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Dr. Peter A. Malaspina

New York State Office of the Attorney General

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PATENT CITATION ANALYSIS AND PATENT DAMAGES

DR. PETER A. MALASPINA *

INTRODUCTION

In recent years, parties have sought to establish new methods for estimating patent damages awards that are firmly grounded in economic principles.¹ To this end, some experts have turned to using quantifiable patent characteristics to ascertain insight into patent values. One such quantifiable characteristic is the total number of times a given patent has been cited by subsequently issuing patents (forward citation counts). This paper provides a discussion of the intuition and existing methods for analyzing forward citation counts to estimate patent damages awards (referred to herein as “Patent Citation Analysis.”)²

The use of Patent Citation Analysis is not without its controversies, as several experts’ Patent Citation Analyses have been excluded by the courts over concerns about reliability. To address these issues of reliability, this paper provides a review and discussion of the courts’ orders on the admissibility of Patent Citation Analysis under the *Daubert* standard.³ I find

* Chief Economist at the New York State Office of the Attorney General (The views expressed here are those of the author and do not reflect the views of the New York State Attorney General or the Office’s Division of Economic Justice). I am grateful to David Churella and Craig Slater for their research assistance. I am also grateful to Jeremy Petranka, Chris Velturo, Paul Malherbe, Jeff Boaz, and David Molin, for their many useful suggestions.

1. Zelin Yang, *Damaging Royalties: An Overview of Reasonable Royalty Damages*, 29 BERKELEY TECH. REV. 647, 648 (2014).

2. Patent damages can take the form of lost profits or a reasonable royalty. In order to receive damages in the form of lost profits, the patent holders must show that, but for the infringement, it would have made a subset of the infringer’s sales. In the case where the patent holder does not claim (or cannot demonstrate) lost profits, the patent holder is entitled to damages in the form of a reasonable royalty based on what the patentee would have received from an arms-length negotiation with the infringer, with both parties assuming the patent(s) at issue is valid and infringed. (See Mark A. Lemley, *Distinguishing Lost Profits From Reasonable Royalties*, 51 WM. & MARY L. REV. 655, 655–56 (2009)).

3. The standard comes from the Supreme Court case *Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 579, 598 (1993); The *Daubert* standard is “used by a trial judge to make a preliminary assessment of whether an expert’s scientific testimony is based on reasoning or methodology that is scientifically valid and can properly be applied to the facts at issue.” (See *Daubert Standard*, LEGAL INFORMATION INSTITUTE, https://www.law.cornell.edu/wex/daubert_standard (last visited Feb. 28, 2017, 3:56pm)).

that the courts' reasons for excluding certain instances of Patent Citation Analysis stem from findings of fault in each excluded expert's particular execution of Patent Citation Analysis. Therefore these exclusions are not indicative of any inherent unreliability in the analysis generally. Furthermore, to supplement this discussion on reliability, I present Patent Citation Analysis methods that may be employed to address the courts' concerns.

Patent Citation Analysis is an important tool for estimating patent damages awards. Patent Citation Analysis is particularly valuable in a world where the products covered by patents are increasingly complex because of the analysis's ability to apportion value among multiple patented technologies that may coexist within a commercial embodiment (*i.e.*, within a covered product(s)). This paper seeks to facilitate Patent Citation Analysis's use as a tool (under the proper circumstances), by providing clarity on the intuition and methods and discussing the issues of reliability raised by the courts.

The remainder of this paper is organized as follows: Section II provides a brief overview of the intuition behind Patent Citation Analysis and the relevant academic literature; Section III provides an overview of the relevant case law; Section IV discusses the relevant issues from the case law, and demonstrates methods of Patent Citation Analysis that address the issues raised by the courts. Section V offers concluding remarks.

I. PATENT CITATION ANALYSIS OVERVIEW

In this section, I provide a basic overview of the intuition behind using patent citation counts to infer an economic value. I also provide a brief description of the relevant academic literature on the methods used in Patent Citation Analysis.

A. *The Intuition of Patent Citation Analysis*

Each U.S. patent contains references to previously issued patents under the patent's "References Cited" as a way to identify the relevant patented inventions in the prior art.⁴ The empirical foundation of Patent Citation Analysis exists in the observed counts of forward patent citations—the number of times a patent has been referenced by subsequently issued patents. The compilations of these "backward citations" (for each patent) are a collaborative effort made by the patent applicant, counsel for the applicant,

4. Manuel Trajtenberg, *A Penny for Your Quotes: Patent Citations and the Value of Innovations*, 21 RAND J. OF ECON. 172, 173 (1990).

and the patent examiner.⁵ Each one of these backwards citations engenders a forward citation for the referenced patent (*i.e.*, a backwards citation from a newer patent to an older patent counts as a forward citation for the older patent received from the newer patent). In Patent Citation Analysis, the total counts of forward citations (“citation counts”) are used to estimate a patent’s economic value by comparing citation counts across samples of patents.

