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# Describing Patents as Real Options

Christopher A. Cotropia

University of Richmond, ccotropi@richmond.edu

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# **Describing Patents as Real Options**

**Christopher A. Cotropia**

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## I. INTRODUCTION

A fairly robust economics literature exists which analogizes patents to real options. Real options create the right, but not the obligation, to purchase the underlying asset at a defined exercise price.<sup>1</sup> A patent is like a real option, economists say, because it allows its owner to choose between exclusively commercializing the patented invention sometime during the patent term or foregoing commercialization altogether.<sup>2</sup> Economists have taken this analogy and used real options analysis to place specific values on patents. A few economics articles have gone a step further, identifying some policy implications from the real options description of patents.<sup>3</sup>

The legal literature is a bit behind in using this analogy. A few scholars have engaged in the same valuation exercise as economists. Russell Denton and Paul Heald, for example, previously set forth a state of the art discussion of how to value patents using options analysis.<sup>4</sup> Shaun Martin, Frank Partnoy, and Michael Abramowicz have taken the second step, arriving at definite policy conclusions based on a real options view of patents.<sup>5</sup>

This Article continues the use of real options in patent law by taking a step back. The Article proceeds in three parts. Part II describes the concept of real options and catalogs the existing economics and law literature discussing patents as real options. The Article then lays a foundation for previous and future discussions by describing in detail how patents are like real options. Specifically, Part III identifies the particular patent doctrines that make up the common components of a real option—the option price, the exercise price, the expiration date, and the value of the underlying asset. This descriptive analysis is a necessary first step in developing a robust theory of patents as real options—a theory that can have specific patent doctrine implications. Part III also describes how patents can be defined as a series of embedded options. From here, Part IV discusses some implications of using real options theory in patent law, and provides a preliminary taste of the benefits of using real options theory in patent law. Real options analysis allows both patent problems and patent solutions to be examined in terms of “macro patent elements”—elements defined by the operational components of a real option. Real options theory also facilitates viewing patents the same way industry views research and development projects—as real options. Finally, there is promise in the underlying

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1. See, e.g., TOM COPELAND & VLADIMIR ANTIKAROV, *REAL OPTIONS: A PRACTITIONER'S GUIDE* 5 (2001); see also *infra* Part II.A (providing a more thorough definition of real options).

2. See, e.g., Rita Gunther McGrath & Atul Nerkar, *Real Options Reasoning and a New Look at the R&D Investment Strategies of Pharmaceutical Firms*, 25 *STRATEGIC MGMT. J.* 1, 16–17 (2004); see also *infra* Part II.B.

3. See *infra* notes 47–48 and accompanying text.

4. F. Russell Denton & Paul J. Heald, *Random Walks, Non-Cooperative Games, and the Complex Mathematics of Patent Pricing*, 55 *RUTGERS L. REV.* 1175, 1203–34 (2003).

5. See Michael Abramowicz, *The Danger of Underdeveloped Patent Prospects*, 92 *CORNELL L. REV.* 1065, 1073–74 (2007) (discussing uncommercialized patents); Video: Patents as Options (Frank Partnoy & Shawn Martin, Washington University in St. Louis 2005), available at <http://law.wustl.edu/CRIE/index.asp?id=1737#videos> [hereinafter Partnoy & Martin] (discussing commercializing innovation). The abstract for the presentation is available at Washington University in St. Louis School of Law, Abstracts: Commercializing Innovation Conference (Nov. 4–5 2005), <http://law.wustl.edu/CRIE/index.asp?id=1738#partnoy>.

enterprise—using the concept of real options to articulate a new theory of the patent system.

## II. CURRENT LITERATURE ON PATENTS AS REAL OPTIONS

### *A. Real Options Defined*

“A real option is the right, but not the obligation, to take an action (e.g., deferring, expanding, contracting, or abandoning) at a predetermined cost called the exercise price, for a predetermined period of time—the life of the option.”<sup>6</sup> It is called an option because it gives the holder just that—an option to do something, but not a requirement to act. The term is modified by the term “real” to distinguish it from a financial option. This means that the option is on an investment project, as opposed to a financial instrument.<sup>7</sup> Instead of the options granting the right to buy a stock, bond, or some other underlying security at a set price during a set time period, a real option concerns the same type of right regarding a capital investment or project with a more fluid time to expiration.<sup>8</sup> And, as with financial options, there are “call” real options that give the option holder the right to purchase the underlying asset at an exercise price, and “put” real options that give the option holder the right to sell the underlying asset at an exercise price.<sup>9</sup>

Examples of financial options abound and are probably the most recognizable.<sup>10</sup> Purchasing the right to buy 100 shares of Microsoft stock at \$100 a share over the next year is a typical financial option. This would be a call option, in that the owner of the option can exercise the option by actually buying 100 shares of Microsoft stock at \$100 a share during the defined period.

A real option operates in a similar manner, but considers a managerial decision regarding the allocation of resources. An example of a real option would be the decision to purchase a fleet of flexible fuel vehicles for your package delivery business.<sup>11</sup> Buying such vehicles gives your business the flexibility to purchase either gasoline-only fuel or a gasoline blend with up to 85% ethanol (E85).<sup>12</sup> Such flexibility allows the business to shift its fuel purchasing based upon the price of regular gasoline and relative fuel efficiency. In addition, at some time, the options these vehicles provide will become obsolete. Either E85 is no longer available, and the option expires, or the cost differential between the two fuels becomes negligible, and the option becomes valueless.

The value of these options—both financial and real—is in the flexibility they provide.<sup>13</sup> The owner of the option can decide whether they want to buy Microsoft at

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6. COPELAND & ANTIKAROV, *supra* note 1, at 5 (2003).

7. Ming-Cheng Wu & Chun-Yao Tseng, *Valuation of Patent—A Real Options Perspective*, 13 APPLIED ECON. LETTERS 313, 314 (2006).

8. *Id.*

9. LENOS TRIGEORGIS, *REAL OPTIONS: MANAGERIAL FLEXIBILITY AND STRATEGY IN RESOURCE ALLOCATION* 1, 4 (1996).

10. *Id.* at 69–72 (describing a financial option).

11. *See, e.g.*, Flex-Fuel vehicles, <http://fueleconomy.gov/feg/flextech.shtml> (last visited Mar. 29, 2009) (describing flexible fuel vehicles). For a similar example see COPELAND & ANTIKAROV, *supra* note 1, at 13.

12. *See* LISA RYAN & HAL TURTON, *SUSTAINABLE AUTOMOBILE TRANSPORT: SHAPING CLIMATE CHANGE POLICY* 41–45 (2007) (discussing flexible fuel vehicles).

13. TRIGEORGIS, *supra* note 9, at ix–x.

\$100, or purchase gasoline or E85. And the option holder has the full term of the option over which she may make this decision. This flexibility does come at a price—the price of the option. Accordingly, real options “giv[e] the investor access to a greater range of potential outcomes on the upside, while containing the exposure on the downside. This effectively truncates the left-hand tail of a performance distribution, creating a performance distribution curve that is skewed to the right, yielding asymmetric pay-offs.”<sup>14</sup> Options therefore become valuable when the value of the underlying asset is uncertain at the time of the option’s purchase.<sup>15</sup> The greater the uncertainty over time as to the value of the asset covered by the option, the more valuable the option.<sup>16</sup> This is why there is a growing body of literature that suggests managers should consider capital investments in term of real options.<sup>17</sup>

All real options have certain commonalities. As described above, these common features include a purchase price (the cost of buying the option), an exercise price (the cost of exercising the option and obtaining the underlying asset), and a time at which the option expires (an expiration date).<sup>18</sup> A call option, with some of these components labeled, is graphically depicted below.

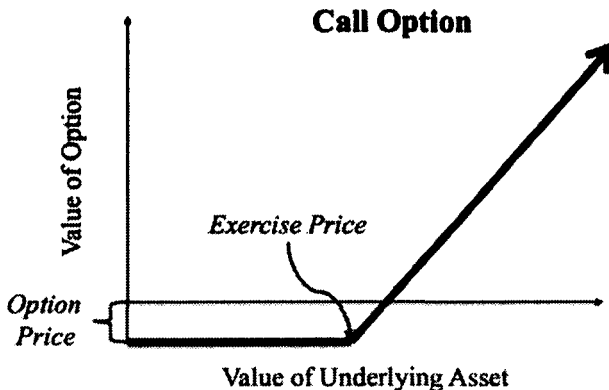


Figure 1

14. McGrath & Nerkar, *supra* note 2, at 3.

15. RICHARD A. BREALEY ET AL., *PRINCIPLES OF CORPORATE FINANCE* 16–18 (8th ed. 2006) (stating that “[t]he more uncertain the outlook, the more valuable this flexibility becomes”).

16. *Id.*; AVINASH K. DIXIT & ROBERT S. PINDYCK, *INVESTMENT UNDER UNCERTAINTY* 6–25 (1994).

17. See TRIGEORGIS, *supra* note 9, at ix–x (noting that decision makers should consider option-based approaches for capital and strategic decisions).

