

## PATENT CARROTS AND STICKS: A MODEL OF NONOBVIOUSNESS

by  
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*The authors develop an informal model of the impact of the nonobviousness standard on the choice of research projects. Previous models assume that the basic question confronting a researcher is, "Shall I produce this particular invention?" More realistically, the authors think a researcher asks, "Which research path shall I pursue?" The model shows that a patent serves as a carrot to induce the choice of more difficult projects than would be pursued under the no-patent alternative. The nonobviousness standard serves as a stick to prod researchers to choose even more difficult projects. The results of the model help us understand why a fact-intensive issue like obviousness is a question of law. The model also helps us understand the optimal relationship between the nonobviousness standard and patentable subject-matter exclusions. Commentators often suggest subject-matter exclusions are unnecessary if the nonobviousness standard is used appropriately. The authors' model suggests this intuition is wrong for inventions characterized by large social spillovers and high social costs of patenting; a simple subject-matter exclusion would be more efficient.*

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## I. INTRODUCTION

The question of obviousness is central to determining patentability, yet what it means for an invention to be obvious in light of relevant prior art is one of the most difficult puzzles in patent law. The Supreme Court's recent decision in *KSR International Co. v. Teleflex, Inc.*<sup>1</sup> overturned the Federal Circuit's rigid reliance on the "teaching, suggestion, motivation" test for obviousness. In *KSR* the Court reaffirmed the general framework laid out in the Supreme Court's seminal *Graham v. John Deere Co.*<sup>2</sup> opinion in which nonobviousness is a question of law to be evaluated in light of underlying factual inquiries related to the context in which invention occurred. Importantly, *KSR* clarified that obviousness must be assessed in light of a context of normal baseline innovation in a particular technical field and assuming a level of ordinary creativity.<sup>3</sup>

The *KSR* decision clears the way for new thinking about the obviousness issue, which, despite its importance, is surprisingly under-theorized. Most scholarly discussions are very informal, simply listing the tradeoffs involved in setting the level of inventive step required for patentability.<sup>4</sup> For the most part, the decision whether to make a

<sup>1</sup> 127 S. Ct. 1727 (2007).

<sup>2</sup> 383 U.S. 1, 36 (1966).

<sup>3</sup> 127 S. Ct. at 1741–42, 1746.

<sup>4</sup> For earlier scholarly commentary on obviousness see, e.g., Margo A. Bagley, *Internet Business Model Patents: Obvious by Analogy*, 7 MICH. TELECOMM. & TECH. L. REV. 253 (2001); John H. Barton, *Non-Obviousness*, 43 IDEA 475 (2003); Rebecca Eisenberg, *Obvious to Whom? Evaluating Inventions from the Perspective of PHOSITA*, 19 BERKELEY TECH. L.J. 885 (2004); Robert P. Merges, *Commercial Success and Patent Standards: Economic Perspectives on Innovation*, 76 CAL. L. REV. 805 (1988) [hereinafter Merges, *Commercial Success*]; John F. Duffy, *Inventing Invention: A Case Study of Legal Innovation*, 86 TEX. L. REV. 1 (2007); Edmund W. Kitch, *Graham v. John Deere: New Standards for Patents*, 1966 SUP. CT. REV. 293; R. Polk Wagner and Katherine J. Strandburg, *Debate, The Obviousness Requirement in the Patent Law*, 155 U. PA. L. REV. 96 (2006), available at [http://www.pennumbra.com/debates/obviousness/Wagner\\_Strandburg\\_Debate.pdf](http://www.pennumbra.com/debates/obviousness/Wagner_Strandburg_Debate.pdf). For more formal models see Glynn S. Lunney, Jr., *E-Obviousness*, 7 MICH. TELECOMM. & TECH. L. REV. 363 (2000); Robert P. Merges, *Uncertainty and the Standard of Patentability*, 7 HIGH TECH. L. J. 1 (1992) [hereinafter Merges, *Uncertainty*]. For empirical studies see Christopher A. Cotropia, *Patent Law Viewed Through an Evidentiary Lens: The "Suggestion Test" as a Rule of Evidence*, 2006 B.Y.U.L. REV. 1517 (2006) [hereinafter Cotropia, *Patent Law*]; Christopher A. Cotropia, *Nonobviousness and the Federal Circuit: An Empirical Analysis of Recent Case Law*, 82 NOTRE DAME L. REV. 911 (2007); Sean M. McEldowney, *New Insights on the "Death" of Obviousness: An Empirical Study of District Court Obviousness Opinions*, 2006 STAN. TECH. L. REV. 4; Lee Petherbridge & R. Polk Wagner, *The Federal Circuit and Patentability: An Empirical Assessment of the Law of Obviousness*, 85 TEX. L. REV. 2051 (2007); Gregory Mandel, *Patently Non-Obvious II: Experimental Study on the Hindsight Issue Before the Supreme Court in KSR v. Teleflex*, 9 YALE J. L. & TECH. 1 (Fall, 2006–2007); Gregory N. Mandel, *Patently Non-Obvious: Empirical Demonstration that the Hindsight Bias Renders Patent Decisions Irrational*, 67 OHIO ST. L.J. 1391 (2006). See also FED. TRADE COMM'N, TO PROMOTE INNOVATION: THE PROPER BALANCE OF COMPETITION AND PATENT LAW AND

particular invention is conceptualized as an isolated yes or no choice depending simply on whether inventive costs exceed benefits captured by the inventor. We introduce a model of the nonobviousness threshold that reflects a somewhat more realistic view. In our model, we assume that research projects are selected by a research manager, who evaluates the potential payoff of various approaches to a particular objective. Thus, we assume that the basic question confronting a researcher is not “Shall I produce this invention?”, but rather “Which research path shall I pursue?”

In this Symposium Article, we explore three insights which arise from considering a simple version of our model in which a research manager chooses from among various independent research approaches to a particular objective. While patent protection serves as a “carrot” to induce greater technological advance, the nonobviousness threshold can serve as a “stick” to induce more ambitious, socially optimal research projects than would otherwise be pursued.

We argue first that a nonobviousness threshold serves at least two important purposes: Along traditional lines, our patenting model provides an incentive to pursue more costly inventions by allowing inventors to appropriate more of the value of their inventions. A nonobviousness threshold ensures that patents do not encumber technologies for which non-patent-based incentives are sufficient.<sup>5</sup> Over and above this traditional justification, our model suggests that the nonobviousness requirement serves another very important purpose where, as is realistically nearly always the case, the social value of research projects substantially exceeds their private value. When this is the case, the socially preferable level of invention exceeds the privately optimal choice *even when patents are available at both levels*. The nonobviousness threshold may be used as a “stick” to induce researchers to pursue more difficult, socially preferred research projects.

Second, the model aids in understanding why and in what sense obviousness must be deemed a question of law. In *Graham*, the Supreme Court held that “the ultimate question of patent validity is one of law,”<sup>6</sup> which, as it pertains to obviousness, “lends itself to several basic factual inquiries.”<sup>7</sup> The Court thus established obviousness as a question of law to

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POLICY (2003), *available at* <http://www.ftc.gov/os/2003/10/innovationrpt.pdf>; STEPHEN A. MERRILL ET AL., NAT’L RESEARCH COUNCIL, A PATENT SYSTEM FOR THE 21ST CENTURY (2004). *See generally* Symposium, *Nonobviousness—The Shape of Things to Come*, 12 Lewis & Clark L. Rev. 323 (2008).

<sup>5</sup> *See, e.g., KSR*, 127 S. Ct. at 1746 (“And as progress beginning from higher levels of achievement is expected in the normal course, the results of ordinary innovation are not the subject of exclusive rights under the patent laws. Were it otherwise patents might stifle, rather than promote, the progress of useful arts”). Merges, *Uncertainty supra* note 4; Lunney, *supra* note 4; Wagner and Strandburg, *supra* note 4 (Strandburg argument).

<sup>6</sup> *Graham*, 383 U.S. at 17 (1966).

<sup>7</sup> *Id.*

be resolved in light of specific factual predicates, a standard reiterated by the Federal Circuit repeatedly since its inception.<sup>8</sup> Nonetheless, it is far from clear what it means for obviousness to be a “question of law,” particularly in light of its highly technical nature. Our model suggests an interpretation of the nonobviousness requirement as highly policy-dependent and intertwined with the social value (as well as the technical difficulty) of an inventive project. Consistent with the Supreme Court’s division of the issue between questions of fact regarding the technical context of invention and an ultimate legal determination of whether the inventive step is sufficient to warrant a patent, this interpretation helps us to understand the appropriate division of labor between courts, factfinders, and the United States Patent and Trademark Office.

Third, our model sheds some light on the need for patentable subject matter restrictions. In some cases, the social costs of patenting may be sufficiently high that the social benefit of the greater technological step that can be induced by patenting’s carrots and sticks is not enough to offset the social cost of patent protection. Our model suggests that while advocates of patent protection for “anything under the sun that is made by man”<sup>9</sup> are correct that patents will induce greater inventive steps, they are incorrect in assuming that this is always socially preferable. Society may be better off with a less ambitious series of inventive steps which contribute unpatented technology which is more widely and cheaply available.

In Part II of the Article, we introduce our model and discuss its assumptions and limitations. We also compare our model to some earlier treatments of the obviousness question. In Part III, we explain how our model leads to a “carrots and sticks” view of the nonobviousness requirement and lay out (but do not explore in detail here) some of the considerations that would come into a practical application of this view of nonobviousness. In Part IV, we explain why our model contributes to understanding what it should mean for obviousness to be treated as a question of law. In Part V, we discuss how the social costs of patent protection play into the question of whether some types of inventions should be denied patent protection categorically, rather than evaluated for sufficient technical advance. The model helps to explain why a heightened nonobviousness standard is not necessarily an acceptable alternative to a doctrine of patentable subject matter. Part VI concludes by summarizing and briefly describing some limitations of the model. Elsewhere, we consider extensions of the model to address these

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<sup>8</sup> A Lexis search for (“question of law” /s (obvious! or nonobvious!)) yields 169 Federal Circuit cases spanning from November 23, 1983 to the present day (last performed Apr. 16, 2008).