The basic intuition for using citation counts as a proxy for economic value is that patents with relatively high values tend to receive more forward citations than relatively less valuable patents, all else being equal.⁶ The logic behind this intuition is that valuable patented technology will encourage new yet related innovations, which will increase the number of citations back to the prior patented technology thereby increasing the citation counts of the prior patented technology. Using this basic economic framework, one can estimate the relative economic value of patents. This estimate can be achieved by comparing citation counts across a sample of comparable patents, so long as suitable controls are put in place.

B. Literature Review

The evidence that citation counts correlate with patent values is well documented in the existing economic literature.⁷ In a 1990 article, Manuel Trajtenberg found that citation-weighted patent counts are indicative of the value of innovations using a sample of CT Scanner patents.⁸ Harhoff et al. (1997) employs a wider sample of U.S. and German patents that support “Trajtenberg’s conclusions that patents with greater economic value are

5. *Id.* at 174.

6. Dietmar Harhoff, et. al, *Citations, Family Size, Opposition and the Value of Patent Rights*, 32 RES. POL’Y. 1343, 1343–44 (2003); Bronwyn H. Hall et. al, *Market Value and Patent Citations*, 36 RAND J. OF ECON. 16, 16–17 (2005); Manuel Trajtenberg, *A Penny for Your Quotes: Patent Citations and the Value of Innovations*, 21 RAND J. OF ECON. 172, 172–75 (1990); Adam B. Jaffe & Gaétan de Rassenfosse, *Patent Citation Data in Social Science Research: Overview and Best Practices*, 68 J. ASS’N. FOR INFO. SCI. & TECH. no. 6, 1360, 1364 (2017); Bronwyn H. Hall et. al, *The NBER Patent Citations Data File: Lessons, Insights and Methodological Tools* (Nat’l Bureau of Econ. Research, Working Paper No. 8498, 2001).

7. Dietmar Harhoff, et. al, *Citations, Family Size, Opposition and the Value of Patent Rights*, 32 RES. POL’Y. 1343, 1343–44 (2003); Bronwyn H. Hall et. al, *Market Value and Patent Citations*, 36 RAND J. OF ECON. 16, 16–17 (2005); Manuel Trajtenberg, *A Penny for Your Quotes: Patent Citations and the Value of Innovations*, 21 RAND J. OF ECON. 172, 172–75 (1990); Adam B. Jaffe & Gaétan de Rassenfosse, *Patent Citation Data in Social Science Research: Overview and Best Practices*, 68 J. ASS’N. FOR INFO. SCI. & TECH. no. 6, 1360, 1364 (2017); Bronwyn H. Hall et. al, *The NBER Patent Citations Data File: Lessons, Insights and Methodological Tools* (Nat’l Bureau of Econ. Research, Working Paper No. 8498, 2001).

8. Manuel Trajtenberg, *A Penny for Your Quotes: Patent Citations and the Value of Innovations*, 21 RAND J. OF ECON. 172, 172–75 & 184–85 (1990).

more heavily cited in subsequent patents.”⁹ Gaffe and de Rassenfosse (2016) provide a meta-analysis of published research on Patent Citation Analysis and found that “forward citation intensity is, in fact, correlated with economic value.”¹⁰

The literature also contains insight into the common methods for dealing with patent citation data. For example, Hall et. al. (2001) provides a discussion of patent data sources and proposes adjustment methods to be used when analyzing patent citation counts.¹¹ A general resource on the use of patent citation data exists in the compilation of research papers found in “Patents, Citations, and Innovations,” by Jaffe and Trajtenberg.¹²

Also relevant to Patent Citation Analysis are the published estimates of the distributions of patent values. For example, research by Schankerman (1998) reports estimates of the distribution of patent values by percentiles for four industries: pharmaceuticals, chemicals, mechanical, and electronics.¹³ Similarly, Harhoff et. al. (1997) estimates the value of patented inventions using samples of German and U.S. patents.¹⁴ The findings from this research can be utilized within Patent Citation Analysis to calibrate the imputed values from citation counts (as described in Section IV.C below).

II. OVERVIEW OF RELEVANT COURT ORDERS

This section provides an account of the recent, publicly available court orders on the admissibility of Patent Citation Analysis under the *Daubert* standard. This account is intended to provide context for the discussion that follows wherein I address the issues raised by the courts

9. DIETMAR HARHOFF ET AL., CITATION FREQUENCY AND THE VALUE OF PATENTED INNOVATION 1-11 (Centre for Eur. Econ. Res. (ZEW), Discussion Paper No. 97-27, 1997).

10. Adam B. Jaffe & Gaétan de Rassenfosse, *Patent Citation Data in Social Science Research: Overview and Best Practices*, 68 J. ASS’N. FOR INFO. SCI. & TECH. no. 6, 1360, 1364 (2017).

11. BRONWYN H. HALL ET. AL., THE NBER PATENT CITATIONS DATA FILE: LESSONS, INSIGHTS AND METHODOLOGICAL TOOLS (Discussion paper No. 3094, 2001).

