equitable considerations mandate its application by the judge. Under this view, the jury should never determine equivalence. See id. at
The majority and concurring opinions validated the doctrine of equivalents as an essential supplement to the literal infringement analysis of section 271 and a question of fact for the jury. They supplemented the tripartite function, way and result test of *Graver Tank* with the "insubstantial differences" test. According to the court, additional evidence to consider when evaluating the substantiality of the differences includes: 1) function, way, result; 2) copying; 3) designing around; 4) existing knowledge of interchangeability; and 5) independent development.

Both the majority and concurring opinions lack any reference to patents as monopolies. Instead, Judge Newman's concurrence advocates evaluating patent rights from a public interest aspect, analyzing how broadly evaluating infringement to include both literal and insubstantially different equivalents positively impacts technological innovation. She notes that "[t]he principle of equivalency thus serves a commercial purpose, as it adjusts the relationship between the originator and the second-comer who bore neither the burden of creation nor the risk of failure." She cites a series of patent scholars and economists who substantiate that commercializing patents stimulates innovation. Judge Newman extends the thesis to the doctrine of equivalents, arguing that enlarging the value of the patent to the innovator also increases the net social value and serves as a risk-reducing factor in commercial investment. She concludes by recommending that the patent bar and judiciary confer to convince

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1539 (Plager, J., dissenting) (noting that the doctrine of equivalents is a judge made exception to the Patent Act and must be used sparingly by the courts when equity demands).

171 See id. at 1512.

174 See id. at 1527, 1529.

175 See id. at 1519-20. Under the insubstantial differences test the alleged infringing device is compared to the patented device to determine if they are substantially different. If there are only insubstantial differences then the device is infringing under the doctrine of equivalents. See id. The court also noted that in certain cases the insubstantial differences test would be supplemented with "other evidence relevant to the substantiality of the differences" such as known interchangeability and/or copying. Id. at 1519.

176 See id. at 1524 (noting that often the function, way and result test may be enough to establish insubstantial differences).

177 See id. at 1519-20.

178 See id. at 1529-31 (Newman, J., concurring).

179 See id. at 1531.

180 See id.

181 See id. at 1533. Judge Newman cites numerous sources to support her thesis, including Zvi Griliches. Id. at 1531. Recall that Griliches refuses to acknowledge the conclusive evidence regarding the impact of patent protection on gross domestic product and innovation. See supra note 73. See generally Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, J. ECON. PERSP., Winter 1991, at 29 (discussing whether patent protection provides incentive for cumulative research). Judge Newman also notes that with high-research costs industries tend to be more dependent on the patent system as an innovation device. See *Hilton Davis*, 62 F.3d at 1533 (Newman, J., concurring).
Congress to codify the doctrine of equivalents, thereby eliminating some of the uncertainty surrounding the doctrine.  

In sharp contrast to Judge Newman’s concurrence, Judge Plager’s dissent laboriously argued that the majority’s broad application of the doctrine of equivalents undermines the constitutional mandate of patent law and unlawfully extends this limited monopoly.  

The Supreme Court had the final say by affirming that the doctrine of equivalents is indeed a viable legal doctrine that supplements the literal infringement analysis.  Unfortunately, however, the Court

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182 Hilton Davis, 62 F.3d at 1535-36 (Newman, J., concurring) (“It is not the doctrine of equivalents, but the uncertainty of its application, that causes the uncertainty in commercial relationships. . . [a] statutory system that could accommodate the major factual scenarios of technologic equivalency could provide added certainty both to patentees and to those seeking to build on the subject matter of the patent.”).

183 Id. at 1539-45 (Plager, J., dissenting). The dissenters argued that preserving the doctrine and placing it in the domain of the jury would lead to an improper expansion of claim scope, with the late Judge Helen Nies opining that she could reconcile the doctrine if it were applied to each element of the claim, rather than to the accused product as a whole. See id. at 1574 (Nies, J., dissenting). Many also argued that the doctrine itself directly conflicted with the Patent Act of 1952 and should be abolished by the Court. Id. at 1578-79 (Nies, J., dissenting).

