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Abstract
The patent paradox is the over-valuing of patent protection by industry participants despite data showing that patents have low value, and thus must not be an efficient means of protecting intellectual property. The portfolio theory attempts to explain the patent paradox, based upon the assumption that the marginal expected gain in value from the addition of a patent to a well-crafted patent portfolio is greater than the marginal costs of acquiring the patent. While the portfolio theory unifies prior existing theories regarding the valuation of large firm patents, it does not take into account the behavior of small firms in relation to their intellectual property. This comment describes the value of patents to small firms, and explains their relation to venture capital and litigation. This comment also proposes that speculation into the value of innovation of small firms, especially by venture capital, creates an initial value in the patents of small firms.

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I. INTRODUCTION

The patent paradox is the over-valuing of patent protection by industry participants despite data showing that patents have low value, and thus must not be an efficient means of protecting intellectual property.\(^1\) Parchomovsky and Wagner propose a portfolio theory to explain the patent paradox.\(^2\) Their theory is based upon the assumption that the marginal expected gain in value in the addition of a patent to a well-crafted patent portfolio is greater than the marginal costs of acquiring the patent.\(^3\) The portfolio theory suggests that the patent paradox is explained through the synergistic increase in value that patents have, when added to a patent portfolio of related patents.\(^4\)

While the portfolio theory emphasizes the real importance of portfolios as a tool for firms to obtain broad claim scope and unifies prior existing theories regarding the valuation of large firm patents, it does not take into account the behavior of small firms\(^5\) in relation to their intellectual property. Moreover, the paradox itself is often based on information acquired from the employees and actions of larger companies, excluding data from small firms.\(^6\) Small firms value and use their intellectual property in a different way from large firms. Much of the data that show a low value for patents are based upon the non-payment of maintenance fees and may not be able to capture the true average value of patents, or the value of the most prized patents, especially in the context of small firm patents.\(^7\)

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2. Id. at 1.
3. Id. at 28.
4. Id. at 27.
5. Firms with fewer than 500 employees are considered small firms. See discussion infra Section III.B.
6. For an example of a patent-effectiveness study in which “small start-up ventures, important sources of innovation, were underrepresented” see Richard C. Levin et al., Appropriating the Returns from Industrial Research and Development, 3 BROOKINGS PAPERS ON ECON. ACTIVITY 783, 791 (1987).
7. But see Mark Schankerman, How Valuable is Patent Protection? Estimates by Technology Field, 29 RAND J. ECON. 77, 104 (1998) (extending research on patent renewals to conclude that patent rights are “clearly valuable” and “equivalent to an R&D cash subsidy rate of about 15-25%” on average across four technology fields in France); Ariel Pakes, Patents as Options: Some Estimates of the Value of Holding European Patent Stocks, 54 ECONOMETRICA 755, 778-79 (1986) (applying a patent-renewal model to conclude that patent rights create annual returns which are “nonnegligible in comparison to privately funded R&D activity” and, in fact, such returns were equal to 13.14 percent of research and development expenditures at business enterprises in France, Germany, and the U.K. in 1963).
Section II of this comment first summarizes the portfolio theory and explains that it does not account for two factors important for an accurate valuation of patents. First, the portfolio theory does not take patent claim scope into account when it describes the value of a patent to a given portfolio.\(^8\) Practitioners suggest that their clients create patent portfolios to increase claim scope. They seek multiple patents for a variety of practical reasons involving limitations on the scope of claims often allowed in a single given patent.\(^9\) However, as argued below, the quality of a patent portfolio depends mostly on the scope of the claims of the patents in the portfolio, not necessarily the number of patents.\(^10\) The possession of large numbers of patents by many large firms does mean that any patent reasonably related to a patent portfolio will synergistically gain value by being added to that portfolio.

Second, the portfolio theory ignores changes in patent value over time. Parchomovsky and Wagner cite data estimating low average patent value based on the non-payment of maintenance fees on many patents, suggesting that these patents are not even valuable enough to justify paying relatively low maintenance fees.\(^11\) Looking at the payment or non-payment of maintenance fees only establishes the value of patents at the time the fees are due, not at times before the fees are due. Many patents have a high value early on in their lives, before payment of the first maintenance fee, because of speculation in the value of the technology that the patent protects.

Section II concludes that although the portfolio theory may help to explain the value of patents to large firms, it does not explain the value of patents to small firms. Existing valuation methods contribute

\(^8\) But see Parchomovsky & Wagner, supra note 1, at 33 (explaining that “the breadth of the right to exclude conferred by a patent portfolio is essentially the sum of the individual patent rights,” but “[t]he broader protection conferred by patent portfolios offers a range of benefits to the holder different in kind as well as size from a simple collection of unrelated individual patents.”).

\(^9\) Other practical issues that can limit the scope of claims in a single U.S. patent are patent strategies in which narrower claims are pursued during a parent patent application and broader claims are pursued in later offspring applications. See U.S. PATENT AND TRADEMARK OFFICE, MANUAL OF PATENT EXAMINING PROCEDURE §§ 801-823 (8th ed. 2006) [hereinafter MPEP] (discussing restriction and double patenting as it relates to U.S. patent applications).

\(^10\) See discussion infra Section II.

