WHY WE NEED A STRONG PATENT SYSTEM AND WHEN: FILLING THE VOID LEFT BY THE *BILSKI* CASE

by

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> If we could first know where we are and whither we are tending, we could then better judge what to do and how to do it.[2]
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> Abraham Lincoln
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> The patent system... added the fuel of interest to the fire of genius, in the discovery and production of new and useful things.[3]
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> Abraham Lincoln

ABSTRACT

Patent law is presently under-theorized. Patents are granted to serve as rewards for certain types of inventive successes,[4] but the nature of the successes to be rewarded, the circumstances that should trigger rewards, and the size of the rewards that will best serve the public remain in substantial dispute. One of the primary reasons for these uncertainties is the incompleteness of underlying theories explaining why patented inventions deserve special treatment and rewards. The lack of good understanding of the theoretical justifications for patent rewards (and the limitations of those justifications) means that patent law standards are being

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1 The author would like to thank ???.

2 "A House Divided", June 16, 1858.

3 "Second Lecture on Discoveries and Inventions", February 11, 1859.

4 The reward logic and technology enhancement goals of the patent system are embedded in the Constitutional provision that forms the basis for the United States patent system. The Constitution provides that Congress may establish a patent system "To promote the Progress of … the useful Arts" by granting inventors exclusive control over their discoveries for limited times. U.S. Constitution, Article I, Section 8, Clause 8. This provision envisions grants of exclusive rights in discoveries as means to reward discoverers and to thereby promote more discoveries and the expansion of knowledge about useful advances. Through this greater knowledge, the patent system was expected to achieve progress in the accumulation and use of specialized knowledge in the "useful arts."

reconsidered and revised without a clear sense of patent law goals. If we do not know where we are trying to go in setting patent standards, how can we know how to proceed?

This article seeks to overcome these limitations on present analyses of patent policies and standards. The article attempts to better define the innovation reward goals of patent laws and to set directions for future thinking about a variety of patent law standards. It describes a model of patent rewards based on the work of Harold Demsetz concerning property controls limiting access to public goods. The article argues that patented invention designs should be limited to excludable designs for which workable access controls and access payment systems are feasible. Access to these sorts of inventions – as with other types of excludable public goods -- should be regulated and controlled by patent rights to attract resources to the production of patentable inventions and to ensure that these inventions are produced at socially desirable levels.

The article considers the merit of providing patent rewards conforming to this model. It also considers at what points the model breaks down and under what circumstances patent rights should be withheld accordingly. By considering both the justifications for strong patent rewards and the limitations of those justifications, the contours of desirable patent standards in several areas of patent law become clearer. The concluding section of this article offers preliminary thoughts on how the model developed here can be used to shape several important patent law standards.

I. Introduction

A. The Post-*Bilski* Void in Patentable Subject Matter Standards

Over the past two decades, federal courts have struggled to define the boundaries of the patent system.[5] The struggle has focused on attempts to define generally applicable standards for identifying patentable subject matter. Such standards specify the types of advances that can qualify for patents if other patent law tests are met. Since an advance that is not patentable subject matter can never qualify for a patent no matter what other features the invention may have, this standard places outer boundaries on the patent system. It specifies ranges of useful advances for which patents will never issue and for which patent incentives and rewards will never be factors. Because patentable subject matter criteria limit the outer boundaries of the patent system and its effects in this way, these criteria are among our most important patent law standards.[6]

The clarity of patentable subject matter standards is a critically important feature of the patent system since these standards signal when potential innovators can look to patent rewards as incentives. Doubts about whether the patent system will apply reduce and weaken the incentives for innovation that the system provides. If a potential innovator is uncertain about

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[5] The particular standards adopted and rejected by courts in these struggles are recounted in detail at a later point in this article. See text at notes ???, *infra.*

[6] Subject matter standards for determining the range of items and processes that are governed by property rights are among the bedrock standards of any property system. *See generally* Abraham Bell & Gideon Parchomovsky, *A Theory of Property*, 90 CORNELL L. REV. 531, 575-76 (2005)(arguing that any property law must address four interlocking fundamental questions: "(1) what things property law protects; (2) vis-à-vis whom; (3) with what rights; and (4) by what enforcement mechanism").

whether a given type of advance will qualify for a patent, she will discount the importance of patent rewards below the levels that the innovator would perceive if she thought that the issuance of a patent was more certain. Hence, uncertainty regarding the range of patentable subject matters risks undercutting the incentives and impacts of the patent system in the areas of uncertainty. The judicial struggle over patentable subject matter standards – and the highly unresolved state of this struggle at present – have impaired the operation of the patent system and potentially curtailed the development of valuable technologies by creating doubts about the applicability and scope of patent rewards for many socially valuable advances.

The Supreme Court's brief and largely superficial opinion in *Bilski v. Kappos*[7] has brought the need for greater analytic underpinnings and definition in patentable subject matter standards to the fore. In *Bilski*, the Court rejected a generally applicable subject matter test previously articulated by the Federal Circuit court, while refusing to provide a substitute of its own. The Supreme Court's analysis of the invention before it (a method of managing risk in commodities transactions) involved pointing out that patentable inventions must not be just "abstract" ideas (as distinguished from more practical inventions) and then finding that the invention before it was too abstract. The Court did not indicate why it thought that abstract ideas were not properly subject to patent rewards, nor did it describe what makes a design too abstract for patenting. The Court's analysis seemed to reflect no underlying theory of patentable subject matter, which precluded a reasoned explanation of why the abstractness of an advance matters. Nor did the Court indicate what features of a useful advance would bear upon whether the advance constitutes patentable subject matter as distinct from an abstract idea.

The lack of a viable standard articulated in *Bilski* – or even a viable approach to stating or implying such a standard – leaves future determinations of patentable subject matter largely unstructured and susceptible to wide variation. Lower federal courts will need to define new approaches to determining patentable subject matter that are general enough (and forward looking enough) to provide meaningful answers regarding the applicability of the patent system to technologies with characteristics that we cannot even imagine today. Ideally, in order for the incentives of the patent system to encourage and regulate the production of new advances, potential inventors of new technologies should have confidence that the their advances will probably be inside or outside the patent system when they contemplate the development of their advances and the rewards they can expect for successful development efforts. Absent some predictability that the patent system and associated patent rights and rewards will probably apply to a given type of advance, it is hard to see how the patent system can encourage and regulate the production of that type of advance. Hence, there is a particularly strong need for clearly articulated principles determining patent system scope and specifying (in a predictable manner) the outcomes of patentable subject matter analyses.

B. In Search of Theoretical Underpinnings

The Supreme Court's lack of a clear approach in defining the outer boundaries of the patent system stems from the Court's incomplete specification of the goals of the system. If it had a clearer picture of the incentive functions Congress intended to be served by the patent system, the Court would have had an easier time in *Bilski* in specifying criteria for determining

[7] 130 S.Ct. 3218 (2010).

when the system should apply. Without these theoretical underpinnings, the Court was at a loss to articulate generally applicable tests or principles for assessing whether patentable subject matter is present, other than to repeatedly utter the largely unhelpful notion that patentable advances must not be too "abstract".[8]

Had the Court considered the goals of the patent system in its analyses, it would probably have concluded that these goals remain poorly defined in both prior cases and academic literature. While there is some general sentiment – stated in both cases and articles – that the patent system is aimed at rewarding inventors for their work, there is little detail on how this reward system is to work and when. Hence, the incomplete understanding of the reward logic of the patent system has curtailed the use of reward objectives as criteria for evaluating the patent system and for constructing and interpreting vague patent law standards such as patentable subject matter tests. This article aims to improve this situation by providing a greater understanding of how and when the patent system may provide beneficial rewards to inventors and thereby encourage and regulate the production of valuable inventions.

Academic commentators have described a number of theories describing the impacts of patent rights and patent enforcement.[9] This subsection summarizes these descriptions of patent impacts and assesses how these descriptions relate to the production of new advances by inventors. Overall, these patent theories provide a remarkably incomplete picture of how patents can beneficially influence the production of new advances and the allocation of scarce resources to such production.

C. A Brief Overview of Patent Law Theories

Theories describing the impacts of patents fall into broad three categories: 1) theories describing the impact of patents on the production of patent-eligible advances, 2) theories describing the impact of patents on the disclosure and use of advances after they are invented, and 3) theories describing the role of patents in dividing up and organizing activities surrounding the production of new advances.

This subsection summarizes these theories and their relation to the production of new innovations.

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[8] The court also noted that there are two other well recognized grounds for excluding useful items from patentable subject matter. These involve advances that are laws of nature or physical phenomena. *See Bilski*, 130 S.Ct. at 3223-25. Neither of these grounds for exclusion were addressed in the Supreme Courts' analysis of the invention at issue in *Bilski*.

[9] The discussion here focuses on instrumentalist theories of patents, derived from similar instrumentalist theories of property rights more generally. Instrumentalist theories of property justify property rights as means to serve some valuable end, with differences in the specific theories focusing mostly on the different end that can be served by various property rights. *See* Abraham Bell & Gideon Parchomovsky, *A Theory of Property*, 90 CORNELL L. REV. 531, 534-35 (2005). Instrumentalist theories stand in contrast with formalistic theories, which hold that property rights are natural rights gained through some relationship of persons or their actions to specific items of property. *Id.* at 534-35. Under this view, the recognition of property interests is part of law's efforts to maintain moral order. *Id.* at 542. In recent years, most property analyses have moved away from formalism and almost all property theories are based on some version of instrumentalism. *Id.* at 546-57.

1. Reward Theory: Describing Patent Influences on Invention Production

Reward theory provides the oldest descriptions of the intended impacts of patents on inventions. This type of theory treats patents as means to influence the production of new advances. The special rewards of patent rights are attached to nonobvious advances that are intellectual outliers in their respective technical fields to encourage more such advances and to diversify the technological approaches used in various fields. Under this view, patents are instrumental means to promote greater numbers of patent-eligible inventions. Not just every type of invention is encouraged, however. Only the narrow category of nonobvious advances that are beyond the commonly held knowledge and skill in a particular field are specially promoted by the promise of patent rewards.

Under this view, patents are utilitarian tools, employed via government action to enlist potential inventors in serving societal needs. Patent rights are recognized, according to reward theory, as means to induce increased attention to inventive efforts that address societal needs and desires. Professor Donald F. Turner summarized these patent law ends and means as follows:

> The basic rationale of the patent system can be simply put. The economic case rests upon two propositions: first, that we should have more invention and innovation than our economic system would provide in the absence of special inducement; and second, that the granting of a statutory monopoly to inventors for a period of years is the best method of providing such special inducement.[10]

Using exclusive control over patented advances (via patent rights and enforcement) to generate economic rewards to inventors has several advantages over alternative means of encouraging inventive efforts.

First, the size of patent-influenced rewards for inventions is scaled to the value that the new inventions provide to invention users. Users will tend to pay amounts for access to new inventions up to (but nor more than) the new value that they receive from using the inventions; hence, the payments and gains that inventors can expect to realize from patent controls over access to inventions are scaled to the value that users perceive in the inventions. As noted by John Stuart Mill, the grant of an "exclusive privilege" to control an invention under a patent tends to provide a reward to the inventor of an advance that that is proportionate to the "usefulness" of the advance.[11]

Second, patent-induced rewards to inventors have the added advantage that the rewards are paid by the specific users of inventions. These rewards are paid via patent-elevated prices charged for patented goods and services or via royalties paid for licensed technologies. These sorts of payments place the costs of invention incentives administered through patent rights upon invention users, the parties who benefit from the inventive efforts being fostered. This matching of burdens to the benefitted parties was recognized by Jeremy Bentham in his early descriptions of patent system dynamics. He saw patent-influenced payments to inventors as the equivalents

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[10] Donald A. Turner, *The Patent System and Competitive Policy*, 44 N.Y.U. L. Rev. 450, 450-51 (1969).

[11] *See* John Stuart Mill, Principles of Political Economy, in Collected Works of John Stuart Mill 1, 928 (J.M. Robson ed., Univ. of Toronto Press 1965).

of bonuses paid by invention users to successful inventors who have aided the users' activities. The bonuses are paid out of the public gains and benefits achieved by the discoveries. Because exclusive patent rights produce incentives to inventors from the gains the inventors achieve, Bentham saw grants of exclusive patent privileges as "the best proportioned, the most natural, and the least burdensome [means of] produc[ing] an infinite effect and cost[ing] nothing."[12]

Third, rewards to inventors paid through patent-influenced purchase prices or licensing royalties have the added advantage of providing self-executing mechanisms for paying rewards to inventors. These rewards flow directly from the demand for new inventions, coupled with patent rights which ensure that patent rights holders are the sole parties capable of providing certain technological solutions to societal needs (by providing products or services based on a patented advance). The rewards system is implemented through private market processes and does not depend on government reward-implementing actions or the discretion of government officials as would be the case in a system rewarding inventors though governmental bonuses or payments for the creation of useful inventions.[13]

Reward theory contemplates impacts of future patent rights on inventors before inventions are made, with the promise of patent rights and rewards attracting potential inventors to work on new inventive projects. However, the details of how this should occur – and the extent of invention production that should be encouraged – are not specified by the basic forms of reward theory which have been articulated to date.

The enhanced reward theory described in this article explains patent rights and their impacts in terms of invention production decision making. Patent rights are treated here as means for reconciling invention production with user demands for new inventions and for allocating scarce resources to invention projects rather than to other competing uses of the same resources. The ways that patent rights should be shaped to achieve these ends are addressed Section III of this article.

2. Theories Describing the Influence of Patents on Completed Inventions

Other patent law theories seek to describe the influence of patents on actions regarding inventions after the inventions are already in existence. As such, they are not concerned with rates of production of inventions, but rather with seeing that society receives the maximum gains from already realized inventions. Disclosure theory sees patent rights as sources of rewards encouraging parties who have already made useful inventions to disclose those inventions rather than only using them only on a narrow scale for personal advantage or under secrecy constraints. Rent dissipation theory treats patents as means to discourage duplicative inventive efforts once one party has completed the discovery of an invention. Prospect theory views patents as means to encourage patent holders to maximize their efforts to find applications for inventions and to thereby extend the societal uses of the inventions. Commercialization theory sees patents as means to encourage patent holders to engage in commercially effective product design,

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[12] Jeremy Bentham, Manual of Political Economy, in The Works of Jeremy Bentham 31, 71 (1962).

[13] John Stuart Mill, Principles of Political Economy, in Collected Works of John Stuart Mill 1, 928 (J.M. Robson ed., Univ. of Toronto Press 1965).

manufacturing, and marketing efforts that spread the use of products and services incorporating patented advances.

a. Disclosure Theory

Disclosure theory views patent law as a tool for encouraging disclosures of useful inventions by successful inventors who would, at least in many cases, otherwise keep their inventions secret.[14] A successful inventor might, in the absence of patent rewards, keep an invention secret for a number of reasons, including personal disinterest in the useful applications of the invention (for example, because the inventor is simply not in the type of business where the invention would be useful and sees no benefit is efforts to disclose and popularize the invention), a desire to withhold the invention from competitors while using it in secret to the inventor's personal advantage, or a goal of spreading the use of the invention under secrecy constraints (perhaps implemented through trade secret controls) and commercializing the advance by charging for access in this way without granting complete public access to the invention.

Disclosure theory sees patent rights as part of a bargain aimed at overcoming these considerations promoting secrecy about inventions and instead encouraging full public disclosures about such advances. An inventor is required in order to obtain a patent to describe not only the functional features of his invention, but also how to make and use the invention. These features must be included in a patent application and will be disclosed to the public either when the application is published or when a patent issues. In exchange for these public disclosures, the inventor is granted valuable patent rights. In essence, the inventor is paid through these rights for giving up the advantages of secrecy about his invention.[15]

The increased disclosures that result from this type of patent-influenced bargain are several fold. First, information disclosed in a patent application or issued patent may enhance subsequent research and innovation.[16] Understanding the workings of the patented invention may provide insights into how to approach other innovations that do not incorporate the patented design and that therefore may be used immediately without infringing the patent on that design. Second, disclosures of a patented design may provide the starting point for further research to improve the patented design (although commercialization of these improvements will require a license from the patent holder). Third, upon expiration of the patent, free availability of the disclosed invention will allow widespread productive use of the advance involved, as well as free incorporation of this advance in further research and additional inventions.

Disclosure theory treats patent rights as a means to overcome secrecy barriers to the use of inventions without asserting that patent rights have any influence over the numbers of inventions created. It is doubtless true that the public generally will gain from widespread information about new advances and (at least eventually) the free availability for use of those

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14 *See* Kevin Emerson Collins, *Propertizing Thought*, 60 SMU L. Rev. 317, 357-58 (2007).

15 *See* Pfaff v. Wells Elecs., Inc., 525 U.S. 55, 63 (1998); Bonito Boats, Inc. v. Thunder Craft Boats, Inc., 489 U.S. 141, 150-51 (1989).

16 *See* Donald S. Chisum, 1 Chisum on Patents § 7.01 (2007).

advances. Hence, the disclosures about completed advances that patent law promotes are undoubtedly important.

b. Rent Dissipation Theory

Rent dissipation theory describes the impact of patents in helping to discourage duplicative efforts to develop similar inventions. When a new advance is developed, society frequently gains increased utility (through the use of the advance) over and above the cost of developing the invention. This net gain from an invention is sometimes referred to as the monopoly rent associated with the invention.[17] Society gains most where this net gain is maximized – that is where the gain realized from an invention exceeds the costs of developing the invention by as much as possible. Where several parties work on the same invention (or similarly functional inventions) in parallel, resulting in only one commercially successful, widely used invention, monopoly rents (that is, net societal gains from an invention) can be squandered or "dissipated" because the costs of the multiple inventive efforts only result in socially valuable invention.

Rent dissipation theory views patent rights as creating incentives to promote early disclosures of inventions and to discourage competing inventors from continuing duplicative efforts at the earliest possible points.[18] Patents minimize the dissipation of monopoly rents (and the squandering of net societal gains from inventions) because patent rights tend to cut off the efforts of additional inventors once they realize that one party has "won" the race to develop a successful invention and has gained a patent on the invention. By disclosing the features of a particular invention in a patent and gaining exclusive control over the invention through patent rights, a patent holder signals to other potential inventors that continuing their competing efforts to develop the same type of invention will be wasteful because the patent holder will be able control who can make, use, or sell the patented invention for the life of the patent and will be able to bar competing inventors from using the fruits of their own efforts. An issued patent becomes a means to discourage competing inventive efforts and, thereby, to reduce total invention production costs. Reduction of these costs minimizes monopoly rent dissipation. Society's net benefits from an invention are increased to the extent that duplicative efforts of multiple inventors are minimized.

c. Prospect Theory

Prospect theory focuses on the potential role of patents in encouraging patent holders to explore or "prospect" for applications of an invention once at least one rudimentary version of the invention has been produced.[19] By giving an inventor control over subsequent uses of a patented invention and an interest in the commercial success of later uses, the patent holder is encouraged to prospect for additional uses of the invention much as a miner is encouraged to prospect for ore in a particular plot of ground by being given exclusive control over a mining claim. Patent rights encourage patent holders to prospect for the full range of socially valuable

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17 *See* Mark F. Grady & Jay I. Alexander, *Patent Law and Rent Dissipation*, VA. L. REV. 305, 308 (1992);

18 *See id. at* 316-17; Edward W. Kitch, *The Nature and Future of the Patent System*, 20 J.L. & ECON. 265, 278 (1977).

19 *Id.* at 272-79.

applications of their patented inventions so as to maximize their own commercial stake in the inventions. To the extent that this prospecting for additional applications is successful, the rights holders will expand the use and social value of the patented inventions.

Prospect theory treats the discovery of a patented invention as the starting point for a product development process and patent rights as means to encourage a patent holder to invest additional resources in the efficient and effective development of a raw invention into useful products across as many socially valuable applications of the invention as possible. A patent holder will also be able to prevent duplicative efforts by multiple parties to prospect for new applications of patented advances, thereby preventing rent dissipation in the prospecting phase of realizing social value from a patented advance.

d. Commercialization Theory

Commercialization theory is similar to prospect theory in that it focuses on encouraging patent holders to take actions after an invention is made in ways that tend to increase the societal use and utility of the invention.[20] While prospect theory sees patents as inducements for patent holders to prospect for additional applications of patented advances, commercialization theory treats patents as inducements for patent holders to take other commercial actions to produce products based on patented designs and to bring the products to market, thereby putting the patented designs into use by more parties and increasing the total societal gains from the advances. Patents, as seen by commercialization theory, ensure that inventors (or their successors in interest in patent ownership) are encouraged to follow through on inventions with effective commercial efforts that popularize products and services based on the inventions.

3. Specialization Theory: Describing the Influence of Patents on the Organization of Innovative Efforts

At least one additional theory sees patents as means to aid parties in divide and organizing engineering and business activities surrounding patented advances and related products. Specialization theory argues that patents help parties to organize the work of multiple specialists in bringing innovative products and services to the public. This sort of division and specialization of work on patent-eligible advances can produce improvements in innovation processes by realizing specialization gains at various stages of innovation and commercialization processes.

Specialization theory treats patents as aids in allocating work on patented advances among specialists, while giving each specialist a stake in the success of the overall engineering and commercialization efforts regarding the advances. A patent gives its holder a stake in the ultimate usefulness and commercial value of products based on the patented innovation even if the party holding the patent will not be the party to sell related products to the public. Patents can facilitate the separation and specialization of work in discovering, developing, and commercializing new inventions and in allocating components of this work to businesses that are

[20] *See* F. Scott Kieff, *Property Rights and Property Rules for Commercializing Inventions*, 85 MINN. L. REV. 697, 732-36 (2001).

efficient in scope and effective in operation, thereby maximizing the benefits of specialization effects gained through work experience and research.[21]

Patents aid parties in separating work on different aspects of patented advances by providing means to transfer ownership interests in the commercial success of patented advances and to thereby encourage each of several specialized parties to apply their particular capabilities to advancing the overall practical success and social propagation of new advances. By aiding the division and distribution of work among separate organizations (each with work content that best suits the skills of those parties involved in a project and the potential specialization economies that are available in a particularly invention development setting), patent rights facilitate diverse choices about organizational groupings of work on patentable advances. Patent rights allow parties to pass on the fruits of specialized work in early phases of the development of patented advances to other parties who will work on later phases. At each phase, the ownership of patent rights in an invention gives a party taking specialized actions concerning the invention a direct self-interest in doing that party's best work to promote the eventual commercial success of the invention. In this way, patent rights facilitate the separate of work into efficient work units and organizational contexts where size efficiencies and specialization effects can be used to advantage, while still ensuring that persons working on discovering inventions and on post-invention commercialization activities are encouraged to do their best work in accomplishing partial steps towards the full commercialization and broad public use of patented advances.

The benefits that patent rights bring to the organization and specialization of work on patentable advances have been summarized by Jonathan Barnett as follows:

> Patents enable innovators to make efficient selections of firm scope by transacting with least-cost suppliers of commercialization inputs. These expanded transactional opportunities reduce the minimum size of the market into which any innovator -- or the supplier of any other technological or production input -- can attempt entry. Disaggregation of the innovation and commercialization process then induces the formation of secondary markets in disembodied technology inputs. These organizational effects over transactional, firm and market structure generate specialization economies that minimize innovation and commercialization costs, which in turn exerts incentive effects consistent with the standard thesis and market growth effects that extend beyond it.[22]

4. Reconciling the Multiple Theoretic Approaches: The Fundamental Importance of Reward Theory

The theories of patent rights summarized here differ significantly in their approach to invention production. Only reward theory and specialization theory contemplate and seek to explain potential impacts of patents on numbers and types of inventions. All of the other theories assume that inventions are produced largely outside of the influence of patents and seek

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[21] *See* Jonathan Barnett, *Intellectual Property as a Law of Organization,* (June 10, 2010). USC CLEO Research Paper No. C10-10. Available at SSRN: http://ssrn.com/abstract=1623565.

[22] *Id.*

to explain how patents can impact the further steps used to achieve societal advantages from the inventions.

Patent theories other than reward theory generally take the presence of a patented advance as a given – that is, as a starting point in their accounts of patent influence -- and then explain the possible impacts of patent rights on the subsequent implementation or use of the invention. The types of post-invention benefits purportedly achieved by patent rights are seen differently in the different theories.