184 See Warner-Jenkinson Co. v. Hilton Davis Chem. Co., 520 U.S. 17 (1997). The petitioners argued that the 1952 Patent Act conflicts with the doctrine of equivalents and thus should be abolished by the Supreme Court. See Brief for Petitioner at 13, Warner-Jenkinson Co. v. Hilton Davis Chem. Co., 520 U.S. 17 (1997) (No. 95-728). Alternatively, petitioners adopted the view of the dissenters in the Federal Circuit that at a minimum the Court should severely narrow the doctrine and limit it to compelling equitable circumstances. See id. at 31. The brief cites several Supreme Court cases where the Court takes a narrow, “monopolyphobic” view of
was unwilling to fully embrace the appellate court's broad view of the doctrine and rendered an opinion heavily focusing on the tension between the DOE and the notice function of the claims/specification.\(^{185}\) Adopting the view of the dissenters in the Federal Circuit, it noted that the DOE "has taken on a life of its own . . . [and] when applied broadly, conflicts with the definitional and public-notice functions of the statutory claiming requirement."\(^{186}\) The Court then held that the insubstantial differences test outlined by the Federal Circuit must be evaluated under an element-by-element analysis of the claims.\(^{187}\)

The Court further narrowed the doctrine of equivalents by establishing that where the prosecution history or "file-wrapper" is silent concerning the purpose for an amendment limiting a claim element, the court should presume that the amendment related to patentability and is therefore barred by prosecution history estoppel.\(^{188}\) To avoid

\(^{185}\) See Warner-Jenkinson, 520 U.S. at 30-37.
\(^{186}\) Id. at 28-29.
\(^{187}\) See id. at 29 ("Each element contained in a patent claim is deemed material to defining the scope of the patented invention, and thus the doctrine of equivalents must be applied to individual elements of the claim, not to the invention as a whole."). The Federal Circuit originated the element-by-element test in Pennwalt Corp. v. Durand-Wayland, Inc., 833 F.2d 931 (Fed. Cir. 1987). Here, the Federal Circuit established that the doctrine of equivalents required an element-by-element comparison in order to determine whether there was an equivalent for each element. See id. at 934. In the years following Pennwalt, some argued that the Federal Circuit inconsistently applied the all-element test, and in some cases abolished it altogether. See, e.g., Hughes Aircraft Co. v. United States, 148 F.3d 1384, 1385-86 (Fed. Cir. 1998) (Clevenger, J., dissenting); see also Rudolph P. Hoffman, Jr., The Doctrine of Equivalents: Twelve Years of Federal Circuit Precedent Still Leaves Practitioners Wondering, 20 WM. MITCHELL L. REV. 1033, 1060 (1994) (noting that the application of the doctrine of equivalents remains uncertain).

In Warner-Jenkinson, the Supreme Court failed to provide a complete test for equivalence and left this to the expertise of the Federal Circuit.

With these limiting principles as a backdrop, we see no purpose in going further and micro-managing the Federal Circuit's particular word choice for analyzing equivalence. We expect that the Federal Circuit will refine the formulation of the test for equivalence in the orderly course of case-by-case determinations and we leave such refinement to that court's sound judgement in this area of its special expertise.

\(^{188}\) See id. at 34. Under the doctrine of prosecution history or file wrapper estoppel, limitations added to a claim during patent prosecution may create a bar to recapturing the broader limitation later under the doctrine of equivalents. Prior to the Supreme Court opinion, prosecution history estoppel could only create a bar if the limitation was expressly added to overcome
the estoppel, the patentee must establish an alternative reason for the amendment.\(^{189}\)

In *Hilton Davis*, the Court consciously sought to balance the property rights of the inventor against the public's right to public domain information. However, the opinion also illustrates the potential pitfalls from evaluating the patent right from an anticompetitive monopoly perspective. Categorizing patents as property circumvents the negative presumption surrounding the term "patent monopoly," which prevailed during the second cycle of judicial hostility toward patents, and which periodically surfaces when courts seek to narrow patent rights.\(^{190}\) The next section illustrates how the various cycles of judicial hostility negatively impacted patent application filings, which, in turn, negatively impacted economic growth to some degree.

**B. Judicial Enforcement of Patents, Relation to Patent Application Proportions and Economic Growth**

*If U.S. industries are to remain competitive in world markets, our laws should not inhibit invention and innovation; rather, they should nurture and encourage them.*\(^{191}\)

The suggestion that there have been cyclic variations in the level of American inventiveness has been rejected more be-
cause of failure to discover any evidence supporting the sug-

The 1996 FTC’s Competition Policy Report notes that “[r]esearch-intensive industries, such as the computer, semiconductor, software, communications, aerospace, pharmaceuticals, scientific instruments, and chemicals industry, have grown at an average of twice the rate of growth in real GDP from 1972-1992.” The report also cites evidence suggesting that both intellectual property protection and competition are important to spur such innovation. Unfortunately, few legal scholars and economists have researched and clearly documented the nexus between patents and technological innovation in the United States. Indeed, Edwin Mansfield has emphasized that, “given the age and prominence of the patent system, it is surprising how little is known about its effects on the rate of innovation.”