<sup>9</sup> See, e.g., *AT&T Corp. v. Excel Commc’ns., Inc.*, 172 F.3d 1352, 1355 (Fed. Cir. 1999), *cert. denied*, 540 U.S. 946 (1999) (citing *Diamond v. Chakrabarty*, 447 U.S. 303, 309 (1980) (quoting S. REP. NO. 82-1979, at 5 (1952); H.R. REP. NO. 82-1923, at 6 (1952))). See also, e.g., F. Scott Kieff, *The Case for Registering Patents and the Law and Economics of Present Patent-Obtaining Rules*, 45 B.C. L. REV 55 (2003).

limitations and explore the implications of the model for nonobviousness doctrine in more detail.<sup>10</sup>

## II. A MODEL OF RESEARCH AND NONOBVIOUSNESS

We start this Article with a model of research, patenting, and the nonobviousness requirement. The model takes an *ex ante* perspective, asking how a research manager would go about choosing from a number of different projects aimed in a particular technological direction. Our model yields several insights into how patent policy affects an innovator's choice of research projects. First, the grant of a patent, even when there is no test of obviousness, serves as a "carrot" that induces firms to choose more difficult research projects than they would choose in the absence of a possible patent. Second, the patent carrot may be insufficient to induce the choice of the socially optimal research project, and the nonobviousness standard can be used as a "stick" to push firms to undertake more difficult research projects. Third, the rigor of the nonobviousness standard is limited by the reality that firms must prefer patenting to not patenting. If pursuing a nonobvious research project is too costly, then firms will simply opt out of patenting and pursue less costly projects. When the social cost of a patent is too high, then the best policy is to prohibit patenting and let non-patent-based private incentives guide the choice of research project.

### A. Introduction to the Model

Our model assumes a research entity with a particular general objective. *Ex ante*, there may be several possible research projects aimed at that objective. To be concrete, let us consider a stylized story of the invention of the incandescent light bulb.<sup>11</sup> Specifically, suppose in 1878 a potential inventor had a general goal of inventing a better filament that would improve the quality of existing light bulbs and possibly make them commercially feasible. We can sketch a range of possible research projects that the potential inventor could choose from.<sup>12</sup> He might work with platinum filaments. Platinum worked in earlier light bulbs but it was expensive and has a relatively low melting point. The potential inventor might experiment with different structures of platinum filaments, or develop a combination of platinum filaments and powdered charcoal. He might instead try to improve the carbonized paper filaments that had met with some earlier success. He might try tungsten or some other metal

<sup>10</sup> MICHAEL J. MEURER AND KATHERINE J. STRANDBURG, NONOBVIOUSNESS AND NERD CULTURE (work in progress).

<sup>11</sup> See The Incandescent Lamp Patent, 159 U.S. 465 (1895) for one part of the light bulb filament story.

<sup>12</sup> See, e.g., The Edison Papers, Electric Lamp, <http://edison.rutgers.edu/lamp.htm>, for a description of the history of the development of incandescent light bulbs and filaments.

or alloy for the filament. Or he might follow the path of Thomas Edison and experiment with plant fibers and other carbon-based filaments.<sup>13</sup> In this simplest version of our model, we assume that our research entity selects a single project and that sufficient funds may be borrowed to perform the research so that there is no budget constraint. Thus the research entity in our model will select the research project that, when viewed *ex ante*, maximizes its private expected return. In other words, the firm bases its planning on the *ex ante* expected costs and benefits of a given research path.

We define  $y$  as the technical difficulty of the research project (or, alternatively, we order all potential projects by technical difficulty). In our model, we thus suppose that the projects that a researcher would consider to attack a particular objective can be ordered and arrayed along a horizontal axis as in Figure 1. To return to our light bulb filament example, we assume that conventional wisdom in 1878 could be used to order the potential projects in terms of difficulty. Perhaps the tungsten filament project (which met success about twenty years later) would be furthest to the right. Perhaps the carbonized paper filament project would be furthest to the left. The others would be somewhere in between. We believe that this ordering is generally feasible. In other words, if asked, people having ordinary skill in the art tend to agree on whether a particular research project is difficult or easy. They tend to agree on whether a particular project is likely to be cheap or costly, humdrum or exciting. Most importantly, we argue that this *ex ante* assessment of technical difficulty is what should be relevant for assessing obviousness.<sup>14</sup> In our filament example, patent law should not ask whether a carbonized bamboo fiber is an obvious filament invention *ex post*. Rather, the law should take an *ex ante* perspective and ask whether a well managed research project investigating plant fibers as filaments would be easy or difficult (likely or unlikely to succeed). This perspective helps diminish the hindsight bias that might have occurred if Edison had been lucky and stumbled on his favored bamboo fiber in one of his first tests.<sup>15</sup>

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<sup>13</sup> Edison held numerous patents on light bulb filaments. See The Edison Papers, Edison's Patents, <http://edison.rutgers.edu/patents.htm>, for a list of all of Edison's patents.

<sup>14</sup> We do not frame the obviousness inquiry in terms of the particular research path followed by an inventor *ex post*. When we speak about the inventor's project, we are speaking about the objective of the research rather than its eventual path. For example, we suppose that Edison's objective was to find an improved carbon-based filament, or perhaps to find a plant fiber that worked as an improved filament. Thus, our modeling approach is consistent with patent law. Patent law insists that obviousness is judged objectively from the perspective of the person having ordinary skill in the art (PHOSITA). Our standard focuses on the difficulty of the path or paths that PHOSITA might take to complete the inventor's research project.

<sup>15</sup> Cf. Merges, *Uncertainty*, *supra* note 4, at, 38–39 (lucky inventions often occur in the context of a costly research project and they should not be categorically excluded from patent protection).

Given a particular research path,  $y$ , we denote the expected cost of a project  $c(y)$ . The expected private value of the research depends on whether the firm gets a patent after successfully completing the project, among other things. We denote the expected private value of  $y$  when the firm does not expect to get a patent on the technical improvement resulting from the research project  $y$  as  $v(y)$ , and the expected private value when a firm expects a patent to be available as  $V(y)$ . Because the success of a particular research project is at least somewhat uncertain, both  $v(y)$  and  $V(y)$  are discounted by the probability of success. The expected profit from the project  $y$  is thus  $v(y) - c(y)$  without a patent and  $V(y) - c(y)$  with a patent. At present, we assume that each research project leads to a different technical result. Thus, in the example of the light bulb filaments, one project leads to a platinum filament, one to a carbonized paper filament, and so forth. It is natural to assume that expected cost and expected private value increase as  $y$  increases.<sup>16</sup> While it might turn out, for example, that a brilliant scientist has an insight that solves a technically difficult problem in one afternoon or that a technically “easy” approach requires very expensive, but routine experimentation, we think that, for a given technical objective, costs expected *ex ante* will ordinarily increase with technical difficulty, as illustrated in Figure 1. The assumption that the expected value of a research project increases with technical difficulty may not always be correct in fact, but we think that it is sufficiently embedded in the justification for a patent system that is intended to encourage technical progress to be justified for our purposes. Alternatively, we can justify the assumption of increasing benefit by assuming that research entities themselves will screen out projects that are of great difficulty and little value so that we need not consider them in our model.

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<sup>16</sup> It is probably possible to imagine situations in which these plausible assumptions would not hold. We exclude such exceptional and, we think, rare situations from our analysis.

Figure 1

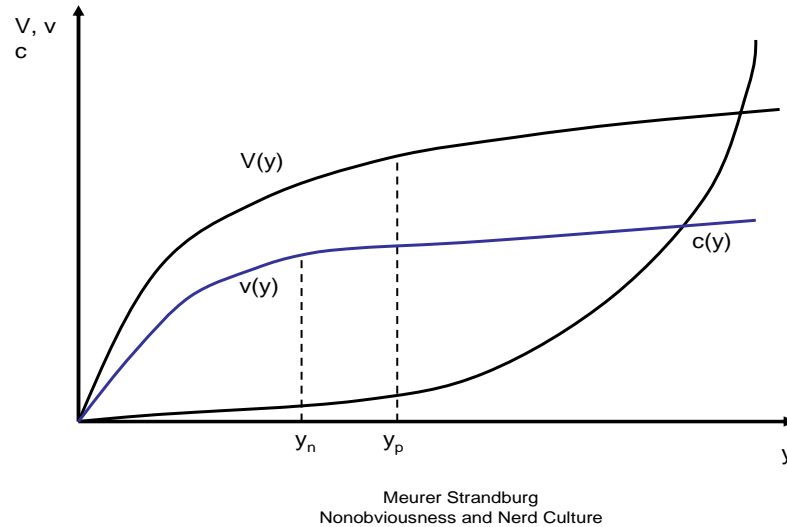


Figure 1 thus displays plausible expected cost and expected private value curves for an inventive firm. In this Article, we mostly assume that  $y$  is a continuous variable—i.e., that there is a continuum of increasingly difficult projects. In some cases, it will be more appropriate to think of  $y$  as an ordinal variable, ordering projects by technical difficulty. We do not believe this distinction is of great significance for our primary results and conclusions, but we recognize that it may have some consequences and will consider them in our more detailed treatment. Though there is no quantitative scale for technical difficulty, we believe that there is an intuitive scale of difficulty approximately shared by PHOSITA in a given field and that on this intuitive scale, marginal costs tend to increase with technical difficulty as depicted in Figure 1.<sup>17</sup> The curvature of the value curve shown in the figure reflects the expectation that there are decreasing returns to technological improvement. We also assume that the expected private value of an invention is increased by patenting and thus that  $v(y) < V(y)$ . There are undoubtedly situations in which this is not the case—a researcher who expects to be able to exploit an invention secretly for longer than the patent term might well expect private value to be decreased by patenting. In such situations, the nonobviousness threshold is irrelevant, since researchers will eschew patent protection. We thus set these situations aside for the present analysis.

<sup>17</sup> Alternatively, and without loss of generality here, we could scale the horizontal axis to cost and draw a linear cost curve. The linear cost curve assumption breaks down if we want to compare different cost curves for the same set of research projects—for example if we want to model different classes of potential inventors. We do this in our more detailed treatment, but it is not necessary for the present Article.



Given the private costs and benefits of available projects, as illustrated in Figure 1, one can determine the optimal choice of research project by maximizing net private return. If the firm does not plan to patent (or if no patent is available), then the project that maximizes expected profit is  $y_n$ . If the firm does plan to patent, then the profit-maximizing project is  $y_p$ . These choices maximize the difference between expected private value and expected cost.<sup>18</sup> Because a patent increases private returns from each given invention, the optimal project if a patent is available (denoted  $y_p$  in Figure 1) is at a higher level of technical difficulty than the optimal project if no patent is available (denoted  $y_n$  in Figure 1), as illustrated by the fact that  $y_p$  is to the right of  $y_n$  in the figure. This observation is consistent with the general idea that a patent provides an “incentive” for invention, but it is a somewhat more subtle interpretation than the simple idea that a patent allows an inventor to recoup her investments in inventive activity.