18. The time period of the option is also called the time to maturity. See *id.* at 69 (referring to the specified date as the expiration or maturity date). Real options are said to have expiration dates. These are rarely defined calendar dates, but instead are more properly described as expiration conditions—they remain open until a pre-defined condition becomes true and the option holder must make a decision to either exercise or abandon.

### *B. Economics Scholarship on Patents as Real Options*

The concept of real options has had “a huge impact on academic research” in economics.<sup>19</sup> Real options theory has allowed economists to take into account “management’s flexibility to adapt . . . to unexpected market developments”<sup>20</sup> when valuing capital-investment projects.<sup>21</sup> This allows one to take the tools financial options theory provides—mainly valuation tools—and apply them to “real investment analysis.”<sup>22</sup> The literature has applied the theory of real options to various forms of investment activity.<sup>23</sup> The concept appears in many finance textbooks.<sup>24</sup>

The main use of real options theory is to value flexibility—that is, the value of strategic resource allocation decisions.<sup>25</sup> The decisions—essentially the options—available to a company can be characterized as real options and defined in terms of value by real option elements such as the exercise price or expiration date. Essentially, “[t]he real options approach seeks to scientifically explain the evaluation of intangible assets.”<sup>26</sup> For example, using a real options approach, a company can define the value of the ability to close and then reopen a natural resource mine or the value of purchasing a flex-fuel vehicle, as discussed above.<sup>27</sup>

Real options theory has also been used descriptively—to explain the way in which companies are behaving. A company’s investment behavior can be observed to see if it falls in line with “real options reasoning” (ROR).<sup>28</sup> That is, real options theory allows an investigator to determine whether “decision-makers implicitly (or explicitly) respond to the value of the right to preserve decision rights in the future in their investment choices.”<sup>29</sup>

A natural area for economists to apply real options theory, both to value corporate decisions and to explain them, is technological development. The real option “to [d]efault during [s]taged [c]onstruction ([a] [t]ime-to-[b]uild [o]ption)” fits most research and development projects.<sup>30</sup> Research and development of a new technology typically occurs in stages, with current research facilitating follow-on research and the eventual launch of a commercial product.<sup>31</sup> At each stage, the company can default (abandon) the

19. Alexander Triantis, *Realizing the Potential of Real Options: Does Theory Meet Practice?*, 17 J. APPLIED CORP. FIN. 8, 8 (2005); see also Joseph A. Grundfest & Peter H. Huang, *The Unexpected Value of Litigation: A Real Options Perspective*, 58 STAN. L. REV. 1267, 1273 (2006) (providing further explanation as to why real options theory has had such a significant impact).

20. Grundfest & Huang, *supra* note 19, at 1273.

21. TRIGEORGIS, *supra* note 9, at 1.

22. Steven R. Grenadier, *An Introduction to Option Exercise Games*, in GAME CHOICES: THE INTERSECTION OF REAL OPTIONS AND GAME THEORY xv (Steven R. Grenadier ed., 2000).

23. Triantis, *supra* note 19, at 8.

24. Grundfest & Huang, *supra* note 19, at 1274.

25. TRIGEORGIS, *supra* note 9, at xi, 16–20 (detailing the growth in the literature that defines how a real option is valued, leading to a “transition from a theoretical stage to an application phase”).

26. Wu & Tseng, *supra* note 7, at 313.

27. See COPELAND & ANTIKAVROV, *supra* note 1, at 17–18 (providing the example of opening and closing mines).

28. McGrath & Nerkar, *supra* note 2, at 1.

29. *Id.* at 2.

30. TRIGEORGIS, *supra* note 9, at 10–11.

31. See MERLE CRAWFORD & ANTHONY DI BENEDETTO, NEW PRODUCTS MANAGEMENT 26–33 (8th ed. 2006) (describing the “phases” of new product development); Robert G. Cooper, *A Process Model for Industrial*

development process.<sup>32</sup> An R&D dollar spent today is, essentially, the purchase of a call option on the resulting technology or future application.<sup>33</sup> For example, economists have used real options to value research and development decisions in the pharmaceutical industry.<sup>34</sup> They have also used ROR to describe retrospectively the research and development decisions companies make.<sup>35</sup>

An outgrowth of the economics literature that looks at research and development from the real options perspective is the use of real options by economists in the patent area. The literature starts with the general observation that patents are real options. "In short, a patent confers on the firm the right but not the obligation to make further investments, culminating in a decision whether to commercialize its knowledge or not. Investments made towards commercializing the knowledge underlying the patent are analogous to the exercise price on the real option."<sup>36</sup> The patent allows its holder to delay decisions regarding the underlying asset—the invention—with little fear that others can commercialize it. The patentee can:

secure its claim to commercialize this knowledge through patenting. Subsequently, it may elect to proceed to extend the knowledge, commercialize its knowledge, to do nothing with it, or to seek or leverage the knowledge in some other way, for example by sharing it with a joint venture partner or licensing it out.<sup>37</sup>

The literature then consists of economists, armed with this definition of a patent as real option, valuing patents. Valuation is very specific in some cases. For example, Prahlad Laxman and Sandeep Aggarwal assigned a specific value to "a real 3G-telecom patent of Sasken Communication Technologies Limited."<sup>38</sup> Other research is more abstract, either assigning value to protection for a given industry—the pharmaceutical industry for example—or the value of a patent in general.<sup>39</sup> A commonality amongst these valuation approaches using real options is the high degree of uncertainty as to the value of the underlying asset—the invention.<sup>40</sup>

There is also a group of articles focusing on patent maintenance fees and whether the payment or non-payment of maintenance fees provides an indication of patent value.<sup>41</sup> For a patent to remain enforceable after it issues, the patent holder must pay

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*New Product Development*, 13 IEEE TRANSACTIONS ON ENGINEERING MGMT. 2, 2–11 (1983) (articulating a seven stage development process).

32. TRIGEORGIS, *supra* note 9, at 10–11.

33. *See id.* at 341–44 (describing multiple technological development processes as real options).

34. *See, e.g.*, Eduardo S. Schwartz, *Patents and R&D as Real Options*, 33 ECON. NOTES 23, 24 (2004) (using real options theory to simulate the value of research and development decisions by pharmaceutical companies).

35. McGrath & Nerkar, *supra* note 2, at 16–17.

36. *Id.* at 6.

37. *Id.*

38. Prahlad Rao Laxman & Sandeep Aggarwal, *Patent Valuation Using Real Options*, 15 IIMB MGMT. REV. 44, 44 (2003). The final value concluded for the company's United States and foreign patents totaled \$8.11 million. *Id.* at 50.

39. *See, e.g.*, Schwartz, *supra* note 34, at 26 (providing a theoretical model of patent value using real options and then applying the model to data from the pharmaceutical industry).

40. *Id.* at 24–25.

41. *See, e.g.*, Francesca Cornelli & Mark Schankerman, *Patent Renewals and R&D Incentives*, 30 RAND

maintenance fees at defined intervals.<sup>42</sup> The articles start from the basis that the requirement to pay to keep the patent enforceable at various points in time presents real options.<sup>43</sup> The patentee can either purchase the option to continue the patent right, or choose not to pay and abandon the patent. The determination to purchase or not purchase this option, in conjunction with the cost of the option (the maintenance fee), gives an indication of the patent's value at the time of the option's purchase.<sup>44</sup>

A few economists go a step further and set forth patent policy insights based on a real options analysis. For example, some of the articles focusing on patent maintenance fees suggest how changing patent fee structures can filter out bad patents.<sup>45</sup> There is also an article by Philipp N. Baecker that uses real options analysis to determine the industry impact of "imperfect patent protection"—that is, patent protection that is not efficiently enforced or perfectly excluding.<sup>46</sup>

### C. Law Scholarship on Patents as Real Options

Legal scholars have begun to apply real options analysis to a variety of areas of law.<sup>47</sup> Joseph Grundfest and Peter Huang, for example, applied real options analysis to the decision to pursue a lawsuit or settle.<sup>48</sup> Lee Fennell used real options as the foundation for a proposed intermediate entitlement that attempts to gain the benefits of both property and liability rules.<sup>49</sup> There was even a conference at the University of Virginia in 2004 which focused on real options and the law.<sup>50</sup>

Notably, there has been very little legal scholarship using real options theory in patent law, let alone intellectual property law in general. Some of the legal literature follows the main thrust of the economics literature—using the general analogy established by economists and then valuing the patent right.<sup>51</sup> Russell Denton and Paul

J. ECON. 197 (1999); Suzanne Scotchmer, *On the Optimality of the Patent Renewal System*, 30 RAND J. ECON. 181 (1999); Marc Baudry & Beatrice Dumont, *Patent Renewals as Options: Improving the Mechanism for Weeding Out Lousy Patents*, 28 REV. INDUS. ORG. 41 (2006); Ariel Pakes, *Patents as Options: Some Estimates of the Value of Holding European Patent Stocks*, 54 ECONOMETRICA 755 (1986).