Mayers, in his 1957 piece, stated that public sentiment had some effect on the cyclical judicial hostility toward patents, but also argued that factors such as cyclical inefficiency of the administration at the patent office and reexamination laws equally influence the trend. Similarly, Zvi Griliches argues that “patent numbers are an imperfect index of inventive output. . . . [with] patent numbers leav[ing] us where we began, with a suggestive but possibly misleading puzzle.”

This section documents preliminary research conducted to evaluate the relationship between the cyclical judicial hostility towards patents, the number of patent applications filed and gross domestic prod-

192 Mayers, supra note 86, at 51.
194 See id. ch. 8. The report also notes that patents may have an anticompetitive effect if used in violation of antitrust laws as in illegal tying monopolies, cross licensing schemes etc., or if the PTO issues an overly broad patent grant. Id.
195 Scholars have conducted industry-specific research as well as research on smaller countries, to conclude that intellectual property rights do play a role in economic growth. These scholars have concluded that countries with strong intellectual property protection have stronger economies and technological innovation. See, e.g., Gould & Gruben, supra note 73 (comparing intellectual property rights in various countries); Narin & Noma, supra note 72 (examining the correlation between patents and corporate technological strength in the pharmaceutical industry).
196 Mansfield, supra note 18, at 173. Mansfield conducted a limited empirical study of 100 random U.S. manufacturers to support his thesis that patent protection does positively impact innovation. He notes that the drop in propensity to patent in the late 1960s and 1970s may be attributable to a decline in the annual number of patents granted to U.S. inventors. See id. at 178-79.
197 See Mayers, supra note 86, at 36-41, 43-46.
198 Griliches, supra note 72, at 319.
There appears to be some nexus between cyclical judicial hostility and the level of inventiveness that ultimately impacts economic growth (as reflected in GDP). For instance, there is a substantial Pearson’s correlation between cyclical judicial hostility and number of applications filed, and there is also a significant Pearson’s correlation between patents filed and GDP. It was more difficult, however, to establish a clear cause-and-effect relationship between patents adjudicated, patents filed and GDP. This is not surprising since productivity via innovation is one of several components that determine growth of GDP. Thus, more detailed economic analysis is required to establish conclusively the cause-and-effect relationship. Nonetheless, it is possible to utilize the rank correlation technique to substantiate that there is a direct relationship between patents adjudicated, patents filed and GDP. This synergy presents plausible evidence that society’s attitude toward intellectual property, and patents in particular, plays a significant causative role in driving inventiveness, which ultimately impacts economic growth.

As noted in the previous section, Figure 1 and Table 1 represent a statistical analysis of appellate cases to determine the percent of adjudicated patents held valid during the periods of 1891–1993. For statistical purposes, a case was adjudicated valid if any single claim of the patent was held valid and infringed. Alternatively, any cases

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199 I chose gross domestic product over gross private domestic investment since I am only investigating a trend and a possible cause-and-effect link between patent protection and economic growth. I encourage economists to follow up on this data with the proper logarithmic analysis to further verify the relationships, particularly with reference to gross domestic investment.

200 In fact, it was patent instability (caused by non-uniformity and forum shopping) which led to the formation of the Federal Circuit. See supra notes 161-63 and accompanying text.

201 Specifically, GDP results from several variables, including but not limited to, such factors as savings rate, exchange rate, savings, income, and governmental policy.

202 The rank correlation technique is useful when one or more variables in question cannot be measured in an ordinary way. The range utilized is from +1 to -1. A positive rank correlation suggests that the variables are directly related, while a negative one suggests that they are inversely related. The two extremes represent a perfect direct or inverse relationship, respectively. Statistical independence would have a rank correlation coefficient of zero.

203 One flaw in the analysis was using total application numbers and comparing these to national GDP without breaking it down by industry. Mansfield and Griliches, in their studies, compared patent applications/grants by key industry to industry specific GDP data. See Mansfield, supra note 18; Griliches, supra note 73. Neither study has added into the analysis the tracking of individual cases in which patents were held invalid. My next paper will attempt to link the three, through a focus on the pharmaceutical industry.

204 The percentage of patents held valid was determined by dividing the number of cases in which a patent was held valid by the total number of cases in which validity was determined, then multiplied by one hundred. For the years preceding 1957, case data was obtained from the Mayers paper, supra note 86, and was available as totals per multi-year period. Donald Dunner graciously supplied data for the years 1982–1994. See Dunner et al., supra note 17, at 153.