\(^11\) See Parchomovsky & Wagner, supra note 1, at 14. See also Francesca Cornelli & Mark Schankerman, Patent Renewals and R&D Incentives, 30 RAND J. ECON. 197 (1999) (stating that “[t]ypically, more than half of all patents are voluntarily cancelled by nonpayment within ten years of the date of patent application” and “[e]conometric studies have confirmed that renewal fees influence the decision to patent and that more valuable patents are held longer”).
to the perception of a patent paradox because they disguise differences among large firm and small firm patents. Smaller firms or individuals who are trying to break into an industry, value patents differently than larger firms that are trying to strengthen their positions within an industry and prevent upstarts from getting a foothold. When these differences between patent valuation of small and large firms are taken into account, it becomes clear that patents are valued differentially over time and thus there is no patent paradox. Many patents, which lapse for non-payment of the first maintenance fee, were more valuable at an earlier period in their life. This is, in part, why inventors and their assignees seek patent protection.

Section III describes the reasons that patents are valuable to large firms. Large firms are trying to amass claim scope with which they can ensnare infringers and induce licensees. This scope correlates with portfolio size for practical reasons, but is not necessarily created by the addition of patents to a related portfolio. The language of the claims of the individual patents in the portfolio is what meaningfully creates the claim scope. Valuation methods based on non-payment of maintenance fees do not capture this dimension of patent value.

Finally, Section IV of this comment describes the value of patents to small firms, and explains their relation to venture capital and litigation. This comment proposes that speculation into the value of innovation of small firms, especially by venture capital, creates an initial value in the patents of small firms. This value is usually ephemeral, and later drops to approximately zero for most patents. However, a minority of these small firms experience large increases in value evidenced, in part, by their possession of high value litigated patents. Because of this venture capitalists can recoup their losses realized on the majority of firms in their small firm portfolio and earn a profit by realizing huge gains on the minority of firms in their portfolio. Existing valuation methods based on the payment of maintenance fees do not capture this because they only show the value of patents at a single point in time.

II. THE PORTFOLIO THEORY DESCRIBES HOW LARGE FIRMS PATENT, BUT DOES NOT EXPLAIN THE PATENT PARADOX

The value of patents depends on the reasons for which they are pursued and held. The simple addition of patents to a patent portfolio does not increase the value of the patent portfolio in and of itself. The value of a patent portfolio increases as the aggregate claim scope of
the patents in a patent portfolio increases, in a relevant technological field. The portfolio theory does not consider how claim scope correlates with patent value. The portfolio theory also does not explain why the maintenance fees of more patents are not paid, despite the assertion of the potential value of many patents when they are placed in a patent portfolio.

The portfolio theory is based on the presumption that patents that are reasonably related to the subject matter of a patent portfolio will increase the value of the patent portfolio by an amount greater than their value taken separately. The theory asserts that this explains the patent paradox. Patents that are maintained are ones that make their way into portfolios, where they are more highly valued, while patents with no corresponding portfolio are not maintained because of their lower value.

According to Parchomovsky and Wagner, this increase in the value of patents in portfolios is related to two advantages: scale and diversity. Advantages of scale are related to the increase in the claim scope of a patent portfolio beyond each of its constituent patents. This increase in scope is asserted to be more than simply additive in relation to the value of the portfolio. Parchomovsky and Wagner argue that greater patent scope associated with a portfolio allows for greater freedom of subsequent innovation, provides strong market position, avoids litigation, improves the firm's defensive position, and enhances the firm's ability to attract capital. Advantages of diversity are related to the depth and redundancy of coverage of the patent portfolio. Having interlocking coverage by multiple patents will insure that protection will not dissipate if one of the patents in the

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12. Parchomovsky & Wagner, supra note 1, at 1.
13. Id. at 2.
14. Id. But see id. at 42 (explaining that under the patent portfolio theory, "firms patent heavily to maximize the benefits of patent portfolios, and such benefits are directly determined by the quantity of patents assembled . . . . patenting decisions are essentially unrelated to the value of the individual patent.").
15. Id. at 31.
16. Id. at 31-32.
17. Id. at 33. Presumably, the actual patent scope of the patent portfolio would be, at most, additive. An overlap in the claim scope of two patents in a portfolio would not create greater scope in the portfolio. Thus, only non-overlapping claim scope would expand the claim scope of the portfolio.
18. Id.
19. Id. at 36.
20. Id. at 37.
portfolio is invalidated.\textsuperscript{21} Many of the advantages are similar to the
features stipulated above for the advantage of scale.\textsuperscript{22}

The portfolio theory convincingly explains that patent scope is
generally greater with more patents and that greater aggregate patent
scope due to the proper manipulation of a patent portfolio is more
valuable to firms than the relatively smaller scope, usually afforded
by a single patent. This explanation, however, does not explain the
patent paradox.

First, although patent portfolios are valuable, the value of a
portfolio is related to the aggregate scope of the claims of the patents
in the portfolio, and not necessarily the number of patents in the
portfolio. The number of patents in a patent portfolio should generally
correlate with the claim scope covered by the portfolio. However,
greater claim scope is not caused by the number of patents in the
portfolio, but by the claim scope of the individual patents making up
the portfolio.