42. See 37 C.F.R. § 1.20(e)–(g) (2000).

43. See, e.g., Pakes, *supra* note 41, at 755–56 (describing the renewal as an option).

44. See, e.g., *id.* at 756, 778–80 (attempting to gain insight into the value of patents based on their renewal rates).

45. See, e.g., Baudry & Dumont, *supra* note 41, at 60–61 (suggesting an alternative maintenance fee schedule for policy reasons).

46. Philipp N. Baecker, *An Option-Based View of Imperfect Patent Protection* (Jan. 10, 2007) (unpublished research paper, available at <http://ssrn.com/abstract=907983>) (discussing imperfect patent production).

47. See Grundfest & Huang, *supra* note 19, at 1274 n.23 (cataloging recent legal scholarship using real options).

48. *Id.*

49. See Lee Anne Fennell, *Revealing Options*, 118 HARV. L. REV. 1399, 1406–10 (2005) (suggesting a new entitlement regime labeled "entitlements subject to self-made options (ESSMOs)").

50. See generally University of Virginia Law School, John M. Olin Conference on Real Options and the Law, Oct. 1–2, 2004, [http://www.law.virginia.edu/html/academics/olin/olin\\_conference04.htm](http://www.law.virginia.edu/html/academics/olin/olin_conference04.htm) (providing information regarding the conference).

51. See Dan L. Burk, *Property Rules, Liability Rules, and Molecular Futures: Bargaining in the Shadow of the Cathedral*, in GENE PATENTS AND CLEARING MODELS: FROM CONCEPTS TO CASES (Geertrui Van Overwalle ed., forthcoming 2009) available at <http://ssrn.com/abstract=1359216> (noting the call option nature



Heald developed a state of the art method for valuing patents using financial options valuation methodology.<sup>52</sup> They leveraged the patent as options analogy to develop a version of the Black-Scholes formula, traditionally used to value financial options, tailored to the particulars of patents in order to price patents.<sup>53</sup> Jerry Hausman, Gregory Leonard, and Gregory Sidak use real options for a very different purpose—to analyze the patent infringer's actions and, in turn, critique current patent damages case law.<sup>54</sup>

Shaun Martin and Frank Partnoy presented "Patents as Options" at a law conference, with the presentation discussing the real options/patent analogy.<sup>55</sup> Martin and Partnoy analogize patent rights to real options, particularly a call option—the ability to decide, at a future date, to exercise the patent exclusivity option to gain exclusive space to commercialize the claimed invention.<sup>56</sup> They went beyond the general description used in most economics papers and provided more description of the option price, exercise price, and expiration.<sup>57</sup> They also provided some important policy implications from this analysis, which are discussed in detail below.<sup>58</sup> Michael Abramowicz then took Martin and Partnoy's analysis and applied it to the question of commercialization of the underlying asset—the invention.<sup>59</sup> I have done the same, using Martin and Partnoy's analysis to support my recent critique of the early filing nature of the patent system.<sup>60</sup>

### III. AN INITIAL STEP—DETAILED DESCRIPTION OF PATENTS AS REAL OPTIONS

There is clearly an interest in using real options theory in patent law. While most of the focus is on valuation, there has been some headway—both by economists and legal scholars—in deciphering the policy implications presented by a real options analysis. However, a first step is missing from the literature: a detailed description of the analogy between patents and real options. Many have made the general analogy—describing in broad terms how operationally a patent, particularly the accompanying right to exclude and predefined patent term, behaves like a real option.<sup>61</sup> Some have even taken targeted steps to make this analysis more specific, identifying how a particular patent rule fits

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of patent rights); Denton & Heald, *supra* note 4, at 1194–95 (2003) (detailing the patent/real option analogy).

52. Denton & Heald, *supra* note 4, at 1203–34 (offering a variation on the Black-Scholes valuation approach adapted for the peculiar properties of patents).

53. *Id.*

54. Jerry A. Hausman et al., *Patent Damages and Real Options: How Judicial Characterization of Noninfringing Alternative Reduces Incentives to Innovate*, 22 BERKELEY TECH. L.J. 825, 841–45 (2007). Viewing the decision to infringe a patent as a real option is troublesome, however, because it relies on the shaky assumption that infringers make a conscious decision to infringe. See Mark A. Lemley, *Distinguishing Lost Profits from Reasonable Royalties* 4 n.13 (Stanford Public Law Working Paper No. 1133173, 2008), available at <http://ssrn.com/abstract=1133173> (discussing patent damages).

55. Partnoy & Martin, *supra* note 5.

56. *Id.*

57. *Id.*

58. *Id.*; see *infra* Part III.A.1.

59. Abramowicz, *supra* note 5, at 1073–74 (2007).

60. Christopher A. Cotropia, *The Folly of Early Filing in Patent Law* 44–47 (Feb. 24, 2009) (unpublished research paper, available at: <http://ssrn.com/abstract=1353211>).

61. See *supra* notes 51–60 and accompanying text. Again, this is not to undersell the previous work on patents as real options, which does a tremendous job in using the concept of option to either nail down the value of a patent, like in Wallace and Heald's work, or to facilitate a policy discussion, such as in Michael Abramowicz's work.

within the options framework.<sup>62</sup> But the literature lacks a detailed framework as to what patent doctrines comprise or impact the various elements of a real option. That is, what exactly defines the patent's option price, exercise price, expiration date, and underlying asset value.

For the analogy between patents and real options to fully be exploited by either discipline—economics or law—there needs to be a complete understanding as to what elements of patent law make up the operational components of the patent option and impact its value. This section attempts to take the first step in fully understanding the patent-real option analogy by providing an explicit description of patents as real options.

### A. A Patent's "Option Price"

Every option has a price. One of the first steps in creating a detailed picture of a patent as a real option is to define the patent's purchase price. The most obvious component of the patent option price is the fee associated with filing a patent application. This fee includes a base filing fee and increases with the number of claims in the patent application.<sup>63</sup> Before one files, a patent application needs to be drafted. While an inventor can do this herself, an attorney or patent agent is usually hired to draft the application, increasing the cost of filing, and thus increasing the price of purchasing the option.<sup>64</sup>

The price of the patent option also includes the cost of creating the invention. You need to have an invention before you can file for a patent, and it must be a patentable invention in order to get a patent.<sup>65</sup> The requirements for patentability define this aspect of the option price. The inventor must invest the resources to conceive of a new, nonobvious, and useful invention.<sup>66</sup> This amount of investment—both of time and capital—varies. It can vary with the technological field—with some technologies, such as pharmaceuticals, being research and development intensive. Other fields require fairly low cost to generate a patentable idea (such as computer software and business methods).<sup>67</sup> There is also a variance in cost depending on the efficiency of the inventor. Development of patentable ideas also has a randomness to it, with some patentable ideas being the result of "eureka" moments, requiring very little opportunity cost.<sup>68</sup> However,

62. For example, the literature on patent maintenance fees and real options does this—it looks at a particular patent concept (the maintenance fee and its structure) and describes and analyzes it under a real options framework with a focus on patent reform. See *supra* note 41 (listing examples of relevant articles).

63. See 37 C.F.R. § 1.16(a)(1) (2006) (setting forth the filing fee for both a regular applicant and a small entity); 37 C.F.R. § 1.16(i) (identifying an extra fee for each patent claim over twenty in an application). There are other factors that can increase the filing fee, such as the length of the application. See 37 C.F.R. § 1.16(s) (identifying an extra fee for a patent application exceeding one hundred pages).

64. Attorneys charge, on average, \$9412 to prepare a complex mechanical invention. See AIPLA REPORT OF THE ECONOMIC SURVEY 2007 I-79 [hereinafter AIPLA REPORT]. This cost varies with complexity and technological area. See *id.* at I-78 (reporting the average cost for a minimally complex application to be \$7012).

65. See 35 U.S.C. § 151 (2000) (noting that a patent issues "[i]f it appears that the applicant is entitled to a patent under the law"); see also 35 U.S.C. § 282 (2000) (indicating that a patent claim must be valid to be enforced against those who infringe).

66. See 35 U.S.C. §§ 101–103 (2000).

67. Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1581–83 (2003) (describing the variation in R&D needed to innovate amongst industries).

68. See *id.* at 1581 ("Some inventions are accidental or the result of a flash of insight and require

patent law's patentability requirements focus on the objective, external value of the invention, not the cost of its development.<sup>69</sup> This makes this component of the option price extremely variable when attempting to define it in terms of patent rules, but an element of the option's price nonetheless.

Other patentability requirements influence the cost of the patent option. In general, the patent system asks the inventor to file early in the development process.<sup>70</sup> The inventor does not need to physically construct her invention and test it to ensure it works.<sup>71</sup> She just needs to file a patent application that memorializes her conception of the invention.<sup>72</sup> The invention also does not need to be so definitely described as to remove all need for experimentation to implement it.<sup>73</sup> The inventor also does not need to demonstrate a commercially viable use for the invention.<sup>74</sup> The invention just needs to be theoretically operable.<sup>75</sup>

There is another cost in addition to filing costs and the cost of inventing—the cost of losing trade secret protection. The patent system requires public disclosure of the patented invention.<sup>76</sup> An application is secret when filed, but once it is published 18 months from filing, the information regarding the invention is available to all.<sup>77</sup> The patent requirements also mandate that the inventor disclose the “best mode” of practicing

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essentially no research budget.”).