Disclosure theory assumes that some inventions (such as those potentially protected by trade secrets) may be commercialized by inventors in secret absent patent protections. The result of secret commercialization (or no commercialization at all) will be that information about the advances will be bottled up with the inventors and will not enable broader uses and understanding of the inventions by all interested parties. In this theory, patent rights are means to encourage disclosures of useful inventions, with the result of both enhanced information distribution about the inventions and enhanced availability of use of the inventions (at least after patent rights have expired). However, this account assumes that the relevant inventions for which disclosure is an issue already exist; it says nothing about producing more or different inventions under the influence of patent rights.

Rent dissipation theory sees the merit of patents in preventing post-invention waste due to duplicative inventive efforts that will achieve no additional societal benefits over the results of the first successful effort to produce an invention. This theory treats the first to discover an advance as the "winner" of the race to make this discovery and then seeks to cut off duplicative efforts of other inventors to produce the same results a second time. The aim is to gain social efficiency by preventing these duplicative efforts. There is no aim in this theory to explain why the first inventor discovered his or her invention or to encourage more of these first discoveries.

Prospect theory is aimed at describing how patents can encourage increased efforts to explore and design the full range of applications made possible by an already completed invention. The goal is to realize the full measure of societal gains made possible by a given invention by carrying forward the invention into the broadest possible set of applications and user gains. The aim is to ensure that the full societal potential of a new advance is realized, for the benefit of both the inventor and potential invention users. Prospect theory does not, however, purport to explain how the promise of a patent may produce more patent-eligible advances susceptible to prospecting.

Commercialization theory likewise focuses on maximizing post-invention use of new advances and on avoiding inefficiencies from failing to gain the greatest possible social advantages from already completed inventions. In commercialization theory, the focus is on the impact of patents on commercial efforts to create, manufacture, and market viable products. These efforts put patented advances into the hands of numerous consumers and thereby produce large-scale societal gains through widespread use of the patented advances. Commercialization theory contends that patents are important in promoting effective commercialization of patented advances, in part because such commercialization may be particularly difficult and uncertain. Difficult commercial challenges concerning patented advances may stem from the new and

sometimes very unusual features of these advances and the potential difficulties of new product design, manufacturing, and marketing that popularizing the patented advances may entail. Commercialization theory does not, however, purport to explain how patents affect the making of new advances and, hence, does not say anything about how patents influence the number or nature of new advances. This theory only seeks to describe how patents can improve commercial follow through on patent-eligible advances, to the gain of both patent holders and product users.

Specialization theory is the one exception among the theories discussed here in that it describes some potential impacts of patent rights on the number and nature of patent-eligible advances. Specialization theory argues that patents aid firms in dividing and organizing work on the production and use of patent-eligible advances. Such a process of work division among firms (linked by patent rights giving each firm a stake in the commercial success of the project they are contributing to) can achieve specialization benefits that produce different results than if the same tasks were undertaken without the ability to organize work in this manner. Specialization theory describes a means whereby patents can change the number or nature of advances that are produced under the influence of patents. Inventions will change in number or nature if the specialization effects promoted by the availability of patent rights change inventive processes to produce different invention outputs than would prevail in the absence of patents and the specialization effects patents promote. Certain types of specialization effects enhanced by patents may produce more inventions or different types of inventions than inventive processes without these specialization effects.

Specialization theory is not focused just on these invention production effects, however. Some work divisions and associated specialization effects that patents promote relate to commercialization steps after the creation of a new invention. These sorts of specialization effects will realize benefits in the post-invention phase – that is, in the exploration for applications of the invention or in the further steps needed to commercialize the invention. In these post-invention versions of specialization promoted by patents, the benefits described by specialization theory are more like those associated with prospect and commercialization theories. In addressing these types of post-invention actions, specialization theory only explains how patents help us to be more efficient in our use of patent-eligible advances, not how to produce more such advances.

Only reward theory focuses primarily on the production of more inventions and is, in this sense, a more fundamentally important type of patent theory than the others. Reward theory describes how patents can encourage more (or more useful) inventions. It explains how patents can produce more of the things – inventions – on which the other theories operate and, in this sense, is a root theory from which other theories build or improve. If aspects of patent law can produce more (or better) inventions as reward theory posits, other aspects can (perhaps) go further and achieve the additional benefits posited by the other theories of patent law. However, if there are no inventions to operate on, the post-invention benefits described by the other theories of patent law are of little or no importance. These additional theories are, in this sense, supplemental to reward theory and the production of patent-eligible inventions.

Because reward theory attempts to describe how the patent system can produce more inventions, it is in a sense a more fundamental theory of patent rights than these other theories which focus primarily on post-invention efficiency. If patents can, as reward theory suggests, produce more patent-eligible advances, then the further impacts of patents as described by the other theories can be obtained over a wider range of inventions. If an accurate account of how patents influence the production of more patent-eligible advances can be described and used to shape the patent system to this end, the result will be bigger, more socially responsive and beneficial set of patent-influenced inventions, towards which the additional advantages described by the other patent theories can also be pursued. Because reward theory and its impacts on invention production have this type of especially fundamental impact on the number and nature of patent-eligible inventions and the associated social benefits such inventions can realize, the reformulation and refinement of reward theory concepts of the sort attempted in this article are especially worth our attention.

II. Placing Patent Rewards in the Context of Property Law Theory

A. Basic Property Law Goals: Long-Term Perspectives and Stable Ownership

???Property laws permit property owners to control the use of property, potentially for extended periods. Property rights generally achieve this by affording property owners the right to exclude parties from their property and to selectively allow access to the property in exchange for payments or other compensation. This right to exclude, coupled with the right to transfer property ownership and the right to exclude to other parties, gives an owner the reassurance that they will control the use of an item of property not only now, but in the future. This long-term perspective is a key goal of property law. A property owner can take a long-term view of what is an advantageous present use of property, knowing that the owner (or transferees of the owner's property interest) will benefit in the future from the good husbanding of property now, as well as from investments in changes and improvements to that property which will enhance its future value. The encouragement of property owners to adopt long-term perspectives regarding the use of property is a primary goal of property laws in general and, as discussed later in this section, of intellectual property laws in particular.

1. Property Laws and Long-Term Use Perspectives

Robert C. Ellickson has summarized the importance of the long-term perspectives on asset use that property rights can instill. In discussing the implications of property rights in the context of real property ownership, Ellickson emphasized the following perspective-setting impacts of property rights:

> Although the assertion may seem counterintuitive, the key to land conservation is to bestow upon living persons property rights that extend perpetually into the future. The current market value of a fee in Blackacre is the discounted present value of the eternal stream of rights and duties that attach to Blackacre. A rational and self-interested fee owner therefore adopts an infinite planning horizon when considering how to use his parcel, and is spurred to install cost-justified permanent improvements and to avoid premature exploitation of resources. The fee simple in land cleverly harnesses human

> selfishness to the cause of altruism toward the unborn, a group not noted for its political clout or bargaining power.[23]

The transferability of ownership interests concerning an item of property gives the owner a long-term perspective on how the property should best be used since optimizing this use will maximize the transfer value of the property, even if the present owner will not be the only one to use the property over the long term.[24]

While his description does not separate the two, Ellickson's account addresses the impacts of property rights on both the maximization of the value of property in its present state (referring to "land conservation" and "the avoidance of premature exploitation of resources") and in encouraging improvements in property features (referring to the impact of property rights in "spur[ing owners] to install cost-justified permanent improvements" to owner-controlled property). Property rights – and the long-term perspectives they encourage -- have important impacts in both the present use and future-focused improvement of assets.

2. Additional Advantages of Stable Ownership

More recently, Abraham Bell and Gideon Parchomovsky have expanded on the importance of property laws in creating long-term owner control regarding the use and improvement of items of property. They argue that protecting stable ownership is the unifying theme of property law.[25] In their view:

> [P]roperty law as a legal institution is organized around creating and defending the value inherent in stable ownership. Property law both recognizes and helps create stable relationships between persons and assets, allowing owners to extract utility that is otherwise unavailable. Adopting this focus enables us to recast many of the key insights of the extant property literature and demonstrate that these insights can form a coherent theory of property.[26]

Beyond just promoting the management of an asset so as to maximize the long-term value of the asset, Bell and Parchomovsky see several other advantages in property rights ensuring stable ownership of assets. These additional advantages of legal protections promoting stable ownership include:

1) Facilitating more open and frequent uses of assets, as owners need not rely only on secrecy and physical possession as means to retain control over assets;
2) Enabling the decoupling of ownership and possession (or use/operation), thereby increasing the use value of assets by making possible the temporary transfer of assets to higher-value users who cannot afford to purchase the assets (through actions like rentals or even informal arrangements like cab rides);

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23 Robert C. Ellickson, *Property in Land*, 102 YALE L. J. 1315, 1369 (1993).

24 *Id.*

25 *See generally* Abraham Bell & Gideon Parchomovsky, *A Theory of Property*, 90 CORNELL L. REV. 531 (2005).

26 *Id.* at 538 (footnote omitted).

3) Promoting expanded asset use value through learning how best to use an asset during long-term association with the asset; and
4) Encouraging parties to count on the availability of an asset over the long term and to assemble complementary assets that are productive in combination with the asset.[27]

3. Reconciling Patent Law Goals with Property Law Goals Generally

As the analyses of property law purposes by scholars like these demonstrate, rights to exclude parties from property are generally granted for one or both of two purposes.

First, rights to control access to property ensure that the present use of the property can be managed to its greatest value by property owners, adopting the use with the greatest value and avoiding wasteful overuse or other value-decreasing uses. This purpose of property controls involves the efficient use of existing property.

Second, rights to control access to property are also imposed to induce parties to create new property and to improve existing property. In this regard, the promise of controls once new property is constructed or improved provides a means to gain value from the newly created or improved property and to encourage the production of such property. As Ellickson noted, a rational owner will be encouraged by property rights controlling use of property to add cost-justified improvements that enhance the value of the property. In this regard, property controls serve an asset production incentivizing function encouraging asset production.

Patent law controls limiting access and use of patented inventions are unusual forms of property controls as they serve the second of these property law purposes, but not the first. Use of patented ideas is not rivalrous and, consequently, not in need of property controls to ensure efficient use to the most valued ends. However, the production of new inventions is rivalrous in that it involves scarce resources devoted to invention (if at all) in rivalry with other potential uses of the same resources, meaning that patent controls and rewards for inventions can serve valuable ends in promoting the production of new property in the form of new inventions.

The remainder of this section summarizes why patent controls over the use of patented advances serve some but not all of the traditional functions of property law.

B. Property Justifications for Controls to Ensure Efficient Use of Consumable Assets Do Not Apply to Patents

Patents give their owners the ability to exclude other parties from the making, using, and selling of items or services incorporating patented inventions.[28] These rights limit the use of patented inventions by unauthorized parties. Such restrictions on the use of invention ideas are not needed to avoid overconsumption or other inefficient use of the ideas since the use of such

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[27] *Id.* at 556-58.

[28] 35 U.S.C. § 271(a) ('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 therefore, infringes the patent").

ideas by one party does not diminish the value of the ideas if used by another.[29] Nor are restrictions on the use of design ideas needed to ensure that these ideas are used by the parties who value the ideas the most. Since design ideas can be used by multiple parties without limiting each other's use, the parties who value the ideas most should be able to use them along with all other interested parties.

This means that patent controls over access to patented designs – that is, patent controls for ideas about designs of useful items or processes – are not needed to ensure efficient use of the designs. Indeed, by elevating the cost of use for patented designs, patent controls may diminish the overall use of patented designs below levels that would be socially desirable in the absence of patent-imposed costs. Hence, focusing on uses of designs for useful items and processes, property controls over patented designs would appear to be without justification and potentially harmful as undesirable burdens on valuable uses of useful designs. At least patented ideas lack the beneficial impacts on efficient use of assets that provide key justifications for property controls in other property domains.[30]

C. Property Justifications for Controls to Ensure Asset Improvements Do Apply to Patents

However, control over use of patented designs may be justified as means to encourage the production of new and improved designs and to attract the allocation of scarce resources to this type of design production. In this respect, the production-enhancing ends served by property controls in the patent field are similar to the asset-enhancing benefits of property rights generally. The focus of property rights in promoting improvements to assets is on mediating the allocation of scarce resources to asset improvements.

Many accounts of property rights (such as Professor Ellickson's account quoted earlier in this article[31]) describe the potential impacts of patent rights in encouraging improvements to existing properties, such as the encouragement that real property ownership gives to property owners to consider and advance building projects on their land as means to improve the property characteristics and to maximize the long-term value of the property. However, in personal property and intellectual property settings, the promise of long-term property controls creates incentives to "improve" property by creating it. The production of new goods or patent-eligible advances is an act of property creation which is encouraged and mediated by the expectation that the party producing a new item will have long-term control over it and will be able to realize gains from use of the item over a substantial period. This promise of future controls mediates the

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29 The use of an idea does not diminish its value to another because an idea is shared, not consumed. This point was mad in the following discussion of literary works by Tom G. Palmer. Palmer observed that the literature is of value to numerous readers without any consumption or diminishment effect because "there is one Othello for all of us, rather than one Othello for each of us, or even one for each of our separate readings or viewings of the play." Tom G. Palmer, *Are Patents and Copyrights Morally Justified? The Philosophy of Property Rights and Ideal Objects,* 13 Harv. J.L & Pub. Pol'y 817, 846 (1990).

30 *See* Peter S. Menell, *The Property Rights Movement's Embrace of Intellectual Property: True Love or Doomed Relationship?,* 34 Ecology L.Q. 713, 726 (2007)("Unlike tangible goods, knowledge and creative works are public goods in the sense that their use is nonrivalrous. One agent's use does not limit another agent's use.").

31 *See* text at note ???, *supra.*

production of new goods and new patent-eligible advances, just as it mediates the construction of new improvements to parcels of real property. In all of these instances, the promise of future gains from the new property or improvements establish criteria for determining whether it is worth devoting scarce resources to the creation of the new property or improvements.

Because scarce resources are significant in the production of both patented advances and other types of assets, property controls are important in promoting production in all of these areas. The purposes served by patent controls in this respect are much like the purposes served by property interests more generally. Some of our knowledge about how property interests serve to promote asset production in other settings can aid us in analyzing the impacts of patent policies on allocations of scarce resources and in proposing desirable patent law reforms.

III. The Private Production of Public Goods: A Demsetzian Framework for Evaluating Patent Rights

A. Property Controls to Attract Resources to Public Goods Production

The analysis here builds on the work of Harold Demsetz regarding the private production of public goods and the potential role of property controls over access to public goods as means to encourage such production. His conclusions about the desirability of property controls for public goods (including public goods like patented ideas) incorporated three key insights: 1) previously defined economic principles for analyzing the production of joint supply goods (that is, goods for which there are at least two purposes and two different types of consumer demands) also provide valuable tools for analyzing the production of public goods, 2) the production of public goods through private means (including the production of ideas defining patent-eligible inventions) can be promoted by restricting access to public goods and precluding non-purchasers from using the goods, and 3) such a system of exclusion and charging for access can create a form of market for the production of public goods that both attracts scarce inputs to the production of public goods and helps to ensure that pubic goods are produced in socially optimal amounts.[32] These conclusions were all described in Demsetz's landmark article "The Private Production of Public Goods",[33] first published in 1970, but now somewhat neglected, particularly in intellectual property studies.[34]

This section describes the major tenants of Demsetz's analyses in this area. The next section shows how these views about public goods production can be extended to define an improved patent reward theory – that is, a theory describing how patent rights incentivize and regulate the private production of public goods in the form of additional patent-eligible advances.

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32 *See* Harold Demsetz, *The Private Production of Public Goods*, 13 J. L. & Econ. 293 (1970).

33 *Id.*

34 A Westlaw search showed only 107 articles in the JLR database (addressing all areas of law, not just patent law or intellectual property) have cited Demsetz's article in the 40 years that it was written. One key exception to the general neglect of Demsetz's views on public goods production among intellectual property scholars is the work of Brett M. Frischmann, who has analyzed (and criticized) Demsetz's views in the context of copyright law. *See* Brett M. Frischmann, *Evaluating the Demsetzian Trend in Copyright Law*, 3 Rev. L. & Econ. 649 (2007). *See also* Harold Demsetz, *Frishmann's View of "Towards a Theory of Property Rights",* 4 Rev. L. & Econ. 127 (2008) (responding to Frishmann's criticisms).

1. Constructs for Evaluating Joint Supply Goods Production

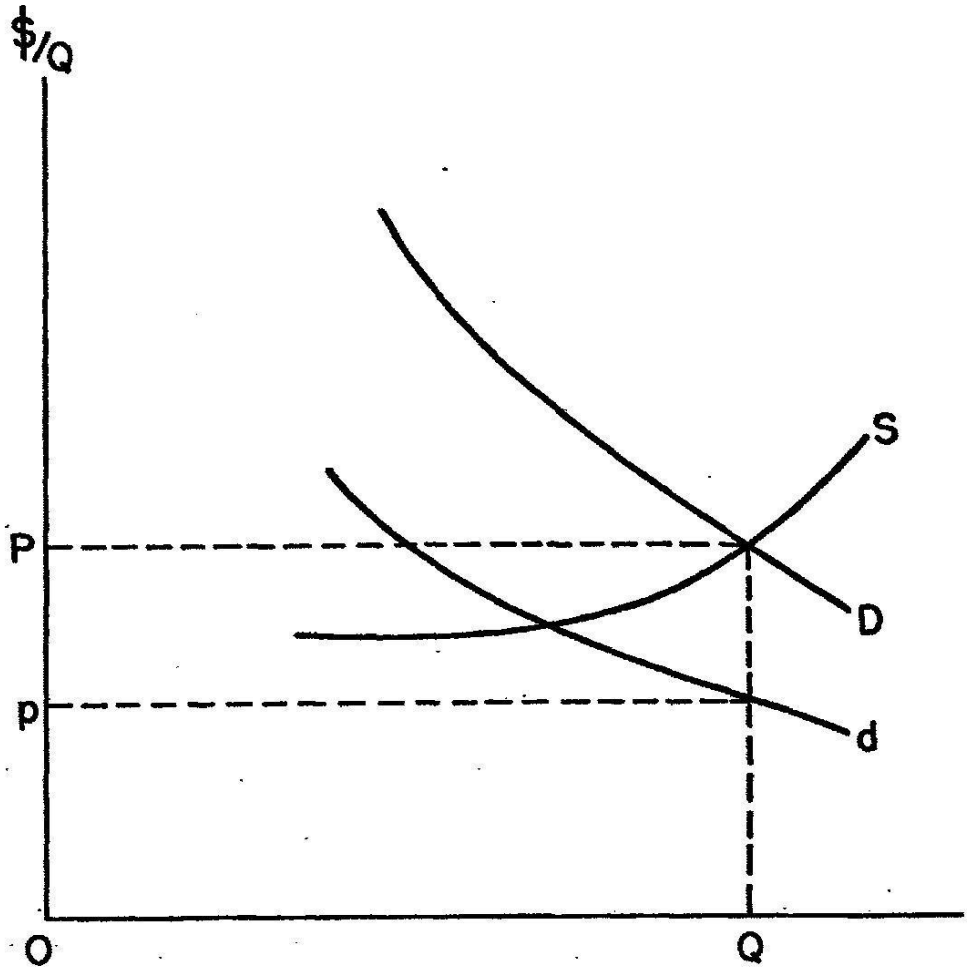
Demsetz' first insight is stated clearly at the outset of his analysis: "The allocation of resources to the production of public goods can be understood with the aid of the model formulated long ago by Alfred Marshall for the analysis of joint supply."[35] A joint supply good is one for which there are two or more uses (usually of different parts) and, hence, two or more demands. Marshall's insights were that these two demands would operate somewhat independently in sales of components of a joint supply good, but would combine to produce a hybrid demand function affecting and incentivizing the upstream production of the joint supply good.

A simple example used by Demsetz in his analyses illustrates Marshall's earlier ideas about the production of joint supply goods. Steers are produced with the expectation that a particular steer will ultimately be used to supply both meat and a hide. The production of steers for slaughter is therefore influenced by the demand for both meat and hides. Under competitive conditions, the rate at which steers are raised and slaughtered is determined by an aggregate demand function (and associated marginal returns for slaughtering one more steer) which reflects the sum of the demands and returns for meat and hides.

[35] Harold Demsetz, *The Private Production of Public Goods,* 13 J. L. & Econ. 293, 293 (1970). The insights of Alfred Marshall referred to by Demsetz were described in Alfred Marshall, PRINCIPLES OF ECONOMICS (1890).

Demsetz recognized that he was not the only analyst to see the relationship between the analysis of joint supply goods production and the analysis of public goods production. He notes that some earlier analysts had mentioned the similarity of these types of production in passing, but had not explored the implications of this equivalency for public goods production to the degree that Demsetz pursued in his work described in this article. *See* Harold Demsetz, *The Private Production of Public Goods,* 13 J. L. & Econ. 293, 293 n.1 (1970) (describing the work of other analysts who had, as of 1970, recognized the similarities between joint supply goods production and public goods production).

Figure 1



In standard format, the supply and demand characteristics for consumption of meat and hides and the supply of steers are as shown in Figure 1. The x axis in this figure reflects the quantity of items and the y axis reflects the price per unit quantity. The curve d reflects the demand for hides, the curve D is the sum of the demands for hides and meat (the demand curve for meat alone is not shown, but would equal D-d at every quantity Q). Curve S reflects the number of steers that suppliers are willing to produce at various price points. The equilibrium price-quantity combination is determined by both the aggregate demand (reflecting the component demands for both hides and meat) and the marginal costs of producing additional steers. The equilibrium point is represented by the intersection of the S and D curves at price P and quantity Q.

In general, this analysis reflects standard (and fairly basic) economic analyses of supply and demand under circumstances of competition. The one key addition that is special to joint supply goods is that the separate market demands for components of the joint supply good can be translated into a single demand function influencing production and supply of the joint supply

good. Competition in these circumstances maximizes the sum of welfare for users of the component parts (although it may not provide optimal levels of hides or meat looking at either of these alone).

Another way to look at this is that the compensative system economizes on opportunity costs. A competitive system of the sort shown in Figure 1 ensures that net societal costs (taking into account opportunity costs) are minimized in the production of steers as joint supply goods. If production is at levels below the P-Q point, the aggregate opportunity costs to hide and meat consumers of forgoing one more unit of hides and meat will be greater than the marginal cost of producing one more steer and avoiding these opportunity costs. Where this is the case, competitive processes will tend to ensure that the opportunity costs will be avoided because an additional steer will tend to be produced to fill this demand at a price that is on the S curve and acceptable to steer producers. In this manner, the aggregate demand for a joint supply good tends to discourage under supply of that good, with the optimal supply level determined by the minimization of total opportunity costs to users of the components of the joint supply goods.

Competitive processes can ensure against oversupply of joint supply goods in a similar fashion. The equilibrium reached at P-Q is one where the missed opportunity value of having one more hide and meat unit (taken together) is less to hide and meat users than the marginal costs of producing that additional steer. A socially advantageous equilibrium is achieved because the opportunity costs of foregoing additional production are less than the marginal costs of proceeding with additional production.

2. Extension of the Joint Supply Model to Public Goods Production

a. Promoting Public Goods Production Through Access Charges

Demsetz saw the production of public goods as having key similarities to the production of joint supply goods. Provided that potential users of public goods can be excluded from use unless they pay for access to the public goods, a system of use payments (or use-related payments) will establish demand functions for the supply of public goods. These demands will aggregate across multiple users of the goods to produce an overall combined demand for the goods. The combined demand (reflecting the willingness of all interested parties to pay for access to the goods) will encourage and incentivize the production of public goods at optimal levels, much as the aggregate demand for joint supply goods encourages the production of joint supply goods at socially optimal levels.

A word on nomenclature is perhaps in order here. The term "public goods" is sometimes used in two different senses. To some analysts (including Demsetz), the term refers to nonrivalrous items (for which use of the item by additional parties is possible at no additional cost or impairment of the use by prior users), but which may be excludable in that nonpurchasers or other unauthorized parties *can* be excluded from use.[36] In this usage, the term "public goods" refers to goods that are nonrivalrous, but possibly excludable. To other analysts, the term "public goods" is used in a stricter sense to refer only to goods which are both nonrivalrous (meaning that they can be used by additional parties without additional costs) and nonexcludable

[36] Harold Demsetz, *The Private Production of Public Goods,* 13 J. L. & Econ. 293. 295 (1970).