The claim scope of any single patent is limited by a number of
factors. First, restriction practice in the United States and Europe will
only allow patents to be drawn to a single invention.\textsuperscript{23} Often claims to
variants of a single manufacture or composition of matter are required
to be claimed in different patents. Also, often methods of using and
making a manufacture or composition of matter are required to be
claimed in different patents. Thus, multiple patents are generally
required to cover a given inventive concept in all of its embodiments
and methods of making and using these variants. Second, prior art
problems may require the splitting of claim scope of an invention in
more than one application. For example, if the prior art recites a
combination of elements A and B, and an inventor shows that A and
B may be used with elements C or D, the inventor may have to file
two applications, one with claims drawn to A, B and C and the other
with claims drawn to A, B and D. Third, certain prosecution strategies
or fiscal necessities may require the pursuit of narrower claims in a
parent patent application, followed by the filing of continuation
application(s) for broader claims, or claims of different scope. Fourth,
a patentee may file an application with claims specifically drawn to

\begin{thebibliography}{99}
  \bibitem{21} Id. at 38.
  \bibitem{22} Id. at 38-39.
  \bibitem{23} See 35 U.S.C. § 121 (2000) (stating that the Director may require independent and
distinct inventions to be filed as separate divisional applications, which would issue as distinct
http://www.epo.co.at/legal/epc/e/ma0.html (stating that each patent must be related to one
invention or a group of inventions linked so as to form one inventive concept).
\end{thebibliography}
the activity of a competitor which the patentee believes is covered by his/her patent family after a previous application issued with other claims. Thus, more than one patent is often necessary to cover a given innovation, and so the number of patents in a portfolio should generally correlate with greater claim scope.

However, while this does not happen frequently in practice, it is not impossible for a single patent to have extremely broad claims and to be a "super-patent" unto itself.\(^{24}\) A super-patent would have a broad independent claim, and numerous dependent claims. Dependent claims define narrowed embodiments within the scope of the independent claim.\(^{25}\) If this one super-patent covered the same scope as a portfolio with similar claims spread over multiple patents, the value of the patent portfolio would not be much greater than that of the single super-patent.

Having many patents does not necessarily provide greater protection against a claim of substantive invalidity than having fewer patents or even one patent. Claims are rejected separately for lack of novelty, obviousness, enablement, utility or written description. A patent application as a whole is not rejected if one of its claims is not patentable.\(^{26}\) Likewise, a patent is not wholly invalidated if one of its claims is later found to be invalid. The patent’s other claims would still stand, if they were held valid. To render a whole patent invalid based on the substantive validity of the patent’s claims each of its claims would have to be found invalid. Thus, the risk of substantive invalidation of a given claim should not change whether it is present in one patent containing a number of claims or multiple patents contain the same number of claims. Multiple patents do not provide a safer substrate for claims insofar as protecting claims from substantive invalidation.

A greater number of patents in a portfolio may protect against findings of inequitable conduct. Having claims in multiple patents would be slightly safer in the face of a finding of inequitable conduct in one of the patents. Examples of inequitable conduct include withholding prior art from the USPTO during prosecution,\(^{27}\)

\(^{24}\) A super patent is a single patent with a very broad claim scope. But see Parchomovsky & Wagner, supra note 1, at 32 (describing a patent portfolio as a "super-patent").

\(^{25}\) MPEP, supra note 9, § 608.01(n).

\(^{26}\) Pending claims in a patent application are examined on a claim-by-claim basis, however a patent application would not be allowed while it contained rejected claims. However, deletion of rejected claims from a patent application with allowed claims would lead to issuance of the application as a patent.

\(^{27}\) MPEP, supra note 9, § 2001.
withholding the best mode of using the invention known at the time of filing from the patent application, or practicing fraud before the USPTO, generally. A finding of inequitable conduct results in the invalidation of the patent, and all of the claims therein. Thus, having multiple patents may diminish the chances that any one was invalidated under inequitable conduct. However, inequitable conduct is relatively rare when compared to claims of invalidity of individual claims of a patent. Additionally, if a group of patents were drawn to the same subject matter and are related to each other, and thus likely to have been prosecuted at the same time and by the same people, it is more likely that a finding of inequitable conduct in one patent will result in a finding of inequitable conduct in another. While having claims spread through multiple patents is still helpful, it is unlikely that this relatively small increase in value would justify the assertion that the addition of each patent to a patent portfolio drawn to related technology would synergistically increase the value of the portfolio.

Thus, a patent portfolio provides only a marginally safer substrate for patent claims than a single super-patent. The redundancy of a patent portfolio provides protection from findings of inequitable conduct, but these findings occur rarely. Generally, greater patent scope can only be accorded through the procurement of multiple patents, so, from a practical standpoint patent portfolio size does correlate with claim scope breadth. This is so, not because each patent that is relatively related to the subject matter of the portfolio is synergistically more valuable when included in the portfolio than when it is excluded from it, but because of practical considerations affecting the acquisition of patent claim scope during the prosecution of patents. The portfolio theory does, to some extent, account for why large firms value patents at all; however, it does not fully account for the patent paradox.

The second reason the portfolio theory does not explain the patent paradox is that if a patent would have increased value if it were held in a portfolio, it should still have some value alone. However, based on the valuation methods cited by Parchomovsky and Wagner, the value of individual patents does not reflect this portfolio dependent value.

The valuation methods which Parchomovsky and Wagner cite in their paper use non-payment of maintenance fees to determine the

28. MPEP, supra note 9, § 2165.
29. MPEP, supra note 9, § 2016.
30. Id.
value of patents. In most countries, maintenance fees must be paid to keep the patent in force. If these fees are not paid, it can be presumed that the patents are not as valuable as the maintenance fee. This valuation method demonstrates the patent paradox in that patents are largely not maintained, meaning that they must not be worth even as much as the maintenance fee, which is generally less than the cost of acquiring the patents in the first place.