In Parts III, IV, and V, we will build upon this basic model to address the issues of the function of the nonobviousness threshold, the reasons for treating nonobviousness as a question of law, and the need for a patentable subject matter restriction. Before doing so, we pause to compare the model we have just introduced with earlier attempts to model the nonobviousness issue.

#### B. *Comparison of the Model to the Previous Literature*

Even though most commentators identify the nonobviousness doctrine as the most important standard for obtaining a patent, there is surprisingly little formal analysis of the standard by either lawyers or economists.<sup>19</sup> Most discussions of the issue revolve around attempting to distinguish those inventions that would have been made even without the patent incentive—because first-mover advantages and other non-patent rewards for invention

<sup>18</sup> See Merges, *Commercial Success*, *supra* note 4, at 852 (drawing lessons from the work of Nelson and Winter: firms emphasize business factors including expected cost and value and not just technical difficulty when they invest in R&D); Merges, *Uncertainty*, *supra* note 4, at 10–11 (the prospect of getting a patent likely affects research project choice).

<sup>19</sup> See references cited, *supra* note 4, for earlier commentary on the issue of nonobviousness. Some of the work on cumulative innovation by economists also can be applied to the nonobviousness requirement. Robert Hunt has done this explicitly. He shows that weakening the nonobviousness requirement raises the expected value of patenting and provides an incentive to firms to do more research, but it also increases patenting by others. The patenting of others will hurt the research incentive of pioneers when subsequent patents cover improvements of or complements to the technology covered by the pioneer’s patent. See Robert M. Hunt, *Nonobviousness and the Incentive to Innovate: An Economic Analysis of Intellectual Property Reform* 38 (Fed. Reserve Bank of Phila., Working Paper No. 99-3, 1999), *available at* <http://www.philadelphiafed.org/files/wps/1999/wp99-3.pdf> (showing “that weaker nonobviousness requirements can lead to *less* R&D activity, and this is more likely to occur in industries that rapidly innovate”); Robert M. Hunt, *Patentability, Industry Structure, and Innovation*, 52 J. INDUS. ECON. 401, 402 (2004). We will discuss cumulative innovation in our longer article, *Nonobviousness and Nerd Culture*, *supra* note 10.

provide sufficient excess returns to cover inventive costs—from those that need a patent to garner sufficient returns.<sup>20</sup> The question is usually framed in terms of whether it is possible for an inventor to recoup her investments in invention without a patent or whether a patent is required to make a profit. From this dichotomous perspective, commentators often argue that an optimal choice of patentability standard should minimize error costs.<sup>21</sup> One type of error, called a false positive, occurs when the patent incentive is not needed to induce the invention, yet a patent is granted. In such cases, society needlessly bears the cost of a patent. The other sort of error, called a false negative, occurs when a patent is not available for an inventive project that will not be profitable without the additional private return which patent exclusivity would provide. Under these analyses, a more rigorous obviousness standard increases false negatives and reduces false positives. An optimal policy finds the right balance. Though this approach is useful in advancing our general understanding of alternative means for inventors to recoup inventive investments, the “on/off” picture of invention is unrealistic and has so far been unsuccessful in leading to doctrinal tools for setting the nonobviousness threshold.

Our model differs from these informal discussions of the law and economics of obviousness by assuming that research managers choose among possible research projects of varying technical difficulty rather than making a simple yes or no choice—conduct research or not in pursuit of a particular invention. In the analysis that follows here and in our more detailed article, we consider how those research manager choices relate to socially preferable research choices.

Two earlier approaches to the nonobviousness issue bear a closer relationship to ours and it is worth describing them in a bit more detail here for purposes of comparison. Professor Robert Merges has proposed and analyzed a model which, like ours, is inspired by the conception of a research manager determining how to invest in research and development.<sup>22</sup> Like our model, Merges’s model goes beyond a simple dichotomous choice to invent or not invent based on whether a positive net private return is expected *ex ante*. He presents a two-stage model featuring a decision to conduct research in stage one and a decision to develop the resulting technology in stage two.<sup>23</sup> In Merges’s model, uncertainty plays the primary role.<sup>24</sup> The first stage of research reduces the uncertainty associated with the decision to pursue the second stage of development. Merges uses his model to argue that, because of the important role played by uncertainty, adjustments of the obviousness standard are not likely to change the expected value of a research project significantly.<sup>25</sup> Nonetheless, Merges emphasizes, like we do,

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<sup>20</sup> See, e.g., Merges, *Uncertainty*, *supra* note 4, at 29–31; Kitch, *supra* note 4, at 301.

<sup>21</sup> See, e.g., Cotropia, *Patent Law*, *supra* note 4, at 1563–67.

<sup>22</sup> See generally Merges, *Uncertainty*, *supra* note 4 (analyzing the effect of nonobviousness on business judgments by R&D managers).

<sup>23</sup> *Id.* at 21–23.

<sup>24</sup> *Id.* at 23–26, 31.

<sup>25</sup> *Id.* at 25–26.

that the obviousness standard is still important to give the right incentives to guide investment of the marginal research dollar.<sup>26</sup> He argues that the probability of technical success should be the key to implementing the nonobviousness requirement, both because it is so important for determining whether a project will be undertaken and because it is a relatively feasible standard to implement.<sup>27</sup> Research projects that are sufficiently likely to succeed should not yield patents because such projects are likely to go forward without the prospect of a patent. By denying patents in such cases, society avoids the social costs patents impose. In contrast, uncertain projects, especially when the cost of research is high, should satisfy the obviousness standard because the patent incentive is probably needed as an incentive to invent.<sup>28</sup>

Merges's model incorporates a more sophisticated view of the way in which a given research project progresses than is featured either in more informal discussions of obviousness or in our model, which does not break the research project down into stages (though it does account for the overall uncertainty of a research project). Despite its sophistication, however, Merges's model retains the focus on a single, given, research project.<sup>29</sup> Our model broadens the view of the function of the obviousness requirement to include its possible influence on the choice of various possible research directions.

Though lacking the detailed treatment of uncertainty reduction that is present in Merges's model, our model incorporates uncertainty to some degree by focusing on expected costs and benefits. We assume that inventive costs rise for projects of great technical difficulty. This rise is attributable in significant part to the increased uncertainty of such projects.<sup>30</sup>

Professor Glynn Lunney has proposed an approach to nonobviousness which is similar to ours in that it compares incentives to invest in various possible projects.<sup>31</sup> Where our model focuses on a research manager's choice among research projects, Lunney's analysis focuses on the choice between inventive and non-inventive investments.<sup>32</sup> He argues that what he terms the "creative investment fraction" affects the availability of innovation rents (based on first-mover advantages and so forth) where patent protection is

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<sup>26</sup> *Id.*

<sup>27</sup> *Id.* at 2–3, 29–32, 35–37 (uncertainty based theory of nonobviousness).

<sup>28</sup> *Id.* at 41–55 (favoring patents when there is high variance of research cost coupled with risk aversion).

<sup>29</sup> *Id.* at 19–20. Merges does note in passing the potential for a patenting threshold based on riskiness of research to displace lower-risk research, *id.* at 20–21, but the selection between research projects is not a focus of his analysis.

<sup>30</sup> Merges also discusses the implications of risk aversion, particularly for high cost research projects. *Id.* at 43–55. Our model does not deal with risk aversion explicitly, but our assumption that there are diminishing marginal returns to inventors as technical step increases is consistent with risk aversion (though motivated more by an assumption that technical improvements generally do produce diminishing marginal improvements in the social and private value of inventions).

<sup>31</sup> Lunney, *supra* note 4.

<sup>32</sup> *Id.* at 404–12.

unavailable.<sup>33</sup> The “creative investment fraction” is the fraction of the overall investment in a project which is spent on presumably easy-to-copy invention, as opposed to things like materials and capital equipment. The “creative investment fraction” thus reflects the degree to which a second-comer can produce a product more cheaply than the inventor.<sup>34</sup> In other words, it is a measure of the extent of possible free riding. Lunney advocates setting a threshold of creative investment fraction for awarding a patent.<sup>35</sup>

A key insight of Lunney’s article is that the nonobviousness threshold may be used to shift investment between projects. Lunney argues that free riding can decrease the private rents available from high-creativity projects, thus drawing investment to lower-creativity projects even if the high-creativity projects have higher social value. The nonobviousness threshold is used in his proposal to award patents on high-creativity projects so as to deter free riding and shift investment toward those projects.

Our model assumes a research manager who chooses only among creative projects. However, the creative investment fraction for a given research project is reflected in our model in the ratio between  $V(y)$  and  $v(y)$ . A project with a high creative investment fraction (and corresponding high potential for free riding) will have a high ratio of  $V(y)/v(y)$ . Conversely, a project with a low creative investment fraction (and correspondingly greater first mover advantage) will have a ratio of  $V(y)/v(y)$  closer to one. If, for example, we were to assume that the costs of producing light bulbs are relatively insensitive to the choice of filament material, then a graph like Figure 1 for the light bulb project would show an increasing proportional separation between  $V(y)$  and  $v(y)$  as  $y$  increased. The result of such an increasing “creative investment fraction” would be reflected in our model in a larger separation between  $y_n$  and  $y_p$ .

As discussed in the next Part, our model departs from both Lunney’s and Merges’s in the way it accounts for the social value of invention. Our model suggests that neither a fixed threshold based on creative investment fraction nor a fixed uncertainty threshold sufficiently accounts for the divergence between socially and privately optimal choice of research projects.

### III. THE CARROT AND STICK OF THE NONOBVIOUSNESS THRESHOLD

#### A. *The Patent Carrot*

Up to this point, we have said nothing about the role of the nonobviousness threshold in motivating the choice of research project in our model. Figure 1 shows how patenting provides a carrot to induce researchers to pursue more difficult projects, but a nonobviousness threshold apparently is not needed to induce this higher level of activity. To understand the role

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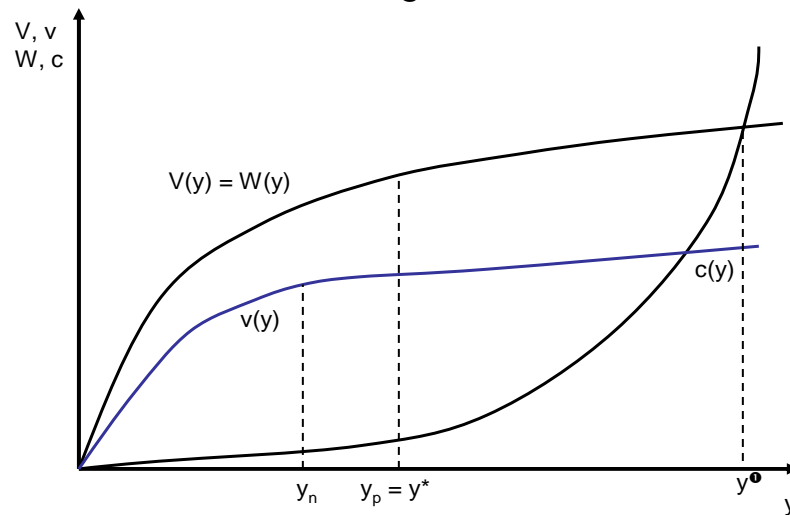
<sup>33</sup> *Id.* at 413–15.