(meaning that persons cannot be excluded from using the items).[37] To Demsetz, a public good that satisfies the additional condition of non-excludability is better treated as a distinct type of good, which he terms a "collective good."[38]

This article adopts Demsetz's nomenclature and refers to designs of patent-eligible advances as excludable public goods.[39] These are public goods because they are nonrivalrous. There are no marginal costs associated with additional use of these advances, meaning that their use by multiple parties is nonrivalrous. However, these same advances are excludable (at least to a degree) because limits on access to the advance can be imposed, usually by limiting access to items or processes which implement the advances.

The potential for effective access controls over implementations of patent-eligible advances creates opportunities to charge for access to the advances and thereby provides the basis for payment schemes that reward and incentivize producers of the advances. The key point for our purposes is that patented designs are nonrivalrous in use, but are subject to access controls imposed through the patent system (with some imperfections in access controls that are discussed at a later point in this article). Persons who do not reach an arrangement with a patent holder and pay that party for access (or pay someone else who has already paid for and gained access to the patented invention) can be excluded from access to the invention through injunctions and other relief. These limitations on access are not costless, but are recognized under patent laws to establish an access payment and reward scheme that is designed to encourage production of patentable inventions and to regulate the allocation of resources to such production.

b. Parallels in Joint Supply Goods and Public Goods Production

The parallels between the dynamics of the production of joint supply goods and public goods and the equilibriums between supply and demand that tend to prevail in the production of both. These parallels are apparent if we reconsider the supply and demand functions in Figure 1 as descriptions of public goods production relationships rather than as plots of supply and demand relationships for joint supply goods production. Assume now that we are interested in the production of an excludable public good, say television shows to be made available through cable television systems.[40] This type of intellectual product is an excludable public good. Television program are public goods in that one party's viewing of a program does not interfere with or diminish the experience of viewing by an additional party. However, in systems like cable television, access to these programs in excludable and a system of charging for access can be implemented.

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37 *See* Abraham Bell & Gideon Parchomovsky, *A Theory of Property*, 90 CORNELL L. REV. 531, 578 n.250 (2005).

38 Harold Demsetz, *The Private Production of Public Goods*, 13 J. L. & Econ. 293. 295 (1970).

39 If one wishes to adopt a nomenclature other than the term "public goods" for nonrivalrous, but excludable items, the analysis in this article is the same.

40 This example is one proposed by Demsetz, who focused on the demand for two parties for access to televised showings of taped programs. *See id.* at 294-95 I have updated this example to specify the means of controlling access to the programs as being the access and charging controls imposed through cable television systems.

The advantage of analyzing the production of this sort of public good in terms of the same factors as the production of joint supply goods can be seen by interpreting the implications of the relationships shown in Figure 1 in terms of public goods production.[41] For simplicity, consider a two consumer world in which the demand for television programs depends on just two parties seeking these programs, Mr. H and Ms. M. The transmission over a cable channel of a program can satisfy the demand of both H and M, just as the slaughtering of a single steer can satisfy the demand for both meat and hides. By taking the different demand functions of H and M into account and combining them to form a single demand function, the analysis of public goods production dynamics tracks the production of joint supply goods as previously discussed in this article.

Reinterpreted in terms of public goods production, Figure 1 presents a summary of the supply and demand relationships influencing public goods production. The curve d represents the demand of H for more of the public good, in this case more access to television programs. The curve D represents the aggregate demand of H and M (that is, D represents the sum of the individual demands of H and M). The curve S represents the willingness of a maker of programs to supply more programs at various per program access prices. Overall, this represents a system in which program viewers (the consumers in this system) are willing to pay for access at any point on line D, where as providers of access are willing to supply access at any point on line S.

The production of more programs will tend to reach an equilibrium at the point P-Q. At this price/volume point, the production of additional programs is efficient in the sense that net costs (taking into account opportunity costs of the program viewers) are minimized. Any less production would leave the viewers (H or M or both) with unsatisfied demand for which they would have paid more to satisfy than the supplier would have charged to satisfy it. Provided that the supplier was aware of this demand, sales of access to more programs would increase in number to meet the demand until the volume represented by P-Q was reached. Thus, underproduction (in relation to viewers' desires and willingness to pay) is corrected by increases in production and access up to the point where prices charged and willingness to pay are matched at point P-Q. In a similar fashion, efforts to produce too many goods and to charge too much for access will be discouraged. A supplier that tries this will be met with an unwillingness of viewers to pay and will need to move its offerings to a lower point along the S curve. The result will again tend to be a matching of supply and demand at point P-Q.

Demsetz described the general similarity of the factors governing the production of joint supply goods and public goods as follows:

> [J]ust as the number of goods which are supplied jointly (meat, hides, bones, etc.) is not limited to two except for expositional convenience, so the number of persons demanding a public good is not limited to two. With joint supply if the number of goods is increased or with a public good if the number of persons is increased, we will merely have complicated the geometry [of graphs such as Figure 1] without changing the analytical similarity of the two cases at all.

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41 *See id.* at 294.

> What then is the difference between the two cases insofar as rate of output is concerned? There is no difference…, *provided that [parties] can be excluded from consuming the public good if they fail to pay for it*, which, of course, is implicitly assumed to be true in the joint supply problem.[42]

3. Advantages of Restricting Public Goods Under Access Controls

Controlling access to public goods and allowing private originators of the goods to charge for access has two important advantages in mediating the private production of public goods.

First, it encourages the private production of additional public goods up to, but not beyond, the levels that meet the public's demand for more access. An access control system can thereby mediate the production of public goods at efficient output levels.

Second, an access pricing system can also regulate inputs to the private production of public goods in desirable ways. Such a system effectively puts a price on additional units of public goods, which can in turn influence the allocation of scarce resources towards the private production of additional public goods. This pricing mechanism tends to attract resources to the production of additional public goods and additional access opportunities where this is the best use of the resources (as measured by the public's value and willingness to pay for more access). An access control and payment system for public goods can therefore mediate the allocation of scarce resources to the private production of public goods in socially valuable ways.

This section analyzes both these aspects of access controls for public goods, explaining how access controls and access pricing practices governing the publics' use of public goods can realize the types of societal benefits just described. The next section of this article describes how these same benefits can be realized through patent-based access controls and access pricing mechanisms for inventions.

a. Regulating and Targeting Private Production of Public Goods

A system controlling access to public goods and permitting the controlling party to charge a price for access achieves production incentivizing and regulating benefits by attaching a value to the production of additional quantities of public goods. By signaling to potential producers the willingness of public goods users to pay for more access to public goods, such a pricing system creates incentives for potential producers to create the types of public goods the public values and to expend production resources up to (but not beyond) the amounts that the public will pay for access to additional amounts of public goods. In this manner, the production of public goods is directed towards goods that the public values and is regulated to levels of production that match the limits of the public's willingness to pay for more units of public goods.

This type of system also signals the priorities of the public in its demand for additional public goods. The willingness to pay for access to additional public goods indicates priorities in several dimensions, including the importance placed by the public on one version of a public

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[42] *Id.* at 294-95 (emphasis in original)

good versus alternative versions of the same type of public good, on one type of public good versus an another type of public good, and on public goods of various sorts relative to other types of goods and services. The willingness to pay for access to additional public goods signals the public's aggregate level of demand for additional access to the goods. These signals can be used by potential producers of public goods to target and regulate the production of additional public goods and to create additional access opportunities.

A system of pricing of public goods access in this manner is efficient in that it economizes on opportunity costs related to access to public goods. Where there is someone willing to pay for additional access to a public good at a particular price and there is some party willing to provide the additional access at a marginal cost less than that price, this type of pricing system will encourage the potential provider of the access to act and meet the demand of the other party seeking access.

An equilibrium will eventually be reached where the marginal costs of production of additional access to the public goods matches the marginal price that parties are willing to pay for that access. Such an equilibrium will minimize the joint opportunity costs of the producers and users of public goods. At lower levels of production of public goods, the potential users will suffer opportunity costs. These will stem from their missed chance to have more access to the public goods at prices that are less than the gain they expect to realize from more access. The missed opportunities to gain perceived benefits that are greater in value than the costs of access to the public goods are opportunity costs to the unsatisfied users of the public good. In a reciprocal fashion, the overproduction of public goods will create opportunity costs to the producer of the goods as some amounts of available access are not utilized and the amounts expended to make those available are not fully compensated. The opportunity costs here are related to the chances to use these wasted production resources elsewhere to greater advantage. A public goods access system of the type described here will tend to drive pricing and production of public goods access to levels where the opportunity costs of both producers and users of the public goods are minimized, thereby achieving a socially optimal production level.

b. Attracting Scarce Resources to the Production of Public Goods

Beyond regulating the private production of public goods to encourage the production of types and amounts of public goods that match public interests, a public goods access control system like the one described here can realize additional benefits by regulating the allocation of resources as inputs to the production of public goods. The pricing of opportunities to access public goods tends to ensure that scarce resources are allocated to the production of public goods where this is the most valued use of these resources, taking into account both their value in producing additional public goods and their value in other uses.

This type of "input management" advantage of access controls and access pricing for public goods has benefits in both encouraging and discouraging the use of resources for the production of public goods. Where there is a strong need for more public goods – as evidenced by a willingness of numerous members of the public to pay substantial amounts for additional access opportunities – potential producers of the goods will be encouraged to bring scarce resources to the production of public goods and to forego the other products and benefits that

different uses of the same resources might have produced. However, where the value placed on additional access to public goods is small, then scarce resources will not be attracted to the production of more access opportunities and scarce resources will tend to be allocated to other, more attractive ends.

The resource allocation decisions under consideration here are similar to those faced by a builder deciding whether to build a house on speculation (that is, not for himself, but rather to be sold to buyers upon completion). His projections of the ultimate sale price of the house will determine whether he initiates the house building project, as well as what type of house he will try to build and what materials he will use in constructing the house. Consider just one of the many resource allocations decisions he will make in assembling inputs to the building project. In evaluating the purchase of lumber for construction of the house, he will confront a market price for standard lumber (such as 2x4 boards and other standard components) that will be a key factor in determining whether and how he goes forward. If the costs of these and other construction components (plus the costs of the labor needed to complete the project) are less than the amount he projects he will be able to sell the house for, he will consider going forward with the construction. Actually, a mere nominal profit (that is, a profit from a projected sale price that is just slightly greater than the projected costs of production) will probably not be enough to convince the builder to go forward. The projected net profits will need to be compelling in context – that is, the projected profits from building the house will need to be greater than the projected profits that the builder expects from the next best use of his time, efforts, and money. If the construction of the house (based on its projected price as influenced by future property controls over the house if built) has a projected profit that trumps the other alternatives available to the builder, the builder will probably go forward with the construction and, by this action, divert and allocate a quantity of lumber to the purpose of building the house.

This allocation of lumber is a reflection of its projected value in the construction project. If this builder values it sufficiently, the lumber in question will go to the construction of the house. If the potential builder values the lumber less, then the lumber might go to the construction of other houses or other commercial properties. If lumber is generally valued at low levels at a given time, then the production of lumber might diminish and some potential lumber might be kept in reserve as trees until a later time at which point lumber was needed again in greater quantity and more trees were processed to produce more lumber. In these ways, the decisions of those who produce useful items and who value production inputs (like lumber in a construction project) allocate scarce resources to serve as inputs to production where this is the most valued use of the resources in question.

In so allocating scarce resources to the production of items, a product pricing system carries back upstream in the production process to affect decisions to produce scarce resources, the prices that are paid for them, and the degree to which these resources are devoted to various types of production in which they can play a role. By establishing access controls and access pricing for public goods, the production of public goods is brought into this resource allocation system. Projects for the private production of public goods compete with other projects (such as the private production of private goods or the construction of real estate properties) for the allocation of scarce resources that might be put to these other purposes.

Absent a scheme for pricing access to public goods and the establishment of an associated reward and incentive system for producers of those goods, the private production of public goods is disadvantaged in the battle for scarce resources with other types of profitable production. Resources that are scarce and consequently costly to obtain will tend to be allocated by market systems to uses with clear payoffs. The production of public goods will proceed at less than publicly optimal rates and the allocation of scarce resources will be diverted away from public goods desired from the public. The result will be a misallocation of those scarce resources to ends less valued by the public, all as the consequence of the failure to translate the public's demand for additional public goods into access controls and access prices that would influence production decisions and attract more scarce resources to the production of additional public goods.

IV. Patent Rights: Why We Need Them

This section explores the benefits of applying Demsetz's analyses of public goods production to the private production of patent-eligible inventions. It argues that patent rights and rewards are best interpreted as means to implement invention access controls and pricing mechanisms that achieve an approximation of Demsetz's ideal system for incentivizing and regulating the production of private goods, operating in the case of patents in the particular realm of the production of patent-eligible inventions.

A. Patent Rights and Rewards as Means to Regulate Invention Production and Allocate Scarce Invention Inputs

The view of patent rights and rewards described in this article explains how patent rights establish prices for access to new inventions and thereby encourage the production of new advances and the allocation of scarce resources to such production. This view is developed here in a theory of patent rewards that is both descriptive (in helping us understand how patent rights affect invention production and decisions about how to allocate scarce resources to such production) and normative (in specifying why the invention incentives and resource shifts resulting from the enforcement of patent rights achieve socially beneficial levels of invention production and thereby serve the public interest).

The next portion of this section examines how Demsetz's framework for evaluating the private production of public goods provides valuable insights when applied to patent rights and the production of patent-eligible advances. Demsetz's views are used to define a theory of patent rewards in which these rewards serve as efficient means to regulate the production of patentable advances. This theory is used descriptively to explain how strong controls over the making, use, and sale of patented advances (as enforced through patent rights) influence the types and amounts of new inventions targeted by potential inventors and further how impacts of patent rights on the valuation of new inventions has a derivative effect in attracting scarce resources to work on developing highly valuable new inventions.

In the concluding portion of this section, the analysis shifts to a normative mode in which the theory developed here is used to evaluate the public benefits from a strong, predictable patent system in which the nature of probable patent rights and rewards can be anticipated by potential

innovators and meaningfully influence their decisions about how to conduct inventive projects. The analysis will argue that strongly enforced patent rights are beneficial to the public in ensuring that invention production is encouraged and targeted in relation to the nature and strength of public desires for various types of new inventions.

B. An Improved Patent Reward Theory for Regulating Invention Production

Demsetz's framework for analyzing the private production of public goods suggests an improved patent reward theory in which patents play central roles in pricing access to patented inventions. Patent rights serve as access controls regarding patented inventions. These controls are imposed as means to implement a charging mechanism regarding invention access, with the resulting access fees serving as rewards for the production of patent-eligible inventions. This fee and reward system is imposed to encourage and regulate the private production of additional patent-eligible advances as public goods.

In order for patent-influenced access fees to reflect the full scope of user demands for new inventions, the fees for access paid by each party gaining access to a new invention design should equal (as closely as possible) the incremental utility seen by this party in gaining access. This incremental utility will reflect the new levels of utility achieved by the user in using the new invention over the utility experienced by the same party in using earlier (and usually non-patented) substitutes that perform the same tasks as the patented item. In a system of costless information and transactions, full price discrimination between users would be possible and individuals would be required to pay for access to new inventions at individually determined prices. Each potential user of a new product embodying a new design would be willing to pay an amount for access to the product up to the amount of their new value gained from access to the product. Potential inventors of new products would consider expending resources up to the aggregate demand of these users in developing new inventions.[43]

Seen this way, the full invention-pricing functions of patents and patent enforcement are apparent. Patent rights are not simply means to gain inventors some rewards for producing inventions. Patent rights are rather means to establish the value of inventions and to put the production of inventions into the larger picture of potentially valuable asset production. With a value attached to the production of additional inventions, efforts to produce new patent-eligible inventions can compete effectively for the attention of talented individuals and resource rich organizations amidst other potentially profitable and rewarding actions that might be chosen. At the same time, invention valuations enhanced by patent rights and invention access controls

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[43] Ideally, again in a world of costless information gathering and pricing administration, price differentiation by product users would be possible and each would be charged for access to a new design in light of his or her personal willingness to pay for new utility. This type of price differentiation, were it possible, would maximize the total demand for new inventions, which would in turn increase the amounts that potential producers of the inventions would feel it wise to expend in producing the new inventions. A perfectly administrable system of access controls would make this type of particularly efficient price differentiation possible; as we shall see in later discussions, what the real patent system uses as a substitute is more in the nature of categorical price differentiation, where users of different embodiments of patent inventions are charged different patent-influenced prices that approximate their different demand and perceived invention utility characteristics, but do not achieve individualized price differentiation that would be even better if the costs of administering it were not prohibitive.

serve to attract scarce resources to the production of patent-eligible advances in efficient ways. Thus, interpreting patents as the linchpins of an invention access pricing system – the improved patent reward theory described in this article – provides new insights into the functioning of the patent system and the types of patent law reforms that may increase the public benefits from the patent system.

C. Descriptive Implications of the Improved Theory: How Patent Rights Regulate Invention Production

The potential impacts of patents on both invention inputs and outputs can be seen by extending Demsetz's framework for analyzing the impacts of property laws on the production of public goods generally to the particular case of the production of patent-eligible advances. This involves recasting his analysis into a patent context. The remainder of this subsection reexamines Demsetz's conclusions as they apply to the particular case of restricting access to patented inventions and thereby influencing and beneficially regulating the private productions of patentable inventions.

The aims of a patent-based invention reward or "pricing" system in this context are to summarize consumer demand and valuation assessments for inventions through patent-influenced prices for goods embodying inventions or through royalty payments to inventors for other types of access to inventions. This type of patent-influenced reward system defines a set of demand and pricing characteristic for the production of additional inventions. The planning of potential inventors (and their backers such as large corporations) will tend to respond to this demand with attempts to supply highly valued inventions. The result will be that choices about how many inventions to pursue, of what sort, and at what invention development cost will be determined in research planning decisions in relation to the desires and demand characteristics of potential invention users.[44]

An example will make this type of operation of the patent system and its regulation of invention production clearer. For simplicity sake, consider a two consumer world in which the demand for mousetraps depends on just two parties seeking these traps, Ms. H and Mr. M.[45] Ms. H runs a restaurant and thus values the elimination of mice (and a better mousetrap that will do

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[44] Of course, the ability of parties pursuing inventions to plan their efforts in light of these factors depends on the availability to them of information on these aspects of invention demands and rewards. Limitations on the availability of this type of information may make an invention reward system useless in mediating the production of potentially useful inventions. Where the needed information is lacking, this may justify withholding the application of the patent system entirely and saving the associated administrative costs that administering the patent system would otherwise have produced. The possibility that information gaps and transaction costs may justify a more limited system of patent rewards and rights than the ideal reward system discussed at this point is considered at a later point in this article. The aim here is to profile the ideal system assuming few information gathering costs and low transactional costs. Later discussions will address how we may wish to back away from this ideal to take into account the practical deficiencies of our information gathering and transactional abilities and to tailor our real patent system in light of these real world limitations.

[45] This example is derived from one proposed by Demsetz in which he focused on the demand for two parties for access to a televised showing of a taped program. *See id.* at 294-95 I have translated his example from the world of copyrighted television programs into the world of patented inventions.

this more effectively) very highly. Mr. M is a homeowner and is interested in a more effective mousetrap, but less strongly than Ms. H.

Returning to Figure 1, assume now that the demand curve d reflects the prices that Ms. H will pay for access to additional types of new mousetrap designs with increasing utility to him (with access charges implemented, for example, through patent-elevated prices imposed when buying traps with the new designs). What constitutes increased utility and value to Ms. H is a personal choice. He will, if he is a rational consumer, tend to be willing to pay more for access to designs that serve him better, but features of a design that make it better to him and how much he will pay for access to a new design are consumer-specific choices assumed here to be summarized in his demand curve.

Demand curve D in Figure 1 reflects in our current analysis the aggregate demand of Ms. H and Mr. M for access to new mousetrap designs (with the individual demand of Mr. M not shown, but mathematically ascertainable from the D and d curves shown and equal to D-d). Curve S reflects the willingness a supplier who can control access to mousetraps with new designs to produce and supply new designs at various reward levels. The socially optimal amount of production of the new mousetrap designs is encouraged by the combined demands of individual mousetrap users for new designs and the creation of market forces that encourage the development of new designs, but only up to the level of aggregate consumer demand. The resulting incentives should encourage the production of just enough new inventions as public goods – not too many (as to waste resources on inventions with less increased utility to invention users than the costs of developing the new inventions) and not too little (so as the leave invention users with unmet needs that could have been met through the cost-effective development of additional inventions at costs less than the utility gains the inventions would have produced).

Obviously, a two consumer marketplace for new designs is a trivial case. In the real world, these two parties would probably link forces and seek to contract directly with the persons who could supply new mousetrap designs. Such a contract-based system could provide efficient incentives for invention by setting contract payments for successful inventions at levels that encouraged efficient efforts to develop and supply those inventions. The result would be a contract-implemented agency relationship in which the potential users of a new advance are the principals seeking efficient invention services from innovators serving as agents. Whether or not the work of the agent was efficiently encouraged or completed would depend on the accuracy with which the users could define their invention needs, the degree to which the agents could be incented to produce advances serving the users' needs without wasted efforts on other designs and tasks, and whether the amounts spent in contract-defined rewards exceeded the gains that the users realized from the new designs and mousetraps that resulted from the work of the innovators.[46] This sort of contract-based system could be implemented through direct contacts

[46] In addition to agency problems that might interfere with this type of innovation through private contract incentives, in the absence of patent rights limiting use of the designs, the parties might also be worried about free rider effects -- that is benefits to non-paying competitors of the contracting parties. These effects would be present if the advances that were the targets of the contracting scheme were freely available to others not paying a share of the development costs. This might occur because physical limits on access to the resulting designs (or trade secret protections limiting access) were not sufficient to prevent knowledge of the designs by competitors once products reflecting the designs were publicly sold.

between innovators and invention users. It requires no patent system to link the interests of these parties.

Demsetz' analysis describes a different means to link the interests of innovators and invention users through market processes, a mechanism which will play a much more central role than contracting in situations where potential invention users are numerous and dispersed widely such that effective contracting processes are not possible. The implications for the patent system of Demsetz's insights about the desirability of access controls for public goods are apparent if Mr. H and Ms. M in the prior example are thought of as very different individuals, each with a different set of demand characteristics and a different demand curve. Demsetz recognized that a producer of a public good faces the whole market demand for that good, meaning that the public good can be supplied to all parties that seek it (and are willing to pay the access price demanded for use of the good). The aggregate demand for new inventions of a particular type (such as a new mousetrap design) will reflect the sum of the incremental values that different types of invention users place on inventions and carry forward in their willingness to pay for access to the new advances. Hence, in the prior example, Ms. H and Mr. M can each be thought of as a representative of a category of invention users that will pay, as a category, a certain amount for access to more inventions with a particular quality (with the nature of the quality of interest somewhat different by category, just as the point of interest of consumers of hides and meat was somewhat different in the case of steer production).

Seen this way, the combined demand function graphed in Figure 1 summarizes the aggregate demand of different types of potential users for products based on new inventions. This demand reflects the interest and value to users of the new products in the functionality provided by the new products. The details of the functionality of interest (and the value that each category of invention user places on the functionality) will vary for different invention users, but an overall demand for new inventions can be projected from these component demands. From this aggregate demand, potential innovators can determine (at least roughly) what types of inventive projects will be likely to meet with favorable consumer reactions and at what sorts of payment levels.

The role of patent law in this system is to enable the exclusion of parties from access to patented technologies without paying for that access. Patent infringement suits leading to injunctive relief help to ensure that users of patented advances (as well as makers and sellers) do not have access to the advances without paying for the access. These suits (and the threat of them) are means to direct consumers to gain access to the patented inventions through channels authorized by the patent owners and with payments to those owners (in either patent-elevated sales prices for patented items or license fees paid to patent owners by producers of those goods). Suits leading to damage recoveries supply payments for completed access that substitute for privately negotiated access fees charged by the patent owner. The threat of these suits encourages the payment of access fees without litigation. Overall, the patent system and its remedies tend to preclude unpaid access to patented advances and to provide a basis for the type of invention "pricing" system envisioned by Demsetz. As such, patent law plays a central role in regulating the production of excludable public goods such as patent-eligible inventions.

The enhanced patent reward theory described here has many potential uses in helping us to understand the impacts of patent law features in diverse areas of the law.[47] Evaluating the range of inventions for which patent-based production incentives and regulation are particularly valuable can help us to define the proper scope of patentable subject matters and the corresponding scope of patent system influence. The desirability of limiting patent-based access controls to situations where the present utility of an invention is manifest and potential users can evaluate and price access to the inventions in terms of the incremental utility of the advances suggests that presently identifiable utility should be a minimum feature of advances constituting patentable subject matter. Furthermore, in order to aid in the operation of a system of access controls and pricing of the sort described here, a clear description of the present utility of an advance should be a minimum requirement of enabling invention disclosures in patent application documents.