If this is the case, for the maintenance fee valuation test to jibe with the portfolio theory, the patent market must be extremely inefficient because under the portfolio theory most patents should be valuable when they are placed in the appropriate portfolio. If the patenting firm owns a patent portfolio, and the value of the patents in the portfolio is realized, then the firm would pay the maintenance fees on the patents in the portfolio. If a patent would fit better into another firm’s portfolio, a portfolio owning firm would negotiate with the patent owning firm for rights to the patent in order to capture the synergistic value in its portfolio. Even in the situation where a firm could not afford to pay a maintenance fee, it would be able to sell the portfolio or parts of it to another party who would find the patents useful as a portfolio. It is unlikely that a firm would not know what is in its own patent portfolio. It is also unlikely that a patent portfolio holder would allow the patent of another to go abandoned if it had use for it in its portfolio and it could acquire ownership of the patent. Patents are easily searchable because they must be published in order to receive patent grants, and search engines are available in the United States and Europe. Thus, it seems unlikely that the market for patent licensing is inefficient; at least in terms of knowing what patents may be eligible for licensing. For the portfolio theory to mesh with data showing non-payment of maintenance fees, there must be much acrimony in patenting licensing deals generally, with patent owners

32. In the United States, maintenance fees must be paid at 3.5, 7.5 and 11.5 years from issue. These fees are $900, $2300 and $3800 respectively (small entities pay half). Ass’n of Corporate Counsel, Intellectual Property Primer, http://www.dicksteinshapiro.com/files/upload/IP_Primer.pdf, at 106 (last visited Jan. 20, 2007). In Europe, renewal fees are due every year after the third year from patent grant. The fee is €380 at 3 years and increases every year until it is €1020 at year 10 and every subsequent year. European Patent Convention, supra note 23, art. 86.
33. Parchomovsky & Wagner, supra note 1, at 14.
34. Id.
refusing to maintain patents that should be bringing in at least some licensing dollars. I cannot find any evidence of widespread refusal to deal in patent licensing and Parchomovsky and Wagner do not show any evidence of this.

Alternatively, many patents may be allowed to expire because there is no existing portfolio into which these expired patents could have been placed. Perhaps the expired patents are simply outside the claim scope of all existing portfolios and cannot be readily absorbed by them because they are not reasonably related to any portfolio. This is entirely possible, and would fit with this comment’s theory that the patenting behavior of small firms is different from large firms, and in part accounts for the patent paradox. To better appreciate the differential value of patents it is important to examine the patenting behavior of large firms, as explained in Section III, as compared to small firms as explained in Section IV.

III. THE PORTFOLIO THEORY’S EXPLANATION OF WHY LARGE FIRMS VALUE PATENTS AT ALL

The portfolio theory has the greatest explanatory power in terms of the patenting strategies of large firms. Large firms have other methods of protecting their intellectual property besides patents, but still make up the top firms that are acquiring patents. The portfolio theory explains that larger firms are not necessarily acquiring patents to protect their technology alone, but also to leverage their portfolios into licensing dollars and to repress Schumpter’s “creative destruction” by inhibiting the growth of upstart competitors in their areas of technological expertise. Also, large firm patent portfolios help large firms to defend their territory from interlopers by discouraging litigation of their patents and maintaining the firms’ access to research areas.

Large firms have non-patent tactics to protect intellectual property that smaller firms do not have. These tactics include branding strategies, manipulation of lead-time and learning curve advantages. Branding strategies allow larger, better known firms to keep consumers coming back to their brand to purchase a given product. Thus, if a competitor attempted to move into the market in

38. Barnett, supra note 36, at 1259; Levin et al., supra note 6, at 783-84.
which a large firm was operating, even if the interloper firm could match the quality of the large firm product, the interloper firm would face an uphill battle in order to take market share away from the large incumbent firm.\textsuperscript{40} However, even matching the incumbent firm's product would be a challenge. Absent patent protection, an incumbent firm could protect the product or best methods of making and distributing the product as a trade secret.\textsuperscript{41} Thus, an interloper firm would have to repeat any research the incumbent firm undertook.\textsuperscript{42} Further, nothing would prevent the incumbent firm from continuing its research to keep itself ahead of any interloper firm trying to move in on the incumbent firm's market share.\textsuperscript{43} Many large firms find that these methods are more important to maintaining market dominance than patents.\textsuperscript{44}

These methods for staying ahead of interloper competition leave one wondering why large firms patent at all, because as mentioned above, they patent more than smaller firms.\textsuperscript{45} As the portfolio theory explains, large firms patent to maintain portfolios of patents that they can use to defend the market in which the firms are operating, and to yield licensing dollars. These portfolios are more useful for defense and for profit when they have greater claim scope. Large firms are not necessarily looking to their portfolios to defend discrete inventions from infringement. Because of the factors explained above, large firms do not have to worry as much as smaller firms have to about infringement. Because these portfolios are used for defense and independently derived profit, the greater the claim scope of these portfolios, the greater value they have for the large firms that hold them. This claim scope is generally attained by adding patents to the portfolio because of the practical limits of patent scope in single patents as explained in Section II above.