<sup>34</sup> *Id.*

<sup>35</sup> *Id.* at 415–18.

of the nonobviousness requirement, we must consider the social welfare implications of the project choices researchers make. What is the relationship between the privately optimal research project and the socially preferable choice? To answer this question, we must consider the likely relationship between private and social value of the research. Figure 2 illustrates a highly stylized situation in which a patent provides perfect appropriation of the value of the invention. In that case, the expected social value of project  $y$ , which we denote  $W(y)$ , equals the expected private value with a patent,  $V(y)$ . We also assume in Figure 2 that the social and private costs are equal. In the simple case depicted in Figure 2 the socially optimal project, which we call  $y^*$ , would match the privately optimal project when the inventor pursues a patent,  $y_p$ .

Figure 2



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Figure 2 provides a helpful benchmark that we use to make three preliminary points. First, there is a socially optimal level of technical improvement. More is not always better. Society could get positive expected returns from any project up to  $y^*$ , but it would be socially wasteful to push for difficult projects to the right of  $y^*$ , because the cost of those projects rises more quickly than the benefit. Thus, the goal of patent law (and the nonobviousness requirement more specifically) should not be to encourage greater levels of invention per se, but to encourage the socially preferable level of invention. In Figure 2, the socially preferable level is the same as the privately preferable level because we assume that the patentee captures all the benefits of the invention. Realistically, the expected social and private values are likely to diverge. They coincide only if the inventor captures all the value of the invention, and if the patent does not impose any social cost in

excess of the costs invested directly in research and development. As we discuss in greater detail later, most of the time, the socially optimal research project will be more ambitious than the private optimum because of spillovers in value, but sometimes it may be lower than the private optimum in the presence of patenting because of the social costs patenting imposes.

Second, the optimal choice of a nonobviousness standard is inextricably linked to spillovers and patenting costs. When the assumptions underlying Figure 2 hold true, there is no need for a nonobviousness requirement and patenting would always be optimal because private parties would choose the socially (and privately) optimal level of invention even if patents were available at lesser levels of technical improvement. Third, our model reminds us that the frequent crude assumption that an invention will be pursued as long as private benefits outweigh private costs is unlikely to pertain to realistic inventive scenarios where researchers seek to maximize net returns.

### B. *The Nonobviousness Stick*

In this Section, we relax the assumption of no spillovers illustrated in Figure 2. We then explain why spillovers create a role for a nonobviousness standard. Figure 3 displays a setting in which the expected social benefit generally exceeds the expected private benefit of a research project, i.e.,  $W(y) > V(y)$ . For simplicity of analysis, we interpret  $W(y)$  to represent the net social benefit over and above the direct costs of the research project (which we have previously denoted  $c(y)$  rather than displaying a separate social cost curve.<sup>36</sup> Private and social benefits generally diverge for several reasons.<sup>37</sup> Probably the two most important are (1) that a patent owner does not capture all the value enjoyed by users of his or her invention,<sup>38</sup> and (2) that disclosure of an invention, including the disclosure in the patent, helps others develop subsequent inventions.<sup>39</sup>

<sup>36</sup> This assumption is important in interpreting our later graphs, in which we allow the possibility that social value depends on whether the invention is patented.

<sup>37</sup> For a discussion of the ubiquity and importance of spillovers of intellectual property, see Brett M. Frischmann & Mark A. Lemley, *Spillovers*, 107 COLUM. L. REV. 257 (2007); Mark A. Lemley, *Property, Intellectual Property, and Free Riding*, 83 TEX. L. REV. 1031 (2005). See also JAMES BESSEN AND MICHAEL J. MEURER, *PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAWYERS PUT INNOVATORS AT RISK* (Princeton University Press 2008) (discussing why patents fail to work effectively as property rights).

<sup>38</sup> Consumer surplus is the term economists apply to the value enjoyed by consumers. Normally, patentees lack the information and the market power required to extract all consumer surplus. For a discussion of price discrimination and consumer surplus extraction by patent holders, see generally Jerry A. Hausman & Jeffrey K. MacKie-Mason, *Price Discrimination and Patent Policy*, 19 RAND J. ECON. 253 (1988); F. Scott Kieff, *Property Rights and Property Rules for Commercializing Inventions*, 85 MINN. L. REV. 697 (2001).

<sup>39</sup> Patent rights are limited in important ways so that subsequent improvers can earn rents from their improvements, and thus, they have an incentive to pursue improvement innovations. See, e.g., Robert P. Merges and Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839 (1990); SUZANNE SCOTCHMER,

Normally, the divergence of social and private value implies the divergence of the socially optimal project from the privately optimal project. Figure 3 shows that, at least for cost and benefit curves of the generally reasonable shape depicted,<sup>40</sup> the technical advance corresponding to the socially optimal project,  $y^*$ , exceeds that of the privately optimal project,  $y_p$ , even when the inventor pursues a patent. Intuitively, a social planner wants to push for a more difficult project because the marginal *social* gains at  $y_p$  are large enough to more than offset the marginal cost of a project at level  $y_p$ , even though the marginal private gains are not. The divergence between  $y_p$  and  $y^*$  is due to the assumption, reflected in Figure 3, that the greater the technical advance, the more the social value associated with that advance exceeds the private value. This assumption reflects the reasonable notion that bigger inventive steps are likely to lead to more extensive and broader opportunities for follow-on innovation and, in particular, that they are more likely to lead to a broader and more extensive set of improvements that will not be made by the original inventor.

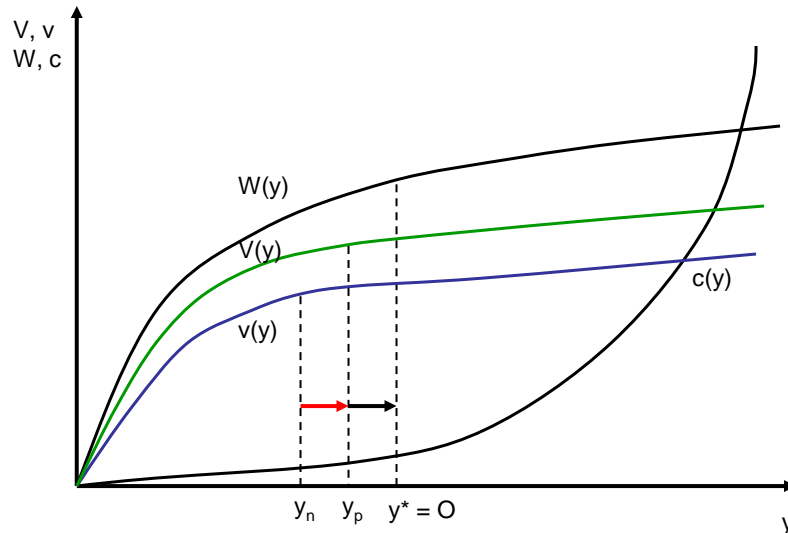
One new insight from our model is that it is to a great extent because of this gap between privately and socially optimal invention levels that a nonobviousness threshold is desirable. The obviousness standard can be used as a stick to prod an inventive entity to choose a more difficult research project than is privately optimal. We let  $O$  represent the threshold level of difficulty that must be met or surpassed before a firm can get a patent. If  $O$  is set at any value less than or equal to  $y_p$ , then it is not binding, in the sense that it does not push the research entity to choose a more difficult project than it would otherwise choose. On the other hand, if  $O$  is greater than  $y_p$ , it is binding in the sense that if an inventive entity wants a patent, it must choose a project that is more difficult than it would have chosen in a regime with no obviousness standard (or a lax standard).

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INNOVATION AND INCENTIVES (2004) (discussing the ways in which patent law balances incentives for original and follow-on inventors).

<sup>40</sup> It is possible to imagine scenarios in which social and private value are not related as depicted here. For example, private and social values could approach one another in such a way that the socially optimum research project is less of an inventive step than the privately optimal step. Depending on the specifics, it may be optimal in such cases to refrain from patenting altogether. We address this question in more detail in our longer article, but for now we simply state that we believe that in most cases social spillovers will increase with the size of the technological advance.

Figure 3



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In Figure 3, the socially optimal choice of  $O$  simply equals the value of  $y$  that maximizes the difference between expected social value and cost,  $y^*$ . Figure 3 thus illustrates how patents can function as both a “carrot” and a “stick” in stimulating invention. Patents virtually always act as a carrot to stimulate the choice of more difficult research projects. Even without an obviousness test, a patent creates an incentive that induces the firm to choose  $y_p$  rather than  $y_n$ . The nonobviousness requirement, however, can provide a stick to push inventors to choose even more ambitious, socially preferable projects. Thus, Figure 3 shows that the effect of a patent system with an obviousness standard of  $O$  can be decomposed into a carrot effect and a stick effect. The sum of these two effects raises the choice of research project from  $y_n$  to  $y^*$ .

The view of the nonobviousness threshold suggested by our model is significantly different from the perspective suggested by the usual discussion based on the “on/off” view. The usual discussion has two parts: First, it assumes that inventions are produced as long as they produce a net profit for the inventor. In terms of our model this would mean that inventions are produced without the patent incentive as long as  $v(y) - c(y) > 0$ . Second, it posits that the purpose of the nonobviousness threshold is to avoid awarding patents to inventions that would be produced even without the patent incentive. If we consider this simplistic view in the context of Figure 3, we see that it leads to a contradictory analysis. The assumption that projects are pursued as long as there is a nonzero net return would suggest setting the



obviousness threshold quite high—at the point where  $v(y)$  and  $c(y)$  cross. Importantly, this point is above the socially optimal value of  $y$ . Moreover, our model suggests that if the obviousness threshold were in fact set that high, rather than choosing to pursue such a large inventive step our research manager would choose the privately optimal project,  $y_n$ . Thus, a nonobviousness threshold set at the point where  $v(y) - c(y) = 0$  would backfire, leaving us without the benefits of the patent incentive carrot. On the other hand, if we take the second part of the usual analysis seriously—that the nonobviousness threshold should be set just so as to avoid patenting those inventions that would be produced without a patent incentive—the implication would seem to be that we should set the nonobviousness threshold at  $y_n$ . A nonobviousness threshold at  $y_n$ , however, would fail to provide a “stick” to push our researcher toward the socially preferred choice. Indeed, setting the nonobviousness threshold at  $y_n$  has no impact on the research manager’s choice to pursue the  $y_p$  research project. Our model provides a more reasonable understanding of where the nonobviousness threshold should be set.