The types of circumstances where we are most concerned about misallocation of scarce resources and most in need of the type of resource allocation mechanism provided by the type of reward system described here may inform our laws on non-obviousness. The range of parties who should be expected to pay rewards to invention developers and thereby beneficially influence the decisions of potential inventors about the scope and targets of inventive projects may inform our laws about tests for patent infringement triggering infringement remedies. Finally, because they are clearly central to a system of invention access pricing and rewards, standards for the relief available for patent infringement may be directly shaped by consideration of the enhanced reward theory described here. Implementation of the type of invention production system described here will depend on patent infringement damage payments that are large enough to properly compensate patent holders for the increased utility provided to past users of patented inventions. Patent remedy standards must also provide for a range of injunctive relief that will ensure inventors have the needed confidence over invention access controls to project inventive project payoffs and to shape their projects in terms of payoffs from meeting the full range of user needs that they can satisfy through efficient private production of new patentable inventions as public goods.

These and other implications for patent law standards of the reward theory described here are discussed at a later point in this article.

D. Normative Implications of the New Theory: The Case for Strong Patent Rights

An invention access pricing and reward system implemented through strong patent rights and access controls potentially can produce two key public benefits. Such a patent-based system of invention controls and access pricing can encourage the production of inventions in socially desirable forms and numbers. Such a system can also allocate scarce resources to the production of inventions in an efficient manner. This subsection considers these beneficial patent system impacts, thereby summarizing the normative case for strong patent rights.

1. Features of a Strong Patent System

[47] Many of these implications of patent reward theory for patent law standards are explored more completely in section IV of this article.

A strong patent system is one where patent rights apply to particular inventions in a predictable manner and, where they apply, patent rights prevent unauthorized (and uncompensated) access to patented advances in a predictable manner. A patent system that is predictable in these two senses will provide inventors with means to protect rewards or "prices" for successful inventions and to make informed decisions about innovation projects and resource allocations.

The aim of patent rights to exclude parties from unauthorized access to patented inventions is to activate bargaining and pricing processes that aid patent holders in charging for access to their inventions. The resulting access fees, charged through patent-influenced sales prices or through licensing fees paid by producers or users of patented advances, establish prices and values for various types of inventions. Exclusive rights and the injunctions that back them up are the starting points for privately implemented invention pricing schemes. Patent holders are able to carry out these invention pricing schemes by selectively enforcing patent rights (where an access fee is not paid) and contracting for invention use (where an acceptable access price is paid for use).

In this framework, damage remedies for patent infringement are backstops to clean up after failed efforts to charge for access, with dollar payments to the patent holder serving as substitutes for the access prices the holder would probably have charged (equal to the profits the holder would have realized) had an access transaction been constructed through private means. Additional punitive damage awards for knowing infringement tend to encourage attention to possible patent rights conflicts before parties act, thereby promoting contracting for access to inventions and the payment of access fees. In this sense, damage remedies regarding past infringement not only provide a substitute for privately negotiated invention access arrangements and pricing, these damage recoveries encourage care by potential infringers about the possibility of further infringement, thereby tending to bring these parties into the access pricing system.

These aspects of a strong patent system encouraging parties to establish private processes for invention access pricing will tend to ensure that means of charging for access to inventions are implemented in the most efficient ways possible. Patent holders will have a direct stake in efficient charging mechanism because inefficiencies will reduce what they take away from charging for invention access. These same incentives will encourage efficient frameworks for product differentiation and price discrimination among different types of invention users. If patent holders have means for charging different prices for access to patented inventions by different subsets of invention users, the patent holders can charge different access fees for different users that reflect their different invention valuations and their different willingness to pay for access to the inventions. The costs of administering such a system of price discrimination will fall on the patent holders (in the sense that the costs will come out of the potential profits to patent holders from enforcing their patent rights). This means that choices about whether to charge different prices for access to inventions (perhaps by supplying different types of products incorporating the invention), as well as decisions about how to implement different prices and how to group similar users for purposes of charging a particular access price, will tend to be made efficiently to minimize administrative costs that would reduce the gains of the patent holders.

2. Public Gains from a Strong Patent System

Two important types of public policy benefits can flow from a strong patent system like the one just described. An invention access control system like this can encourage publicly optimal levels of invention production and can attract and divert scarce resources to this type of production at publicly optimal levels. However, even if a patent system would produce these public advantages if operated in an ideal form, transaction costs or other detrimental aspects of administering the system may swamp the advantages of a strong patent system and produce no net public benefits from having such a system. These transaction and administrative costs place practical limits on the public benefits from the patent system. Both the potential benefits of the patent system and the limiting impacts of patent system costs are discussed in this subsection.

a. Encouraging Optimal Levels of Patent-Eligible Invention Production

A system of strong patent rights and invention access pricing mediates invention production in desirable ways. It encourages production of patent-eligible inventions at socially optimal levels. In can help to ensure that there is not underproduction of such patent-eligible inventions relative to the public's willingness to pay for more. By controlling invention access through patent rights, patent law assists inventors in implementing an invention reward and pricing system that target and fund invention production levels so as to match the supply of additional patent-eligible inventions with public interest and value in such additional inventions.

In assessing the role of patents in regulating invention production, it is important to distinguish between production of patent-eligible inventions and the production of other more commonplace technical designs and inventions. Patent-eligible advances are outliers among inventions, capable of production only by parties who have and apply design insights that are beyond the obvious reasoning of the bulk of scientists and engineers in the same field. These are simply a different animal from day to day innovations of the sort that are produced by the great bulk of scientists and engineers working with standard design principles and obvious insights to extend earlier designs. We may have plenty of day to day innovation, but lack optimal levels of the types of outlier innovations comprising patent-eligible advances. Patent rewards are designed to give a special boost to the latter, on the ground that these are often important advances that shift technology progress in new directions and avoid stagnation in areas of well know technology and products.

The existence of the patent system is evidence that Congress views these sorts of patent-eligible inventions as special and the producers of these inventions as somewhat privileged. The privileged status is indicated by the monopoly control over invention idea use and implementation given by Congress to patent holders. Such monopoly control is a rare exception to the principles and laws (primarily antitrust laws) encouraging active competition in most other spheres. This special status of patent-eligible advances indicated by Congress should be remembered when we consider the merit of various versions of the patent system. The goal of the patent system is not to encourage inventions in general. It is to encourage the special type of outlier inventions constituting patent-eligible advances. Whether or not the patent system is a

success will depend primarily on its effects on the production of these special types of inventions, not on the impacts of the patent system on all types of inventions.

It may be argued that excessive patent rights regarding patent-eligible advances will have a negative side effect on the production of additional non-patentable inventions. This might be the case where non-patentable inventions are made using patented advances as bases for improvements or as components of broader new products. If use of patented designs is either unavailable or curtailed due to prices charged to pay a price for access, the production of new advances derived from older patented advances might be limited. In this sense, it is argued, patent rights should be interpreted and restricted to encourage the best possible overall levels of innovations in total, with strong enough rights to encourage some exceptional, patent-eligible advances, but not granted to such a strong degree that downstream innovation is curtailed.

This is a false framework for analysis. Whether or not strong patent rights will encourage heightened levels of production of inventions as a whole depends on whether they are granted exclusively (or at least mostly) for inventions that would otherwise not have been made. The strength of the patent rights granted does not matter, so long as these rights are limited to advances that would not have been produced absent the promise of patent rewards. What does matter is the specificity of the rights, not the magnitude of the remedies. If patent rights and rewards are granted only for advances that would not have been made but for the lure of these rewards, this reward mechanism will tend to produce more patent-eligible advances than would otherwise be the case. This will, in turn, provide more inventions that are potential platforms or components for later production of additional patented and non-patented advances. Even if patented advances are only available for use in later inventions after payment of patent-influenced access charges (or only available after the expiration of patent rights), the impact of patent system in producing more patented advances will achieve a net social gain. The availability of some patent-restricted inventions is better for society than not having these innovations at all.

By providing more technology designs as starting points for further innovation, patent rights adding to our store of patent-eligible inventions will tend to enhance later invention opportunities and, over time, will probably increase total numbers of subsequent inventions of all types (both patent-eligible advances and other more mundane advances). Conversely, if patent rights and associated access charges are added to inventions that would have been produced by normal competitive processes, these charges become just deadweight losses that impose costs on the later production of inventions which depend on the patent-eligible advances. The production of some advances derived from the patented advances will be unnecessarily curtailed or foregone if these costs must be paid.

b. Encouraging Optimal Diversion of Scarce Invention Production Inputs

A system of invention access controls and access pricing can serve a second valuable public function in allocating scarce resources as invention inputs. Invention rewards defined by such a system tend to attract and allocate scarce resources to the production of patent-eligible advances in circumstances where such allocation is the highest, best use of these resources as

measured by the interests and values of the public. The invention pricing process becomes an intermediary system whereby the use of scarce resources is prioritized and directed to projects involving the largest public needs and greatest public impacts. By tying public values of new inventions to the private values of potential inventors and the organizations that back them, the private interests and agendas of the inventors and organizations are made at least roughly congruent with the aggregate public interest in new advances. As the inventors go forward with resource planning concerning potential invention projects, their resource acquisition and allocation decisions are made with the public value of potential inventions in mind. Hence, these inventors and their organizations become agents of the pubic in acquiring resources for the private production of public goods in new inventions and in prioritizing and economizing on the use of scarce resources for this purpose.

In this regard, the patent system supports market mechanisms for valuing potential inputs to the production of inventions, enabling markets to take this use of resources into account in additional to other potential uses for the same inventions. Where inventions are expected to be of high value by those who are capable of developing the inventions, resources (including the time of highly capable inventors and other resources needed to support the innovators' efforts) will be drawn to innovation projects. Where inventions appear less valuable, the same resources will tend to be devoted to other purposes where the resources appear to have greater value. By mediating the allocation of scare resources potentially serving innovation but also potentially serving other valuable ends, patent rights and the invention valuation and reward processes these rights support serve valuable public functions in promoting the efficient use of scare resources.

3. The Offsetting Effects of Administrative Costs

Public gains from the patent system of the sort described to this point may be offset and even eclipsed by the negative effects of various costs of administering the patent system and the enforcement of patent rights. Several types of costs may have this effect, including costs associated with reviewing patent applications, enforcing patent rights, and determining whether projected activities will conflict with patent rights. Additional costs including the lost value of activities not undertaken where there were actually legitimate in the face of patent rights, but mistakenly interpreted to be infringing. Where costs such as these outweigh societal gains from the improved regulation of invention production under the influence of patent rights, then the patent system will have produced a net loss to society rather than gain. Under these circumstances, it will be desirable to withhold the impacts of the patent system and exclude a corresponding realm of subject matters or activities from patent coverage.

A complete exclusion of a particular technology or type of infringement from patent rights and rewards on grounds of administrative costs will rarely be justified, however. This will be warranted only where the costs of patent enforcement will always (or almost always, to an extent that it is not worth assessing the paramount size of system costs on a case by case basis) trump the advantages of patent influence on invention production in the area of technology or useful advance under consideration.

In most technology settings, it will probably be desirable to recognize the potential for projected patent rewards to draw out socially valuable innovation for the reasons described to

this point, and to leave it to particular inventors to determine if the projected patent rewards for their anticipated work and projected inventions still provide net incentives for action after the costs of patent enforcement and net rewards these imply are taken into account. In short, an inclusive view on patent system scope and patentable subject matter will be mitigated by the case-specific factual assessments of particular potential inventors; if the costs of gaining patent rewards, when added to the costs of producing a successful invention, seem unlikely to produce net returns that trump the returns on similar investments of time and resources in other avenues of action, then the costs of administration in that setting (at least those felt by potential inventors who are contemplating the advantages of being patent holders) will put a practical limitation on the scope of the patent system in particular cases.

V. Patent Rights: When We Need Patents

Looking at the patent system as a means to promote the production of patent-eligible inventions as public goods, when do we need such a system? As a system that has many potential costs – in system administration expense, reductions in productive activities by persons who must pay elevated fees for access to patented advances, and in reduced competition to produce and sell patented advances – the patent system must have considerable advantages before it will overcome these costs and create net public benefits. In short, the preliminary public case is slanted against the patent system because of its manifest costs. When will the advantages of the patent system be great enough to overcome these costs and to establish a positive public policy case supporting a strong patent system?

An answer to this question is possible through extending the analysis of the patent system just described. The patent system is an artifice designed by Congress to solve a problem: the potential underproduction of technical advances that are outliers in their technical fields. The patent system should be implemented where this problem is most acute. That is, the strongest public policy case for the patent system favors applying the system where the underproduction of technical advances has the most severe public consequences. If the patent system is a tool for matching the production of patent-eligible advances to public needs for such advances, then the patent system is most important where a mismatch between inventions and public needs is likely to have the greatest consequences.

In considering the type of mismatch between invention production and public needs that is the province of the patent system, it is important to remember that patents do not promote all inventions, but rather just those outlier inventions constituting patent-eligible advances. Hence, the case for patent system (if one exists) must turn on identifying when there will likely be an under-production of these special patent-eligible advances absent patent rewards and where such under-production will have serious societal consequences.

An emphasis on the need for the patent system to overcome an invention production mismatch provides a guiding principle for assessing when we need the patent system. This principle leads us to three subsidiary questions: 1) When is the under-production (in terms of unmet societal desires for inventions providing functional improvements) of patent-eligible advances socially important? 2) When are normal competitive processes likely to encourage production of inventions at socially optimal levels such that the special boost of the patent

system is not needed? and 3) When are the costs of administering the patent system so great as to overwhelm the invention production advantages of the system, thereby justifying limits on the scope of the patent system?

To fully justify taking on the manifest costs of the patent system, we should probably reserve such a system for circumstances where the answers to all three of these questions support the existence of patent rights. This indicates that we should limit the patent system to settings where the underproduction of inventions has serious social consequences, where there are reasons to believe that scarce resources will be under allocated to the production of socially important inventions, and where there are not predictably high transaction costs of administering patent rights that will exceed and cancel out the societal benefits of producing more inventions.

The remainder of this subsection addresses these questions in turn by way of providing an overall answer to the question: When do we need a strong patent system?

A. When Invention Underproduction Matters

If the patent system is primarily a means to encourage and regulate the private production of patent-eligible advances as public goods, then we most need the patent system where we are concerned about the underproduction of patent eligible inventions. Put in functional terms, given that the patent system is a means toward the end of invention production enhancement, the patent system is most strongly justified where that end matters to us. Where invention underproduction is particularly important to society, using the patent system as a means to offset such underproduction may be correspondingly important.

The underproduction of patent-eligible inventions may be a problem for several different reasons (with more than one of these problems potentially present in a given technical area). At least three types of reasons for underproduction patent-eligible inventions may extend over a wide range of technologies: 1) the failure of contracting processes to produce proper levels of invention because of the large number of potential users of a product or service and the burdens of reaching these parties to charge for invention access through contracts; 2) the likelihood of strategic behaviors limiting innovation because potential inventors are unwilling to advantage competitors who may gain as free riders on realized inventions; and 3) the hesitancy of parties with specialized research capabilities to commit these to innovation with no practical means of realizing returns from product producers or users without encountering free rider problems. Each of these potential reasons for invention underproduction (and the circumstances in which they may apply) are described in this subsection.

1. The Limited Range of Contract Incentives

Where the user sets for particular types of innovations are small, contracting processes (in which rewards for successful inventions are set up as “bounties” for providing the inventions) can be structure to encourage parties to pursue inventions at optimal levels. A party (or group of parties) seeking a particular type of invention would simply approach a party capable of producing the needed advance and agree to contract terms providing for a specified payment to the potential producer upon delivery of an invention design meeting certain functional

specifications. This sort of contract – essentially a specialized design services contract – would have the potential to create optimal incentives for the pursuit of cost-justified invention development efforts and for the devotion of resources to these efforts in an efficient manner. Where this sort of contracting process is likely to be effective, there seems to be little reason to also provide for patent rights. Indeed, given that the administration of the patent system would add costs to this situation, it would seem desirable to withhold patent rights in these circumstances.[48]

But the opposite will generally be the case where contract processes are ineffective or particularly costly to implement; the patent system and the invention incentives that it creates can serve as a contract substitute to cause potential innovators to see the merit of various inventions (and the processes needed to create the inventions) with the perspectives and value judgments of potential invention users. These incentives can make potential inventors agents of invention users for purposes of pursuing inventive projects. As such, patent rights can serve as a substitute for equivalent agency contracts in settings where the latter are not possible or not cost-effective to implement.

Why might innovation-inducing contracts be difficult or impossible to implement. There may be many reasons, but at least two seem likely to arise relatively often.

First, the number of potential users of an invention may be so large as to make it unwieldy to implement a contractual system for charging for access to the resulting invention. In these circumstances, only a subset of the potential user group could be banded together to form an administratively workable contracting group and could only be expected to pay a reward for successful invention that corresponding to their advantage from gaining access to a particular invention. This would create some incentives for invention, but not the same scope of incentives as if all the relevant and interested potential users of a successful invention could be expected to provide portions of the rewards for successfully producing an invention. Since contracting processes cannot be expected to include and reflect the user preferences and value placed on a particular invention by large groups of invention users, these processes will create suboptimal levels of incentives (and suboptimal levels of invention) where the size of potential invention user groups is large.

Second, where the identity of potential producers of a useful invention are unclear, it may be difficult or impossible for interested potential users of a particular type of advance to contact the relevant parties and establish the needed incentives with those who are capable of responding to those incentives with a successful invention. Here the issue is not numerousity of the potential user set (we can assume that the relevant parties have banded together successfully to seek an invention of common interest), but rather a lack of knowledge about invention potential needed to select a viable inventor and to target the needed incentive contract. Even an open ended reward contract (in which the relevant parties agreed to pay the first party to submit a design with certain characteristics a particular reward) would have to be publicized to the potential innovators and administered to determine who had made a successful submission. Where, as will typically be the case for the sorts of generally non-obvious advances for which patents are

[48] I have previously argued that this is a desirable limit on the patent system and should be included as a component of standards for patentable subject matter. *See* Richard S. Gruner, ???

an influence, the parties having unusual insights in a field will not be generally known and the ability of potentially contracting parties to be in touch with these rare innovators may be limited at best. For lack of this knowledge about who is a viable innovator in the realm of non-obvious advances, contracting processes aimed at promoting these sorts of advances at optimal levels may be difficult or impossible to target effectively.

For these reasons (and perhaps others), contracting processes aimed at creating optimal incentives for the production of non-obvious advances may be difficult or impossible to implement in many fields. Hence, the need for patent incentives as a substitute for contract-based incentives may be great across many innovation settings.

2. Free-Rider Effects Among Competitors

Invention underproduction may also be a problem because of strategic behaviors between competitors who might otherwise engage in innovation to stay ahead of each other in their competitive activities. In serving a potential set of customers, a particular type of business will tend to keep the future interests of the customer set in mind, including the interests of the customers in outlier innovations of the sort that the patent system is aimed at influencing. This type of motivation would tend to cause a business to act as an agent of its customer for purposes of innovation. It would, as part of this mission, tend to include some mix of work on outliner innovations (produced by itself or by contractors working for the business) to the extent that the projected success of work to produce the outlier innovations seemed cost effective in light of the probable value of the projected results and the projected likelihood of success. In short, businesses might serve as surrogates for consumers in producing inventions at optimal levels, in which case the special incentives of patents will not be necessary.

However, where there are two or more businesses competing for the same sales to customers, strategic behavior among the businesses may cause each to hold back from efficient innovation and a lack of optimal invention production to result. The problem that will tend to limit optimal invention production stems from fear of free rider effects. Potential inventors who lack means to control inventions after they are produced will be loath to invest large sums in the discovery and development of new innovations, only to see a competitor reap the main business benefits from a new advance. This would be the case if a competitor could copy a new design, get an equivalent product into the marketplace, and gain the business benefits of that design nearly as well as the originator of the design, without paying any of the design costs. Fear that this will occur will cause each potential innovator to hold back from innovation, resulting in a less than optimal total production of new advances.

This type of free rider problem will be most serious where the ease of free riding is greatest and the likelihood that potential innovators will appreciate this and hold back from innovation accordingly is also greatest. This will be the case where the costs of innovation are high and the costs of copying and gaining from an advance as a free rider are low. This combination of circumstances will produce the greatest gains to free riders and the greatest injuries to the innovators who are victimized by the free riders. This will also created the greatest apparent threats from free riders and, correspondingly, the greatest deterrents to innovation that patents can offset to public benefit.

3. Free-Rider Effects Limiting Specialized Research Activities

Free rider impacts may also significantly limit innovation where this type of work would otherwise best be undertaken by research specialists. Given the complexity of many types of modern scientific and engineering research, the research function is now often quite different from the function of producing and marketing goods and services to consumers. Effective and efficient research is conducted by parties with skills and resources that are divorced from those of production and marketing. In some large corporations, these specialized research functions are simply conducted in a different department or unit of the overall corporate enterprise. However, in an increasing number of contexts, the research functions leading to socially significant products and services are conducted in organizations that are primarily dedicated to research as their primary tasks. The two primary examples of these specialized research organizations are startup companies developing new technologies and university research labs producing new technological advances in conjunction with new scientific and engineering knowledge.

These specialized research enterprises are conducted in sole or in part for commercial gains, although for some (primarily university organizations) this may be a secondary mission. In order to initiate large projects, the managers of these enterprises must be able to present a convincing case to parties controlling the necessary resources (which are often staggeringly large) that there will be means to produce commercial gains from successful completion of the research that is being considered. A plausible business objective is necessary, even though there is never a guarantee that a successful scientific or engineering result will be produced or that such a result, if achieved, will translate into a commercial success. Research results must have a foreseeable commercial value (even if this is contingent) if projects are to be funded (or at least aided) in light of their commercial potential.

The difficulty of free rider effects in this context is that, if successful research results are not capable of being controlled by research organizations, they will have little if any means to gain a return on their research efforts and investments. Once successful results are made public, any party will be able to use them in the absence of patents and the research organization will have little if any means to gain a return on its valuable discovery. Concern about free riders will destroy any vision of future profit potential in commercially significant lines of research. The research organization will bear the costs; the free rider will reap the gains. There will be no means to link commercialization to research costs in a way that will produce research payoffs and cost recoveries. Absent such a manifest link, research enterprises will be loath to start out on costly projects and the production of innovations at optimal levels will be curtailed.

As with the counterpart problem between competitors, this version of free riding will be most serious – and the need for patents as counteracting forces will be greatest – where the costs of research and innovation production are largest and the costs of acting as a free rider are lowest. In these circumstances, research organizations will see that they have much to lose from the initiation of what will probably be uncompensated research and, correspondingly, potential free riders will be likely to capitalize on most or all opportunities to take up unprotected new advances and commercialize them in lieu of parties who have formal relationships (and

compensation arrangements) with the research organizations that discovered the advances. In circumstances of high research costs and highly likely free riding which will cut off research compensation and return, research organizations are highly likely to be deterred from initiating costly research and the public will suffer from resulting suboptimal production of new innovations.

B. When Resource Under-Allocation Matters

Patent incentives for heightened production of patent-eligible advances are most strongly justified where society needs the advances and where normal competitive processes are unlikely to allocate scarce resources to the production of socially optimal amounts of innovation to produce these advances. Even where a type of invention with high societal importance is at stake, normal competitive processes (unrestricted by patent limitations and patent system burdens) may be adequate to encourage production of the important type of invention. Accepting the costs of the patent system will not be warranted where there are other means to encourage production of inventions (even very important types of inventions). Under what circumstances, then, are normal competitive commercial processes likely to be inadequate and the special spur of patent rights likely to be needed to bring sufficient scarce resources to the production of patent-eligible advances?

The answers to this question depend on both how normal competitive processes allocate resources to the production of various items in socially desirable quantities, and the reasons why these normal processes may break down in connection with the production of patent-eligible advances. Both these topics are considered in this subsection.