There is a tendency for larger firms to be perceived as focusing more on incremental research than innovative research.\textsuperscript{46} For example, IBM was perceived as dominating its field of technology from 1950-1970; however, during this time, it came up with only 6 of

\textsuperscript{40} \textit{id.}  
\textsuperscript{41} \textit{id.}  
\textsuperscript{42} \textit{id.}  
\textsuperscript{43} \textit{id.}  
\textsuperscript{44} Levin et al., supra note 6, at 784.  
\textsuperscript{45} See supra notes 36-37 and accompanying text.  
\textsuperscript{46} Barnett, supra note 36, at 1286.
the 21 major innovations.\textsuperscript{47} This is not because IBM did not invest in research. IBM invested $4.2 billion, while the research and development costs of its four largest competitors combined was $1.4 billion.\textsuperscript{48} The lack of domination of the innovation in its field by IBM suggests that IBM’s research dollars went somewhere else besides the innovation of new products. Most likely the money went to make IBM’s existing products better.\textsuperscript{49}

This allocation of research and development efforts makes sense for large firms. Large firms have an incentive to incrementally improve and debug their existing innovations, but less incentive to undertake more expensive and risky innovation which is more likely to render the large firm’s existing innovation obsolete.\textsuperscript{50} Even if a large incumbent firm won at the innovative research game, it may still ultimately lose. Innovative research tends to replace the product currently dominating the given market.\textsuperscript{51} If an incumbent firm already owns the product that is dominating a given market, it would have no incentive to replace itself.\textsuperscript{52} A large incumbent firm would be better off buying a smaller company that had created hopeful innovative results than undertaking the risk itself.

IBM’s choices regarding how to invest its research and development money are reflected in this sort of patent strategy. This past year, IBM again had more issued patents than any other company.\textsuperscript{53} IBM generally acquires many patents with limited claim scope in each patent, increasing the number of patents necessary to cover a given claim scope and increasing the number of patents in its portfolio. IBM’s patent practice develops a large portfolio, which IBM uses to control the technological landscape around its central inventions and generate licensing dollars in this area.

Large firms are not trying to protect new innovation, but trying to protect incremental improvements of the major innovation from which they are already profiting. Large firms often have become large by innovating when they were smaller. Then, they take this innovative

\textsuperscript{48} Id. at 412.
\textsuperscript{49} Id.
\textsuperscript{50} Barnett, supra note 36, at 1259.
\textsuperscript{51} Rosen, supra note 47, at 412.
\textsuperscript{52} Id.
core, amplify it and defend it. Large firms are using a defensive approach to patenting by maintaining portfolios including patents with claim scope that encompasses their main technology and small improvements of that technology. Large firms could simply rely on lead-time and brand loyalty to keep them ahead of the competition. For example, the success of name brand drugs such as Tylenol® and Advil® which have long been off patent in light of cheaper store brand equivalents, would seem to militate against acquiring any patent protection. The use of patents allows incumbent firms to rest on their laurels and delay research that will keep them ahead of their competition because their competitors are limited from innovating by the large firm’s patent portfolio. Also, large firms are able to leverage their patent portfolios into licensing dollars, giving additional incentive for them to pursue patent protection.

One could conclude that large firms are behaving as described in Kitch’s prospect theory. For example, IBM was reported to have collected over $500 million in 1999 from its patent holdings. Arguably, IBM is organizing members of its industry to manage parts of IBM’s portfolio that it does not have the resources to implement. On the other hand, IBM’s activities could be seen as defensively stifling innovation in the intellectual space around its patents by patenting slight variants of methods that are already in wide use. For example, IBM has been searching for infringers of its portfolio and negotiating licenses, or suing them. This does not, on its face, resemble a Kitch-like prospector organizing innovation, rather it resembles an ensconced party managing innovation so that its products are not replaced.

The portfolio theory seems to describe the value of patents to large companies. Large companies patent around their existing technology in order to accrete a large claim scope breadth and capture infringers or induce licenses. The revenue from licenses from these infringers may be considerable, while at the same time allowing a

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57. Kitch, supra note 55, at 277-78 (explaining that patents allows patent holders to signal to firms with complementary technology for cooperation).
59. Id.
large incumbent firm to manage the research occurring around its main technology, and to know and modulate its research expenditures. While large firms do not need patent protection in order to successfully profit from their technology, their patent portfolios generate additional income on top of sales from whatever innovation has been developed by the large firm. Thus, patent portfolios of increasing scope that can catch more infringers have greater value, because the larger the net the greater chance of significant license revenue. Additional scope may lead to super-additive licensing depending upon the subject matter of the large firm’s portfolio and the actions of its competitors.

IV. VALUATION OF PATENTS POSSESSED BY SMALL FIRMS: VENTURE CAPITAL SPECULATION IN LITIGABLE HIGH VALUE PATENTS EXPLAINS THE PATENT PARADOX

The portfolio theory shows why and how large firms patent but, as discussed in Section II, does not fully explain the patent paradox. First, the portfolio theory does not take into account the scope of patent claims. Patents have differential value depending on their scope. Second, the portfolio theory does not take into account the value of patents over time. Both of these factors affect how small firms patent. This section fills in the gap left by the portfolio theory, by focusing on why and how small firms patent. The portfolio theory and the underlying paradox rely on patent valuation methods that are not meaningful in all contexts. The non-payment of a maintenance fee means that a patent is not valuable now, in or out of a patent portfolio. That does not mean that it was never valuable.