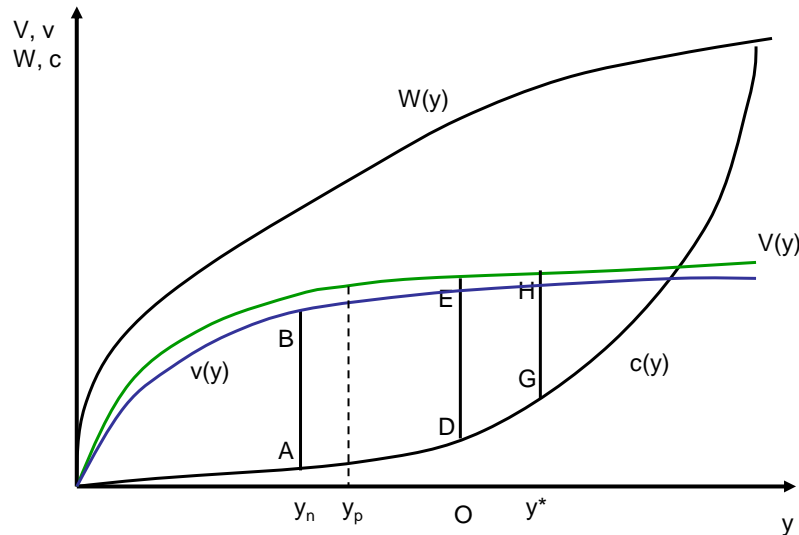
Figure 3 also illustrates another of the misleading aspects of the crude “on/off” view of the incentive effects of patenting. If the nonobviousness threshold is mistakenly set too high, the result is not that invention is foregone, but that non-optimal and inefficiently difficult projects will have to be undertaken to obtain a patent. This is a social cost, of course, but not the cost that (and probably not as great a cost as) the simpler perspective suggests.

While it is desirable to set the nonobviousness threshold at the social optimum, even a perfectly informed social planner faces a constraint when using the obviousness standard as a stick. Prospective inventors will choose not to pursue patentable projects if the nonobviousness threshold is set so high that it is privately preferable to pursue a lower-tech unpatentable project. We will call this the patenting constraint. The obviousness standard can be used to prod an inventor to choose the socially optimal research project only as long as that research project is at least as profitable (given a patent) as the profit available from the research project,  $y_n$ , that the inventor would choose in the absence of a patent. As a policy matter, this means that in some cases involving relatively large social spillovers, other mechanisms (such as direct government funding of research) may be needed to obtain the socially optimal level of research.

In Figure 3, the patenting constraint does not impede full use of the obviousness standard as a stick. By inspection one can see that the private profit available with a patent at  $y^*$  exceeds the private profit available without a patent at  $y_n$ . Thus  $O$  can be set at the socially optimal level,  $y^*$ , that maximizes  $W(y) - c(y)$ . The patenting constraint binds in the example displayed in Figure 4, however. In Figure 4, the obviousness standard  $O$  should be less than  $y^*$  because the profit at  $y^*$  is too small to induce a research manager to pursue a patentable invention. The vertical distance  $AB$  measures the maximum expected profit if the firm chooses not to patent. That distance is larger than  $GH$ , the expected profit given a patent and the choice of  $y = y^*$ . One can see from Figure 4 that the patenting constraint is

likely to be important when the social benefit from an invention is considerably greater than the private benefit captured by patenting, so that  $y^*$  greatly exceeds  $y_n$ .

Figure 4



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Even when the patenting constraint binds, as in Figure 4, the obviousness standard can still be used as a stick to prod an inventive entity to choose a more difficult project than it would otherwise choose. The socially optimal choice of  $O$  in such a case, illustrated in Figure 4, is that value of  $y$  at which the expected profit, measured by  $DE$ , equals the expected profit,  $AB$ ,<sup>41</sup> which an inventor expects to receive by pursuing the privately optimal unpatentable project at  $y_n$ . Though social welfare would be increased even more by a project of difficulty  $y^*$ , the patent system cannot induce investment in a project at that level.

The patenting constraint has the following policy relevance: If the constraint binds tightly, then the obviousness standard cannot be used to push up the difficulty of research projects very much. In such cases, a rigorous obviousness standard can be counterproductive. If it is mistakenly set too high, then inventive entities will forego pursuing patentable inventions and the project difficulty will fall to  $y_n$ . The risk of this error is apt to grow as the patenting constraint binds more tightly.

<sup>41</sup> There is no harm in assuming that the firm will choose to patent when patenting and not patenting are equally profitable.

To summarize, our model gives us the following advice as to where the nonobviousness threshold should be set: if possible, set  $O$  at the socially optimal technical level,  $y^*$ . If the patenting constraint binds, set  $O$  at the highest feasible technical level, as illustrated in Figure 4. Of course, this result does not give us a recipe for assessing obviousness in the real world, where we do not know how to draw the curves shown in Figures 3 and 4. What it does is help us to understand the goal of the nonobviousness requirement and give us an idea of the factors we should consider in constructing a practical approach to the nonobviousness question. It is, for example, important to understand how research costs rise as the technical approaches to a particular objective increase in difficulty. Many of the factual inquiries laid out by the Supreme Court in *Graham*<sup>42</sup> and *KSR*<sup>43</sup>—such as the inquiry into the level of ordinary skill in the art and the secondary consideration of “long-felt need”—can be viewed as means to probe the shape of the cost curve, and we argue elsewhere that there are other factors that should also be included.<sup>44</sup>

The model also sheds light, for example, on the puzzle of how the “level of ordinary skill in the art” is connected to the ultimate assessment of nonobviousness. A naïve approach might conclude that the higher the level of skill in a particular art, the more obvious new inventions are likely to be. Such an approach seems to call for a higher nonobviousness threshold in more skilled fields—thus suggesting, counterintuitively, that the obviousness threshold should be “higher” in biotechnology than for simple mechanical inventions. Our model illustrates why such an approach makes no sense. What matters for nonobviousness is not the level of ordinary skill in one art compared to the level of ordinary skill in another, but the level of ordinary skill in a particular art with respect to the technical difficulty of the problems in that art. The latter determines the rate at which costs increase with technical difficulty.

Besides drawing our attention to the shape of the cost curve, the model also informs the analysis of how to perform the ultimate assessment of obviousness, which should not be viewed as a merely technical assessment, but must be made in light of an understanding of social spillovers. We turn to the ramifications of this observation in the next Part of this Article.

#### IV. OBVIOUSNESS AS A QUESTION OF LAW

It is settled law that the ultimate determination of obviousness is a question of law with factual underpinnings. As the Supreme Court put it in its seminal *Graham* opinion:

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<sup>42</sup> *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

<sup>43</sup> *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1740–43 (2007).

<sup>44</sup> MEURER AND STRANDBURG, *supra* note 10. For an earlier discussion of the importance of taking into account factors such as regulatory and technical change, *see, e.g.*, Duffy, *supra* note 4, at 11–14. *See also* Wagner & Strandburg, *supra* note 4, at 104.

While the ultimate question of patent validity is one of law, the §103 condition, which is but one of three conditions, each of which must be satisfied, lends itself to several basic factual inquiries. Under § 103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstance surrounding the origin of the subject matter sought to be patented.<sup>45</sup>

Despite the clear and oft-repeated understanding that obviousness is a question of law, neither the significance of the legal aspect of the issue, nor the way in which the factual underpinnings should be related to the ultimate legal assessment is at all well understood. Indeed, there has been a tendency to transmute obviousness into an effective question of fact while paying lip service to its status as a legal issue.

Historically, the status of nonobviousness as a question of fact or law was disputed. Case law prior to the enactment of the 1952 Act frequently treated the issue of “invention” (the precursor to modern-day “nonobviousness”) as a question of fact.<sup>46</sup> To this day, the question is frequently decided by a jury—with or without special interrogatories as to the underlying factual premises.<sup>47</sup> Even more tellingly, the Federal Circuit’s repeated invocations of the “question of law” mantra in its obviousness jurisprudence were belied by its actual approach to the obviousness issue. Until the Supreme Court’s recent rejection of the Federal Circuit’s rigid approach to obviousness, the Federal Circuit had held that no patent claim could be ruled obvious without an evidentiary, factual finding<sup>48</sup> of a “teaching, suggestion, or motivation to combine” (TSM) prior art references to produce the claimed advance.<sup>49</sup> Because such a factual finding was a prerequisite of a conclusion that an invention was obvious, the factual inquiry quite literally swallowed the potential for “legal” analysis where no such teaching was found since the only acceptable legal conclusion under those circumstances was that the

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<sup>45</sup> 383 U.S. at 17–18 (citations omitted).

<sup>46</sup> See, e.g., 2 DONALD S. CHISUM, CHISUM ON PATENTS, § 5.04[3] (2007).

<sup>47</sup> See, e.g., Federal Circuit Bar Association Model Patent Jury Instructions 4.3b et seq., available at [http://www.memberconnections.com/olc/pub/LVFC/cpages/misc/purchase\\_resources.jsp](http://www.memberconnections.com/olc/pub/LVFC/cpages/misc/purchase_resources.jsp); Am. Intellectual Prop. Law Ass’n, Model Patent Jury Instructions § 7.0 (2005), available at <http://www.aipla.org/Template.cfm?ContentID=10448&template=/ContentManagement/ContentDisplay.cfm>.

<sup>48</sup> See, e.g., *Alza Corp. v. Mylan Labs., Inc.*, 464 F.3d 1286, 1289 (Fed. Cir. 2006) (“[T]he presence or absence of a motivation to combine references in an obviousness determination is a pure question of fact[.]” (quoting *In re Gartside*, 203 F.3d 1305, 1316 (Fed. Cir. 2000))).