205 For example, see Mayers, supra note 86, at 34, stating:
holding a patent not infringed without considering validity was discarded from the analysis. Clearly, the most troublesome cycle of judicial hostility occurred from the mid-1930s through the 1950s. Figure 1 shows a substantial drop in validity findings during the Court’s “anti-patent” bias, fueled by the Sherman Act and the Court’s belief that all patents were anticompetitive monopolies.

Similarly, it is no coincidence that within a short period of time following the Loew’s presumption that patents automatically confer market power and thus are ‘per se’ restraints on trade, we entered another cycle of judicial hostility towards patents. As seen in Figure 1, after a brief upswing of validity determination in the early 1960s, a series of dips in validity findings occurs through the 1970s. Comparing this dip to the dip occurring after the patent misuse cases (decided in the 1930s and 1940s) strengthens the thesis that when the judiciary view patents as anticompetitive limited monopolies, they narrowly evaluate patents and are less inclined to find the patent right valid and enforceable.

Figure 1a further illustrates the negative impact of the cyclical judicial hostility towards patents. It compares the total patents adjudicated with the percent held valid between 1891-1992. The graph illustrates a significant positive relationship between the total number of patent cases adjudicated and the numbers of patents that are held valid. In light of the data reflected in Figure 1, a plausible explanation for this correlation is that during cycles of judicial hostility patentees are reluctant to appeal findings of invalidity. Thus, the decrease in total validity adjudications during a period of minimal percent validity findings may indicate a higher litigation threshold for a patent-owning business. A business having a bad experience attempting to enforce a patent may be reluctant to enforce its other patents unless the chances of success start increasing. During a period when courts are hostile towards patents and find a low percentage valid, many patentees will become litigation-averse and will decline to enforce patent rights in court for fear of an invalidity finding. This results in a drop in infringement filings and a decrease in total validity adjudications.

[A] decision holding any claim of a patent valid shall be counted as favorable to the patent... even though some or all claims may have been held not infringed. This is on the rationalization that a holding of partial validity, without more, recognizes the presence of invention in the questioned patent and promises the patentee pro tanto judicial protection, regardless of further holdings on collateral issues.

Id.

206 My research assistant Eric Kron pointed out another explanation for the similarity in trends between patents adjudicated and percent held valid. He notes that the trend may be an
Yet, although legal scholars have explored the various cycles of hostility, a clear consensus that judicial sentiment toward patents directly and significantly impacts the variances in validity determinations is still lacking. As substantiated by the case analysis, however, negatively viewing patents as monopolies was a key factor behind each dip. Other factors that are more difficult to document and measure included variances in examiner proficiency, productivity at the PTO, and the reexamination and reissue proceedings. Unfortunately, the patent validity data is somewhat imperfect since it fails to include cases of patent infringement where validity was not raised as a defense. However, since validity is an issue in the overwhelming majority of cases, this impurity does not affect the ability of this data to signal and measure each “monopolyphobic” cycle.

artificial creation of the criteria used to select which cases are validity adjudications. He made several intriguing observations. Cases in which a patent is expressly declared valid are considered validity adjudications. Additionally, cases where patents are held infringed are also considered validity adjudications, based on the logic that if a patent is held infringed then the patent must be valid. Furthermore, cases in which patents are expressly held invalid are counted as invalidity adjudications. However, cases where patents are held not infringed are not counted as invalidity adjudications because the issue of validity may not have been reached. Thus, two categories of holdings that are beneficial to the patentee are considered validity adjudications: express declarations of patent validity and findings of infringement. Conversely, only one category of holding that is hostile to the patentee is counted as an invalidity adjudication: express declarations of patent invalidity. Although the appellate court may express hostility toward patents by refusing to find infringement, this type of hostility appears to be excluded from the invalidity adjudication. Thus, during a hostility period it may appear as if the total number of validity adjudications decreased from a time when the court was friendly toward patents. He posits that in this hypothetical, the decrease is explained by the fact that findings of infringement are counted as invalidity adjudications, whereas findings of non-infringement are not.

My response is that because the overwhelming majority of cases include the invalidity defense and validity adjudication, the few cases where non-infringement is found without a validity determination do not significantly impact the trend. Nonetheless, I concede this is a valid point that presents food for thought in this area.

See, e.g., Mayers, supra note 86 at 50-51. Mayers cautiously concludes that the evidence supports a correlation between the data on patent validity determinations and cyclical public sentiment toward industrial manufacturers and the patent right. He notes, however, that we still need to explore other dominant causes for the cycles, such as cyclical inefficiency of the PTO. “The suggestion that there have been cyclic variations in the level of American inventiveness has been rejected more because of failure to discover any evidence supporting the suggestion than in the light of evidence rebutting it.” Id. at 51.