1. Normal Competition is Often Sufficient to Attract Invention Inputs

Competitive processes (including competitive markets for pricing and allocating resources) will tend to respond to consumer demands for various types of advances if there are numerous parties who are capable of producing the advances in question. Where this is the case, one or more of the various possible inventors will tend to put together the resources needed for effective innovation and to produce new inventions capable of meeting public demand for such inventions. Hence, where there are numerous persons with the analytic talents and research resources needed to produce a particular type of invention, normal competitive business processes are likely to encourage the production of inventions at socially optimal levels. Normal competitive processes should prove adequate to – that is, at levels that meet the demand of the public for the type of advance in question – and the special added incentives of patent controls on access and patent rewards will not be needed to boost invention production.

However, where the inputs to the production of a particular type of advance are scarce – because either few personnel have the relevant analytic abilities or there are few parties with sufficient resources to support effective innovation – then patent rewards may be needed to attract these scarce inputs to the production of inventions and to ensure that these resources are not put to less socially valuable alternative uses. Patent rewards can solve the problem of under devotion of scarce resources to types of inventions that society has a strong interest in producing and using. Hence, the special invention incentives provided by the patent system are particularly

warranted in situations where there are both strong needs for a type of invention (indicating that the consequences of underproduction of that type of invention are particularly severe) and probable problems in attracting inputs to the production of that type of invention through normal competitive processes (in most instances because one or more of the needed inputs are scarce and, absent patent rewards, the scarce inputs will be devoted to other uses).

2. Sources of Scarcity in Invention Inputs

Outlier inventions (of the sort patents cover) have features that often depend on scarce resources. These are inventions that are not within the design capabilities of persons with average skills in the relevant fields.[49] This means that the outlier inventions that are the subject of most patents are produced by only a few highly capable scientists and engineers (rather than by the great bulk of persons in the same fields who have average or less than average skills). The persons with the relevant skills and knowledge needed to produce patented inventions are scarce resources. The special lure of patent rewards may be needed to lure these scarce innovators to the production of patentable advances rather than to the other ends that the parties with scarce knowledge or skills might pursue.

As I have analyzed in more depth elsewhere, inventors capable of producing patentable advances (and the resources needed to support these inventors) may be scarce for a variety of reasons.[50] Knowledge in many science and engineering disciplines is now very complex and specialized, meaning that only a few persons may have mastered and be able to apply any particular body of knowledge to produce a related type of invention. Advanced training in universities tends to track this same pattern of specialization, producing only a few parties with advanced training in particular disciplines. Supporting resources needed for innovation in particular fields – including laboratory facilities, research staffs, administrative staffs, equipment, and supplies – are extensive and only possessed by a few corporations or universities. The scarcity of the innovators or supporting resources in these various types of situations imply that the lure of patent rewards may be needed to attract these resources to the production of patent-eligible advances rather than to other productive activities that the resources might support.

3. Indicators That Invention Inputs are Not Scarce and That Normal Competition Will Probably Suffice to Produce Inventions

Conversely, some features of invention production processes or contexts tend to ensure that there are many potential providers of particular types of inventions and that, accordingly, there are not the sorts of conditions of inventor scarcity that need the special incentives and resource allocations achieved by the patent system. Where the skills necessary to produce new advances are widespread and costs of producing inventions are small, neither the relevant researchers nor the supporting resources are scarce resources. The likelihood of many new advances – including, as part of the overall mix, a substantial component of outlier advances – is high. Under these conditions, there will not be a case for application of the patent system.

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[49] *See* 35 U.S.C. § 103.

[50] *See* Richard S. Gruner, *Dispelling the Myth of Patents as Non-Rivalrous Property: Patents as Tools for Allocating Scarce Labor and Resources* (in preparation).

Conditions of this sort are present, for example, in many business environments, where numerous parties may be capable of identifying and pursuing certain types of new business practices innovations and where the resources needed to try out new methods may be small. This combination of many potential innovators and sufficient supporting resources to produce and test advances suggests that business method patents may not be needed to spur advances in most business settings.

However, even types business method patents are not needed in all business settings, they may still serve a valuable resource allocation purpose in narrow business domains. Business method patents may have strong justifications in specific business settings where the generally prevailing conditions of abundant potential innovators and low innovation costs are not met. For example, in some areas of highly rare business skills such as computer-enhanced financial methods, numerous business innovators capable of working at the most advanced levels may be rare. The elite computer-savvy financial specialists capable of producing these advances are a scarce resource.

Patent incentives may be valuable to encourage them to apply their skills and talents to the development of new financial services techniques. Assuming that the development of new financial methods is of substantial societal importance (that is, it meets the first criteria for application of the patent system because underproduction of this type of advance will have adverse societal consequences), then patent incentives can ensure that the rare skills (and associated computer resources) of high-level financial specialists are applied to the development of new financial methods rather than to other tasks of significant value to financial concerns and users of the services of those concerns.

Thus, even in a domain such as business methods where there are sometimes many possible innovators, there may be subdomains where innovators are scarce and patents are more justified. This will be the case where innovation depends on very specialized knowledge or unusual resources and there are very few parties with both the needed knowledge and the necessary supporting resources to produce outlier innovations.

This suggests the need for careful analysis of the merit of patents in subdomains of fields and that a categorical exclusion of all business methods from the patent system as non-patentable subject matters may not be wise. Rather, the appropriateness of patents for specific types of business methods should be screened through the context-specific knowledge and innovation technique standards of non-obviousness tests. By applying the latter to determine if a given advance was one that only rare innovators could have produced (because the advance was beyond the knowledge and skill of persons with average or less than average abilities in the same field), business method patents and other patents in fields where patents are not generally needed to spur innovation can still be a force in exceptional subdomains where key analytic skills or innovation resources are rare. In these settings, the need for patent incentives to attract scarce innovators and scarce innovation resources to important tasks is particularly strong and the case for patent system inclusion is compelling.

C. When Administrative Costs Trump Patent System Advantages

Even where socially important inventions (with serious consequences if underproduced) are present and there are reasons to believe that special incentives such as patent rewards are needed to attract scarce resources to the production of these important inventions, application of the patent system may still not be desirable where the costs of administering the system are large and these costs trump the advantages of patent impacts. If the administrative costs of granting and enforcing patents will overwhelm the social benefits of increasing the production of the important inventions in question, the patent system will not produce any net social gains and no patents should issue. Patent rewards should be recognized only where society realizes a net benefit in the increased production of patent-eligible advances even after patent system administrative costs are taken into account.

This subsection considers the circumstances where the costs of administering the patent system are likely to be large and when patent rights should be withheld in light of these probable costs.

1. Limits Based on Difficulties in Identifying Infringement and Triggering Rewards

One potentially important source of transactional costs in administering the patent system lies in costs associated with accurately identifying unpaid access to patented advances as triggers for providing patent holders with remedies for that unpaid access. In traditional patent law terminology, the costs in this category include costs in accurately determining patent infringement. These may include costs of determining standards for measuring infringement (including costs of claim construction as a preliminary to assessing infringement), costs in gathering and analyzing facts related to infringement determinations, cost incurred by defendants in forcing them to pay for access to patented technology where no access and advantage to the defendant from the invention has actually occurred (that is, costs due to over-inclusive findings of infringement), and costs paid by plaintiffs in being forced to accept unpaid access to patented technology where such access has incurred, but defendants are not legally required to pay for the access (that is, costs due to under-inclusive findings of infringement).

The costs of accurate determinations of infringement depend in part on the similarity of infringing and non-infringing items and the difficulty of telling them apart. Where distinguishing these (and providing remedies only for infringing items) is difficult, the tendencies towards mistargeting of patent remedies will be great. Hence, types of inventions that are little different from non-patented predecessors (or which are different only in ways that are difficult to detect) might be excluded from the patent system on the ground that the costs of accurate infringement findings and closely tailored patent rewards are too great to justify the invention production advantages of these findings.

Where, for example, a patented technology incorporates only small, difficult to detect changes in a prior technology, such a technology might be excluded from patent protections on the grounds that accurately targeting access controls and patent rewards for such a technology will regularly take more resources than the societal gains that are likely to result from more production of the inventions. Indeed, no greater production of such inventions will be likely if potential innovators perceive that infringement claims will be hard to press (because

infringement will be hard to prove) and that infringement remedies will be curtailed accordingly. The same sort of logic might justify excluding advances that are used in circumstances that are frequently difficult for patent holders (or parties working on their behalf) to scrutinize in indentifying when infringement is present. Certain business methods, for example, are used so frequently in private, concealed business environments that infringement will rarely be possible without major expenditures. The difficulty of identifying infringing activities and seeking corresponding remedies and patent-influenced rewards will undercut the incentives that patents can create for such advances.

Another source of difficulties and transaction costs in making infringement findings relates to the ability of potential defendants to disguise their products and activities so as to conceal infringing products and practices. The more defendants can misrepresent the nature of their products and practices in ways that utilize patented technologies while avoiding patent infringement remedies, the weaker that patent incentives become. Where defendants can disguise or conceal infringement, the costs of making accurate infringement findings go up (or the costs resulting from misapplied patent liability go up). At some point, the ease of disguising or otherwise concealing infringing items will be so great that infringement inquiries are not worthwhile and patent rights will also be a waste. This will be the case where the costs of accurate infringement findings overshadow the advantages of producing more patent-eligible advances in a particular area of technology.

2. Limits Based on Difficulties in Determining Proper Reward Size (Damages)

A patent-implemented invention access control system of the sort described in this article will only tie invention production incentives to invention access payments representing consumers' full measures of invention value if patent remedies for infringing conduct provide meaningful substitutes for voluntary access payments. This means that, where a party gains the benefit of invention use without paying access fees (in the form of licensing fees or patent-elevated product sales prices), then the relevant patent holder should be able to claim damages for the party's infringing conduct that are roughly equal in amount to the gains the patent holder would have received from a voluntarily negotiated access fee. In this way, patent damages will provide a roughly accurate substitute for market-determined access fees and the rewards and incentives for invention production that those fees normally provide.[51]

Further, heightened damage awards – that is, punitive damages – may be needed to encourage parties with notice that they are about to engage in infringing conduct and a clear opportunity to gain access to an invention through payment of access fees to be penalized when

[51] Current standards for compensatory damages based on patent infringement provide for damages that are substitutes for privately determined invention access fees, thereby serving the function of patent damages described here. These damages are determined by reference to private transactions for determining the amounts that parties would pay for access to patented inventions, thereby making patent damages roughly equal to and a substitute for market determined fees for access to patented inventions. Under prevailing patent damage standards, compensatory patent damages are to equal no less than the licensing fees that a patent holder and infringer would have been likely to have determined (in an arms length negotiation) to be reasonable compensation for the infringer's use of a patented invention. Cite to damages cases x?

they make the opposite choice and knowingly engage in infringement.[52] Awards of punitive damages in these circumstances will, like awards of compensatory damages, also necessitate determinations of the value that invention users place on access to patented inventions since the aim of the punitive damages will be to not just equal and offset these gains to intention users, but to exceed these gains and thereby create a net deterrent to knowing choices to infringe. This sort of deterrent will discourage parties from ignoring the production system for pricing patented inventions that is implemented through the patent system. It will discourage parties from adopting a business strategy of ignoring normal commercial channels for accessing patented inventions, channels that have been authorized by the patent holder and that play a role in pricing and rewarding the production of patented inventions. The likelihood of these heightened remedies and penalties will discourage and deter the next round of potential intentional infringers from ignoring market processes for invention pricing and the invention production system that these pricing mechanisms support.

A key problem and limitation in the administration of patent damages may be that the transaction costs of measuring the likely value and willingness to pay of infringers may be so large as to overwhelm the incremental advantages of more accurate estimates of user value and willingness to pay. Where greater accuracy in determining the willingness of defendants to pay consumes extensive resources in discovery or court processes, little if any advantage may be achieved in the better targeting of incentives for invention. Better invention production incentives will not be realized in these circumstances because the net rewards to patent holders will not be little different than they would have been without efforts to measure the damages more accurately. The greater awards that the plaintiffs might have received with costless information and more accurate determinations of invention users' valuation of inventions and willingness to pay for access to the inventions will have been eaten up by discovery and court costs. The result will be that plaintiffs will be no better off than if less accurate determinations of defendant valuations of intention access were used in determining infringement damage awards.

This type of transaction cost analysis suggests two possible limits on the patent system. First, litigants could be just left to take these sorts of net recovery dynamics into account in decisions about when to terminate litigation by settlements. Where the costs of further discovery and court proceedings do not seem likely to enhance the recovery that will be obtained (taking the costs of further litigation steps into account), the litigants can simply reach a settlement and maximize the plaintiff's net recovery as determined at that point in the development of the legal proceedings. There are at least two advantages to this approach. First, it allows the litigants to take into account diverse factors in assessing the strengths of a case on both sides and the likely litigation costs to come if a case is continued rather than settled. Second, it encourages the litigants themselves to formulate new valuation frameworks in considering case valuations and settlement terms.

A second possible solution to the problem of transactional costs in particularizing damage measurements lies in assessing damages for broad categories of defendants without worrying about the further factual findings necessary to particularize the findings to individual defendants within the categories. Categorical damage assessments will avoid the costs of achieving more

[52] Cite to punitive damages standards. x?

particularized assessments of how much each defendant in a class would be willing to pay for access to a given technology. So long as the damages assessed for a class of defendants approximates the average for the class including the defendant, the amounts recoverable by plaintiffs will approximate the rewards that they would achieve through more individualized remedies (although some defendants will end up paying more or less than they would be required to pay as damages in a system that made more particularized assessments of damages and enforced patent remedies and rewards accordingly).

3. Limits Based on Difficulties in Administering Remedies

A further source of transaction costs that may justify some curtailment of the patent system relates to the costs of administering remedies when imposed. While damage remedies may be relatively easy to impose, injective relief may be particularly difficult to administer for several reasons.

First, it may be difficult to ascertain the actual nature of the defendant's past or future infringement and to tailor an appropriate injunction to prevent that infringement in the future. Where a given defendant has disguised the nature of its actual use of a patented technology, an injunction realized in litigation may restrict the apparent activity, but not the full scope of the defendant's uncompensated use of the technology involved. Where defendants are particularly good at disguising or counterfeiting activities, the mistargeting of injunctions (and the related under-compensation of patent holders as the defendants make uncompensated use of patented technologies outside of the mistargeted injunctions) will be particularly severe.

Second, even where an injunction is properly targeted to prevent continuation of a defendant's improper use of a patented technology without compensation to a patent holder, policing adherence to the terms of the injunction may be difficult. Errors in such policing will either over or under compensate patent holders, with each type of error leading to social costs in over or under incentivizing inventions relative to socially optimal levels.[53]

Over-enforcement of injunctions (like overly broad findings of liability) will tend to advance the production of patent-eligible advances over the level that is socially optimal. This will, in effect, divert the use of some resources to the production of these advances where the resources would be better applied to other tasks in order to produce the best overall satisfaction of societal demands for both inventions and other products potentially produced with the same resources.

The under-compensation of patent holders through the under-enforcement of injunctions may also produce several adverse consequences. If deviations from injunction terms have no practical consequences, the injunctions will have little or no effect in stopping uncompensated

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[53] Over payments of rewards to inventors will, of course, not affect the incentives related to the remedies as these inventions will already be complete when the remedies are granted. However, such over payments will be witnessed by other inventors and similar overpayments will be anticipated by these inventors in the future. The result will be a tendency towards over production of the types of inventions associated with overpayments. In a similar fashion, underpayments will tend to lessen invention production below socially optimal levels.

access to patented technologies and encouraging users to pay for such access to patented technologies. The greater the "leakage" of patented technologies into the hands of users in violation of injunction terms, the greater the uncompensated weaknesses in the invention production system because the incentives for creating similar inventions in the future will be perceived as being likely to be affected by similar leakage. As a result, incentives for innovation will be less substantial than would be the case with full remedy enforcement. In addition, the ability of some invention users to gain access to patented technologies without paying for such access will encourage others to do the same (either because they no longer perceive much deterrence in the threat of patent litigation leading to impotent remedies or because they are in competition with the users gaining free use of the patented technology and feel the need to act like those users to keep up in the competition).

At some level of injunction enforcement costs, the costs of policing and seeking more accurate and defendant-specific judicial enforcement of violated injunctions will be greater than the incremental gains that the patent holders involved will realize. In these settings, withholding additional policing and enforcement will increase the net gains and incentives realized by patent holders and encourage invention production at greater levels than would be the case will more costly injunction enforcement.

VI. General Principles for Recognizing Patentable Subject Matter: Reconstructing Standards in the Post-*Bilski* Era

Patentable subject matter standards specify the range of practical discoveries that fall within the patent system and that are potentially subject to the types of production incentives and resource attractions that patent rights can provide. As described in this article, the patent system is a tool for encouraging and regulating the production of patent-eligible advances at production rates that match public demands. Where patents can serve this end, patentable subject matter should be recognized. Where achieving this end is impossible – because public demands for advances cannot be translated effectively into production incentives or because the costs of doing so overwhelm the public advantages of trying – the patent system should not be applied and advances should be found to be non-patentable subject matter. In this way, the purpose of the patent system in regulating invention production provides a guiding principle for the construction and interpretation of patentable subject matter standards.

Patent law is peculiarly in need of such a principle as patentable subject matter standards are at once ill-defined in current case law, yet needed by potential patentees, patent holders and others concerned about the validity of present patents, and potential infringers who are worried about the scope of patent infringement liability. This section describes the present lack of meaningful standards for patentable subject matter, assesses why past standards have been inadequate in light of the purposes of the patent system described in this article, and proposes a new patentable subject matter standard that will serve the purposes of the patent system more directly and completely.

B. Past Standards Reevaluated

This subsection provides a brief overview of past patentable subject matter standards which have each enjoyed brief acceptance, only to be rejected by reviewing courts that have found weaknesses in the standards upon full analysis and consideration. My object in this critique is to point out the deficiencies of these past standards in focusing the patent system and its incentives on the types of access controls and innovation production incentives described in this article. Following this critique, the next subsection goes on to suggest a new patentable subject matter standard better limiting the sweep of the patent system to advances that can be encouraged by the access controls and payment systems the patent system facilitates.

1. Supreme Court Standards

a. *Benson* Test

Much of the current confusion in patentable subject matter standards stems from the Supreme Court's cryptic analysis of such standards in the case of *Gottschalk v. Benson*.[54] In *Benson*, the Court held that a computer-based information processing method – divorced from any particular implementation in a specific computer or other piece of hardware – did not constitute patentable subject matter. The invention at issue was a method for converting information from one computer-readable format to another computer-readable format.[55] The Court interpreted the claims of the disputed patent as covering all implementations of the method described in the patent, including implementations "not limited to any particular art or technology, to any particular apparatus or machinery, or to any particular end use."[56]

The Court's reasons for finding this advance unpatentable were described in very convoluted terms. Different portions of the Court's opinion in *Benson* seemed to focus on different reasons why the invention at stake was not patentable subject matter. However, the discussions were very unclear, both individually and in their relationships to each other.

One stated concern of the Court was that the information processing method at stake was no more than an unapplied idea. The Court noted that just as "one may not patent an idea," one could not patent the "formula for converting [binary coded decimal (BCD)] numerals to pure binary numerals . . . ."[57] This discussion suggests that the Court was concerned with the lack of practical details in the patent claims regarding the implementation of the claimed invention and that a more concretely described and implemented computer-processing sequence might have passed muster.

The need for a complete description of a patentable advance remains an important consideration under the view of the patent system advocated in this article. To serve as the focus of access controls and user valuations of the sort described here, a patented invention must include sufficient practical details to distinguish the advance from other, similarly functioning items or processes. An advance lacking such characteristics would be hard to control in an

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54 409 U.S. 63 (1972).

55 The patent at issue described the method sought to be patented as "a method for converting binary-coded decimal (BCD) numerals into pure binary numerals." *Id.* at 64.

56 *Id.*

57 *Id.*

access system and hard for users to evaluate in order to determine how much they would pay for access. Ideally, to avoid limiting access to the wrong items or practices through the enforcement of patent rights, the description of an advance in a patent should be complete enough to distinguish the advance from other items and practices found in the same operative environments and potentially confused with the new advance. Hence, the Court's analysis in the *Benson* case provides some support for the type of patent system advocated in this article.

The problem with *Benson* is that the Court did not explain the basis for its concern over the lack of practical details in the invention at issue there. over poorly defined advances. The Court's opinion failed to address why the lack of practical details in the advance under scrutiny precluded patenting of the advance. It also failed to discuss the types of practical design features that would have transformed the unpatentable idea present in *Benson* into a patentable invention. It is unclear from the Court's analysis whether a somewhat more concretely defined computer processing method (perhaps with additional concrete details on the computer software code needed to implement the method or the computer equipment needed to implement the method) would have been sufficient to make the advance patentable subject matter. In short, the *Benson* decision indicates that inventors must go beyond mere ideas to create patentable subject matter, but provides little indication in its discussion of unpatentable ideas about what distinguishes an unpatentable idea from a patentable implementation of the idea.

Unfortunately, the *Benson* Court did not limit its criticism of the invention at issue to concerns over patenting an idea. The Court confused matters further by mentioning several additional but ill-described grounds for finding the invention to be nonpatentable subject matter. The Court shifted perspective several times in its analyses and identified several other reasons why the advance under analysis was not patentable subject matter, without indicating which if any of these rationales were independent grounds for rejecting the patentability of the invention in question).

Some portions of the Court's opinion suggested that it was concerned about a patent that might be interpreted to protect computer software per se. The Court noted that the invention at hand was described in terms of information processing steps (easily implemented in corresponding computer software code) without any further physical device details and that the Court was seeking to exclude computer software *per se* from the patent system.[58] This portion of the opinion was taken by some observers as an indication that the Court was trying to announce (somewhat cryptically) that computer software was unpatentable.

Yet another portion of the Court's opinion indicated that the information processing algorithm underlying the advance at stake was unpatentable because the algorithm held great promise for application within the computer field and should remain available for use by later computer process or device designers rather than being restricted under the control of one party through patent rights.[59] The Court gave no indication of how to identify algorithms with this

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[58] *Id.* at 64, 71-72.

[59] The court noted that:

> The mathematical formula involved here has no substantial practical application except in connection with a digital computer, which means that if the judgment below [finding the patent

potential future importance, nor any explanation of why the development of such important algorithms should not be encouraged through the recognition of associated patent rights and rewards. The Court seemed to paradoxically note the importance of the method at hand, yet deny the application of patent rewards and incentives that would encourage the production of more such methods in the future.

The confusion created by this multiplicity of rationales given by the Court to explain its decision in *Benson* (without any indication as to which were particularly important), as well as the lack of underlying explanations for why the Court was emphasizing many of these factors, left the *Benson* decision as a source of confusion rather than clarity regarding patentable subject matter standards. Lower federal courts (and to a degree the Supreme Court itself) have struggled to interpret and apply the holding in *Benson* for many years. Not surprisingly, given the several rationales mentioned in *Benson* for rejecting the patentability of the method analyzed there, different parties have found support in *Benson* for many different patentable subject matter tests. Unfortunately, the rationales underlying the Court's analyses are so confused and unexplained that the *Benson* decision provides little help in determining the scope of patentable subject matter in new technological contexts. The concern expressed in *Benson* over the need for a practical advance with defined features is laudable as far as it goes, but the case does not make clear why we are concerned about these features. Nor does it specify how we should determine if a given invention has sufficiently defined features to make the invention patentable subject matter.

b. *Chakrabarty* Test

Although it is generally understood and remembered as a case concerning biotechnology patenting and the importance of not limiting patentable advances to non-living innovations, the landmark case of *Diamond v. Chakrabarty*[60] offers some guidance regarding the minimum features of patentable subject matter. In addition to holding that the patent system extends to living subject matters, the Supreme Court spoke in *Chakrabarty* about the characteristics of patentable subject matters generally. The discussion of patentable subject matter standards was embedded in the Court's evaluation of the invention at issue in *Chakrabarty* – a bio-engineered bacteria for use in cleaning up oil spills. In its discussion of standards for identifying a new manufacture and how those standards would apply to the invention in dispute, the Court indicated that distinctiveness of the invention and identifiable new usefulness of the invention were the keys to determining if it was patentable subject matter. Regarding the patentability of the contested bacteria, the Court reasoned that the:

> respondent's micro-organism plainly qualifies as patentable subject matter. His claim is not to a hitherto unknown natural phenomenon, but to a nonnaturally occurring manufacture or composition of matter-a product of human ingenuity "having a distinctive

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> covering the advance to be enforceable] is affirmed, the patent would wholly pre-empt the mathematical formula and in practical effect would be a patent on the algorithm itself.

Id. at 71-72.

[60] 447 U.S. 303 (1980).