<sup>49</sup> See, e.g., *KSR Int’l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1734–35 (describing the Federal Circuit’s test). In the more unusual case of a single prior art reference, the Federal Circuit required a teaching, suggestion, or motivation to “modify” it. See, e.g., *McGinley v. Franklin Sports, Inc.*, 262 F.3d 1339, 1356 (Fed. Cir. 2001).

invention was nonobvious. In practice, the TSM test also effectively swallowed the legal inquiry in cases where there was such a teaching, suggestion, or motivation to combine, since a conclusion of nonobviousness in such a case was also extremely rare.<sup>50</sup>

In light of the Supreme Court's ruling in *KSR*, which unseated the Federal Circuit's rigid requirement of a teaching, suggestion, or motivation to combine as a prerequisite to a legal conclusion of obviousness and mandated a return to the *Graham* framework, the question of what it means for obviousness to be a question of law is now open and an answer to this question is urgently needed as part of a re-thinking of the nonobviousness requirement more generally. To further complicate matters, the doctrine of obviousness as a question of law was developed before the Supreme Court's ruling in *Dickinson v. Zurko* brought judicial review of the United States Patent and Trademark Office (USPTO) into the standard administrative law fold.<sup>51</sup> Once the Federal Circuit's TSM short-circuit of the legal question of obviousness is abandoned, the *Graham* framework raises difficult questions not only about the relationship between the Federal Circuit and the lower courts, but also about the relationship between the Federal Circuit and the USPTO with respect to judicial review of obviousness determinations.

Here, we do not attempt to address those potentially thorny administrative law issues. Rather, we seek to contribute to the development of nonobviousness doctrine by asking the more fundamental question of why the nonobviousness determination should be deemed a question of law as a policy matter. The line between questions of law and questions of fact crops up in many contexts, of course, and is generally a somewhat perplexing issue to which various approaches are possible.<sup>52</sup> One approach, which we adopt here, is to treat the question of whether an issue should be treated as a question of law or fact as a practical question of institutional competence.<sup>53</sup>

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<sup>50</sup> We surveyed Federal Circuit cases between 1995–2006 and found that in 44 out of 45 cases in which a teaching, suggestion, or motivation to combine was found, the invention was deemed obvious.

<sup>51</sup> *Dickinson v. Zurko*, 527 U.S. 150 (1999). See Stuart Minor Benjamin & Arti K. Rai, *Who's Afraid of the APA? What the Patent System Can Learn From Administrative Law*, 95 GEO. L. J. 269, 270–71 (2007).

<sup>52</sup> See, e.g., Edward H. Cooper, *Civil Rule 52(a): Rationing & Rationalizing the Resources of Appellate Review*, 63 NOTRE DAME L. REV. 645, 649 (1988) (standards of review serve to allocate responsibility between trial tribunals and the courts of appeals); Mark P. Gergen, *The Jury's Role in Deciding Normative Issues in the American Common Law*, 68 FORDHAM L. REV. 407 (1999); Ronald M. Levin, *Identifying Questions of Law in Administrative Law*, 74 GEO. L. J. 1 (1985); Randall H. Warner, *All Mixed Up About Mixed Questions*, 7 J. APP. PRAC. & PROCESS 101 (2005); Ronald J. Allen & Michael S. Pardo, *The Myth of the Law-Fact Distinction*, 97 NW. U.L. REV. 1769 (2003).

<sup>53</sup> As the Supreme Court said in *Markman v. Westview Instruments, Inc.*, 517 U.S. 370, 388 (1996):

Where history and precedent provide no clear answers, functional considerations also play their part in the choice between judge and jury to define terms of art. We said in *Miller v. Fenton*, 474 U.S. 104, 114 (1985), that when an issue ‘falls somewhere between a pristine legal standard and a simple historical fact, the fact/law distinction at times has turned on a

We thus frame the question in this way: Who is better suited to make the determinations required to decide whether a patent should be granted on a particular invention, factfinders or judges?<sup>54</sup> Factfinders are conversant with the evidence in a particular case and have had the opportunity to hear witnesses and assess their credibility. Judges, on the other hand, are conversant with the interpretation of statutory language and are able to take a broader, policy-based view of the possible ramifications of particular outcomes in particular cases.

While the line between questions of law and questions of fact is difficult to draw in many contexts, it may be particularly difficult to draw in the patent arena because of the importance not only of the kind of case-specific facts relevant to questions such as negligence and of over-arching policy issues of the kind common law judges routinely take into account, but also of highly technical matters which are to be gauged from the perspective of the PHOSITA.

Thus, we turn here first to the question of whether difficult technological inquiries are appropriately treated as questions of law or of fact. Despite their complexity and difficulty, questions of technology are generally treated as questions of fact in patent law, presumably because of the lower court's greater access to expert and documentary evidence and to the development of technological issues throughout the course of a trial. Certainly, putting aside the litigation context for a moment, patent examiners would seem to be better positioned than judges to deal with technological questions and it would seem reasonable to afford their technological assessments the kind of deference afforded to agency factual determinations according to the Supreme Court's ruling in *Dickinson v. Zurko*.<sup>55</sup>

Many issues in patent law involving the assessment of technological matters similar to those underlying the obviousness determination are

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determination that, as a matter of the sound administration of justice, one judicial actor is better positioned than another to decide the issue in question.'

(internal citations omitted).

<sup>54</sup> Here we oversimplify by considering, for the most part, the determination of validity in the context of a lawsuit where the rules of factfinder and judge are clear (even though they may be played in some cases by the same district court judge). Of course, most determinations of obviousness are made by the USPTO, an administrative agency. Agencies often act in both factfinding and legal capacities. The PTO's position is particularly complicated because it does not have substantive rulemaking capacity. We wish to avoid here the complexities of determining, for example, what form of deference would be appropriate for the Federal Circuit to give to a PTO determination of a question of law. We think the higher-level matter of whether, and in what sense, obviousness is a question of law can be resolved without getting into these admittedly important questions, simply by analyzing whether the obviousness inquiry is more appropriately addressed to an actor playing the factfinding role or an actor playing the legal role. For simplicity, we thus speak of juries and judges while recognizing that the factfinding and legal evaluation tasks are both performed in the first instance by a PTO examiner.

<sup>55</sup> *Dickinson*, 527 U.S. at 164.

treated as factual inquiries. Infringement under the doctrine of equivalents, for example, is a question of fact, despite requiring a determination of whether a PHOSITA would have deemed an element of an allegedly infringing invention to be interchangeable with a claim limitation.<sup>56</sup> Novelty, which requires a comparison of a claimed invention to an allegedly infringing embodiment, is also treated as a factual question.<sup>57</sup> The written description requirement is also deemed a question of fact.<sup>58</sup>

Exceptions from this general treatment of technology-based questions as fact questions provide additional insight. The existence of a statutory bar under section 102(b), for example, is considered a question of law.<sup>59</sup> At first glance, this is surprising in light of the fact that much of the art available to challenge validity under 102(b) is of the same ilk as that available under 102(a)'s novelty provision. However, upon further reflection it is clear that 102(b) is the locus of significant policy balancing. To the chagrin of generations of patent law students (and with not a shred of statutory justification), 102(b) analysis treats trade secret use of an invention prior to filing differently depending on whether it is used by the inventor or by a third party.<sup>60</sup> This distinction results in a complicated analysis that reflects a juggling of various patent law policies involving not removing things from the public domain, protecting the interests of smaller inventors, and forestalling gamesmanship aimed at extending effective patent life. The presence of these policy issues makes it sensible to treat 102(b) as a question of law.

Enablement, which requires determining whether a PHOSITA would be enabled to make and use an invention without undue experimentation by reading the specification, is deemed a question of law by the Federal Circuit, though it was treated as a question of fact by some earlier courts.<sup>61</sup> Like obviousness, it is determined on the basis of underlying questions of fact.<sup>62</sup> The factual considerations are technical questions akin to those underlying the obviousness determination:

They include (1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7)

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<sup>56</sup> See, e.g., *Hilton Davis Chem. Co. v. Warner-Jenkinson Co.*, 62 F.3d 1512, 1521 (Fed. Cir. 1995).

<sup>57</sup> See, e.g., *Rockwell Int'l Corp. v. United States*, 147 F.3d 1358, 1363 (Fed. Cir. 1998) ("Anticipation under 35 U.S.C. § 102 requires the disclosure in a single piece of prior art of each and every limitation of a claimed invention. Whether such art is anticipating is a *question of fact*." (citations omitted) (emphasis added)).

<sup>58</sup> 3 DONALD S. CHISUM, CHISUM ON PATENTS, § 7.04[f] (2007).

<sup>59</sup> See, e.g., *Lough v. Brunswick Corp.*, 86 F.3d 1113, 1120 (Fed. Cir. 1996).

<sup>60</sup> Compare, e.g., *Metallizing Eng'g Co. v. Kenyon Bearing & Auto Parts Co.*, 153 F.2d 516, 520 (2d. Cir. 1946) with *W.L. Gore & Assoc., Inc. v. Garlock, Inc.* 721 F.2d 1540 (Fed. Cir. 1983).

<sup>61</sup> See CHISUM, *supra* note 58, at § 7.03[b][i] for a discussion of the history of the treatment of enablement as a question of law.

<sup>62</sup> See, e.g., *In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988).

the predictability or unpredictability of the art, and (8) the breadth of the claims.<sup>63</sup>

The ultimate question of enablement is a policy assessment of whether the disclosure is sufficient to warrant the quid pro quo of a patent or whether the PHOSITA must engage in “undue experimentation.” The amount of experimentation required is thus a technical question which is determined by factfinders, but it is a policy matter whether the experimentation required is “undue.”

Claim construction might seem like an exception to the general treatment of technological questions as questions of fact.<sup>64</sup> However, it is treated as a question of law not because of its technical complexity but because of presumed judicial expertise in construing written documents, despite its involving technical understanding of those documents. In holding in *Markman v. Westview Instruments, Inc.* that claim construction is a question for the judge, the Supreme Court did not delve into the question of who is better situated to deal with complicated technology, resting its decision on the judge’s generally superior ability to construe documents and on the need for uniformity in claim construction determinations.<sup>65</sup> However, the Federal Circuit’s later interpretation of the *Markman* ruling as authorizing de novo review of claim construction rulings<sup>66</sup> has been extremely controversial, even among Federal Circuit judges.<sup>67</sup> Critics of the Federal Circuit’s current position argue that district judges who have heard the evidence and expert testimony on the technical questions underlying claim construction are better positioned to make the underlying technological determinations relevant to claim construction and should be afforded deference as to those underlying issues.

In most instances, then, courts have come to the conclusion that factfinders, who have the opportunity to hear extensive testimony, often by experts, and to peruse relevant technical references, are more competent than appellate judges at coming to grips with the technological aspects of patent law. The treatment of inquiries into the state of technology as questions of fact is reflected in the Supreme Court’s framework for the obviousness inquiry, which treats “the scope and content of the prior art,”

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<sup>63</sup> *Id.*

<sup>64</sup> See *Markman v. Westview Instruments, Inc.*, 517 U.S. 370 (1996) (claim construction is a question for the judge; there is no right to a jury determination); *Cybor Corp. v. FAS Technologies, Inc.*, 138 F.3d 1448 (Fed. Cir. 1998) (claim construction is reviewed by the Federal Circuit de novo).