In contrast, Zvi Griliches is unwilling to accept even Mayers’s basic thesis; he argues that the impact of the PTO is far more significant than public sentiment/judicial hostility. See generally Griliches, supra note 72, at 298-99 (arguing that rising opportunity costs at the PTO negatively impacts independent patent applications).

See Mayers, supra note 86, at 36-37, 43-46; see also Griliches, supra note 72, at 295 (arguing that examiners are taking longer to complete the application process due to the rising complexity of the applications).

Another source of impurity is that most patent cases involve multiple claims. For counting purposes, in a multiple claim case, if at least one claim was held valid, the entire case was considered valid. The theory is that the single claim was enough to commercially exploit the invention commercially.
Next, we evaluated how the cyclical judicial hostility toward patents affected inventors and filings of applications in the PTO. In other words, did any particular cycle of judicial hostility affect the subsequent desire of inventors to seek patent protection? Figure 2 and Table 2 include both the percent of adjudicated patents held valid and the number of patent applications filed for the years 1925-1993. In general, the curves appear to follow similar trends. Upon close inspection, however, we noted some interesting differences.

First, between 1925 and 1946 there is a more direct correlation and the curves mirror each other, with a sharper decrease in patent applications filed right after the Great Depression and World War II. Similarly, during World War II, when there was an economic boom, there is a sharp upswing in the number of applications filed.

Severe economic shifts thus appear to have a greater impact on applications filed than validity adjudication. This may be expected, since investments by private industry are far more sensitive to economic swings than to the attitudes of the judiciary. For example, a severe downturn in the economy leads to cost-cutting by private industry in order to maintain profitability. Often, research and development monies used to fund patent procurement are included in the cuts, thereby negatively impacting the number of applications filed during such a downturn. As a result, there is less activity in the invalidity curve during periods of sharp economic swings.

Second, after the formation of the Federal Circuit the number of patent applications filed increased dramatically. Patentees appeared to believe that this Circuit possessed the technical expertise to evaluate patentability during the prosecution stage and would consistently and equitably evaluate appeals from the Patent Office. Interestingly, the minor recession suffered in the 1980s had little impact on the number of applications filed. This may suggest that public sentiment about patents and/or the prosecution process more significantly impacts changes in applications filed, rather than economics, unless there is a severe economic shift.

Third, a close inspection of the antitrust cycle (1937-1959) of patent "monopolyphobia" appears to strengthen the position that judicial

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210 The Pearson’s correlation number for percent valid vs. percent change in applications is 0.47 for the time period 1960-1993. Identical data bears a Pearson’s correlation of 1.0, with negative correlations ranging from -.9999 through -1.0. Thus, a + 0.47 Pearson’s correlation seems to indicate, as the curves indicate, a somewhat direct nexus between percent valid and percentage change in applications filed.

211 It would be interesting to pursue further studies on whether the number of infringement suits filed increased during periods of recession/depression. Arguably, reducing research and development expenditures may motivate more firms to copy existing patented technology, rather than invent their own.
hostility significantly affects validity adjudication, which in turn impacts applications filed. During this cycle, the judiciary was openly hostile towards patents, strictly evaluated validity and held numerous patents invalid. This ultimately led to reduced confidence in the courts and reductions in the number of patent applications filed.

To statistically substantiate our visual evaluation of the relationship between the data, we ran Pearson’s correlation, rank correlation and T-test confidence calculations to evaluate the relationships among patents adjudicated on appeal, patent application filings and GDP. Table 2 notes a rank correlation of .660 and a Pearson’s correlation of .646 between adjudication of patents held valid and patent applications filed. Since these numbers are both approaching +1.0, they appear to indicate evidence of a direct relationship between the two variables being compared.

As seen in Table 5, an even stronger statistical correlation is found between percent change in GDP and percent change in patent applications filed. Figure 3 appears to indicate a direct relationship between patents adjudicated, patents filed and GDP. Tables 3 and 4 indicate a rank correlation of .944 and Pearson’s correlation of .887 between patent applications filed and GDP. These measures indicate that these calculations are not statistically independent. Moreover, Table 3 also shows excellent T-test confidence indicators of 16.387 and 11.042, which supports the theses that this Article has advanced.