69. See Linda J. Demaine & Aaron Xavier Fellmeth, *Reinventing the Double Helix: A Novel and Nonobvious Reconceptualization of the Biotechnology Patent*, 55 STAN. L. REV. 303, 379 (2002) (“The Patent Act is designed not to reward labor or financial investment that leads to a new discovery or a slight modification of a preexisting object or process, but to reward new and useful creations of the human mind, regardless of the labor or financial investment involved.”).

70. Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 J.L. & ECON. 265, 269 (1977) (“The second important feature of the patent system which makes it function as a prospect system are rules which force and permit application early in the development process.”).

71. See *Lawson v. Bruce*, 222 F.2d 273, 278 (C.C.P.A. 1955) (noting that an inventor is not required to “show a specific working example” of the claimed invention to be the first to invent it).

72. This is the constructive reduction to practice doctrine, in which a properly disclosed invention in a patent application acts as a substitute for actually making and testing the invention. See *Hoffmann-La Roche, Inc. v. Promega Corp.*, 323 F.3d 1354, 1377 (Fed. Cir. 2003) (“‘Constructive reduction to practice’ is a legal status unique to the patent art. Unlike the rules for scientific publications, which require actual performance of every experimental detail, patent law and practice are directed to teaching the invention so that it can be practiced.”).

73. See *AK Steel Corp. v. Sollac*, 344 F.3d 1234, 1244 (Fed. Cir. 2003) (noting that the specification does not need to “necessarily describe how to make and use every possible variant of the claimed invention, for the artisan’s knowledge of the prior art and routine experimentation can often fill gaps, interpolate between embodiments, and perhaps even extrapolate beyond the disclosed embodiments, depending upon the predictability of the art”).

74. Kitch, *supra* note 70, at 269 (“The patent application need not disclose a device or process of any commercial value, only a version of the invention that will work.”).

75. See *Juicy Whip, Inc. v. Orange Bang, Inc.*, 185 F.3d 1364, 1366 (Fed. Cir. 1999) (“The threshold of utility is not high.”); *Brooktree Corp. v. Advanced Micro Devices, Inc.*, 977 F.2d 1555, 1571 (Fed. Cir. 1992) (“To violate § 101 the claimed device must be totally incapable of achieving a useful result.”).

76. Kenneth W. Dam, *The Economic Underpinnings of Patent Law*, 23 J. LEGAL STUD. 247, 267 (1994) (“On issuance, a patent communicates a considerable amount of information that can help other would-be inventors, including rival firms.”).

77. 35 U.S.C. § 122(b) (2000). An applicant can elect not to publish before issuance. *Id.* However, the patent, once issued, is available to everyone for inspection. *Id.*

the invention.<sup>78</sup> These two factors—public disclosure of the invention and the best mode requirement—work together to force patent applicants to choose patent protection over trade secret protection.<sup>79</sup> The intellectual property system channels inventors to one protection regime or the other.<sup>80</sup> Losing trade secret protection is one of the opportunity costs of patents.

To summarize, the option price of a patent is composed of the filing fees and attorney fees associated with filing the patent application, the cost of inventing the underlying invention, and the benefits of trade secret protection that are lost.

### B. A Patent's "Exercise Price"

The next step is to determine the exercise price of the patent option. To define this price, we first need to identify how exactly a patent option is exercised. Patents provide essentially one right—the right to exclude.<sup>81</sup> So, any exercise of the patent must necessarily involve the exclusion of other companies making, using, or selling the claimed invention.

When scholars talk about exercising the patent option, they usually focus on the commercialization of the underlying asset—the invention—by the patent holder.<sup>82</sup> While this does not involve the patent right directly, the assumption is that the patent plays a role by clearing shelf-space for the commercialization.<sup>83</sup> This exclusive use of the invention allows the patent holder to commercialize the invention and sell it at a supra-competitive price.<sup>84</sup>

Use of the patent option in this way requires the patentee to finish the development of the invention to get it to market. Given that patent law does not require much pre-

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78. 35 U.S.C. § 112, ¶ 1 (2000) ("The specification . . . shall set forth the best mode contemplated by the inventor of carrying out his invention.").

79. See Uniform Trade Secrets Act § 1 (1985); RESTATEMENT (THIRD) OF UNFAIR COMPETITION § 40 (1995) (noting the requirement of secrecy to obtain trade secret protection); *Bayer AG v. Schein Pharms., Inc.*, 301 F.3d 1306, 1325 (Fed. Cir. 2002) ("If an inventor does not disclose a critical trade secret within the best mode requirement, that nondisclosure puts the value of the entire patented invention at risk—a risk beyond the requirements of § 112."). This mutual exclusivity applies only to the claimed invention. *Id.* Aspects of the technology not claimed can remain a trade secret. *Id.*

80. See *Kewanee Oil Co. v. Bicron Corp.*, 416 U.S. 470, 491–93 (1974) (holding that this mutual exclusivity supports the conclusion that "patent law does not pre-empt trade secret law").

81. See 35 U.S.C. § 271 (2000) (stating that "whoever . . . makes, uses, offers to sell, or sells" a patent without right "infringes the patent").

82. See Martin & Partnoy, *supra* note 5; Schwartz, *supra* note 34, at 48 (analyzing how to value research and development projects in regard to patents, and how research and development projects can affect the value of patents).

83. Robert P. Merges, *Software and Patent Scope: A Report From the Middle Innings*, 85 TEX. L. REV. 1627, 1672 (2007) ("Patents are surely playing a role in the age-old battle over 'shelf space' in this competitive industry.").

84. F.M. SCHERER, *INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE* 444, 450–51 (2d ed. 1980). This is not always the case, because the patent may not provide the protection required to keep market substitutes out. See *Walker Process Equip., Inc. v. Food Mach. & Chem. Corp.*, 382 U.S. 172, 177–78 (1965) (noting that "[t]here may be effective substitutes for the [patented] device which do not infringe the patent"); William A. Drennan, *Changing Invention Economics by Encouraging Corporate Inventors to Sell Patents*, 58 U. MIAMI L. REV. 1045, 1158 (2004) (discussing why a monopoly caused by a patent is an inefficient arrangement).

patenting development,<sup>85</sup> the patentee may need to expend significant resources, both to further refine the invention and to establish production and distribution facilities necessary for commercialization.<sup>86</sup> The exercise price includes the cost to commercialize.

The exercise price also includes any policing costs needed to maintain exclusive use of the invention. The patentee may need to send letters to potential infringers and, if required, initiate legal action to enjoin those who are infringing the claimed invention.<sup>87</sup> The patent rules that govern assertion of the patent right—both substantive and procedural—impact this part of the exercise price.<sup>88</sup> This part of the exercise price is also influenced by the remedies available, given that remedies both influence potential infringer's activities and impact the effectiveness of policing activities.<sup>89</sup>

Without commercialization by the patent holder (or someone standing in her shoes such as a licensee), the value of the patent drops because the patentee can no longer charge supra-competitive prices due to the entrance of infringers into the market. In turn, if the patentee does not police and try to exclude others when commercializing, she is not exercising the patent option—she is simply commercializing. Such enforcement costs combine with the cost of commercialization to make up the exercise price of the patent option.

There is another way to exercise the option that was recognized by Martin and Partnoy—assertion of the exclusivity right against another company who has commercialized.<sup>90</sup> Here, the exclusivity the patent provides is not being used to assist in the patent holder's commercialization. Instead, the patentee is using the patent right to extract rents from someone else.<sup>91</sup> Such an exercise can range from simply engaging in licensing negotiations with a potential infringer to litigating a patent infringement claim to final judgment. Anything falling within this spectrum is an assertion of the patentee's right to exclude.<sup>92</sup>

The cost of exercising an option in this manner differs from exercising by commercialization. As Martin and Partnoy recognized, the assert-only exercise price is much cheaper.<sup>93</sup> Instead of making the capital investments necessary to commercialize an invention and bring it to market, the patentee just needs to expend the resources to identify and successfully enforce the patent. While certainly not costless—with a full-blown patent litigation ranging in the multi-millions of dollars in cost<sup>94</sup>—assertion does

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85. See *supra* notes 65–66, 71–75 and accompanying text (describing the patentability requirements).

86. See Cotropia, *supra* note 60, at 54 (showing, in Figure 3, the difference in the development prior to patenting and thus required after patenting to commercialize the invention and exercise the option); Martin & Partnoy, *supra* note 5.

87. See AIPLA REPORT, *supra* note 64, at 25–26.

88. See, e.g., Jonas McDavit, *Putting the Cart Before the Horse: Obstacles to Using Issue Preclusion in a Post-Markman World*, 34 AIPLA Q.J. 45, 46 (“In the years since *Markman*, district courts have used mini-trials, or ‘*Markman* hearings,’ to determine the construction of patent claims. *Markman* hearings can involve considerable time, cost, and effort by plaintiffs, defendants, and the courts.”).