> name, character [and] use." *Hartranft v. Wiegmann*, 121 U.S. 609, 615, 7 S.Ct. 1240, 1243, 30 L.Ed. 1012 (1887).[61]

In the last portion of this passage, the Court seems to be applying a general standard for identifying patentable subject matter. The Court indicates that an item is patentable subject matter if the item is 1) manmade (that is, a nonnaturally occurring product of human ingenuity) with 2) a distinctive name, 3) a distinctive character, and 4) a distinctive use. Such a man-made, distinctive item would qualify for a patent if other patent law standards (such as novelty, utility and non-obviousness of the item) were satisfied.

This standard tracks well with the tests that would be needed to cabin the patent system within the boundaries of an access control and invention reward system of the sort described in this article. In order to be distinctly controlled (to limit access) as well as to be effectively evaluated by users for value and possible access payments, an advance must have a distinctive character and description (for both identification and segregation as part of access controls) and a distinct use (for evaluation of the incremental value of the distinctive use as a precursor to the willingness to make access payments). An advance with these features will be a good candidate for the access controls that the patent system can implement.

There still may be concerns that this test will include too many technologies in the patent system because there may be few public benefits of extending patents to all distinctive, non-naturally occurring advances. If there are few public benefits from encouraging the production of more inventions of a particular distinctive type (or in encouraging more careful use of resources in the production of such inventions), these public benefits may not be worth the administrative costs and other transaction costs of implementing patent rights and rewards. These possible cost concerns of broad patent system scope – and some of the means for reducing these concerns – are addressed in the next subsection of this article describing a proposed patentable subject matter standard.

c. *Bilski* Test

In its 2010 analysis of patentable subject matter standards in *Bilski v. Kappos*,[62] the Supreme Court once again emphasized that an advance that is at heart no more than an information processing scheme should be considered an abstract idea and unpatentable. In that case, the Court assessed the patentability of an invention involving a method of matching or "hedging" risks in investing in commodities. This was seen as merely an abstract idea because the risk matching arrangements at the heart of the advance involved information analysis and processing.[63] The Court also emphasized that the addition of post-solution activity (that is, post-information processing actions) to record a result will not transform an information processing advance into patentable subject matter, nor will the limitation of use of the advance to a specific industry or field of use.[64]

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61 *Id.* at 310.
62 130 S.Ct. 3218 (2010).
63 *Id.* at 3231.
64 *Id.* at 3231.

The *Bilski* court rejected the notion (adopted below in the case by the Federal Circuit) that the presence of a specific machine or physical transformation in a process was needed in order to make a process patentable subject matter. The Court found that the presence of a machine or transformation was "an important and useful clue" as to whether a process constitutes patentable subject matter, but not the sole test for such subject matter.[65] Unfortunately, the Court offered no indication about why the presence of a machine or physical transformation was important, even as a clue. It also left unstated how this clue should work. Is the presence of a machine or transformation a sufficient indicator of patentable subject matter or could some advances having one or both of these features still fail to qualify for patentable subject matter? Where the clue is missing – that is, where an invention fails to include either a machine or transformation – what other factors might still indicate that patentable subject matter is present? What are the necessary and sufficient features of patentable subject matter as seen by the Supreme Court? All of these key considerations were left unresolved by the Court's glib reference to the (somewhat) rejected machine and transformation test as a "clue" to patentability.

The Court did adopt (without really defining) a general standard for patentability in *Bilski*. After rejecting the machine or transformation test as a sole test for patentable subject matter, the Court found the invention at issue in the case to not constitute patentable subject matter because claims to this invention "are attempts to patent abstract ideas."[66] Thus, the test the court applied was to determine if an advance was a mere "abstract idea". The Court's earlier case law – most notably the *Benson* decision – had repeatedly held that abstract ideas, as opposed to applied ones, were not patentable. The Court in *Bilski* provided this approving description of its earlier analyses in *Benson*:

> In *Benson*, the Court considered whether a patent application for an algorithm to convert binary-coded decimal numerals into pure binary code was a "process" under § 101. The Court first explained that " '[a] principle, in the abstract, is a fundamental truth; an original cause; a motive; these cannot be patented, as no one can claim in either of them an exclusive right.'" The Court then held the application at issue was not a "process," but an unpatentable abstract idea. "It is conceded that one may not patent an idea. But in practical effect that would be the result if the formula for converting ... numerals to pure binary numerals were patented in this case." A contrary holding "would wholly pre-empt the mathematical formula and in practical effect would be a patent on the algorithm itself."[67]

The Court went on to explain its holding in *Parker v. Flook*[68] as another example of a case where the Court rejected the patenting of an advances because the advance was, at bottom, a mere abstract idea. The invention at issue in *Flook* was an alarm system based on a novel use of a mathematical formula to analyze physical features of a chemical process and to activate an alarm when the process reached a particular state. The *Bilski* court saw this as an abstract idea (the formula) surrounded "post solution activity" (i.e., the steps needed to activate the alarm) which did not figure in the patentability analysis. Hence, the invention as paired down by the Court

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65 *Id.* at 3226.

66 *Id.* at 3230.

67 *Id.* (quoting quoting *Le Roy v. Tatham*, 14 How. 156, 175, 14 L.Ed. 367).

68 437 U.S. 584 (1978).

was no more than a new formula applied in a particular context. Since a formula is an abstract idea, the advance put forth in *Flook* was seen as an abstract idea as well and was found to not constitute patentable subject matter.

As with the advances at issue in *Benson* and *Flook*, the invention in dispute in *Bilski* was found not to constitute patentable subject matter because the invention was no more than an abstract idea. The Court's brief analysis was as follows:

> The concept of hedging, described in claim 1 and reduced to a mathematical formula in claim 4, is an unpatentable abstract idea, just like the algorithms at issue in *Benson* and *Flook*. Allowing petitioners to patent risk hedging would pre-empt use of this approach in all fields, and would effectively grant a monopoly over an abstract idea.[69]

The Court also noted that portions the patent at issue in *Bilski* which specified the context where hedging was to occur and which claimed control over hedging practices only in the commodities and energy markets did not change the outcome of the patentable subject matter analysis. These field of use limitations were not sufficient to change the abstract character of the claimed invention and that even with these limitations the invention at issue was an unpatentable abstract idea.[70]

The *Bilski* test, like that in *Benson*, reflected a valuable concern that inventions be applied and not purely abstract in order to be patentable. Under the view of the patent system described in this article, the limitation of patentable inventions to applied designs serves to ensure that access controls related to patent rights will be limited to applied items and contexts and that potential invention users will have practical features of the invention to look to in evaluating the value of the invention and the amounts that they are willing to pay for access to them. Unfortunately, the Court's analysis in *Bilski* tells us little about what makes an invention an applied advance rather than an unpatentable abstract idea. The Court would have been more helpful and precise – and would probably have come to the same result – had it indicated that an abstract, unpatentable advance is one with so few specified features and results that patent holders will be unable to control access to the advance as claimed by the inventor and potential users will be unable to evaluate its value and determine an access price they are willing to pay.

The Federal Circuit provided more details on how a patentable advance might be distinguished from an abstract idea in *Research Corporation Technologies, Inc. v. Microsoft Corporation*.[71] The inventions under consideration in *Research Corporation* were computer-based processes for rendering a halftone image on a computer screen. The court found that these advances were patentable subject matter because they fell within the Patent Act's definition of a patentable process and because the advances did not fall within the judicially-recognized exception to patentability for abstract ideas.[72]

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69 *Bilski*, 130 S.Ct. at 3231.

70 *Id.*

71 ___ F.3d ___ (Fed. Cir. 2008).

72 *Id.* at *14-*15.

The court in *Research Corporation* saw the *Bilski* test as requiring a two step analysis of patentable subject matter. First, an invention should be analyzed to determine if falls within one of the statutory categories of generally patentable inventions – that is, to determine if the advance is a process, machine, item of manufacture, composition of matter, or an improvement of one of these. Second, if an advance falls within one of these categories, the advance should be assessed to determine if it is within any of the special exclusions from patentability recognized by the Supreme Court, including the exclusion for abstract ideas.

The Federal Circuit felt that an invention that falls within one of the statutory categories will normally constitute patentable subject matter, unless there is clear evidence that the advance warrants special exclusion from patentability. With respect to the exclusion of an advance from patentability on the ground of that the advance is no more than an abstract idea, the Federal Circuit noted in *Research Corporation* that the :

> this disqualifying characteristic should exhibit itself so manifestly as to override the broad statutory categories of eligible subject matter and the statutory context that directs primary attention on the patentability criteria of the rest of the Patent Act.[73]

In short, the court felt that most inventions which fall within the statutory invention categories addressed in the Patent Act should be deemed patentable subject matter and submitted for review under the other criteria for patenting (such as novelty, non-obviousness, and enablement tests) specified in the Patent Act.

In determining whether the advance at issue in *Research Corporation* was patentable subject matter, the Federal Circuit considered it important that the advance presented "functional and palpable applications in the field of computer technology."[74] The advance addressed a distinct functional need in the field of the advance – that is, a need in the field of computer display controls for a method of rendering halftone images on computer displays. The advance included specifically described physical components, thereby distinguishing the advance from a mere abstract idea. Furthermore, the court noted that the advance was an improvement over previous methods already used commercially to achieve the same end and that "inventions with specific applications or improvements to technologies in the marketplace are not likely to be so abstract that they override the statutory language and framework of the Patent Act."[75]

Refined as described by the Federal Circuit in *Research Corporation,* the *Bilski* test confirms the status of an advance as patentable subject matter if the advance meets the criteria to fall within one of the statutory categories of patentable inventions and the advance is not abstract as indicated by:

1) the functional ends served by the advance in its practical field;
2) the palpable components comprising the invention;
3) the need in the relevant field for the functionality provided by the advance; and

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73 *Id.* at *14.
74 *Id.* at *15.
75 *Id.*

4) the likely commercial significance of the advance, as indicated by the existence in the marketplace of commercially successful items for which the advance is either a method of operation or an improvement.[76]

This version (or extension) of the *Bilski* test offers great promise as a means to implement and contain a system of invention access controls of the sort that the patent system was intended to advance. The limitation of patent controls to advances with palpable components and identifiable functional ends will tend to restrict patent rights to inventions that are both capable of access limitations (which can be implemented by restricting access to the distinct functional results achieved by the invention or to the palpable components of the invention or to both).

The preexisting need in the field of the advance for a process with the functionality of the advance indicates that users are likely to value the advance and to be willing to pay an access charge to gain the use of the advance. The preexisting need suggests a user demand for inventions like the advance and a corresponding likelihood that users will pay rewards to inventors for satisfying the demand.

Finally, the presence in the marketplace of a predecessor to the advance indicates that potential users of the advance will probably assign a value to the advance in the marketplace, just as they already assign a value to the predecessor that is already found in the marketplace. This provides further evidence that a willingness to pay access fees and to create invention rewards is likely to follow the entry of the new advance into the marketplace even if access to the advance is somewhat limited by patent rights.

2. Federal Circuit Standards

a. *Freeman-Walter* Test

In a series of opinions in the late 1970s and early 1980s, the Court of Claims and Patent Appeals (as a predecessor to the Federal Circuit court) developed a test for patentable subject matter that focused on whether an invention submitted for patenting involved an algorithm. The resulting standard was called the *Freeman-Walter* test in light of the two primary cases in which the test was set out.[77] This standard was intended to provide a more useful clarification of the test used (but poorly described) by the Supreme Court in *Benson*. The test evaluated the presence of patentable subject matter in light of the following:

> First, the claim is analyzed to determine whether a mathematical algorithm is directly or indirectly recited. Next, if a mathematical algorithm is found, the claim as a whole is further analyzed to determine whether the algorithm is "applied in any manner to physical elements or process steps," and, if it is, it "passes muster [as patentable subject matter]."[78]

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[76] *Id.*

[77] *In re Freeman*, 573 F.2d 1237 (C.C.P.A. 1978), *amended by In re Walter*, 618 F.2d 758 (C.C.P.A. 1980).

[78] *In re Pardo*, 684 F.2d 912, 915 (C.C.P.A. 1982) (quoting *Walter*, 618 F.2d at 767).

This two part test sought to address two concerns over the potential scope of patentable subject matter. First, inventions that were little more than algorithms for processing disembodied information were excluded from patenting. Where information processing algorithms or relationships were used in situations divorced from a particular practical application, the combined effect of the first and second parts of the test was to exclude the unapplied advances from patentable subject matter.

This type of exclusion was appropriate under the access control view of the patent system discussed in this article since an unapplied information processing algorithm lacks the sort of user utility that is the starting point for user evaluations of advances and a willingness to pay for access to the advances. Absent identifiable utility, users of an advance will not be interested in access and will not determine how much they are willing to pay for such access. An advance that lacked such a practical result and associated likelihood of user valuation is not amenable to the type of incentive system underlying the patent system.

If unapplied advances were accepted for patenting, incentives for the production of such advances might be set either too high or too low. A party developing an information processing method might over or under estimate the range of ultimate uses and the value that users would place on the advance since the range of applications of the advance (and the value of the advances) would not yet be determined. The developer of the advance might over or under estimated the practical ends to which the advance would be put. Absent an anchor for valuation in particular practical ends, the value of an unapplied advance (and the amount of resources that it would be cost effective to put into producing the advance) could not be determined with any accuracy. Absent at least some roughly accuracy means to project the value of a targeted invention, the well-targeted yet regulated production of new advances through the type of patent-implemented access pricing scheme described here would not be possible.

Only once something more than just a pure, unapplied information processing method is developed (through linking the method to one or more practical results) can the value of an information processing advance be translated into consumer demand and patent rewards based on that demand captured through access controls and resulting reward payments to innovators. Hence, unapplied information processing algorithms or relationships lacking identified practical implementations were appropriately excluded from the patent system.

The second part of the *Freeman-Walter* standard looked to the physical application of an information processing algorithm as an indicator that an advance was an applied design, not merely an abstract idea in the form of an unapplied algorithm. However, this test was both over- and under-inclusive of the advances that should have been included in the patent system. Some items involving physical applications of algorithms would not be susceptible to the type of access controls and valuation systems administered through the patent system. Conversely, some applications of algorithms would be amenable to access controls (through controls over the results of using the algorithms), valuations, and rewards to inventors of the sort that the patent system can implement. Hence, as noted by the Supreme Court in *Bilski*, physical elements serve as partial, but incomplete criteria for distinguishing between patentable subject matters (for which the patent system is a useful reward and production mediation tool) and unpatentable

subject matters other useful advances (which are best produced without the access limitations and administrative costs of the patent system).

b. *State Street* Test

Recognizing the weaknesses and incompleteness of the *Freeman-Walter* test, the Federal Circuit eventually reformulated its patentable subject matter standard. In a standard articulated by one of the great masters of patent law, Judge Giles Rich, the Federal Circuit announced and refined a new patentable subject matter standard in a series of decisions. The standard was first mentioned in passing in *In re Alappat*,[79] discussed further in the context of a computer-based business method in *State Street Bank & Trust Co. v. Signature Finance Group, Inc.*,[80] and discussed and explained more completely in connection with a pure information processing advance in *AT&T Corp. v. Excel Communications, Inc.*[81]

While it was applied by the Federal Circuit across several types of inventions in these cases, the standard first used by the court in *Alappat* is most commonly associated with the *State Street* case because it was used there to uphold the patenting of a business method and this result received considerable notoriety. This standard – referred to here as the *State Street* test for convenience -- was aimed at distinguishing abstract ideas from patentable applications. The standard specified that an advance was patentable subject matter if the advance was 1) a specific machine, item of manufacture, composition, or process that, when used, produced a 2) useful, 3) concrete and 4) tangible result.[82]

The Federal Circuit explained its objectives in applying the *State Street* test as follows:

> In *State Street*, this court, following the Supreme Court's guidance in *Diehr*, concluded that "[u]npatentable mathematical algorithms are identifiable by showing they are merely abstract ideas constituting disembodied concepts or truths that are not 'useful.' . . . [T]o

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79 33 F.3d 1526 (Fed. Cir. 1994) (en banc). *Alappat* involved a computer system that controlled the display on a cathode ray tube screen. The system evaluated electronic signals and determined how to best control the screen to display a graphic image corresponding to the signals. The only new feature of the system relative to earlier cathode ray tube systems were the information processing steps implemented by the computer system. The Federal Circuit found that this invention constituted patentable subject matter because the invention was "a specific machine [that produces] a useful, concrete, and tangible result." *Id.* at 1544.

80 149 F.3d 1368 (Fed. Cir. 1998), *cert. denied*, 525 U.S. 1093 (1999). *State Street* involved a computer-based system implementing a particular financial investment management method. The invention in this case helped to administer a "hub and spoke" method for the central investment of funds from multiple financial institutions. The system provided for the collection of funds from multiple institutions (the "spokes") for investment by a single central fund (the "hub"), with frequent status reports made to the contributing institutions. The Federal Circuit found this system to be patentable subject matter because the system met the standard announced in *Alappat* – that is, because the computer-based system was a specific item that produced a useful, concrete, and tangible result. *Id.*, 149 F.3d at 1373.

81 172 F.3d 1352, 1353 (Fed. Cir. 1999), *cert. denied*, 528 U.S. 946 (1999). The innovation in AT&T was a new electronic record keeping method for recording information on long distance calls. The method was held to be patentable subject matter because the method was a specific method producing a useful, concrete and tangible result. *Id.*, 172 F.3d at 1357-58.

82 *See AT&T Corp. v. Excel Communications, Inc.*, 172 F.3d 1352, 1357-58 (Fed. Cir. 1999), *cert. denied*, 528 U.S. 946 (1999).

> be patentable an algorithm must be applied in a 'useful' way." In [*State Street*], the claimed data processing system for implementing a financial management structure satisfied the § 101 inquiry because it constituted a "practical application of a mathematical algorithm, . . . [by] produc[ing] 'a useful, concrete and tangible result.'"
>
> The *State Street* formulation, that a mathematical algorithm may be an integral part of patentable subject matter such as a machine or process if the claimed invention as a whole is applied in a "useful" manner, follows the approach taken by this court en banc in *In re Alappat*. In *Alappat*, we set out our understanding of the Supreme Court's limitations on the patentability of mathematical subject matter and concluded that:
>
> > [The Court] never intended to create an overly broad, fourth category of [mathematical] subject matter excluded from § 101. Rather, at the core of the Court's analysis . . . lies an attempt by the Court to explain a rather straightforward concept, namely, that certain types of mathematical subject matter, standing alone, represent nothing more than abstract ideas until reduced to some type of practical application, and thus that subject matter is not, in and of itself, entitled to patent protection.
>
> Thus, the *Alappat* inquiry simply requires an examination of the contested claims to see if the claimed subject matter as a whole is a disembodied mathematical concept representing nothing more than a "law of nature" or an "abstract idea," or if the mathematical concept has been reduced to some practical application rendering it "useful." In *Alappat*, we held that more than an abstract idea was claimed because the claimed invention as a whole was directed toward forming a specific machine that produced the useful, concrete, and tangible result of a smooth waveform display.[83]

While the Federal Circuit related its *State Street* standard in this way to concerns over not patenting abstract ideas, the court still did not explain why patenting abstract ideas was a problem or how its test for identifying a non-abstract and patentable idea was effective in achieving the goals of patent law. Without a sense of the objectives of the *State Street* standard, there was little way for subsequent courts or other analysts to determine the meaning of the components of this standard and to apply to standard in an effective, consistent way.

Ultimately, the Federal Circuit rejected the *State Street* standard in its opinion in *Bilski*, in part because the court felt that the *State Street* standard was too inclusive and brought too many types of advances within the patent system. Yet the Federal Circuit speaking in *Bilski* did not articulate a criteria for determining what constituted an excessively broad sweep of the patent system and why the *State Street* standard produced such a consequence. Indeed, while the Federal Circuit had purported to apply it for some years, the court rejected the *State Street* standard in its *Bilski* opinion will little analysis and explanation of the reasons for rejecting a well-established standard that had been a frequently applied in lower courts and in patent analyses by private parties.

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[83] *Id.*, 172 F.3d at 1357-58.

The only reasoning the Federal Circuit offered in its *Bilski* opinion to explain its rejection of the *State Street* test was to note that this test focused too much on the results achieved by an advance and not on the features of the advance itself.[84] However, this may have been a criticism resulting from the Federal Circuit's consideration of only part of the *State Street* standard. The Court mistakenly referred to the standard as requiring only that an advance produce a useful, concrete and tangible result in order to constitute patentable subject matter. The full *State Street* standard required such results plus that an advance constitute a specific machine, item of manufacture, composition, or process. This further required element, if interpreted to exclude from patenting advances lacking specific practical details, might have allayed the concerns of the Federal Circuit that the *State Street* test was inadequate to prevent abstract ideas from receiving patents.

While it was technically not before the Court (having been rejected below by the Federal Circuit), the *State Street* standard was nonetheless disavowed (if not outright rejected) by all members of the Supreme Court in various opinions issued in the *Bilski* case.[85] However, the precise reasons for the Court's doubts regarding the *State Street* standards were not articulated, perhaps because the Court's goals for a patentable subject matter standard were ill defined and, absent these goals, there was no clear reasoning that the Court could present as to why the *State Street* test did not serve patent law goals.

Viewed from the perspective of this article, the *State Street* standard captured some of the criteria needed in well-focused standard for patentable subject matter. The *State Street* standard limited patentable advances to specific inventions that were capable of producing useful, concrete and tangible results. Inventions meeting this test would tend to be ones that could be incorporated in workable access controls and valuation methods.

The requirement in *State Street* of a specific device or process as a threshold feature of patentable subject matter suggests that patentable items must be sufficiently defined to be distinguished from other items, which is a necessary characteristic if access controls (based on patent rights) are to be imposed on the patented items but not on other like items. A sufficiently specific advance in this regard is one where the characteristics of the device or process are stated in patent claims with sufficient detail that courts, litigants, and potential actors can be sure when a patented item is present rather than just another item which is based on the same unpatentable abstract idea or information relationship. Were the somewhat ambiguously stated first prong of the *State Street* test interpreted this way, it would be an important feature of a test appropriately limiting patentable subject matter to advances where access controls and the types of rewards furthered by the patent system are administratively possible.

Likewise, the requirements under *State Street* that a patentable advance produce a useful, concrete and tangible result also seem likely to further the invention production goals of the patent system if these requirements are properly interpreted. Clearly, a useful result is necessary if invention users are to see value in access to an advance and to be willing to pay a price for such access. A concrete result – in the sense that the result is not uncertain, but rather regularly

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84 *In re Bilski*, 545 F.3d 943, 959-60 (Fed.Cir. 2008), *overruled by Bilski v. Kappos*, 130 S.Ct. 3218 (2010).

85 *See* 130 S.Ct. at 3231 (majority), 3232 n1. (JJ., Stevens, Ginsberg, Breyer, & Sotomayor, concurring in the judgment); 3259 (JJ. Breyer & Scalia, concurring in the judgment).

produced by use of the advance and manifest in a well-defined, concrete way – is needed for invention users to be willing to assess value from initial uses of an advance, to project that they will gain similar advantages from similar uses in the future, and to be willing to pay for future access to gain the same advantages in the future. The requirement that the result of an advance be tangible – having a useful impact in interpreting or working with objects in the tangible world – ensures that patent rights and associated access controls are restricted to either physical devices and processes or results that are important in measuring or managing physical circumstances (with results tied to those circumstances, which will distinguish them from pure intellectual thoughts or information analyses). This last requirement of tangible results – that is, results affecting or relating to the tangible world – could, if interpreted to restrict patents to advances where the results are trackable and access to them controllable – serve to limit patent rights and controls to advances that are amenable to the types of access controls and production incentives that can be administered through the patent system. Hence, while it was very ambiguous in its initially articulated form, the *State Street* test had the rudiments of criteria for desirable bounds on the patent system. Some clarifying and narrowing interpretations, keeping in mind the goal of ensuring workable invention access controls and access payment mechanisms, might have saved the *State Street* test as a administrable and desirable patentable subject matter test.

c. Machine-or-Transformation Test

In the Federal Circuit's *Bilski* decision, the court sitting *en banc* rejected the *State Street* standard as too ill defined and too broadly inclusive of patentable subject matter. Instead, the court substituted a "machine-or-transformation test" that it felt was dictated by earlier Supreme Court precedents. Although the Supreme Court later held the machine or transformation test was not the sole criteria for determining the scope of patentable subject matter, it did find some value in the test as a "clue" to patentability.[86] The Federal Circuit's analysis in *Bilski* was as follows:

> A claimed process is surely patent-eligible under § 101 if: (1) it is tied to a particular machine or apparatus, or (2) it transforms a particular article into a different state or thing." … [This "machine-or-transformation test" is] the sole test governing § 101 analyses.[87]

This machine-or-transformation test was rejected by the Supreme Court on the ground that it improperly barred patents for some advances that were intended by Congress to fall within the range of the patent system.[88] However, the Court gave little indication of how it saw the purposes of the patent system envisioned by Congress or why the machine-or-transformation test failed to serve these purposes.