<sup>65</sup> *Markman*, 517 U.S. at 388–91.

<sup>66</sup> *Cybor Corp.*, 138 F.3d at 1451.

<sup>67</sup> See, e.g., *Id.* at 1463 (Bryson, J., concurring); *Id.* at 1463–66 (Mayer, J., concurring); *Id.* at 1473–81 (Rader, J., dissenting in part); *Phillips v. AWH Corp.*, 415 F.3d 1303, 1330–31 (Fed. Cir. 2005) (en banc) (Mayer, J. dissenting) (arguing that, under the *Cybor* de novo review standard, “with a blind eye to the consequences, we continue to struggle under this irrational and reckless regime, trying every alternative—dictionaries first, dictionaries second, never dictionaries, etc., etc., etc.” and that “there can be no workable standards by which this court will interpret claims so long as we are blind to the factual component of the task.”).



“differences between the claimed invention and the prior art” and “the level of skill in the art” as factual questions.

If factfinders are considered most competent to determine technical questions, then in what sense is obviousness a question of law? Here our model provides important insight. Previous treatment of the nonobviousness requirement has obscured the non-technological policy questions it involves.

In one view, the assessment of nonobviousness is almost exclusively technological. This view, which we might call the technical view of nonobviousness, seems to underlie the Federal Circuit’s TSM test. In this view, the aim of the nonobviousness inquiry is solely to determine whether, at the time of the invention, if one had presented a representative sample of persons having ordinary skill in the art with the problem addressed by the invention and asked them, “How would you solve this question?”, some reasonable proportion of them would have responded by describing the claimed invention.<sup>68</sup> There are practical difficulties, most notably the hindsight bias,<sup>69</sup> in getting the right answer to this question in retrospect, but on this view of nonobviousness, there is only a technical question to be answered.

The technical view of nonobviousness gives us no particular reason to treat obviousness as a question of law. Cases such as *Markman* also do not justify treating obviousness as a question of law. The underpinnings of the determination that claim construction is a question of law despite its technical content do not really apply to the nonobviousness determination. Obviousness assessment does not revolve around the interpretation of legal documents, nor is there the strong interest in uniformity that exists in claim construction. Once a claim is rejected by the patent office and the rejection affirmed on appeal, it is no longer going to be assessed (uniformly or otherwise) by any other tribunal. Moreover, invalidity determinations in litigation are subject to collateral estoppel, so they are also unlikely to be presented to more than one court.<sup>70</sup> It is thus not surprising that those holding the technical view of nonobviousness would inevitably slide toward treating nonobviousness as a question of fact, even if giving lip service to the Supreme Court’s requirement that nonobviousness be treated as a question of law.

A second view, popular among commentators, which we might call the contextual view of nonobviousness, is that the normative goal of the nonobviousness doctrine is to refrain from patenting anything that would be invented without a patent incentive.<sup>71</sup> Implicit in this view is the assumption, discussed in more detail in Part V, that patenting a particular invention decreases its social value, so that if it would be invented (or perhaps invented

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<sup>68</sup> This view is reflected in the experiments reported by Mandel, *Patently Non-Obvious* and *Patent Non-Obvious II*, *supra* note 4.

<sup>69</sup> *Id.*

<sup>70</sup> *Blonder-Tongue Labs., Inc. v. Univ. of Ill. Found.*, 402 U.S. 313, 316–19 (1971).

<sup>71</sup> See, e.g., Merges, *Uncertainty*, *supra* note 4; Kitch, *supra* note 4; Duffy, *supra* note 4; Wagner & Strandburg, *supra* note 4.

and disclosed) without a patent incentive, patenting it should be avoided. This view moves beyond the technical view, in which nonobviousness could be assessed in principle simply by polling persons having ordinary skill in the art. To determine whether a particular invention exceeds what one of us has called the “competitive baseline”<sup>72</sup> requires an understanding not only of the technology at issue, but also of the social and economic context in which it and similar technology is developed. Understanding this context requires delving into both technical and economic questions that are not raised by the purely technical view. For example, one must account for the problem-solving methodology and tools available to the PHOSITA as well as for the PHOSITA’s ordinary creativity in order to predict where competition alone would take innovation. Information about “the effects of demands known to the design community or present in the marketplace”<sup>73</sup> is needed to assess whether a claimed invention goes beyond the innovation that would have been inspired by the marketplace without a need for patent protection.

The Supreme Court in *KSR* clearly endorses the contextual view of nonobviousness when it says, “Granting patent protection to advances that would occur in the ordinary course without real innovation retards progress and may, in the case of patents combining previously known elements, deprive prior inventions of their value or utility.”<sup>74</sup> Its treatment of the “obvious to try” doctrine seems similarly inspired by the contextual view. There the Court observes,

[w]hen there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.<sup>75</sup>

The contextual view adopted in *KSR* expands the scope of factual questions relevant to determining obviousness, suggesting more robust interpretations of *Graham*’s factors, such as the level of skill in the art, and secondary considerations, such as long-felt need. It may also suggest additional factual inquiries that are relevant to determining to what extent an invention exceeds the competitive baseline, such as whether there have been collateral technological advances, regulatory changes, or shifts in demand that have affected either the cost side or the benefit side of the invention context.<sup>76</sup> In our longer article, we discuss some of these issues as they relate to our model and suggest doctrinal modifications to take this broader view of nonobviousness into account.

While the contextual view of nonobviousness broadens the scope of factual underpinnings of nonobviousness, does it compel us to treat

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<sup>72</sup> Wagner & Strandburg, *supra* note 4.

<sup>73</sup> *KSR Int’l Corp. v. Teleflex Inc.*, 127 S. Ct. 1727, 1740 (2007).

<sup>74</sup> *Id.* at 1741.

<sup>75</sup> *Id.* at 1742.

<sup>76</sup> See, e.g., Wagner & Strandburg, *supra* note 4; Duffy, *supra* note 4.

obviousness as a question of law? Certainly it moves us in that direction because it requires not only an assessment of the current state of technology but a counterfactual prediction of what would happen (or would have happened when the issue arises in litigation) if a patent were not available for a particular technology. Moreover, while a purely technical PTO may be better equipped than a district court to assess the technical underpinnings of nonobviousness, it may be even less well equipped than a district court to confront the economic issues implicated by the contextual treatment of nonobviousness, thus suggesting that a court may be better equipped to make the ultimate nonobviousness determination.<sup>77</sup> Our model is consistent with the contextual view, in that it suggests that we should consider everything (including shifts in demand, changes in the tools available to inventors, changes in non-patent appropriation mechanisms, and advances in collateral technologies) that affects the *ex ante* expected costs and benefits to inventors and thus affects their likely choices of research directions.

Our model provides an additional, and not previously appreciated, reason to treat the ultimate assessment of nonobviousness as a question of law, however. In our model, the appropriate placement of the nonobviousness threshold depends on an assessment of the degree to which a particular sort of research produces social welfare spillovers. It also requires an assessment as to whether the patenting constraint precludes the use of the patent system to promote socially optimal research. The more that social benefit exceeds the private benefit to the patentee, the more likely it is that a privately optimal choice of research project will be substantially less ambitious than the socially preferred project. The choice of nonobviousness threshold to prod potential inventors toward more difficult, socially preferable research projects depends on a normative assessment of the value of social spillovers that seems highly appropriate for judicial resolution, as opposed to determination by a factfinder or even an expert agency.

Both the Supreme Court's *KSR* interpretation of the *Graham* obviousness framework in light of the competitive baseline and our model's implication that the nonobviousness threshold should be keyed to social spillovers may be used to give practical meaning and content to the way in which the nonobviousness determination requires legal analysis over and above the determination of relevant underlying technical and economic facts.<sup>78</sup> Both also indicate what questions the legal analysis should be aimed at answering. This kind of structured interpretation of obviousness as a question of law is important both to obtain the best results from a social perspective and to

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<sup>77</sup> This assessment of institutional competency is highly dependent on the current structure of the PTO as a purely technical agency. One could imagine that an expert patent agency, with the appropriate economic expertise to conduct the assessment of what would have been likely without the patent incentive, could make such assessments better than a court would be able to do.

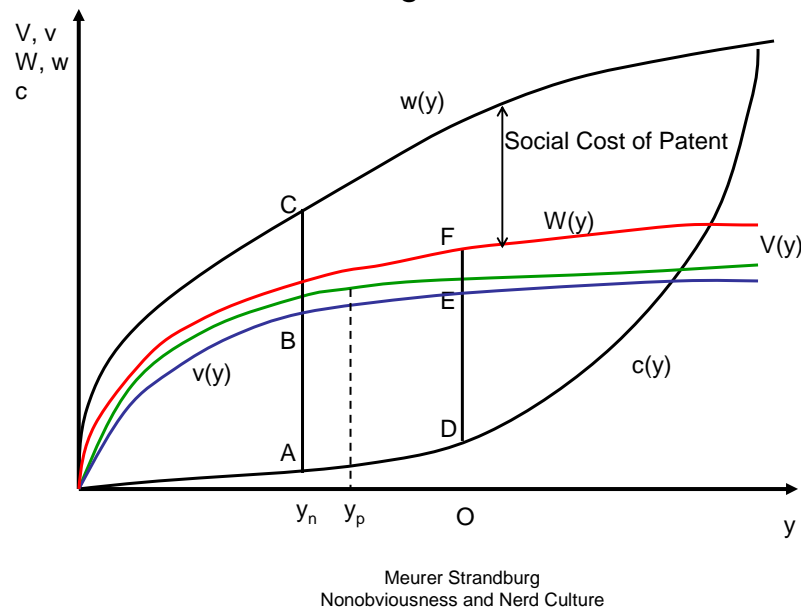
<sup>78</sup> See, e.g., Lunney, *supra* note 4, at 385–86 for a discussion of the difficulties that arise when there is no underlying rationale for the ultimate determination of obviousness. For an argument that obviousness should not be treated as a question of law see, Daralyn J. Durie & Mark A. Lemley, *A Realist Approach to the Obviousness of Inventions*, 50 WM. & MARY L. REV. \_\_ (forthcoming 2008).

respond to the criticism that the demise (or at least demotion) of the TSM test leaves us with an arbitrary “because it looks that way to the judge or examiner” doctrine.<sup>79</sup>

#### V. WHEN A NONOBVIOUSNESS THRESHOLD IS NOT ENOUGH: INSIGHTS INTO THE FUNCTION OF CATEGORICAL PATENTABLE SUBJECT MATTER EXCLUSIONS

Up until now, we have assumed in our model that the social value of an invention,  $W(y)$ , is the same whether or not the invention is patented. In reality, of course, a patent changes the social value of an invention, as the discussions of the tradeoffs involved in patent protection common in both case law and scholarly commentary recognize.<sup>80</sup> Indeed these tradeoffs drive much of patent doctrine. Not surprisingly, they have implications for our model of nonobviousness as well.