89. See, e.g., Yixin H. Tang, *The Future of Patent Enforcement After eBay v. MercExchange*, 20 HARV. J.L. & TECH. 235, 250 (2006) (stating that the reduction in permanent injunctions after the *eBay* decision will make patent enforcement more difficult because large corporations now have less incentive to license).

90. See Martin & Partnoy, *supra* note 5.

91. *Id.*

92. See *supra* note 82.

93. See Martin & Partnoy, *supra* note 5.

94. See AIPLA REPORT, *supra* note 64, at 25–26 (noting that total costs through trial were \$2.992 million

not involve the tremendous costs of commercialization.<sup>95</sup> And litigation costs, once paid, are extinguished as compared to production plants and long-term distribution contracts that a patentee must continue to pay for even if the commercialization is a bust. Litigation costs are simply that, costs, which carry little to no ongoing obligation once the costs are paid. The opportunity costs are less as well. It takes a tremendous amount of company focus to bring a product to market.<sup>96</sup> A litigation, or even an aggressive licensing program, involves less manpower, is less likely to pull business units off-track, and can be outsourced to private law firms.<sup>97</sup>

A final point on the comparison between the two exercise prices is that exercising by commercialization could also include the full cost of assertion. As mentioned, to take full advantage of the patent right when commercializing, some level of assertion of the patent right may be required to keep the market clear for the patentee's product. This fact makes the difference in exercise price even greater—with commercialization requiring the exercise price of assertion *plus* the cost of commercialization. The two exercise prices—commercialization and assertion—are depicted graphically below.

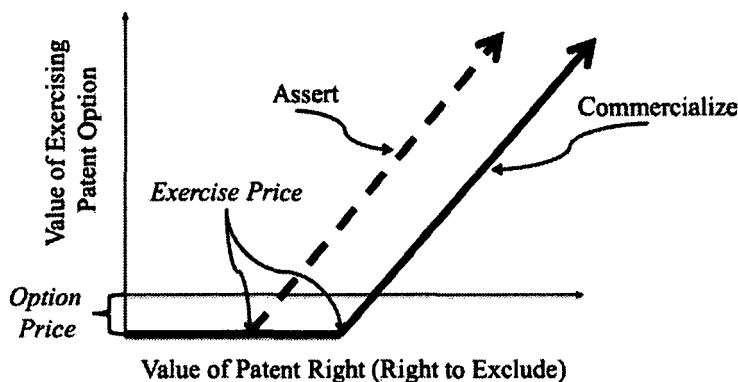


Figure 2

### C. A Patent's "Expiration Date"

The expiration of the option is initially tied to the expiration of the patent. The patent expires, by statute, 20 years from the filing date of the patent.<sup>98</sup>

A patent can, however, *de facto* expire when the breadth of exclusivity the patent's claims provide has no value.<sup>99</sup> "Other products or processes may enter the market during

in 2001, \$3.995 million in 2003, \$4.500 million in 2005, and \$5.000 million in 2007).

95. See Martin & Partnoy, *supra* note 5.

96. See, e.g., MERLE CRAWFORD & ANTHONY DI BENEDETTO, *NEW PRODUCTS MANAGEMENT* 26–35 (8th ed. 2006) (detailing the five typical phases of new product development).

97. See Martin & Partnoy, *supra* note 5.

98. 35 U.S.C. § 154 (2000).

99. See Christopher A. Cotropia, "After-Arising" Technologies and Tailoring Patent Scope, 61 N.Y.U. ANN. SURV. AM. L. 151, 171–72 (2005) [hereinafter Cotropia, *After-Arising*] (explaining that a patent can *de facto* expire when replacement products do not fall within the patent's scope, requiring the patent holder to compete with the substitute product); Ted O'Donoghue et al., *Patent Breadth, Patent Life, and the Pace of Technological Progress*, 7 J. ECON. & MGMT. STRATEGY 1, 2–4 (1998).

a patent's statutory life that act as substitutes for the patented invention."<sup>100</sup> A good example of expiration prior to the end of the patent term is when a patented technology becomes obsolete and is replaced by a technological advance. A patent covering aspects of audio-tape players, while probably not expired, is of little to no practical value because there is little or no demand for audio-tape players.<sup>101</sup> The technology has been completely replaced by compact discs and solid-state audio players (such as mp3 players). The patent has not technically expired, but since the exclusivity is irrelevant to the market demand, the patent holder can no longer dictate market price, and thus the patent has de facto expired.<sup>102</sup>

Substitution, and the accompanying de facto expiration, can also occur because the substitute falls outside the patent's claim scope.<sup>103</sup> Such an occurrence is less likely the larger the patent's claim scope.<sup>104</sup> The larger the claim scope—the greater swath of technology the patent grants exclusivity over—the longer the patent's exclusivity remains relevant to the market. The broader the patent scope, the more substitute products the patentee has power over, and thus the later the patent "expires."<sup>105</sup>

Patent breadth, which is a component of the expiration date of a patent option, is influenced by various patent doctrines. Obviously, the breadth of the patent's claims is influenced by independent factors such as the patent drafter's decisions in writing the claims and the particulars of the invention. However, the requirements of enablement and written description govern how constrained the patent's scope is by the particular examples and descriptions in the patent's specification.<sup>106</sup> The doctrine of equivalents also allows patent scope to grow to cover "equivalents" to what the patent literally claims and to cover after-arising technologies.<sup>107</sup> The particulars of claim interpretation also play a substantive role in determining patent breadth.<sup>108</sup> Put simply, elements of patent doctrine also define how soon a patent option expires because the doctrine impacts the breadth of patent exclusivity.

These two components—the patent's statutory life and the patent's scope—comprise

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100. Cotropia, *After Arising*, *supra* note 99, at 171.

101. See, e.g., John Manning, *Tape Echo: Specialty Labels Keep Cassettes Alive*, BILLBOARD MAG., Oct. 11, 2008, at 19 (noting that most tape sales are now "off the grid").

102. See Cotropia, *After Arising*, *supra* note 99, at 172 ("While the patent has not technically expired, it has effectively expired because the exclusivity that the patent provides is now worthless in the marketplace.")

103. *Id.* ("Non-infringing substitutes impinge on the market power that the patent holder enjoys in the area of the patented technology. While the patent has not technically expired, it has effectively expired because the exclusivity that the patent provides is now worthless in the marketplace.") (footnotes omitted).

104. *Id.* at 172–73 ("A patent's breadth defines the universe of products or activities that cannot replace the patented technology during the patent's statutory lifetime.")

105. See Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, 5 J. ECON. PERSP. 29, 30 (1991) [hereinafter Scotchmer, *Standing*] (noting how the "breadth of patent protection is a key consideration in the incentives to innovate").

106. See 35 U.S.C. § 112, ¶ 1 (2000) (stating the required contents of the patent specification); see, e.g., Gentry Gallery, Inc. v. Berkline Corp., 134 F.3d 1473, 1479 (Fed. Cir. 1998) (limiting the patent's scope because the claimed invention was not properly described in the patent specification).

107. See Warner-Jenkinson Co. v. Hilton Davis Chem. Co., 520 U.S. 17, 39–40 (1996) (discussing the breadth of the doctrine of equivalents); Cotropia, *After-Arising*, *supra* note 99, at 157–59.

108. See Christopher Cotropia, *Patent Claim Interpretation Methodologies and Their Claim Scope Paradigms*, 47 WM. & MARY L. REV. 49, 65–69 (2005) [hereinafter Cotropia, *Patent Claim*] (explaining the procedure for determining the scope of patents).

the patent's life and thus define its expiration date.<sup>109</sup> There are really no other patent doctrines that change the patent option's expiration date. An invalid patent expires early,<sup>110</sup> but such patents should never have been issued in the first place. The option does not necessarily expire as it was invalid *ab initio*.<sup>111</sup> Inequitable conduct, which renders a patent unenforceable, operates in a similar manner as invalidity—concluding that activity by the patentee prior to the patent's issuance (failure to disclose material prior art, for example) made the patent expire.<sup>112</sup> Patent misuse, in contrast, focuses on actions post-issuance that can render a patent unenforceable.<sup>113</sup> If the patentee uses her patent in an anti-competitive manner, she is not allowed to enforce it against anyone.<sup>114</sup> This is an expiration of sorts—however, the patent may become enforceable yet again once the misuse is expunged.<sup>115</sup>

#### D. Value of Asset Underlying the Patent

Another important part of a real option is the value of the underlying asset. Valuation of the underlying asset, as well as the volatility in its value, is an important factor in assigning a value to the real option.

The underlying asset in the case of patents is the claimed invention. The patent claims erect boundaries around a described technology that the patentee can exclude others from practicing.<sup>116</sup> The value of this underlying asset is mostly independent of patent rules. The invention is the invention, and the market sets its value. Patent law's lack of interest as to the commercial value of the patented invention is intentional.<sup>117</sup>

There are, however, patent rules that provide some insight into the value of the underlying asset. Patent law has a utility requirement that is fairly lax.<sup>118</sup> Although the utility requirement does not require evidence of commercial worth, it does ask if the invention is at least operable—that it at least theoretically will work.<sup>119</sup> In some cases,

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109. Cotropia, *After-Arising*, *supra* note 99, at 171.