As with the emphasis on physical elements or steps in the Federal Circuit's *Freeman-Walter* test for patentable subject matter, the emphasis on physical elements or impacts of a process in the machine-or-transformation test was a partial step towards a desirable patentable subject matter standard, but only if these sorts of physical features are interpreted and analyzed in the context of an invention access control system. Physical features of an advance may be

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86 *Bilski*, 130 S.Ct. at 3225-27.

87 *In re Bilski*, 545 F.3d 943, 954, 956 (Fed.Cir. 2008), *overruled by Bilski v. Kappos*, 130 S.Ct. 3218 (2010).

88 *Bilski*, 130 S.Ct. at 3225-27.

important in assessing whether an advance should be excluded from patentable subject matter if those elements (or their absence) indicate that uses of the advance will be hard to limit and that, therefore, an access limiting system for such an advance will be hard to administer through patent rights. Physical elements will frequently aid in ensuring that related invention embodiments or the results that they achieve can be controlled and access given to those embodiments only for persons who pay for such access. However, such physical elements may not necessarily be co-extensive with the presence of an excludable advance that can be subject to meaningful access controls. The ultimate standard should be workability of access controls.

Absent an overarching criteria such as this for assessing the character of useful advances and dividing them into patent-eligible and non-eligible subsets, focusing on relevant types of elements such as physical elements or effects will be meaningless. The presence or absence of these elements will lead to over- and under-inclusive decisions on patentability. Some inventions with physical elements may not lend themselves to easy exclusion from use and, therefore, should probably be omitted from the patent system by finding them to be non-patentable subject matter. In contrast, some intangible advances may be sufficiently tied to physical circumstances, physical feature interpretations, or other use features to provide means for excluding users from the processes or from the results of those processes and to thereby provide viable access controls and access payment mechanisms. Such excludable advances (even without substantial physical instantiation) should be treated as incorporating patentable subject matter.

3. Summarizing Decades of Confusion in Patentable Subject Matter Tests

The Supreme Court's opinion in *Bilski* did little more than referring backwards to the Court's prior case law on patentable subject matter – case law that that had spurred great confusion in lower courts for decades as to what criteria to use for analyzing patentable subject matter. The Court's analysis did not provide any meaningful new guidance and has left the analysis of patentable subject matter in an even more uncertain state than before the *Bilski* decision. Widespread uncertainty and confusion in patentable subject matter analyses began for courts, the USPTO and practitioners with the Supreme Court's decision in *Benson* in 1972. Since then, we have seen the rise and rejection of the *Freeman-Walters, State Street,* and machine or transformation tests, all viewed in their time by the Federal Circuit as needed clarifications of the uncertain standards left behind by the Supreme Court's case law. With the Supreme Court's refusal to add any new guidance regarding standards in *Bilski*, we once again return to this uncertain Supreme Court case law for its very limited guidance on how to conduct patentable subject matter standards. One of the most important types of evaluations in patent law – governing the range of patentable subject matter and, therefore, the range of the patent system itself – rests on underpinnings that have been widely recognized as weak and ill defined for over thirty years. The incentive goals of the patent system and the interests of those who rely on this system for certainty about the system's probable rewards and restrictions deserve far more clarity in patent law standards than the efforts of the Supreme Court and the Federal Circuit have produced.

The primary reason why judicial efforts to define criteria for patentable subject matter in recent years have failed is that these efforts have not been grounded in the objectives of the

patent system. Since patentable subject matter standards effectively set the boundaries of the patent system and its impacts, evaluations of patentable subject matter should work from the objectives of the patent system to set the proper boundaries for the system through the articulation of patentable subject matter standards. If we do not pay attention to the goals of the system, how can we assess what technologies are valuably included or excluded from the system?

The notion that Congress intended to include a wide range of useful advances within the incentives and limitations of the patent system suggests the proper framework for defining patentable subject matter standards. Given this incentive purpose without specific technical boundaries, Congress should be interpreted to have intended the patent system to serve a technology enhancing function wherever the system was capable of achieving such a function. That is, Congress should be seen as intending and authorizing application of the patent system to the full extent that useful advances were capable of being produced in greater quantities through this sort of incentive scheme the patent system could apply (but also that no other technologies be included).

This purpose provides a guiding principle for the construction of patentable subject matter standards. Such a neutral principle offers a means to construct patentable subject matter standards that focus on the practical features of advances that will fall within the patent system without knowing in advance what the advances will look like (e.g., whether they are tangible or not) and without arbitrarily tying the patent system only to types of technologies that resemble industrial or technical discoveries of the past. Such neutral criteria should – given the forward looking goals of the patent system to promote the production of new advances that are non-obvious departures from our current knowledge – help to keep the patent system as a force for the encouragement of presently unforeseen technologies as "times change" and fundamentally new fields of useful advances are possible.[89]

C. Towards a Revised Patentable Subject Matter Standard

This subsection uses the neutral principle of the suitability of advances for access controls and access payments as a criteria for the construction of new patentable subject matter standards. It is hoped that this proposed standard will fill the void left behind by Supreme Court precedent to date and will be extendable as needed based on interpretations and modifications made in light of new technologies and social practices. With such forward-looking, yet well-

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[89] The need to keep the patent system forward looking and to ensure that it will provide incentives for as yet undiscovered types of advances was recognized by a plurality of the Court in *Bilski* which note:

> [T]imes change. Technology and other innovations progress in unexpected ways. For example, it was once forcefully argued that until recent times, "well-established principles of patent law probably would have prevented the issuance of a valid patent on almost any conceivable computer program." But this fact does not mean that unforeseen innovations such as computer programs are always unpatentable. Section 101 is a "dynamic provision designed to encompass new and unforeseen inventions." A categorical rule denying patent protection for "inventions in areas not contemplated by Congress ... would frustrate the purposes of the patent law."

Id. at 3227 (JJ. Kennedy, Roberts, Thomas, & Alito)(citations omitted).

defined features, patentable subject matter standards can tailor the scope of the patent system to advances for which the system can serve the incentive function envisioned by Congress and the drafters of the Constitution.

1. Goals of a Revised Patentable Subject Matter Standard

The standard proposed here is a reflection of the view explained in this article that the patent system exists to encourage and regulate the production of patent-eligible advances. The proposed standard includes practical advances within the range of patentable subject matter if the production of advances can be effectively included in access controls and access payment practices that will incentivize the production of patent-eligible advances as public goods at production rates that match public demands. Where an advance is capable of access controls that lend themselves to such a payment and production modulating system, the advance should be considered patentable subject matter. Conversely, where advances or their uses are such that this type of access limitation and production incentivizing cannot be realized effectively – because demands of the public for advances cannot be translated into production incentives or because the costs of doing so overwhelm the corresponding advantages – then the patent system should not be applied and the advances should be determined to not constitute patentable subject matter. In short, the feasibility of access controls (and related access payment systems) should govern the overall scope of the patent system and the content of patentable subject matter standards.

A system of invention production incentives of the sort described in this article will need to include 1) a means for potential users to recognize an advance as a distinct item from other similar items performing similar functions, 2) sufficient present utility (and projectable future utility) for the users to evaluate the merit of the new advance (relative to the merit of other items that perform the same function) and to determine an amount that they are willing to pay for access to the new advance and its new incremental utility, 3) a mechanism for controlling access to the advance such that persons will seldom gain access to the advance without paying for such access, and 4) a mechanism for transferring access payments from users of an advance to the inventors of the advance, either directly or through intermediate payment steps. With these four components, a system of access controls and associated access payments will tend to encourage the production of new advances in accordance with the value judgments and demands of potential users of the advances. Absent any one of these features, the link between enhanced user value and rewards to inventors will be broken and the invention incentivizing and resource allocation goals of the patent system will not be served.

2. Minimum Features of Technologies Susceptible to Production Incentives Through Patent Rewards

Given that the main purpose of the patent system is to set prices for access to patented technologies and to thereby encourage the production of patent-eligible advances at levels that meet public demand for such inventions (and at levels that minimize opportunity costs suffered by the public when such inventions are under-produced), the patent system should apply to technologies and production settings where this access pricing is possible and likely to be effective in modulating invention production. Hence, the minimum feature of an invention constituting patentable subject matter should be that its production can be encouraged through

the types of access controls and access pricing encompassed by patent laws. This implies further that patentable subject matters should be limited to advances for which there are sustainable methods of exclusion from use and further means of providing selective access only upon payment of relevant access charges.

There are several basic features that a technology must have in order to be susceptible to this type of production incentive system. Absent any one of these features, it seems unlikely that a system of invention access controls and related invention access pricing will produce rewards to innovators that will encourage invention production:

1) Distinct Definition of Invention: In order to be the focus of user valuation assessments and related access controls and access payment arrangements, an invention will need to be separately identifiable. That is, the invention will need to be defined with sufficient particularity to be understood in its practical operation and to be separated from other similar items or processes. Distinctive definition will be a minimum feature of patentable subject matter for several reasons.

   First, the definition of an invention should be sufficiently particularized and linked to practical results to give potential users means to analyze the results and their related utility. These utility assessments will be the basis for invention valuations by potential users and, therefore, the willingness of potential users to pay for access to the inventions.

   Second, the definition of an invention constituting patentable subject matter should include concrete implementation details, such as workable descriptions of the invention's structure (if any) and operation, so as to give potential users means to understand the steps and costs of making, using, and maintaining the advance. Often, the net utility to users of an advance will depend significantly on the costs of making the advance (or acquiring it) and using it, as well as the advantages of using it. The net advantages of use of a new advance can only be understood with information on all of the factors affecting these net advantages, including the means of use and the resources needed to support such use. Hence, concrete knowledge and description of the structure and operation of an advance are important minimum features of patentable subject matter, needed to provide key informational inputs to user value determinations. These details must be both known (an issue of patentable subject matter) and described completely in a patent application (an issue of the sufficiency of invention disclosures and descriptions in the relevant patent specification).[90]

   Third, the definition of an invention will need to be particular enough to permit viable access controls and access payment mechanisms to be implemented and administered consistently and without large fact-finding costs. Absent a detailed definition of an

[90] Even where an advance constitutes patentable subject matter (and might therefore qualify for a patent under a complete description of the invention and upon meeting other patent law tests), an inventor may fail to gain a patent (or may obtain a patent that can later be voided) if the description of the invention provided in the inventor's patent application (in the portion of the application commonly referred to as the invention "specification") is not sufficient to inform average practitioners in the field of the invention how to make and use the invention. *See* 35 U.S.C. § 112.

advance -- including clear means to distinguish it from like items with similar structural features or usage results -- attempts to control access to the advance as part of an access payment system may tend to be over or under-inclusive, improperly sweeping up other non-patented items within access controls or failing to control all instances of access to the patented advance and thereby allowing some users free access to the advance.

Two dimensions of distinctiveness in defining a patentable advance may be relevant here: distinctiveness as to structural elements of the advance and distinctiveness as to functional results achieved by using the advance. A complete description of a patentable advance should include sufficient practical details to both distinguish the patented item from similarly functioning items with different structural features and to distinguish the patented item from similarly structured items with different functions. A description lacking these sorts of distinctive details regarding the structures or results of a new invention will provide little means for invention-specific access controls of the sort needed in applying the patent system effectively to incentivize and modulate invention production.

Complete invention definitions, fully comparing an invention to prior designs and then clarifying the new features which distinguish the advance from its predecessors, may also aid potential users of the advance in assessing the incremental utility associated with the advance. The nature of items used previously for accomplishing the same ends – often unpatented items free for all to use without patent-related payments – should be apparent from the discussion in invention definitions of the predecessors. By limiting patents to advances that involve clearly articulated practical distinctions from prior item designs, potential users of the advances will be able to focus their attention on the new features of the advance that distinguish it from its predecessors and that potentially provide new utility to the users. This will, in turn, support the valuation of the new utility by potential users and the willingness of users to pay for access to the new advances.

2) Regular Invention Operation: An invention constituting patentable subject matter should operate in a regular manner to achieve predictable utility if users are to have confidence in the future utility of the advance and to pay for access to that future utility. Absent this type of regular operation and functional results, potential users of an inventions will not be able to project the value of future access to the invention (because they will lack confidence that presently achieved utility from the advance will correspond to future utility and value) and will be unwilling to set and pay a price for access to the inventions;

3) Manifest Utility Coextensive with Invention Definition: A patentable invention should produce identifiable results and manifest utility when used in accordance with its definition so that potential invention users can assess how much they wish to pay to gain access to the invention and the benefits it produces. Absent manifest utility (as evidenced through the results the invention presently produces or such further results as can be projected reasonably when the invention is brought to the public through patent disclosures), the type of access valuations and pricing that can be administered through the patent system will produce few if any rewards to inventors, making the costs of administering and enforcing patent rights simply wasted resources.

The need for manifest utility to support invention valuation processes explains why advances that are defined only in highly abstract terms without important implementing details should not be seen as patentable subject matter. These advances lack the types of implementing details that correspond to immediately available utility in using the advances. Sufficient practical details should be present to dictate identifiable results from use of advances, such that the utility of these results and value from using the advances can be assessed. This will allow potential users of the advances to make valuation determinations and to arrive at access payment decisions. Lacking such bases for evaluation, advances should not be admitted to the type of access pricing system implemented through patent rights;

4) Means to Limit Access: A patentable invention and the settings in which it is used should be such that there are means to prevent access to the invention (or at least use of the invention) by persons who do not pay for such access (through either license fees or a patent-influenced purchase prices). Absent means to prevent access on this sort of conditional basis, the type of access pricing the patent system can support will not be possible. If persons who do not pay are able to gain access on a similar basis to those who do, there will be little incentive to pay for such access. Indeed, those persons who pay for access and are then forced to compete with persons who gain access without paying will be disadvantaged since both groups will have access to the functionality of the invention in question, but only those who have paid will bear the costs of gaining access. Furthermore, absent clear means of preventing access to inventions without access payments, parties capable of producing new advances may see little way to gain returns on their innovation investments and may forego inventive efforts rather than effectively giving away their costly inventions in the absence of access controls;

5) Payment Mechanisms: The manner and settings in which an invention is used must be amenable to pricing of access and transfers of access payments to invention originators. The intermediate steps through which this will occur may be complex and may imperfectly transfer the prices users pay for access to the parties who produce inventions. Nonetheless, some mechanisms for transferring most of these access charges to inventors (or the organizations that fund inventive efforts) are needed to encourage optimal levels of invention production.

The more imperfectly these mechanisms work – that is, the more that the costs of administering payment systems filter out components of payments and cause only fractions of amounts that users pay for access to be passed on to invention originators -- the less effectively the patent system will encourage and regulate invention production in accordance with user demands.

Furthermore, the more that payment mechanism work on categorical bases – for example, specifying prices for patented items that are sold to a group of users with somewhat differing values placed on use of the items – the more likelihood that some invention users will have unmet demands for additional inventions. This will tend to be the case because no user will be likely to pay more for invention access than that party

feels such access is worth, but some potential invention users might be willing to pay more for additional inventions that are not produced at the access price that a relevant group of users is willing to pay.[91] These additional inventions will not be produced if access pricing mechanisms are not particularized to the individual level and the additional demands of those users are not translated into additional demands seen by invention originators.

This is another way of saying that the ideal form of the patent system would be one where there is perfect price discrimination of invention access across potential invention users – where each user pays what he or she actually thinks that use of the invention is worth. Such a system would present incentives to inventors that would encourage the creation of inventions filling the broadest range of user demands and minimizing opportunity costs due to the under-production of inventions which would have cost less to produce than their values to users.

However, such a system of perfect price discrimination for access pricing would be too costly to administer and we generally will make do with categorical assessments of access prices – that is, with a system providing access to patented items across categories of users at prices that reflect the willingness of substantial number of users in each category to pay for access. Groupings of users in particular categories (and policing different pricing of invention access by category) will depend on the costs of identifying and separating different types of invention users and in charging each type a different price for use of an invention. Where these costs are high, efforts to distinguish between users will tend not to be made, meaning that the users involved will be lumped into one group and charged one price for invention access rather than being subject to price discrimination.

6) Modest Transaction Costs in Administering Patent Rights: The types of invention access controls and use payment mechanisms described in the above criteria must be capable of implementation without large transaction costs if demands for new inventions are to be translated accurately into incentives for invention production. If transaction costs of implementing access controls and access payment mechanisms are large for a particular category of advance, then these costs may soak up amounts that users will pay for access, leaving little or no net rewards for invention users. Such a result would negate the production incentive function to be served by patent laws and rewards. Indeed, even transaction costs that soak up a substantial fraction of the amounts which users are willing to pay for inventions may substantially skew the production of such inventions away from optimal levels. Such costs – even if they leave behind some net rewards for invention producers – will tend to make these rewards so low as to cause many potential inventors to see other uses of their resources as producing greater potential returns and to divert their efforts away from potential inventive efforts.

[91] This is a result of imperfect price discrimination of access pricing in a system where access to an invention is made available to a group of users at a single price.

Transaction costs in administering patent rights may arise from several features of innovations. High administrative costs due to any of the following factors may justify excluding advances from patentable subject matters.

Feasibility of Access Controls: Costs of preventing access to inventions for persons refusing to pay for such access might justify excluding some types of advances from patentable subject matter. Such costs may be high where advances are not susceptible to physical access limitations or other similarly effective means for preventing unpaid access.

Advances involving new devices or compositions of matter should generally be amenable to effective access controls since access to units of the devices or compositions can be restricted through physical constraints and access limitations. Similarly, low cost access controls for processes that achieve physical transformations of items will often be feasible. This will be the case because these sorts of physical transformations will typically be realized by physical equipment and access to the relevant patented process can be controlled by limiting physical access to the corresponding equipment.

Limiting access to advances (usually methods) with no physical embodiments or transformations will sometimes raise more problems. Difficulties may arise for these sorts of inventions in implementing policable systems for access controls (through which persons can be excluded from using an advance until they have paid for access) and payment remedies (through which persons gaining unpaid access can be detected and an appropriate remedy imposed that achieve the equivalent of the payments that should have been made, plus a punitive payment where need to deter knowing non-payment of access fees). Where these sorts of access controls and payment mechanisms will typically be hard or impossible to implement, the reward system of patent laws will break down and no attempt should be made to save it. Rather, the associated type of advance should be deemed non-patentable subject matter and left to other means for encouragement, if any.

Concern over ease of invention access and use and the inability of patent system processes to effectively stop such use suggests yet another reason that pure ideas, as unapplied and used only in mental processes of individuals, should not fall within the patent system. The use of such ideas absent access payments would be hard if not impossible to prevent. Both the means to stop the spread of ideas from one person to another, as well as the measurement of whether particular ideas have been used by additional parties would be highly difficult to implement. Application of the patent system to these sorts of abstract, unapplied ideas is properly withheld due in part to these difficulties. Of course, we also limit the application of the patent system regarding the spread and reuse of ideas in mental processes because the First Amendment protects such communications and intellectual processes and the patent system must be interpreted and applied so as not to interfere with the dictates and ends of this fundamental constitutional protection.

In sum, this analysis suggests two threshold inquiries that will bear on whether transactional costs or difficulties in administering the access controls implicit in the

patent system suggest that the system should not be applied at all. First, are physical controls (of the type normally exerted over personal property) sufficient to ensure access controls over either physical items embodying an invention or over physical equipment through which the invention is carried out such that physical controls will provide a low cost, reliable means to implement invention access controls and related payment mechanisms? Second, where an advance involves few if any physical features, will there be some other regularly successful and minimally expensive means of preventing access to the advance in order to ensure payment? If the answer both these questions is no, then a type of advance should probably be excluded from the patent system on transaction cost grounds.

Note that this type of analysis may call into question the propriety of patenting many business methods that do not involve devices or physical transformations of an item. The use of these methods in business contexts may be particularly hard to detect and prevent absent access payments. Hence, the analysis presented here supplies grounds for excluding some but not all business methods from patentable subject matter. Whether or not a business method should be deemed patentable subject matter should turn (at least in part) on whether the method is of a type (and used in a context) that use of the method is excludable – that is, that access to the business method can be controlled and constrained absent access payments.

Clarity of Use Determinations: Another type of transaction cost that may figure centrally in determining the outer boundaries of patentable subject matter relates to the distinctiveness of the boundaries between an advance and prior items or practices and the corresponding ease with which use or non-use of the new advance can be determined. If a new design is highly similar to an old one (or can easily be disguised as an old one), then identifying unauthorized and unpaid uses of the advance as part of an access control and payment system will be particularly difficult. In these settings, patentable subject matter might not be found because of the difficulties (and costs) of patent infringement determinations for the advances were they to be included in the patent system.

The practical implications of this type of transaction cost analysis suggest limitations on the patenting of advances where, for example, subtle types of discretion must be exercised or determinations made as part of carrying out an advance and the necessary criteria for making these cannot be clearly defined in patent applications and claims. In these settings, patents should be withheld, in part because the patent infringement analyses that would be required to implement patent rewards would be time consuming and speculative.[92]

Another related ground on which a given advance might be seen as falling outside patentable subject matter is that the advance is defined only in highly abstract terms, lacking practical implementation details from which the presence and use of the same

[92] Another reason to withhold patents in these circumstances is that the persons providing the advances have not given the public enough information to use the advances effectively until they have provided clear definitions of the analysis or decision criteria sufficient for other parties to replicate the advances and to achieve utility from using the advances.

advance might be measured as part of an access control system. Here, the abstract nature of the definition of an advance suggests a use measurement problem. Where only an abstract definition is given and a further set of implementing details would be consistent with (or at least similar to the results from) both use and non-use of the abstract advance, measurements of infringement from actual activities of asserted infringers may be highly uncertain and costly. Hence, abstract definition of an advance may be proper grounds for exclusion of the advance from patentable subject matter because of difficulties in determining whether the advance is present in an access control and payment system implemented through patent rights.

3. Special Grounds for Exclusions from Patentable Subject Matter Standards

Because the costs of the patent system are justified as means to minimize (or economize on) the adverse consequences of invention underproduction, the patent system should only apply (through the adjustment of standards for recognizing patentable subject matter) where we are strongly concerned about the systematic underproduction of inventions. There are several reasons why we may not be so concerned and why certain types of advances should be left out of patentable subject matter.

a. Excluding Technologies Suitable to Contract Incentives

Under-production of certain technologies may not be a substantial problem – and the patent system will correspondingly not be needed to counteract such underproduction – where private contracting processes are sufficient to encourage the production of inventions at socially optimal levels. This is to say that, where potential invention users can contract for invention services in a manner that fulfills most of the users desires for additional inventions (and minimizes associated opportunity costs related to unsatisfied demand for these inventions), socially optimal production of inventions can be achieved without the costs of the patent system.

There are several reasons to believe that contracting processes may be sufficient to produce optimal production of inventions in certain technology areas, thereby creating grounds to leave these technologies out of patentable subject matter standards as a means to exclude them from the patent system.

1) Technologies Beneficial to Few Users and Produced By Identifiable Innovators

Technologies that are potentially developed by a few, identifiable innovators and that solve practical problems or that serve needs for only a few potential users might be best left out of the patent system because the users themselves can save themselves from problems of under production of inventions in these technology areas. Users with peculiar interests or needs may be able to create contract incentives to encourage innovators to produce advances and serve these peculiar needs. Contract standards and rewards for successful inventions can be tailored to both the criteria of particular users for a successful invention and to the incentive susceptibilities and interests of potential innovators. Carefully crafted contracts with payments for successful innovations that meet the desires of invention producers and criteria for measuring invention

success that match the needs of invention users can establish efficient agency relationships in which invention producers serve as agents of specific future invention users. In this way, potential users of advances with narrow applications can ensure production of these advances at optimal rates without invoking the more structured and more costly mechanisms of patent rights and rewards. Hence, it may be desirable to exclude innovations with few users from patentable subject matter.