Figure 5



<sup>79</sup> See, e.g., Wagner & Strandburg, *supra* note 4, for a discussion of problems caused by an insufficiently structured obviousness doctrine.

<sup>80</sup> See, e.g., Merges, *Uncertainty*, *supra* note 4; *KSR*, 127 S. Ct. at 1746; *Graham v. John Deere Co.*, 383 U.S. 1, 10–11 (1966) (describing the underlying policy of the patent system that “the things which are worth to the public the embarrassment of an exclusive patent,” as Jefferson put it, must outweigh the restrictive effect of the limited patent monopoly. The inherent problem was to develop some means of

Figure 5 thus further complicates our story and moves us closer to reality by allowing the social value of a research project to depend on whether or not the inventive entity expects to get a patent. In particular, we assume in Figure 5 that a patent imposes a net social cost and that expected social value is lower if the invention is patented than if it is not. Thus, in Figure 5, for any choice of project difficulty  $y$ ,  $W(y) < w(y)$ , where  $w(y)$  is expected social value without a patent, and  $W(y)$  is expected social value with a patent. A patent potentially reduces the social value of a given invention because patent owners restrict diffusion of patented inventions, because patents discourage cumulative innovation, and because of the burden of patent litigation costs. It is important to emphasize that  $w(y)$  and  $W(y)$  represent the social value conferred by research project  $y$ , *assuming it is undertaken*. To assume that  $w(y) > W(y)$  is not to assume that the patent system imposes a net social cost, but merely to make the much less debatable assumption that for *any given research project* patenting imposes net social costs. A primary purpose of the patent system is to induce prospective inventors to move to higher levels (and thus presumably more socially valuable levels) of invention. The net effect of the patent system is a tradeoff of this higher level of invention against the social costs of patenting which may well lead to net social benefits overall.

If patenting an invention decreases its social value, there are at least two important consequences. First, the social cost of patenting generally leads to another role for the nonobviousness threshold in addition to its role as a “stick” for inducing potential inventors to take on more difficult projects. This additional role is familiar from previous case law and commentary. Where patenting imposes social costs, a nonobviousness threshold ensures that patents are not obtained for the inventions created by pursuing research projects like  $y_n$ , since that project would be pursued even in the absence of patenting and its social value is decreased if it is patented.

Besides this well-appreciated implication of the social costs of patenting, allowing expected social value to differ depending on the presence of a patent shows that the extent to which the nonobviousness threshold stick can be used to encourage socially optimal research is limited. This is because when  $w(y) > W(y)$ , there is a second constraint on the welfare problem of choosing the socially optimal research project. We will call it the *social cost constraint*. The social cost constraint implies that optimal patent policy blocks patenting entirely—rather than using patenting to induce more difficult projects—when the social costs of a patent are too high. Simply put, a less difficult project that cannot be patented may be socially preferred to the most preferable optimal project that can be induced by the prospect of a patent because the patent would create unacceptable social cost.

Figure 5 illustrates the social cost constraint. Because patenting reduces the expected social value of the research projects in this example by a large amount, even the optimal patented project is not as socially valuable as the optimal non-patented project. The net expected social value at  $y_n$  is  $w(y_n) -$

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weeding out those inventions which would not be disclosed or devised but for the inducement of a patent.”)

$c(y_n)$ , shown in the diagram as AC. The net expected social value at the optimal nonobviousness threshold,  $O$ , is  $W(O) - c(O)$ , shown in the diagram as DF. Since AC is greater than DF, the socially optimal choice is  $y_n$  even though the private value is greater at  $O$ . Despite the fact that the prospect of a patent induces greater technological progress, it would be socially preferable in this case to discourage patenting and avoid the associated social costs.

Figure 5 also helps us to understand why a fairly robust nonobviousness standard may be a preferable tool for inducing greater levels of technical advance than doctrinal changes, such as increased patent term or patent scope, that increase the extent to which patentees can appropriate the social value associated with their research projects. As patent strength is increased, causing  $V(y)$  to increase toward  $W(y)$  in Figure 5, it also seems plausible that the social costs of patenting increase, causing  $W(y)$  to decline toward  $V(y)$ . As this happens, it becomes more and more likely that the social value of the optimal patented invention is less than that of the optimal unpatented invention. Patenting is, therefore, less likely to be able to produce social gain.

The observation that patenting may be socially undesirable in some scenarios even if it induces researchers to undertake more technically difficult projects is of relevance to the debate over patentable subject matter limitations. Patentable subject matter limitations, such as the bans on patenting of scientific discoveries and abstract ideas, are motivated explicitly by concerns about the high social costs of patent exclusivity for certain categories of inventions.<sup>81</sup> A common response to those concerns is that these social costs are simply a necessary price of further advances. Moreover, it is frequently argued that we can achieve our social goal of “promoting progress in science and the Useful Arts” by taking a very expansive, virtually unlimited view of patentable subject matter and then restraining unwarranted patenting using the other tools of patentability analysis, including, importantly, the nonobviousness requirement and limitations on patent scope.<sup>82</sup>

Our model suggests that the nonobviousness requirement and patentable subject matter restrictions may be playing two separate, and important, roles in regulating incentives for research and thereby illustrates why the two doctrines are not simply interchangeable. The purpose of the nonobviousness requirement, besides preventing inventors from patenting inventions that do not require a patent incentive, is to push inventors to undertake more difficult research than they would choose if simply optimizing their private benefit. Nonobviousness doctrine should be tuned to locate the nonobviousness threshold as near as possible to the socially optimal level of research difficulty in the presence of patenting. It should

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<sup>81</sup> See, e.g., *Parker v. Flook*, 437 U.S. 584, 589–93 (1978); *O'Reilly v. Morse*, 56 U.S. 62, 113 (1854). See also *Lab. Corp. of Am. Holdings v. Metabolite Labs., Inc.*, 126 S. Ct. 2921, 2922–23 (2006) (Per Curiam) (Breyer, J., dissenting) (dismissing of grant of certiorari as improvidently granted).

<sup>82</sup> See, e.g., Kieff, *supra* note 9.

thus be sensitive to the costs of research and to the extent to which particular research directions are likely to produce socially beneficial spillovers.

Our model suggests an entirely different and complementary role for patentable subject matter doctrine. Patentable subject matter doctrine should be used to identify those types of subject matter for which the social costs of patent protection are so high that the increased inventive steps that can be induced by offering a patent are simply not worth the costs imposed by patenting. Thus, as an example, while offering patents for the discovery of new laws of nature might well induce private investors to fund more difficult research projects, the social cost of giving one entity control over applications of that law of nature may simply be too great to be offset by the increased investment in science that the possibility of a patent attracts.

Our justification of patentable subject matter restrictions depends on the assumption that patenting introduces net social costs for a given invention, *i.e.*,  $w(y) > W(y)$ . This assumption is ubiquitous in discussions of patent law; it underlies the traditional discussions of patentable subject matter and also the traditional assumption that a nonobviousness threshold is desirable to avoid patenting advances that would occur without the patent incentive. In some cases, however, patents may raise social value compared to the no-patent case. Exclusivity always has social costs which must be incorporated into  $W(y)$ , as discussed above. Nonetheless, there are two kinds of situations in which we could imagine that patenting a particular invention might result in higher net social value than not patenting it. Theoretically, this would be the case if patenting an invention results in less social cost attributable to exclusivity. This situation could arise if trade secrecy were an option and if the trade secrecy period were longer than the patent term. Patenting such an invention would result in less exclusivity. If this is the case, however, it seems likely that the private value of trade secrecy will exceed that of patenting and thus the potential social benefits of patenting will not be realized. Another way in which patenting could lead to less social cost due to exclusivity would be a situation in which non-patent private value is maximized by trade secret use of an invention, such as an industrial process, but an inventor who gets a patent chooses to license the invention rather than use it exclusively. In such a situation, social value could be higher with a patent available than without.

The other reason that an invention might be worth more to society patented than unpatented is that the patent disclosure might be valuable enough to offset the social losses due to the greater exclusivity afforded by patent protection.<sup>83</sup> This may be the case for particular inventions, but it is certainly not generally expected to be the case. The social value of patent disclosure is not the entire social value of disclosure of the invention but only the value attributable to the fact that the patent disclosure comes earlier than the disclosure inherent in reverse engineering or independent invention, and is perhaps of greater value as a result of the enablement and written description requirements.

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<sup>83</sup> We assume here again that if trade secrecy actually provides greater exclusivity, inventors will prefer trade secrecy regardless of patent policy, so that such cases are irrelevant to our analysis.

The cases in which patenting an invention might increase its social value are therefore those in which trade secrecy is an option, inventors would choose patenting over trade secrecy, and the social tradeoff favors a longer period of patent exclusivity over a shorter period of trade secrecy protection. We suspect such cases are relatively rare, but they are interesting here for two reasons. First, it seems clear that patentable subject matter restrictions should not apply to such cases. Second, it is interesting to note that the traditional justifications for a nonobviousness threshold have no force if patenting produces positive social benefits for a given invention. However, the function of nonobviousness as a “stick” to induce socially beneficial levels of research survives even if patenting increases the social value of research projects aimed at some objective.

To summarize, our model suggests that there may be categories of invention for which the social costs of patenting are such as to justify a patentable subject matter exclusion even if the result of such an exclusion is a smaller inventive step and that those categories of invention are characterized by large social spillovers and high social costs of patenting.

## VI. CONCLUSION

The Supreme Court’s decision in *KSR* provides an opportunity for new and more detailed theoretical inquiry into the optimal design of an inventive step requirement. The model we present here is an initial foray in that direction. The version of the model presented here contains a number of simplifications, of course. Two important simplifications are that we consider only a single research entity pursuing a single research project and that we treat the projects arrayed along the  $y$  axis as independent and non-overlapping both technologically and in terms of eventual patent rights. We defer more detailed treatment of the model and its doctrinal implications to our longer article, where we address these limitations. Even from the simple model presented here, however, we gain insight into the possible reasons for having a nonobviousness threshold, the policy questions that underlie the treatment of obviousness as a question of law, and the distinct functions of nonobviousness and patentable subject matter doctrine.