110. 35 U.S.C. § 282 (2000).

111. *See, e.g.*, *Blonder-Tongue Labs., Inc. v. Univ. of Ill. Found.*, 402 U.S. 313, 350 (1971) (noting that future accused infringers can raise “a plea of estoppel” to defend “a charge of infringement of a patent that has once been declared invalid”).

112. *See* 37 C.F.R. § 1.56 (2006) (describing the type of information a patent applicant is under a duty to disclose); *Molins PLC v. Textron, Inc.*, 48 F.3d 1172, 1178 (Fed. Cir. 1995) (setting forth the three basic elements of inequitable conduct—materiality, non-disclosure, and intent).

113. *See* *Morton Salt Co. v. G. S. Suppiger Co.*, 314 U.S. 488, 493–94 (1942) (enforcing the misuse doctrine); *Brulotte v. Thys Co.*, 379 U.S. 29, 32 (1964) (citing the misuse doctrine when refusing to extend a patent).

114. *Brulotte*, 379 U.S. at 32–34.

115. *Morton Salt*, 314 U.S. at 492–93.

116. *See* *Graver Tank & Mfg. Co. v. Linde Air Prods. Co.*, 339 U.S. 605, 607 (1950) (noting that a claim in a patent provides the metes and bounds of the right that the patent confers on the patentee to exclude others from making, using, or selling the protected invention).

117. *See* John F. Duffy, *Rethinking the Prospect Theory of Patents*, 71 U. CHI. L. REV. 439, 453 (2004) (“Simply put, patent law has no aversion to awarding commercially worthless property rights.”).

118. *See* *Juicy Whip, Inc. v. Orange Bang, Inc.*, 185 F.3d 1364, 1366 (Fed. Cir. 1999) (“The threshold of utility is not high.”); *Brooktree Corp. v. Advanced Micro Devices, Inc.*, 977 F.2d 1555, 1571 (Fed. Cir. 1992) (“To violate § 101 the claimed device must be totally incapable of achieving a useful result.”).

119. *Brooktree*, 977 F.2d at 1571 (“If the claimed subject matter is inoperable, the patent may indeed be invalid for failure to meet the utility requirement. . .”).



the utility inquiry is applied more stringently, asking in chemical and biological cases whether there is a specific use for the invention.<sup>120</sup> This heightened utility requirement makes the inventor better define the value of the invention and also decreases the uncertainty surrounding its value.

Various aspects of the nonobviousness doctrine also provide a window into the value of the underlying asset. The doctrine does not require a particular amount of investment in the invention's creation or that there is a defined commercial demand for the invention.<sup>121</sup> However, some of the secondary considerations that are used to establish nonobviousness address the invention's value. Facts such as the commercial success of the invention and its long-felt need in the industry, both of which rebut a prima facie case of obviousness, speak to the value of the invention.<sup>122</sup> Also, the general theory behind nonobviousness attempts to measure the technical advancement reflected in the invention—which has some relationship to value.<sup>123</sup>

There is also interplay between patent rules that impact the patent's scope and the value of the underlying asset. Basically, patent rules that allow the patent's breadth to expand—such as the doctrine of equivalents—increase the value of the underlying asset.<sup>124</sup> The more products and processes covered by the patent, the more technology is considered part of the option's underlying asset. The opposite is also true. Doctrines that minimize scope—such as the disclosure requirements—have the opposite effect on the underlying asset's value, minimizing the amount of technology covered and limiting value.<sup>125</sup>

#### *E. Additional Complexity—A Patent as a Series of Embedded Options*

The description of a patent as an option can become even more sophisticated. As recognized by at least one pair of economists, the patenting process itself is a series of embedded options.<sup>126</sup> The inventor, at many points during the patenting process, can either continue pursuing the patent or abandon it. The inventor can initially file a provisional patent application, which is not examined and not required to contain any claims.<sup>127</sup> Then, to gain the early filing date of the provisional application, the inventor must decide within a year whether to convert the provisional application to a non-

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120. See, e.g., *Brenner v. Manson*, 383 U.S. 519, 534–35 (1966) (evaluating the substantial utility of a product); *Burk & Lemley*, *supra* note 67, at 1644–45 (explaining the utility requirement for patents).

121. *Damaine & Fellmeth*, *supra* note 69, at 379 (summarizing the objectives of the patent act).

122. “These secondary considerations include evidence of commercial success, fulfillment of a long-felt but unsolved need, licensing to potential competitors, copying by an infringer, progress of the patent application through the Patent and Trademark Office, near-simultaneous invention by another researcher in the field, and professional approval by experts in the field.” Dorothy Whelan, Note, *A Critique of the Use of Secondary Considerations in Applying the Section 103 Nonobviousness Test for Patentability*, 28 B.C. L. REV. 357, 366 (1987).

123. Christopher A. Cotropia, *Patent Law Viewed Through an Evidentiary Lens: The “Suggestion Test” as a Rule of Evidence*, 2006 BYU L. REV. 1517, 1525–26.

124. See, e.g., *Hughes Aircraft Co. v. United States*, 717 F.2d 1351, 1366 (Fed. Cir. 1983) (determining that Hughes's patent claims could capture a later developed technology under the doctrine of equivalents).

125. See, e.g., *Gentry Gallery, Inc. v. Berkline Corp.*, 134 F.3d 1473, 1479 (Fed. Cir. 1998) (discussing patent scope limitations).

126. See *Laxman & Aggarwal*, *supra* note 38, at 44–45 (discussing the evaluation of an option).

127. 35 U.S.C. § 111(b) (2000) (defining the provisional application).

provisional application.<sup>128</sup> This decision point—to convert or not—can be viewed as the expiration of an earlier option—the provisional application option—and the ability to purchase a new option—a non-provisional application option. The purchase of this following option includes the cost of drafting patent claims and getting the application ready for examination in general.<sup>129</sup>

The patent process then presents another series of options. For example, the inventor must decide, perhaps multiple times, whether to respond to the examiner's office rejection of the patent application or to abandon the application altogether.<sup>130</sup> The filing of continuations—requests to continue examination—and continuing to pursue the current patent claims or add new ones is another discrete option.<sup>131</sup>

Laxman and Aggarwal recognized that there are another series of embedded options with regards to a patent application when examining the Patent Cooperation Treaty (PCT) system.<sup>132</sup> The inventor not only gets many opportunities to elect whether to continue pursuing her U.S. patent application; she also has the option to seek patent protection in other countries, which is typically facilitated through the PCT system.<sup>133</sup> The PCT system consists of multiple stages, each of which requires the inventor to elect to continue with international examination.<sup>134</sup> The PCT system ends with the applicant needing to elect which countries to “nationalize” the patent application in—that is, filing a patent with that particular country.<sup>135</sup> These choices can also be viewed as a series of options, where at each point the applicant can either abandon, or narrow, the process of obtaining a patent or proceed unchanged.<sup>136</sup>

Even when the patent issues—either in the United States or in a foreign country—the patentee is faced with further options. Most countries employ a patent renewal system where the patent holder must pay fees at defined time periods to keep the patent

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128. *Id.*; 35 U.S.C. § 119(e) (2000); 37 C.F.R. § 1.53(c) (2006); Robert A. Miglioni, *Twelve Years Later: Provisional Patent Application Filing Revisited*, 89 J. PAT. & TRADEMARK OFF. SOC'Y 437, 441–42 (2007).

129. *See infra* Part III.A (describing these costs).

130. *See* 35 U.S.C. §§ 132–33 (2000) (setting forth the statutory restrictions on the patent examination process).

131. 35 U.S.C. § 120 (2000); Mark A. Lemley & Kimberly A. Moore, *Ending Abuse of Continuations*, 84 B.U. L. REV. 63, 67–69 (2004) (explaining the continuation process). Regulations have been passed to limit the availability of continuations. *See* Changes to Practice for Continued Examination Filings, Patent Application Containing Patentably Indistinct Claims, and Examination of Claims in Patent Applications, 72 Fed. Reg. 46716–46843 (Aug. 21, 2007) (to be codified at 37 C.F.R. pt. 1). The rules are, however, currently enjoined from being implemented. *See* *Tafas v. Dudas*, 511 F. Supp. 2d 652, 671 (E.D. Va. 2007).

132. *See* Laxman & Aggarwal, *supra* note 38, at 45–50 (explaining the PCT system).

133. Patents can be obtained in other countries by other means than going through the PCT process. *See, e.g.*, Marco T. Connor & Lin Yasong, *How to Get Patent Protection in Europe?*, 90 J. PAT. & TRADEMARK OFF. SOC'Y 169, 172–73 (2008) (noting four different ways to obtain patents in Europe, two of which do not involve PCT applications).

134. *See* T. David Reed, *Strategic Use of the PCT, A Discussion from the User's Perspective* 8–9 (Oct. 8, 2008), available at [http://www.wipo.int/export/sites/www/pct/en/pct\\_strategies/strategic\\_use\\_reed.pdf](http://www.wipo.int/export/sites/www/pct/en/pct_strategies/strategic_use_reed.pdf) (depicting the PCT process as a timeline including a series of actions by the PCT applicant and the relevant examining authority).