Our statistical analysis fails to substantiate which set of data establishes cause and effect. However, a visual inspection of Figure 3

\[ \text{Pearson's correlation is a preferred function to compare data sets to evaluate how direct the correlation is between data. It is an estimate of the population correlation coefficient. See AMIR D. ACZEL, COMPLETE BUSINESS STATISTICS 438 (3d ed. 1996). When two data sets are compared using a Pearson's function, the output can range from -1 to +1. Id. at 436. A Pearson's correlation coefficient of +1 means there is a perfect and positive linear relationship between the two variables such that whenever one variable increases, the other variable also increases. Id. Similarly, a Pearson's correlation coefficient of -1 indicates there is a perfect and negative linear relationship between the two variables such that whenever one variable increases, the other one decreases. Id.} \]

On rank correlation technique, see supra note 202.

Finally, the T-test confidence interval measures the probability that a range of values (an interval) contains a given parameter (or value). See ACZEL, supra, at 208. The t-distribution is distinguished from the standard z-distribution by the fact that the population standard deviation (\( \sigma \)) is unknown. Id. at 217.

Since innovation and patent investments comprise percentages of the GDP calculation, it is difficult to obtain a +1 Pearson’s or rank correlation figure. See, e.g., Adam B. Jaffe, Trends and Patterns in Research and Development Expenditures in the U.S., 93 Proc. Nat’l Acad. Sci. USA 12658, 12658 (1996) (noting that in 1994, $169.6 billion was spent on R & D expenditures, which was 2.5% of gross domestic product).
seems to indicate that judicial hostility may cause a reduction in patent filings which then negatively impacts GDP, to some degree. Edwin Mansfield, in an industry by industry comparison of patents granted against GDP concluded that in industries such as pharmaceuticals and chemicals, which rely heavily on patents for intellectual property protection, patent procurement did increase the rate of innovation and had a substantial impact on the industry.\textsuperscript{215} Economist Francis Narin also substantiated that patents are indicators of corporate technological strength in the pharmaceutical industry.\textsuperscript{216} Narin found correlations of 0.82 between expert opinion of pharmaceutical company technical strength and the number of U.S. patents granted to the companies.\textsuperscript{217} He further found correlations in the general range of 0.6 to 0.9 between increases in company profits and sales, and both patent citation frequency and concentration of company patents within a few patent classes.\textsuperscript{218}

This research is preliminary and not meant to establish conclusively that patent filings or procurement drive economic growth. At a minimum, however, this data substantiates that patent filings, along with judicial views, impact economic growth to some degree. In light of this synergy, courts should carefully consider how patents are characterized and avoid utilizing terms like “monopoly” which restrict a fair and expansive evaluation of patent rights. Instead, to enhance this synergistic relationship, the patent right should more properly be viewed as property.

III. COURTS AND CONGRESS SHOULD VIEW PATENTS AS PROPERTY

"In considering patent matters and question, letters patent should be viewed in the same light as a land grant, should never be termed, be accorded the same treatment as other forms of property, and should always be referred to or designated as a patent grant."\textsuperscript{219}

Like trademark rights, patent property rights are readily supported under a utilitarian approach. In this view, property is viewed as a "man-made social institution and means of organization, whose underlying goal is wealth maximization while balancing the relative so-

\begin{itemize}
  \item \textsuperscript{215} See Mansfield, \textit{supra} note 18. Mansfield also concludes, however, that he can not make the same empirical conclusion for other industries such as primary metals, electrical equipment and motor vehicles, which rely much less on patent protection. See \textit{id.} at 180. Harvard economist Zvi Griliches similarly concludes that the data is inconclusive concerning the overall positive impact of innovation (patent procurement) on GDP. See Griliches, \textit{supra} note 72, at 303.
  \item \textsuperscript{216} See Narin et al., \textit{supra} note 72.
  \item \textsuperscript{217} See \textit{id.} at 150.
  \item \textsuperscript{218} See \textit{id.} at 150, tbl. 6.
  \item \textsuperscript{219} Kitch, \textit{supra} note 24, at 32 (citation omitted).
\end{itemize}
cial costs."\(^{220}\) Posner utilizes the utilitarian approach and broadly defines the property right as any "legally enforceable power to exclude others from using a resource, without need to contract with them."\(^{221}\) The patent right fits squarely within the Posnerian property paradigm, which acknowledges that intellectual property rights include both the static benefit of preventing overuse of the resource and the dynamic benefit of providing an incentive to create or improve upon existing resources.\(^{222}\)

Many provisions of federal patent law can be seen as advancing such a benefit to the patentee. The twenty-year right to exclude others from making, using and selling the patented product or process provides a reward and incentive to create useful property. The patent claims provide specific property boundaries,\(^{223}\) while the specification enhances the description of what is claimed. The statutory disclosure and enabling requirements\(^{224}\) ensure that other inventors can use the patented information as building blocks for new and improved devices. Furthermore, the limitations of novelty and non-obviousness prohibit duplicating property already in the public domain, thereby meeting the static benefit of preventing overuse of existing resources.\(^{225}\) Moreover, the PTO examination process and judicial enforcement of patents provide additional means of limiting the breadth and scope of patentable subject matter. Thus, the patent right unquestionably provides benefit; the question remains, at what cost?