Taking the portfolio theory in combination with the patenting behavior of small firms offers a more comprehensive view of the patent paradox. First, the patents of small firms tend to have differential patent value over time. This allows small firms to raise money for research through venture capital. Because small firms tend to patent more innovative subject matter with greater risk involved in its eventual commercialization than large firms, the value of their patents is realized, in part, through speculation on the value of these innovative technologies.

Second, small firms tend to have more extremely high value patents as measured in part by the high value of a subset of patents that tend to be litigated. The value of these litigated patents also correlates with structural differences that have been related to higher
patent value including greater claim scope. Further, the structure and claims of the patents of small firms show a greater emphasis on acquiring and protecting more claim scope. Small firms and individuals generally have not found and successfully commercialized a technology of their own. They are instead attempting to innovate a profitable technology to arrive at large firm status either by being acquired by a larger firm or by generating revenue off of a new valuable technology. Thus, patents filed by smaller firms will be directed to wholly new technologies. Small firms have little incentive to generate relatively small incremental increases in their value, since they often are not publicly held, and often are run by a management that has incentives to build the company quickly at the cost of greater risk. Thus, patents held by smaller firms tend to embody more research, take longer to prosecute, and have more claims, indicating that they may be more innovative and more valuable. This supports theories that describe smaller firms as the real engines of innovation, while larger firms slow innovation by putting more of an emphasis on defending what they already have.

The use of patents by small firms requires a different method of valuing the patents of small firms. Speculative investment, in the form of venture capital, tends to elevate the value of small firm patents, especially early on. Usually, this speculation does not bear fruit and results in the non-maintenance of the patents drawn to the technology of the small firms; however, this does not mean that the patents were never valuable. The potential upside value of these patents is demonstrated by the high value patents which are litigated. This speculation to find innovation defined by high value patents, at least in part, explains the patent paradox. Thus, the patents of small firms are valued, often by venture capital firms, by the value of the innovations they create and on how these innovations perform during their attempted commercialization in the market. A marker for patents that have been estimated at extremely high value is the willingness of parties to litigate matters related to these patents.

60. Allison et al., supra note 56, at 438, 463.
62. Allison et al., supra note 56, at 438, 463.
63. Rosen, supra note 47, at 411-12.
A. Speculation on the Value of Small Firm Patents: An Explanation for the Patent Paradox

The patent paradox can be, at least in part, attributed to speculation in small firm technology by venture capital organizations. Venture capitalists generally trade capital to small firms for stock in the small firm. Often venture capitalists require a controlling share in order to have influence over the management of the small firm.\(^6^4\) Recently, venture capitalists have focused almost exclusively on technology-based small firms.\(^6^5\) In 2000, 91% of venture capital investments were in technology and Internet related companies, according to one national survey.\(^6^6\) Venture capitalists generally try to have a total investment time of seven years.\(^6^7\) In this time, venture capitalists hope for a large return on their investment, in part to compensate for the high failure rate in venture capital investments of approximately 75%.\(^6^8\) The goal of many venture capitalists is to have several of a fund's "portfolio" of companies undergo an IPO or a sale of the company for cash or tradable securities.\(^6^9\)

Venture capital investments in technology companies have increased since 1979, when a clarification by the U.S. Department of Labor led to retirement accounts being able to invest more heavily in venture capital.\(^7^0\) During the period from 1983-1992, venture capital accounted for 3% of the research money spent, but also for 8% of the innovations developed.\(^7^1\) More recently, in 2000, venture capital investors committed $104 billion to 5,458 transactions, up from 1990 levels of just $3.4 billion and 1,317 deals.\(^7^2\) Thus, venture capital has become a significant source of money for innovative development from small firms.

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\(^{65}\) \textit{Id.}


\(^{67}\) \textit{Id.}


\(^{71}\) \textit{Id.}

\(^{72}\) Barrett, \textit{supra} note 69, at 306-07.
This increase in venture capital financing has driven a significantly higher patenting rate, and is associated with innovative and valuable patents. Kortum and Lerner show a correlation between the increase in patenting in certain industries (such as the drug, office, and computing machine industries), and the increase in venture capital investment in these industries. Further, Kortum and Lerner show that this effect on patenting by venture capital represents real innovation and not patenting because of the nature of venture capital investment.

Kortum and Lerner also assessed the value of the patents which were generated by venture capital supported firms, and found that venture capital supported firms tend to litigate their patents more. As the next section will discuss, this supports the innovative value of these patents.

The management of a venture capital supported firm may patent for reasons other than innovation. Firstly, the management may not trust the venture capitalist not to exploit their ideas. Typically, venture capitalists invest in more than one company. A venture capitalist, depending on the economic situation of the companies in its portfolio, may have an incentive to transfer patentable ideas from one company to another. Thus, prior to discussing an innovation with a venture capitalist, the management may file a patent application drawn to the innovation despite not knowing whether the innovation will be valuable or not, as a relatively cheap way to protect themselves. Secondly, the management of a venture capital supported firm may file and prosecute patent applications in order to enhance the firm's attractiveness to venture capitalists. It is often difficult for venture capitalists to assess the value of the patent portfolio of a firm, and the presence of more patents in a portfolio may give the

73. Kortum & Lerner, supra note 70, at 675.
75. Kortum & Lerner, supra note 70, at 689.
76. Id. at 690.
77. Id.
78. Id. at 689, 691.
79. Id. at 689.
80. See id. (suggesting that there is "a real possibility that entrepreneurs' ideas will be directly or indirectly transferred to other companies.").
81. Id.
impression that the portfolio is more valuable merely because there are more patents in it.82

While most firms in a venture capital portfolio will not succeed, the ones that do succeed do so to such a degree that the venture capital portfolio as a whole is still profitable. Venture capitalists perform research into the value of companies and the probability of the successful commercialization of their technology. Thus, at an early stage these companies are, at least to some degree, valued by venture capitalists. Likewise, their patent portfolios are also valued. Over time, the value of most of these small firms diminishes to zero or near zero, and likewise, so does the value of the patents in their portfolios. So, the maintenance fees of these patents are not paid. However, a subset of small firms in which venture capitalists invest turn a profit, and many of these turn a substantial profit.