135. *Id.*; World Intellectual Property Organization, *PCT Applicant's Guide—National Phase—National Chapter 2* (2008) available at <http://www.wipo.int/pct/guide/en/gdvol2/pdf/gdvol2.pdf> (describing the national phase as “the second of the two main phases of the PCT procedure”).

136. *See* Laxman & Aggarwal, *supra* note 38, at 45–50 (noting that the PCT application process contains “many embedded options”).

enforceable.<sup>137</sup> These payment points are called maintenance fees in the United States and they increase exponentially in price the deeper one gets into the patent's term.<sup>138</sup> As mentioned previously, this discrete set of options has been the focus of a number of economists.<sup>139</sup>

#### IV. BENEFITS TO DESCRIBING PATENTS AS REAL OPTIONS

The obvious question is "who cares?" An arbitrage of sorts has occurred—something that contemporary legal scholars do quite frequently—taking a concept from another discipline and applying it to an area of law.

My initial response is that, at least here, some people have already showed they care by writing articles and citing others that discuss patents as real options.<sup>140</sup> There is evidence of "care" on both sides of the aisle—however, it is much more so on the economics side than the law side. So, Part III of this Article, detailing the analogy between patents and real options, should help both of these camps continue the discussion of patents as real options.

To further answer the "who cares?" question, this section provides some thoughts on why the analogy—and thus further nailing down the specifics of the analogy—matters.

##### *A. Defines New "Macro Patent Elements"*

Patent law is made up of a myriad of patent rules. There are rules for patentability, typically viewed as a series of filters that a patentable invention passes through as unpatentable subject matter is trapped. There are also rules governing enforcement of patents and rules defining defenses. These rules all have their own operational definitions. For instance, what is the nonobviousness requirement and what happens if it is not met? What is the importance of a patent claim, what does it define, and how does one interpret it?

These rules are interrelated. They influence one another in technical ways. For example, patent claims must be interpreted first before questions of validity or infringement can be decided. Why? Because the patent claim defines the subject that is at the center of each of those inquiries.<sup>141</sup> Individual patent rules can also influence one another substantively. A good example of this is the prerequisite that a patent claim be valid before it can be enforced.<sup>142</sup> Standards of patentability also necessarily have an

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137. See 37 C.F.R. § 1.20(e)–(g) (2008) (providing the fee structure "[f]or maintaining an original or reissue patent").

138. *Id.* (reciting fees at 3.5 years, 7.5 years, and 11.5 years into the patent term).

139. See *supra* note 41 and accompanying text (noting articles focusing on maintenance fees).

140. See *supra* Parts II.B, II.C (noting previous scholarship in the law and economics field).

141. See 35 U.S.C. § 112, ¶ 2 (2000) ("The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention."); *White v. Dunbar*, 119 U.S. 47, 52 (1886) ("The claim is a statutory requirement, prescribed for the very purpose of making the patentee define precisely what his invention is.").

142. See 35 U.S.C. § 282 (2000) (providing that the invalidity of a patent can be used as a defense against "action[s] involving the validity on infringement of a patent"); *Pfizer, Inc. v. Teva Pharms., USA, Inc.*, 429 F.3d 1364, 1372 (Fed. Cir. 2005) ("To win on its claim of patent infringement, [the patentee] must present proof that [the infringer] infringed a valid and enforceable patent.").

impact on the scope of exclusivity a patent provides.<sup>143</sup>

There is a benefit to recognizing these interrelationships. For example, do various patent rules work together or against one another in the breadth of protection that a patent provides? Seeing these interrelationships helps in identifying the causes of problems with the patent system. A patent problem may be recognizable at a general level; for instance, the patent right is too strong. But to determine the problem's exact cause, understanding the doctrines that impact patent "strength" helps to identify what patent rule can be changed to correct the policy failure. Recognizing interrelationships also helps identify how particular changes to individual patent rules can work together, or against each other, as to their impact on the patent system.

Describing patents as real options, specifically focusing on the few components that make up a real option, identifies these interrelationships between individual legal rules by aggregating them. Part III of this Article identifies these "macro patent elements"—the various components of a real option—and describes the specific patent rules that make up each macro element. For example, the macro patent element—"the patent option's price"—is comprised of a variety of patent doctrines, from the mundane (such as filing fees) to the complex (such as the nonobviousness doctrine).<sup>144</sup> By focusing on a patent's option price, exercise price, expiration date, and underlying asset value, an inquiry into patent law can focus on broader elements while not losing the particular patent rules in play.

To better exemplify how the patents as real options analogy provides access to these macro patent elements, both a current problem with the patent system (the existence of patent trolls) and an arguable solution (the nonobviousness standard adopted by the Supreme Court in *KSR International Co. v. Teleflex, Inc.*)<sup>145</sup> are viewed through the options framework. By doing this, the Article demonstrates that real options theory can abstract the particular causes of a patent problem (here the patent troll problem) and identify the broader impact of a specific patent solution (here the raising of the nonobviousness standard) via macro patent elements. By doing so, the problem and solution are placed in the context of the larger patent system and become easier to understand, both in their own right and within the patent system as a whole.

### 1. Patent Troll Problem in Option Terms

The patent troll problem, put succinctly, is that patents are being held by individuals who have no intention of commercializing the invention and instead use patents to extract rents from those who have commercialized.<sup>146</sup> This type of activity is problematic because the patent is acting solely as a tax on innovation.<sup>147</sup> The patent is not generating

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143. See *Whittaker Corp. v. UNR Indus., Inc.*, 911 F.2d 709, 712 (Fed. Cir. 1990) ("[C]laims are generally construed so as to sustain their validity, if possible."); *Wilson Sporting Goods Co. v. David Geoffrey & Assocs.*, 904 F.2d 677, 684 (Fed. Cir. 1990) ("[A] patentee should not be able to obtain, under the doctrine of equivalents, coverage which he could not lawfully have obtained from the PTO by literal claims.").

144. See *supra* Part III.A (discussing the elements in the patent's option price).

145. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398 (2007).

146. See, e.g., Robert P. Merges, *Introductory Note to Brief of Amicus Curiae in eBay v. MercExchange*, 21 *BERKELEY TECH. L.J.* 997, 997 (2006) (defining "patent troll" as "non-producing, non-research and development (R&D) performing patent holders").

147. See Jeremiah Chan & Matthew Fawcett, *Footsteps of the Patent Troll*, 10 *INTELL. PROP. L. BULL.* 1, 5

societal welfare because its holder has not, and has no plans to, commercialize the claimed technology.<sup>148</sup> Instead, the patent holder uses the patent to delay those who are innovating for the sole purpose of receiving a monetary reward.<sup>149</sup>

Many have opined as to why these individuals—labeled “patent trolls”—engage in such activity.<sup>150</sup> The causes of the patent troll problem can be put in terms of real options.

#### *a. Too Low an Option Price*

First, as I argue elsewhere, the option price of a patent is too low, when viewed in the context of commercialization of the patent.<sup>151</sup> The inventor, under the current patent rules, needs to engage in very little development activity to obtain a patent. Patent law does not require the inventor to actually reduce the invention to practice.<sup>152</sup> The invention need not be physically made or implemented. In addition, the inventor does not need to test the invention prior to patenting to determine whether it works for its intended purpose. In fact, there are other patent rules—the statutory bar and the presumption that the filing date is the invention date to name a couple—that push the inventor to file for patents early in the development process.<sup>153</sup>

Development costs money and time. The less development that needs to be done to get a patent, the cheaper the patent and the lower the option price.<sup>154</sup> This low option price fosters patent trolls. A company like Intellectual Ventures, whose sole purpose is to generate patents, is able to produce more patents because less investment is needed on the front end.<sup>155</sup> The cheaper the patent option, with all other elements influencing value remaining constant, the more likely it will be purchased.<sup>156</sup>

Here is an example of the aggregation facilitated by options theory: The option price is a macro patent element. Under one element of an option—the purchase price—the interaction of a number of individual patent rules can be combined—constructive reduction to practice doctrine, utility requirement, statutory bar, etc. The current level of this macro patent element—the option price—contributes to the patent troll problem.

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(2005) (noting that “[m]any of today’s most popular and pervasive technologies have already felt the sting of patent trolls”).

148. Jason Rantanen, *Slaying the Troll: Litigation as an Effective Strategy Against Patent Threats*, 23 SANTA CLARA COMPUTER & HIGH TECH. L.J. 159, 160 (2006).

149. See Merges, *supra* note 146, at 997 (noting that patent trolls do not seek to produce products or perform research and development).

150. For example, I have argued elsewhere that the early filing nature of the patent system creates patent trolls. Cotropia, *supra* note 60, at 57–59.

151. *Id.* at 52–53 (commenting that the “potential value of the option” is “quite high” when compared to the “relatively inexpensive” cost of the patent application).

152. See *supra* notes 71–72 and accompanying text (noting that a patent does not require an actual embodiment).

153. See 35 U.S.C. § 102(b) (2000) (establishing the statutory bar to patentability); Cotropia, *supra* note 60, at 16–20 (noting these incentives).