Landes and Posner note that there are four costs associated with patent property: (1) transfer cost; (2) rent seeking—the cost incurred by duplicative research and development in identical inventions; (3) protection and enforcement; and (4) social "cost of restricting the use of property when it has a public-good character."\(^{226}\) They posit that intellectual property rights have particularly high costs that mandate limiting them in ways that other property rights are not.\(^{227}\) For pat-

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\(^{220}\) Rose, supra note 9, at 123 n.128 (citing JESSE DUKEMINER & JAMES E. KRIER, PROPERTY 56-57 (3d ed. 1993)) ("This view is without a doubt, the dominant view of property today, at least among lawyers and especially among those working in law and economics.").


\(^{222}\) See id.

\(^{223}\) Of course, the ambiguities surrounding language create difficulties regarding the claims’ setting of clear boundaries. Indeed, the Supreme Court recently held that claim interpretation is not a question of fact for the jury, but is instead a question of law. See Markman v. Westview Instruments, Inc., 517 U.S. 370, 387 (1996).


\(^{225}\) See, e.g., Dam, supra note 39, at 266 ("It [the non-obviousness requirement] sharply limits the littering of the innovation landscape with land mines consisting of patents on what those skilled in the trade would assume to be in the public domain.").

\(^{226}\) Landes & Posner, supra note 221, at 267.

\(^{227}\) See id. at 268.
ent, many of the same benefit-producing provisions also help to reduce such costs. The novelty and non-obvious requirements and the twenty-year term limitation meet this goal with provisions requiring enabling disclosures, clearly defined claims\textsuperscript{228} and early filing; these requirements contribute to minimizing cost.\textsuperscript{229} The right to exclude others from making, using and selling provides the commercializing inventor with a cost advantage that allows her to reap greater profits, resulting in increased production rather than restriction of socially beneficial products. Novelty and non-obviousness weed out discoveries that lack contribution and properly belong in the public domain, thereby minimizing economic rents.\textsuperscript{230} The Patent Act and \textit{Patent Manual of Examining Procedure} provide an elaborate network of law and administrative guidelines that minimize the cost of patent procurement and enforcement.\textsuperscript{231} Finally, a balanced judicial attitude toward patents minimizes rent dissipation by ensuring that the patent property lines are equitably drawn under both the literal infringement and doctrine of equivalents analyses.\textsuperscript{232}

The irrational fear that broadly protecting patent rights impedes free market competition entices courts and scholars to view patents erroneously as anticompetitive monopolies. Yet, some argue that cyclical judicial hostility is a necessary evil since it swings the pendulum away from rewarding inventors at the expense of the public and back toward free market competition.\textsuperscript{233} During periods of increased findings of invalidity, more public good property is returned

\textsuperscript{229} See Dam, supra note 39, at 258.
\textsuperscript{230} See id. at 263.
\textsuperscript{231} See id. at 262 (noting that any property system has an associated administrative cost, but absent an interference proceeding, "the cost per patent is relatively modest"). Dam concedes, however, that the high costs of litigation in the United States create a substantial cost for judicial enforcement of patent rights in infringement cases, but that court costs would be associated with enforcing any property right. See id.
\textsuperscript{232} See Grady & Alexander, supra note 74, at 308 (advocating the rent dissipation theory of judicial enforcement of patents). According to Grady and Alexander, the courts serve the unique role of minimizing rent dissipation by "granting protection broad enough to prevent a race to improve on the telephone, but not so broad as to create wasteful races for other patent goldmines." Id. The authors go on to argue that the cyclical nature of judicial enforcement is the price we pay for minimizing rent dissipation. On this point, I disagree with their thesis, since I believe that this view once again presumes that patents inherently confer market power and create excessive economic rent.
\textsuperscript{233} See, e.g., Littman, supra note 166, at 545. Littman disfavors using economic arguments to support broadly evaluating patent rights. He supports the need for multiple courts of appeal for patent infringement cases, since the formation of the Federal Circuit has tipped the balances in favor of patentees. Littman also cites several Federal Circuit opinions wherein the dissent questioned whether the Federal Circuit has leaned too far toward patentees. See id. But see Harmon, supra note 17, at 794 ("At the present time, I feel comfortable advising clients that the patent enforcement pendulum is swinging toward a more neutral position, where it really ought to be."); see also Grady & Alexander, supra note 74, at 310 ("[W]e theorize that the courts have found ways of minimizing the problem that patents create.").
to the public domain, thereby reducing the high cost associated with the patent property right. However, this view contradicts the data presented and the incentive theory behind the constitutionally-mandated patent grant. Periods of judicial hostility toward patents impede free market competition and limit economic growth. In response to minimal patent enforcement, corporations reduce the number of patent filings by curtailing research and development or resorting to trade secrets. Since a trade secret is never disclosed to the public, the company now has a true, unlimited "monopoly" on information. This negatively impacts our economy in two ways. First, a reduction in patents limits disclosures available for future research and development. Second, encouraging trade secret protection increases a firm's ability to procure market power since competitors can not access this secret information to create new and competitive products or processes.