Most of the patent portfolios of small firms have an increase in value early in the life of the firm when it is able to acquire venture capital backing. Later, in the life of the firm, the technology represented by the patent portfolio either sinks or swims. A minority of the firms and their portfolios increase greatly in value, while, for most of the firms, the value decreases to zero. Thus, even in a situation where most patents are not maintained, small firm portfolios as a group are still, on average, valuable enough to justify the expense of generating them.

B. A Subset of the Patents Owned by Small Firms Have High Value as Demonstrated by Their Tendency to Be Litigated

Small firm patents and large firm patents differ both structurally, in how their claims are drafted and prosecuted, and also in value. Patent litigation is a marker of a certain patent structure and extremely high patent value. Litigated patents tend to be of extremely high value at least at some point in their patent term and are disproportionately owned by small firms. Litigated patents should be among the most valuable patents.83 Obviously litigation is expensive, and so would only be undertaken if the underlying patent rights were

82. See Parchomovsky & Wagner, supra note 1, at 4 (noting that the value of patents is a "seemingly insoluble puzzle" that "has occupied a generation of patent scholars and policymakers"), 41-42 ("firms patent heavily to maximize the benefits of patent portfolios, and such benefits are directly determined by the quantity of patents assembled.").

83. See Allison et al., supra note 56, at 439 (stating that "litigated patents tend to be much more valuable than others on average" and "[w]hile not every valuable patent is necessarily litigated . . . the relationship is strong enough to justify the conclusion that litigated patents are a good proxy for valuable patents.").
valuable. For patent suits with between $1 million and $25 million at stake, litigation costs averaged $2 million per side.\textsuperscript{84} As further proof, litigated patents also have other traits that correlate with scholarly predictions of value.\textsuperscript{85}

Patents that are litigated tend to have more patent claims than non-litigated patents.\textsuperscript{86} Some have posited that the number of claims in a patent is indicative of increased claim scope.\textsuperscript{87} While this is not necessarily so, it is more expensive to prosecute more claims, suggesting that a patent with more claims is more important to the applicant.\textsuperscript{88} Also, a patent application being prosecuted in anticipation of litigation may have more claims in order to make the document more useful in litigation, by more particularly claiming the activity or product of a potential infringer.\textsuperscript{89} Thus, the finding of more claims in a patent that was prosecuted for litigation may be circularly caused by the intent for litigation. However, at least, the value of the subject matter protected by the patent must be higher at least at the time of filing and prosecution if the applicant is spending more money.

Litigated patents also contain more prior art citations.\textsuperscript{90} Additional citations may be indicative of more intense involvement on the part of the inventors during prosecution, since it is generally the inventors, and not the attorneys or agents prosecuting the patent applications, who are most familiar with the prior art. This involvement of the inventors may indicate that the invention is more important to them during prosecution. Also, more prior art searching\textsuperscript{91} may have been done in anticipation of the investment into research upon which the patent is based. There is a duty to disclose relevant art in the United States.\textsuperscript{92} Thus, performing a search and finding relevant art would impose a requirement to cite this art to the examiner during prosecution. More citations cited during a patent’s prosecution tends to show more thought put into the subject matter of the patent, and perhaps a higher importance placed on the patent. Further, patents that are litigated tend to have more self-citations, implying that they are

\textsuperscript{84} Id. at 441.
\textsuperscript{85} Id. at 448.
\textsuperscript{86} Id. at 451.
\textsuperscript{87} Id. at 449.
\textsuperscript{88} Id. at 452.
\textsuperscript{89} Id. at 452-53.
\textsuperscript{90} Id. at 453.
\textsuperscript{91} Further prior art searching is generally not required when filing a patent application.
\textsuperscript{92} MPEP, supra note 9, § 2001.
more likely to be parts of larger patent families.\textsuperscript{93} This also implies that the subject matter of the patent is important enough to undertake the expense of filing and prosecuting multiple patent applications.

Also, litigated patents tend to be cited in other patents much more often than non-litigated patents.\textsuperscript{94} If other patentees are referencing a patent, this may mean that the technological area in which the patent exists is an area in which more development is taking place. However, it may also merely be an indicator that the patent is better known because of litigation.

From the above, it seems that litigated patents tend to have higher value than non-litigated patents. During litigation, firms are willing to invest millions in these patents, making them exponentially more valuable than patents for which maintenance fees are not paid. Also, the other characteristics of these patents suggest that even before the patents were actually litigated, there were additional resources used to generate these patents, suggesting that they were, on average, more valuable to their applicants than other patents even from the beginning, when the technology upon which the patents were based may have been subject to venture capital speculation.