Another way to limit patenting of advances with few users is to allow inventions with few potential users to be patented with the expectation that potential patent applicants and patent holders will take the expenses of patent rights enforcement into account, such that patent applications for advances with few users will be discouraged as too expensive to be worth pursuing or, if patents for such advances are actually obtained, patent enforcement will be discouraged because there is not enough to be gained from the costs of enforcement against the few potential invention users. In this way, the value of patents if enforced becomes a filter against the enforcement of essentially worthless patents that cannot generate substantial revenues if enforced.[93] This avoids the line drawing needed to exclude technologies from patent incentives just because not many users will be served by the inventions (and because the problems of invention underproduction are correspondingly small).

The merit of using this approach rather than generally excluding inventions with few users from patentable subject matters will depend on the rationality of potential patent applicants as they contemplate the benefits of pursuing applications and the accuracy with which they will project their likely returns from patents. Where they are likely (as many will) to over-estimate the worth of their patents, an excessive number of applications may be pursued and a more costly set of patent process and enforcement will be likely than if patenting were cut off categorically through patentable subject matter limitations.

2). Breakdowns in Contract Incentives – Remaining Needs for Patents

A key exception to the logic supporting contract incentives for innovation lies in situations where contracting processes for encouraging the production of new innovations are likely to break down. Effective contracting for innovation may be difficult or impossible if either the number of potential users of an advance is large or if the potential innovators who are likely to produce an advance are difficult to identify in advance of their invention projects.

Where potential invention users are numerous, for example, the costs of contracting with all of them in advance of innovation projects is probably prohibitive and contract-based incentives are unlikely to be adopted as means to encourage and regulate the production of inventions as public goods. In these settings with many potential invention users, the patent system establishes a set of invention rewards that encourages potential innovators to act as agents of eventual invention users without actually contracting with these users in advance.

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[93] If it is apparent from the outset that particular advances will only serve a few users and that the total incremental utility gained from use of the advances will be small, potential innovators will be unlikely to even seek patents as the costs of obtaining and enforcing the potential patents will be projected as exceeding the potential gains from the patents.

Even where the number of likely invention users is small, contracting processes for the creation of invention incentives may break down and fail to create incentives for innovation. One example of this may occur where probable innovators and innovation users cannot find each other in advance of an innovation project or cannot establish contract terms creating invention incentives. Predicting who will be the probably successful innovators who will bring forward a particular type of advance may be highly difficult, meaning that potential invention users will not know who to contract with. These sorts of difficulties may justify having patent rewards available to all potential innovators even where only a few users will ever apply the advances in question. Potential patent rewards will encourage potential innovators to rise to the task of producing useful advances even though they do not, at the outset of their projects, have the confidence of potential invention users and would not, therefore, be targets of innovation contracting by those users. Under these circumstances, the potential for effective contract-based incentives breaks down, leaving the lure of patent rewards for successful invention results as a still desirable means to encourage invention production and avoid the consequences of under-production of patentable advances.

3. Limiting the Patent System to Situations Where Invention Under-Production Has Substantial Social Consequences

Another reason to limit the scope of the patent system – and to restrict patentable subject matter as a means to this end – is that inventions which the patent system might encourage are not of social significance and the invention under-production that the patent system might ameliorate is just not a matter of great social consequence. This is another way of saying that ends of the patent system must justify the social costs of administering the system. Because the costs of the patent system are justified as means to minimize (or economize on) the adverse consequences of invention underproduction, the patent system should only apply (through the adjustment of standards for recognizing patentable subject matter) where we are strongly concerned about the systematic underproduction of inventions.

One can imagine a variety of reasons why particular types of inventions might be deemed to have a type of utility which is so small or socially controversial that the patent system should not be aimed at encouraging more inventions to enhance such utility. In recent years, for example, inventions that sometimes mislead users, that help people reduce tax payments to government, or that aid users in avoiding detection for illegal driving practices have been viewed as having types of user utility that the patent system should not promote and that should consequently place advances in these types of devices or methods outside the incentives and rewards of the patent system.

Without debating the merit of morally-based exclusions of some advances such as these from the patent system, one can make a narrower, morally-neutral to the inclusion of inventions within the patent system that just do not involve much utility of any sort and that, therefore, call upon the incentives and costs of the patent system without providing much societal gain in return. This will be the case for new advances that do not offer much incremental utility over pre-existing alternatives. Based on their lack of substantial net gains to society (and the consequent lack of interest of society in the underproduction of such advances), a substantial

case can be made for exclusion from the patent system of technologies with small benefits relative to second best alternatives.

If a new advance, when used in a typical way, will probably only produce small utility gains over other available technologies for accomplishing the same tasks, society loses little if the advance is not produced and popularized. This is equivalent to saying that technologies should not be patentable where there is likely to be little difference between the utility of the patented advances in their typical uses relative to the utility available from the second best means to accomplish the same tasks.

In these circumstances, our concern over under production of new technologies is mitigated by our confidence that, if under production occurs, users can just fall back on using the second best, nearly as good technologies. The overall consequences of underproduction are small because the advances in question do not add much to total societal utility.

While it would be desirable to withhold the costs of patent system administration from the encouragement of inventions with modest social gains, it may be difficult to identify advances that have this type of characteristic for purposes of excluding them from patentable subject matter. One indicator may be that the advances we should exclude on this ground will generally involve small changes to much broader preexisting designs. These sorts of small changes in the nature of adjustments to prior designs will typically occur in fields where advances are made in small incremental changes or enhancements to already functional designs and where each increment solves a small problem in the field or adds a new small element of functionality. Where this is the case, the increased utility associated with each incremental advance will still be small since potential users can simply forego the advance and continue forward with the slightly less desirable, unpatented substitute item that formed the basis for the new design. These sorts of incremental advances built on top of pre-existing, well functioning designs are characteristic of most software advances, providing a rational for excluding many software advances from patentability.

Of course, where a small design change has large functional consequences, this logic of near-interchangeability of patented and non-patented items will not apply and a stronger case for applying patent incentives and keeping an advance within patentable subject matter will be present. Hence, the small extent of design changes in a new advance should not be enough to definitively exclude the advance from patentable subject matter. Rather, a small scope of design changes in a new advance should be indicative of a need for further inquiries into the degree of new utility associated with the advance. Where small changes can be shown to relate to large increases in utility, then the advance is one of substantial societal value and concern despite the small scope of the design changes. The patent system should apply to this type of advance (even though the design changes in the advance were small) because underproduction of this type of invention would have significant societal consequences and the patent system should be invoked to avoid those consequences.

In contrast, where there is a combination of small changes and resulting small additions to design utility, patentable subject matter should probably not be found because the consequences of invention underproduction are not great and the costs of administering the

patent system concerning such advances are not worthwhile means to encourage and regulate the production of such inventions.

D. A Proposed New Standard for Recognizing Patentable Subject Matter

Based on the considerations described in this article, the following patentable subject matter standard would be a valuable advance over present uncertainty in such standards and corresponding weakness in patent-mediated invention incentives:

> Patentable subject matter is present if an advance includes 1) a distinct definition of structure, operation, and use consequences such that potential users can recognize and evaluate the methods, costs, and results of using the advance, 2) sufficient presently apparent or immediately projectable utility in its defined form to permit users to evaluate the merit of the new advance and to determine how much, if anything, they are willing to pay for access to it, 3) sufficient physical instantiation or other controllable inputs or results such that access to the advance can generally be limited to parties paying for such access, and 4) features and contexts for use such that uses of the advance can be identified and mechanisms for transferring access payments from users of the advance to the inventors of the advance, either directly or through intermediate payment steps, can be implemented without excessive costs.

The proposed standard is consistent with (although more detailed than) the standard used by the Federal Circuit in *Research Corporation*.[94] There, the court recognized patentable subject matter in an advance based on evidence of the functional ends served by the advance, the palpable components comprising the invention, the need in the relevant field for the functionality provided by the advance, and the likely commercial significance of the advance, as indicated by the existence in the marketplace of commercially successful items to which the advance was either applied or used as an improvement.[95] The proposed test focuses on similar factors, but relates the factors more clearly to invention access controls.

The proposed standard, if applied across various present and future technologies, will insure that the patent system and its restrictions and costs are limited to advances that are workable targets of the types of access controls, payments to inventors, incentivizing of invention, and prioritization of resource allocations to inventive activities that the patent system was intended to achieve.

The test proposed here is dictated by the nature of the patent system and its goals, not by the types of technologies and advances that the system is intended to foster. These standards will ensure that patent rights have their proper influence on the allocation of resources to inventive efforts in competition with other demands for the same resources. This will help to give patent rights their proper place as counterparts to personal and real property rights in the attraction and allocation of resources to the production of useful products of human ingenuity. Viewed as means to value and attract scarce resources to the production of patent-eligible advances, patent rights can be seen as one more component in the broader scheme of property rights. Patent rights

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94 ___ F.3d ___ (Fed. Cir. 2010).

95 *Id.* at *14-*15.

can encourage invention production in the same ways that other property rights have influenced production activities concerning real and personal property production for many years.

The test for patentable subject matter proposed here represents a technology-neutral, historically unbound set of criteria for determining the scope and limits of the patent system. As such, the test is suitable to frame the promise of patent rewards for future inventors considering potentially difficult and expensive efforts to discover previously unknown types of technologies. To define the characteristics of patentable technologies in terms of technology criteria (or based on the technology-specific historical background of a technology, whether the technology emerged from industrial, liberal arts, or business sources, or whether the technology will be used in industrial, liberal arts, or business contexts) is probably fundamentally flawed. Our most useful discoveries of the greatest benefit to society in increased utility may come from and be applied in any of these areas. The patent system should back efforts to produce new, useful tools for societal use in whatever fields these tools can be produced and used.

Hence, a set of criteria like those proposed here, which are not technologically limited or historically constrained, but rather framed in terms of the operation of the patent systems and its capabilities, offer the best hope of realizing the full potential of the patent system. These standards will ensure the maximum benefit from the patent system, applying that system where the system has strengths and a positive social role, and withholding the system where it is either ineffective or too costly and cannot serve its intended social function.

V. Additional Patent Law Implications of Patent Rights as Resource Allocators

While the primary focus in the doctrinal analyses in this article has been on patentable subject matter standards, the view expressed in this article of the patent system as an invention production incentivizing and resource attracting system has further implications for the formulation and interpretation of other patent law standards. Indeed, given that the encouragement and regulation of invention production are among the fundamental purposes of the patent system, it is hardly surprising that these goals should be kept in mind in shaping many aspects of the patent system. The full implications of these patent system goals in shaping patent law standards are worthy of further consideration and analyses. This section concludes with some brief thoughts on how the view of the patent system as a means for incentivizing and regulating invention production may warrant reevaluation and reformulation of patent law doctrines beyond patentable subject matter standards.

A. Utility Standards

To qualify for a patent, a particular advance must realize at least a small amount of positive utility when used.[96] Viewed as part of a system of access controls and rewards to invention producers, this utility requirement ensures that patent system controls and costs only apply to inventions with utility that users can assess and value. Absent some immediately apparent advantage in using the invention, the type of patent reward system outlined in this article will be useless and the costs of administering the patent system will be wasted.

[96] 35 U.S.C. § 101.

Furthermore, by insisting that patent applicants pursue, produce, and identify in their patent applications some clear utility for their advances, we ensure that inventors are encouraged to complete their efforts to perfect their inventive projects to the point of producing some manifest positive utility, not just hoped for results. This encouragement to complete their efforts and to bring forth at least some practical examples of how their invention can be used advantageously helps to ensure that patent restrictions and costs are only applied to inventions that have some value and a corresponding likelihood of generating access payments back to invention originators. Since these payments are at the heart of the invention production incentivizing that the patent system can promote, only inventions which have some meaningful present value and corresponding likelihood of generating these sorts of payments should fall within the patent system.

B. Non-obviousness Standards

One of the key purposes of the patent system as envisioned and described here is to attract and allocate scarce resources to inventive projects. Among the key types of resources that the patent system allocates is the time of a few highly skilled inventors. Patent rights are not presented to every party who produces a new advance with practical implications, but rather only to those parties who produce advances that are both new and non-obvious relative to prior knowledge in the same field of technology or endeavor.[97]

The interpretation of non-obviousness standards should be shaped to ensure that patent rights and the incentives that such rights create are focused on attracting the attention and talents of highly skilled (and rare) individuals to inventive efforts. This can be accomplished by tailoring non-obviousness findings to permit patenting of an advance only where the information, analytic techniques, or inventive skills needed to produce the advance were not widely held at the time the advance was made.

Where few if any parties other than the originator of an advance shared the same information, analytic abilities and skills used in producing the advance, then the advance should be treated as non-obvious in the field where it was produced. This will ensure that patent incentives are focused on parties with rare knowledge and abilities (which are key inputs needed to promote certain lines of technical innovation). At the same time, by withholding patent rights in cases of widely shared information, analytic abilities, and research skills sufficient to support research projects, this type of non-obviousness standard will avoid incurring the costs and limitations of patent rights in settings where numerous parties are potentially successful innovators and the talents and knowledge of a few especially capable (and scarce) innovators need not be attracted through the special incentives of the patent system.

By limiting patents to situations where key researchers and supporting resources are scarce inputs to innovation, non-obviousness standards can tailor the patent system to the invention under production problems that the patent system was designed to address.

C. Infringement Standards

[97] *See* 35 U.S.C. §§ 102(a), 103.

1. Direct Infringement

A party is deemed to directly infringe a patent – and to be liable to the patent owner – where the party makes, uses, sells, or imports a patented invention without the consent of the patent owner.[98] Whether or not the item made, used, sold, or imported by an asserted infringer was the same as the patented invention is determined by a one-to-one comparison between the elements of the patent claims and the features of the item of the asserted infringer. Where there is a complete match, direct infringement is found.

This sort of direct infringement analysis should be conducted as part of the policing of a system of patent-mediated invention access control system of the sort discussed in this article. What constitutes an element of a patented invention, and whether the same element is present in an accused item, should be determined and understood as persons analyzing the invention and considering the scope of related access controls and licensing would have approached the same questions. If an item asserted to be infringing would have been seen by most parties in the same field as one controlled by the patent under analysis and only properly made with a license or other consent of the patent holder, then the same item should be found to be directly infringing when made without such consent. In this way, direct infringement findings will be, in effect, findings that the infringers were abusers of the access controls and payment requirements imposed by the patent system. Direct infringes, under these standards, will be persons who have disregarded the access limitations imposed on inventions by the patent system, despite clear opportunities (from reading the relevant patents and the understanding of those patents that would have prevailed in their field) to appreciate that they were undertaking activities and gaining access to patented inventions without paying the access fees demanded by the patent system.

2. Doctrine of Equivalent Infringement

Access controls provided by the patent system can also be abused where parties gain unpaid access to the functionality of a new invention without implementing precisely the same design as the new invention. Under these circumstances, a party may infringe a patent on the new invention under the doctrine of equivalents.

Viewing the patent system as a means to encourage and regulate invention production offers some guidance about the proper scope of the doctrine of equivalents. This doctrine, as interpreted by the Supreme Court, provides that an item which is not identical to a patented invention nonetheless infringes the patent on that invention if the item operates through the same means, serves the same function, and achieves the same result as the patented invention.[99] An item that his this trio of similarities to a patented invention – that is, the same means, function, and result – is viewed as the equivalent of the patented invention. The Supreme Court has further indicated that the equivalency of an item to a patented invention should be assessed element by element, meaning that an item must have an identical or equivalent element to every element of a patented invention before infringement under the doctrine of equivalents can be found.[100]

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98 35 U.S.C. § 271(a).

99 *Graver Tank & Mfg. Co. v. Linde Air Products Co.*, 339 U.S. 605, 609 (1950).

100 *Warner-Jenkinson Co., Inc. v. Hilton Davis Chemical Co.*, 520 U.S. 17, 40 (1997).

The doctrine of equivalents can serve a valuable function in an patent-implemented invention access control system by preventing parties from gaining unpaid access to the functionality of patented advances by making cosmetic or functionally unimportant changes in those advances. By viewing the purpose of the doctrine of equivalents as being to prevent unpaid access to the functional advantages of a patented invention, the nature of equivalent advances that should be deemed infringing under the doctrine of equivalents becomes clearer. Any advance that achieves functional results that are similar to those of a patented advance and that incorporates components and operating sequences that are similar to those of a patented advance should be deemed infringing.[101] Persons using these types of similar advances are gaining access to the practical advantages of the patented invention and should only be able to do so by paying for access.

A system that lets uncompensated use of these sorts of equivalent items slip by without infringement findings and remedies will not only fail to reward inventors for the full range of increased utility that their advances have brought to society (thereby under valuing their inventive efforts and tending to encourage future inventors to make choices to pursue other types of activities and under producing valuable inventions), but will encourage additional parties to create functionally equivalent items that work like patented advances but which do not incur patent-related charges when used. These sorts of imitators (who are effectively free riders on the inventive success of the producers of patented advances) will tend to prevail in their own fields of competition over those parties who pay for access to patented advances. Imitators rather than innovators will tend to prevail in these settings since the imitators of patented advances will not suffer the costs of patent-related access payments that their competitors will bear. Over time, this sort of process will advantage the cleaver user of equivalent items that gain the advantages of patented items without incurring the costs of producing the patented items.

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[101] Under this approach, whether or not a similar advance was directly derived from a patented advance by modifying the latter will not matter for purposes of assessing infringement under the doctrine of equivalents. The salient issues are similarity of the structure and operation of the two items and whether these similarities account for new functionality in the item that is similar to the patented advance. If so, the value of the new advance is being captured in the similar one and a user of the latter should pay the same charges for access to this functionality as the user of the patented advance.

While the derivation of a modified advance from a patented one is not strictly indicative of infringement under the doctrine of equivalents for this reason, the process by which derivation occurred – particularly the degree to which meaningful differences in the functioning of the modified device were objectives of the modifications, perhaps because the modifications were part of a designing around process aimed at avoiding patent infringement – will have some bearing on determining whether a second advance is similar to a patented one in structural, operational, and functional details and, accordingly, whether the second advance should be deemed as infringing a patent on the first.

Even more seriously, attempt to make trivial (that is, functionally unimportant) changes in a patented advance in order to avoid findings of patent infringement are particularly injurious to the ends of the patent system. These efforts to "camouflage" infringement will just make instances of infringement harder to find and compensate, thereby undercutting the type of reward function that the patent system was intended to implement. Intentional efforts to conceal infringement in this way deserve strong condemnation and deterrence. One way to achieve this is to treat efforts aimed just at creating superficial differences between patented and similar items as instances of willful infringement, with the potential for punitive damages as a remedy.

To avoid this result – and the gutting of patent-related payments and rewards as innovation incentives – findings of infringement under the doctrine of equivalents should be robustly made and enforced to police the boundaries of use of the functional results of patented advances. Such functionally-driven findings of infringement are needed to ensure that the parties who gain access to those results – as evidenced by use of items with features that produce the same functional results as those of a patented advance with substantially similar components and operational characteristics – are forced to pay for access to this functionality in the same manner as users of the patented advance itself.

D. Damages

By treating the patent system – including the relief afforded in patent suits when the normal access controls imposed by the patent system are not observed and a party makes unauthorized use of a patented invention – as a scheme for matching user demand with invention incentives, the proper scope of patent damages can be clarified. Patent damages are a substitute for the amount that a user would be willing to pay for access to a patented advance over the amount that they would pay for the next best substitute for performing the same task. Where there are active markets for the patented item and the next best substitute, the difference between these market prices should generally determine the per item patent damages that can be recovered.[102] Where there is no such market, an estimate of the utility gains and value to the infringer of access to one unit of the patented item (less the cost of producing the unit and providing this access) should define the per unit damages that should be recoverable for infringement. This will equal the amount that the infringer would reasonably have been willing to pay for the type of access to the patented advance that the party utilized (without payment of an access fee). The object of damage awards of this sort is to approximate the amounts that would have flowed to the patent holder were the patent system successfully controlling access to the patented invention and had the infringer gained access via legitimate (that is, non-infringing) channels and business processes.

Additional punitive damages may be needed to discourage choices by potential infringers not to seek patented advances from legitimate sources – that is, to discourage choices to engage in infringement knowing that access to an advance was constrained by patent rights. Without punitive damages for choices to forgo access controls and patent-influenced payments to patent holders, potential infringers, confronted with knowledge of patent controls and limitations, will have little reason to respect and adhere to the access controls of the patent system. They will instead be encouraged to choose to infringe by accessing patented advances without payments of patent-influenced prices with the hope that they will not be detected or, in the alternative, with the expectation that upon detection the worst that will happen is that they will have to pay patent damages roughly equal to the amounts that they would have paid for access through legitimate channels of access sanctioned by the patent owner.

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[102] Where the production costs of the patented item and its second best substitute are about equal, the patent damages (equal to lost profits) per item will be equal to the difference in the prices of the two items. Where one item is more or less costly to produce than the other, the per unit lost profit figure need to be adjusted to reflect this difference.

To avoid this decision calculus favoring decisions to infringe, knowing infringers must face heightened damages that, even in light of the chance that their infringement will not be detected at all, create a perception of net projected costs in choosing to infringe and a net projected advantage in seeking access to a patented advance through means consented to by the patent holder.

E. Injunctions

Injunction standards crafted in accordance with the view of patent law described here would focus on the need to prevent uncompensated access to patented inventions. Where a generally available invention access payment scheme has been established by a patent holder – such as a well-established and non-exclusive licensing scheme specifying a price for access to a patented technology – injunction relief for infringement may not be needed at all so long as an infringer pays damages equal to the access fee (that is, licensing fee) the infringer would have paid under the patent holder's access pricing scheme. In this context, damages are a sufficient substitute for privately imposed access charges and further injunctive relief is not needed.[103]

Injunctions to counteract patent infringement will be needed primarily where damages are not easily available substitutes for privately-imposed access charges. Injunctions will help force potential users of patented advances to deal with access controls and to bargain with patent holders as the parties controlling access if the potential users are to have further access to the patented inventions at all. In this respect, injunctions serve as a means to police and preserve the access control system that sets up mechanisms of payments and rewards back to inventors, with the amount of the actual payments and rewards determined through bargaining between patent holders and infringers after injunctions have issued.

Where there is no established price for additional access (perhaps because the patent holder intends to be the sole producer of a technology or intends to grant an exclusive license to only one party), the reward function of the patent system will generally be best served by protecting the patent holder's control over access to a patented invention through the issuance of an injunction barring unauthorized use of the invention. This will ensure that any subsequent access of the infringer will be at a price that the patent holder has bargained for and consented to. The patent holder will have incentives to determine the incremental utility seen in the invention by the infringer and to set the price for access at but not above this point (since a higher price will not be paid by a rational licensee or user of the patented invention). A patent holder will tend to cap their access price at this point since a price – that is, licensing royalty – too high will just cause the potential user to turn away from a license and to use the second best item or practice to achieve the same functionality as the patented item would have provided.

VI. Conclusion

Patent rights exist to serve societal ends. They encourage talented inventors and the resource managers who back these inventors to devote scarce time and resources to the search for new man-made tools for societal use. In encouraging more – but not too much more –

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[103] This criteria of determining whether an injunction is appropriate in a patent case is equivalent to a key component of the standard adopted by the Supreme Court in the *Ebay* case.

attention to the development of these tools, the patent system serves a function like no other legal regime in encouraging and regulating socially desirable inventive efforts. Patent rights encourage and regulate the production of patent-eligible advances that have characteristics which match public demands for new advances.

A lot is at stake in determining the proper scope and means for operation of the patent system. The parties and resources influenced by this system are among our most talented and most valuable. The inventions that patents promote – ranging from life saving drugs to society transforming communications devices – work tremendous changes in our daily activities and offer the best chance for new efficiencies and effectiveness in our economies, our societies, and our lives.

We need a strong patent system because we need the useful tools it generates and the better world they enable. We need a patent system when – but only when – it can encourage the creation of socially valuable tools and can regulate the allocation of scarce resources to the important tasks of creating these tools. While it comes at a price, our patent system aims at promoting the production of our best innovations, propagating the use of these advances, and topping these advances with further innovation. The strength with which we back these innovative processes has much to do with the pace of progress in our society and with the strength of the United States economy as one of the primary sources of valuable innovation in the world.

Ultimately, the patent system is a case in point of "you get what you pay for". We need a patent system because we need what it produces. Valuing these ends, we should be willing, without carelessness and waste, to enforce patent rights strongly and to pay related fees for access to functionally valuable advances produced by talented innovators and risk-taking resource investors. This is the patent bargain -- a good exchange enabled by patent rights and carried out through a costly, but worthwhile patent-mediated system for inducing and regulating invention production.