To maintain the appropriate balance, I propose amending the Patent Act to include an express definition of patents as property. Legislative history noting the problems of labeling patents as anti-competitive monopolies would also be helpful. Ideally, revised section 101 would expressly prohibit use of the term "monopoly" to describe the patent right. This would ensure that "monopoly" is reserved for situations of patent misuse which violate antitrust provisions and restrain trade.

Secondly, I propose codifying the doctrine of equivalents. This would give additional congressional emphasis of patents as property. The concept mirrors the "fair use" provision of the Copyright Act, wherein numerous factors are provided for courts to evaluate fair use. Section 107 of the Copyright Act admonishes that fair use is determined on a case-by-case basis with no single factor being dispositive of fair use. Similarly, amended section 271(d) of the Patent Act would add infringement under the doctrine of equivalents. It

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235 I hope that codification of the DOE also leads to a more consistent evaluation of how to draw effective boundaries around a patentee's right based on what she has claimed, disclosed in her invention, or stated during prosecution. See supra note 22 and accompanying text.

236 17 U.S.C. § 107 (1994). Fair use is one of the enumerated exceptions to the exclusive rights provided copyright owners under § 106 of the Copyright Act. The primary purpose of the fair use doctrine is to provide for reproduction in copies for purposes such as research, comment, teaching and scholarship. The factors which a court must consider in evaluating fair use include: 1) The purpose and character of the use, including whether such use is of a commercial nature or is for nonprofit educational purposes; 2) the nature of the copyrighted work; 3) the amount and substantiality of the portion used in relation to the copyrighted work as a whole; and 4) the effect of the use upon the potential market for or value of the copyrighted work. See id.

237 See id.
would also require an objective evaluation of several factors to determine the substantiality of the differences between the accused and patented devices.

The factors for determining insubstantial differences would be: 1) function, way, result; 2) "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"; 3) evidence of copying; 4) evidence of "designing around"; and 5) evidence of independent development. Like Merges and Nelson, I would add a sixth factor: evaluating the overall design improvement of the accused device. Section 271(d) should clarify that the determination of an "equivalent" is made on a case-by-case basis with no single factor being dispositive of equivalence. This ensures an equitable evaluation of the patent "property" of the patentee, while balancing the competing interest of encouraging new innovation without unfairly extending the statutory boundaries of the patent right.

CONCLUSION

Viewing patents as property helps the Supreme Court, Federal Circuit and district courts evaluate these rights in an equitable and consistent manner. This enhances the synergy between patents and industrial growth, thereby ensuring that we remain a "fountainhead" of technological innovation in an era of ever-increasing global competition.

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239 See Merges & Nelson, supra note 12, at 910 ("The equivalents inquiry, even for a pioneer patent would be centered around whether the improved structures of the accused device show major differences from the structures disclosed in the original specification."). This is basically the Hilton Davis insubstantial differences test, but the authors add the following areas to consider: "materials, change in number of components, greatly improved efficiency in individual components, . . . overall design improvement." Id.
240 The legislative history should point out that consistent with Hilton Davis, there may be times when function, way and result alone may establish equivalence. See Hilton Davis, 62 F.3d at 1522.
APPENDIX

Figure 1
Figure 1a

In this chart, data before 1857 were compiled in five-year periods. Before 1850, Total Patents Adjudicated represent the average over each compilation period.

Total Patents Adjudicated

Year

1850
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000

Total Patents Adjudicated & Percent Held Valid

1891 - 1932

Percent Valid
Figure 2
Figure 3

Percent Change (GDP & Apps)

Year

Percent Valid

GDP and Apps, Percent of Patents Held Valid
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Data was unavailable for the years 1915-1924. Before the year 1958, data was available only in four-year intervals; we averaged the values for each four-year period.
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