These more valuable litigated patents tend to be owned by smaller firms and individuals.\textsuperscript{95} For example, in a study performed by Allison, Lemley, Moore, and Trunkey (Allison study), 39.2\% of patents owned by small entities, as defined by the USPTO, were litigated, while other patents were only litigated 13.6\% of the time.\textsuperscript{96} Seventy one percent of patents that were not litigated were initially issued to large firms, while only 37\% of litigated patents were initially issued to large firms.\textsuperscript{97} This would tend to show that this high value subset of patents is more common to smaller than larger firms.

In further support of the notion of the disproportionate possession of high value patents by small firms, a study by Lanjouw and Schankerman shows an inverse correlation between patent...
portfolio size and litigation, saying that the smaller the portfolio, the more likely litigation is to occur. They assert that this correlation is also true for small firms. That is, smaller firms with more patents are less likely to litigate any of their patents than smaller firms with fewer patents. While Lanjouw and Schankerman’s data seem to suggest that there is still a correlation between small firm size and possession of litigated patents, the inverse correlation between portfolio size and litigation probability seems to be stronger. Upon closer scrutiny, however, it appears that Lanjouw and Schankerman’s data probably supports Allison’s assertions that small firms have a greater tendency to litigate patents than large firms.

The key distinction between Lanjouw and Schankerman’s study and the Allison study is the definition of small firms. Lanjouw and Schankerman define a small firm as one with fewer than 5,425 employees. Thus, many firms that are fairly large such as Biogen Idec (3,340 employees) and Millennium Pharmaceuticals (1,142 employees) would be considered “small firms” in Lanjouw and Schankerman’s study. The Allison study defined small firms the same way the USPTO does, as having fewer than 500 employees. It is unlikely that firms which were defined as small firms under the USPTO rule would have the larger patent portfolios measured in Lanjouw and Schankerman’s study, containing greater than 100 patents. Most of the “small listed” firms in Lanjouw and Schankerman’s study were probably not small entities by the USPTO definition. Firms of fewer than 500 employees would rarely be able to afford large portfolios. This is further evidenced by the behavior of “small listed firms” with larger patent portfolios. These “small listed firms” with patent portfolios of greater than 100 patents seemed to

99. Id.
100. Id. at 57 tbl.3.
101. Id.
102. Id. at 52. This is the median number of employees in their study.
106. Lanjouw and Schankerman refer to firms traded on the stock market as “listed” firms. Lanjouw & Schankerman, supra note 98, at 52.
litigate about as often as large listed firms.\textsuperscript{107} On the other hand, unlisted companies in Lanjouw and Schankerman’s study had the highest rates of patent litigation especially when the unlisted firms had patent portfolios of fewer than 100 patents.\textsuperscript{108} Lanjouw and Schankerman’s “unlisted firms” category, especially unlisted firms with patent portfolios of fewer than 100 patents, should represent some of the smallest entities measured in that study,\textsuperscript{109} many of which would be small entities as defined by the USPTO and Allison. Further, even listed small firms with small patent portfolios probably contain many small entities by the USPTO definition.

For purposes of this comment, small firms are defined using the USPTO definition. While there must be differential patenting behavior between larger firms, such as Biogen Idec and huge firms such as Pfizer (106,000 employees)\textsuperscript{110} and Amgen (16,500 employees),\textsuperscript{111} these differences are not parts of the explanation for the patent paradox put forth here.

Small firms are more likely than large firms to have extremely high value patents as measured by enhanced litigation of small firm patents. This, coupled with the ability to reap large returns from a small company which makes a marketable innovative invention, results in speculative investment in the technologies of small firms and thereby, their patents. Largely, speculation in the value of innovative technologies comes out of venture capital money. Most firms that venture capital firms invest in do not produce a return on the investment. Venture capital firms depend on large returns on a few of the members of their portfolio to recoup this high failure rate. This venture capital money and its increase in use over the last two decades is what largely accounts for the patent paradox.

V. CONCLUSION

The patent paradox is resolved in two ways. The first is that despite not needing patent protection to remain dominant in their technology market, large firms patent to generate additional income

\begin{itemize}
\item \textsuperscript{107} Id. at 57 tbl.3.
\item \textsuperscript{108} Id.
\item \textsuperscript{109} Id. at 66 tbl.7.
\item \textsuperscript{110} Hoover’s Online, http://www.hoovers.com/pfizer/—ID_11175—/free-co-factsheet.xhtml (last visited Jan. 20, 2007).
\item \textsuperscript{111} Hoover’s Online, http://www.hoovers.com/amgen/—ID_12623—/free-co-factsheet.xhtml (last visited Jan. 20, 2007).
\end{itemize}
through the licensing of their portfolios and to defend their existing technologies. The second is that small firms patent in order to protect their technology, and in a sense, advertise for support by venture capital. The investment of venture capital into the speculative market of innovative small firm technology explains the low value of patents when looked at from the perspective of maintenance fee payment. Small firms do value the protection that patents afford because they do not have the same alternatives for the protection of their technology that large firms do. Further, the often radical changes in the value of small firm patents over time and the tendency of extremely high value litigated patents to be owned by small firms explains the patent paradox. The extreme differences in the values of small firm patents by the time of the payment of maintenance fees on these patents shows that valuation by maintenance fee payment does not capture the high value of these litigated patents, and generates the false appearance of a patent paradox, supported by the assertion of large firms that they do not need patents.