154. See *supra* Part III.A.

155. Intellectual Ventures—Frequently Asked Questions, <http://www.intellectualventures.com/Faq.aspx> (last visited Mar. 29, 2009) (“IV’s [Intellectual Venture’s] invention efforts center on ‘invention sessions’ which are multidisciplinary brainstorming events focused on a particular set of issues and possible solutions. IV typically hosts several 1–2 day invention sessions per month.”).

156. See COPELAND & ANTIKAVROV, *supra* note 1, at 5–6.

### *b. Too Low an Exercise Price*

Another element of the patent option also explains patent troll behavior. Patent trolls exercise the patent option by asserting the patent right against others who have commercialized the patented invention. Patent trolls—as the alternative label “non-practicing entity” suggests—do not exercise the option by commercializing the invention themselves. It is this choice when exercising the option that draws patent trolls such criticism.<sup>157</sup> By exercising through assertion, as opposed to commercialization, the patent troll appears to be solely a drag on innovation.<sup>158</sup>

A potential cause of this problem is the comparative low cost of the assertion exercise price to the commercialization exercise price. Recognized by Martin and Partnoy, and further described earlier in this Article (specifically Figure 2), it is simply cheaper to exercise the patent option by asserting than by commercialization.<sup>159</sup> Faced with this stark difference in exercise prices, exercising the option by assertion—and thus acting like a patent troll—becomes the favorable way to use a patent. This low exercise price is another macro patent element that can be identified as a contributory cause of a current patent problem—patent trolls.

## *2. KSR and a Heightened Nonobviousness Standard in Option Terms*

The opposite perspective can also be taken when looking at these macro patent elements defined by the real options analogy. A specific patent law change can be examined as to how it affects one of the elements of the patent option, that is, how a particularly legal change impacts a macro patent element.

The Supreme Court’s recent decision in *KSR International Co. v. Teleflex, Inc.*<sup>160</sup> arguably changed the nonobviousness doctrine. The decision in *KSR* potentially heightened the standard for nonobviousness from that previously articulated by the Federal Circuit.<sup>161</sup> The case raised the bar for what types of inventions qualify for patent protection by expanding the basis upon which one can find an invention obvious.<sup>162</sup> Instead of requiring a teaching, suggestion, or motivation in the prior art to render the invention obvious, common sense and market demand, among other factors, can also be relied upon to establish a finding of obviousness.<sup>163</sup> In addition, the case identifies those inventions whose results are predictable as unpatentable due to obviousness.<sup>164</sup> This change narrows the universe of inventions that can obtain patent protection.<sup>165</sup>

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157. See Brief for Yahoo! As Amicus Curie Supporting Petitioner at 2–3, 6–7, *eBay Inc. v. MercExchange, L.L.C.*, 547 U.S. 388 (2006) (No. 05-130) (commenting that as non-practicing entities, trolls have little incentive to cross-license and, due to the cost of trial, even companies with excellent defenses have a strong incentive to settle).

158. *Id.*

159. See *supra* Part III.B; Martin & Partnoy, *supra* note 5 (arguing that existing policy favors litigation to commercialization).

160. *KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398 (2007).

161. *Id.* at 418–22.

162. C. Paul Wazzan, *The Effects of KSR v. Teleflex on Patent Licensing Costs*, 11 UCLA J.L. & TECH. ¶¶ 7, 14 (2007), available at [http://www.lawtechjournal.com/articles/2007/04\\_071228\\_wazzan.pdf](http://www.lawtechjournal.com/articles/2007/04_071228_wazzan.pdf).

163. *KSR*, 550 U.S. at 418–22.

164. *Id.* at 419–22.

165. Wazzan, *supra* note 162, ¶¶ 7, 14; but see Gregory Mandel, *The Non-Obvious Problem: How the*

A change in the patentability requirement necessarily changes the patent option's price. One component of the price is the cost of coming up with the invention.<sup>166</sup> The higher the standard of patentability, the more that needs to be done to obtain protection—and thus purchase the patent option. Admittedly, an inventor may surreptitiously come upon a nonobvious invention, but generally the view is that nonobvious inventions are those that need the incentives in patent protection to prompt their creation.<sup>167</sup> The invention needs the potential of supra-competitive profits to prompt its creation because the creation process is so costly and uncertain.<sup>168</sup> The standard in *KSR* increases the amount of cost and uncertainty that needs to be involved for an invention to obtain patent protection.<sup>169</sup> Arguably, there has to be less indication from the current state of knowledge that there is such an invention out there and that even creating it will produce predictable results. This heightens the costs of patenting, which also increases the costs of the patent option. A macro patent element—option price—is impacted by this specific doctrinal change.

### *B. Describes Patents Like Industry Views Technological Development*

The other benefit to describing patents as real options is that it frames the patent discussion in the same manner that industry approaches the innovation process. Economists use real options theory on patents in conjunction with their analysis of companies' research and development strategies.<sup>170</sup> The same way R&D spending has real option qualities, so do patents.

From this, economists have noted how many companies—explicitly or implicitly—follow ROR when pursuing certain technological development projects. Rita McGrath and Atul Nerkar note that pharmaceutical firms take a real options approach to their research and development investment. These companies “implicitly (or explicitly) respon[d] to the value of the right to preserve decision rights in the future in their investment choices.”<sup>171</sup>

Patents are meant to further technological progress. The classical theory is that patents create an incentive to invent—that is, engage in the innovation process—because they provide a mechanism by which the inventor can recoup her research and development costs.<sup>172</sup> If patents are supposed to influence the development process for

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*Indeterminate Nonobviousness Standard Produces Excessive Patent Grants*, 42 U.C. DAVIS L. REV. 57, 57–58 (2008) (arguing that *KSR* will lead to more patent grants because of the indeterminacy it introduces).

166. See *supra* Part III.A.

167. Glynn S. Lunney, Jr., *Patent Law, the Federal Circuit, and the Supreme Court: A Quiet Revolution*, 11 SUP. CT. ECON. REV. 1, 41 (2004).

168. *Id.*

169. The decision increases the “gap” needed between what has already been done—the state of technology at the time of the invention—and the technological progress the invention represents. Christopher A. Cotropia, *Nonobviousness as an Exercise in Gap Measuring*, in 2 INTELLECTUAL PROPERTY AND INFORMATION WEALTH 26 (P. Yu ed., 2007).

170. See, e.g., Schwartz, *supra* note 34.

171. McGrath & Nerkar, *supra* note 2, at 2.

172. Wesley M. Cohen, Richard R. Nelson & John P. Walsh, *Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (Or Not)* 3 n.4 (Nat'l Bureau of Econ. Research, Working Paper No. 7552, 2000), available at <http://www.nber.org/papers/w7552> (noting that it is the “expectation” that patent law facilitates the generation of “ex post rents” that provides the incentive to invent).

the better, perhaps thinking about patents the same way industry does can lead to better patent policy. Taking a real options perspective would also help link the economics literature on patents as real options with the legal scholarship on patents.

### *C. Presents a New Theory of Patents*

The use of new economic concepts to describe the patent system is nothing new. For example, Clarisa Long used information cost theory to describe patent (and copyright) law.<sup>173</sup> Paul Heald used the concept of transaction cost to describe a new theory of patents.<sup>174</sup> Both of these exercises provide a new descriptive account of the patent system and introduce interesting policy and doctrinal implications as a result of the new perspective.

Real options theory provides a similar opportunity. The concept of real options—and the particular similarities between real options and patents—provides a framework to produce new perspectives on patents, some of which are described in this Article. In addition, the value of flexibility to patent owners—flexibility being a hallmark of a real option—could provide interesting descriptive and normative insights into patent law.<sup>175</sup> Furthermore, the fact that a real option becomes more valuable the more uncertain the value of the underlying asset could have interesting implications for the situations under which patent protection may be most valuable to industry and, in turn, valuable to society.<sup>176</sup> Finally, real options analysis could add a dimension to the theory of patents focused on their private value, instead of their social value.<sup>177</sup> These concepts need to be fully explored to provide any value to other scholars.<sup>178</sup> However, the application of real options theory to both patent problems and patent solutions in Part IV.A, above, hopefully shows that such an exercise has promise.

## V. CONCLUSION

Real options theory has tremendous potential for both assisting in patent policy discussions and expanding patent theory. This Article's goal was modest and exploratory in nature. First, lay a foundation for future exploration of the patent as real option analogy, and then provide a taste of the policy and theory implications such an analogy presents. The hope is that future legal scholarship continuing the exploration of patents as real options will follow.

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173. Clarisa Long, *Information Costs in Patent and Copyright*, 90 VA. L. REV. 465, 495–538 (2004).

174. Paul J. Heald, *A Transaction Costs Theory of Patent Law*, 66 OHIO ST. L.J. 473 (2005).

175. See COPELAND & ANTIKAROV, *supra* note 1, at 5–6.

176. IAN AYERS, *OPTIONAL LAW* 2–3 (2005).

177. Thanks goes to Kevin Collins for this insight.

178. This is a project, including other areas of intellectual property law such as copyright and trademark, upon which I am currently embarking and for which this article lays the necessary foundation.



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