12. ADAM B. JAFFE & MANUEL TRAJTENBERG, PATENTS, CITATIONS, AND INNOVATIONS (The MIT Press 2005).

13. Mark Schankerman, *How Valuable is Patent Protection? Estimates by Technology Field*, 29 RAND J. OF ECON. 77, 80 (1998).

14. DIETMAR HARHOFF ET. AL., EXPLORING THE TAIL OF PATENTED INVENTION VALUE DISTRIBUTIONS 279-309 (Econ., Law and Intellectual Prop., Springer US, Discussion Paper No. 97-30, 2003).

A. *Oracle America, Inc. v. Google, Inc.*

In 2010, Oracle sued Google, alleging infringement of several of its patents and copyrights relating to application programming interfaces.¹⁵ The defendant's damages expert used a Patent Citation Analysis to rank the value of three of the patents-in-suit relative to a set of 22 other patents.¹⁶ The plaintiff filed a motion to exclude portions of the expert's damages report. In an order, the court decided to strike the ranking of one patent ("the '104 Patent"), while declining to exclude the rankings of the other two.¹⁷

In its order, the court found the expert's implementation of Patent Citation Analysis for the '104 Patent to be "fatally flawed" because the expert failed to account for the fact that the '104 Patent was re-issued twice and therefore failed to include citation counts to its predecessor patents.¹⁸ The defendants responded to this criticism by arguing that because the '104 Patent had been reissued with different claims, "counting citations to predecessor patents would have been inappropriate."¹⁹

The court was not persuaded by the defendant's argument, stating:

Patents are not cited for their claim language; instead, patents are cited if they disclose important ideas material to a later application's patentability. That is why the citations are to the entire patent, which is largely composed of specifications and drawings, not claims. The predecessor patents to the '104 patent had the same specifications and drawings. Not counting citations to these predecessor patents is error.²⁰

Therefore, the court excluded the expert's Patent Citation Analysis with respect to the '104 Patent but did not exclude the Patent Citation Analysis with respect to the other two patent(s)-in-suit.²¹

15. *Oracle Am., Inc. v. Google Inc*, No. C 10-03561 WHA, 2012 WL 877125, at *1 (N.D. Cal. Mar. 15, 2012).

16. *Id.* at *6.

17. *Id.* at *5.

18. *Id.* at *2.

19. *Id.*

20. *Id.*

21. *Id.* at *5.

B. Realtek Semiconductor Corp. v. LSI Corp.

In 2012, Realtek Semiconductor Corp. sued LSI Corp. for infringement of two patents relating to Wi-Fi standards.²² The plaintiff's expert utilized Patent Citation Analysis to determine the value of two patent portfolios, one of which contained the patents-in-suit, which the court excluded.²³

The plaintiff's expert used Patent Citation Analysis to value one patent portfolio that included the patents-in-suit to another allegedly comparable patent portfolio by aggregating patent citation counts across each portfolio of patents. However, the expert did not use Patent Citation Analysis to apportion value to the patents within the patent portfolio which included the patents-in-suit (the "802.11 SEP portfolio"). Instead, the plaintiff's expert decided to apportion (1/N) value to each patent within the portfolio.²⁴

While not addressing the reliability of Patent Citation Analysis generally, the court took exception with the expert's 1/N apportionment of the entire 802.11 SEP portfolio to each of the patents-in-suit. To this end, the court noted that the plaintiff's expert report "indicates that a vast majority (93 percent) of the citations attributed to LSI's 802.11 SEP portfolio come from another patent, which is not one of the patents-in-suit."²⁵ Furthermore, the court noted, that had the plaintiff's expert "calculated the value of only the patents-in-suit based on the patent citation analysis, the value revealed for those two patents would represent only 0.1% of the value of the LSI's entire portfolio."²⁶

C. Finjan Inc. v. Blue Coat Systems Inc.

In 2013, Finjan sued Blue Coat Systems for the infringement of six patents relating to web security.²⁷ The plaintiff's expert conducted a patent citation analysis to value the patents-in-suit, which the court rejected for a "failure to specifically tie the methodology to the facts of this case."²⁸

In its order, the court noted that "[a]lthough a qualitative analysis of asserted patents based upon forward citations may be probative of a reasonable royalty in some instances," the damages expert's application of

22. Realtek Semiconductor Corp. v. LSI Corp., No. C-12-03451 RMW, 2012 WL 4845628, at *1 (N.D. Cal. Oct. 10, 2012).

23. Realtek Semiconductor Corp. v. LSI Corp., No. C-12-03451-RMW, 2014 WL 46997, at *2 (N.D. Cal. Jan. 6, 2014).

24. *Id.* at *12–16.

25. *Id.* at *16.

26. *Id.* at *3.

27. Finjan, Inc. v. Blue Coat Sys., Inc., No. 13-CV-03999-BLF, 2015 WL 4272870, at *1 (N.D. Cal. July 14, 2015).

28. *Id.* at *25.

the analysis must be rejected.²⁹ In reaching this conclusion, the court opined on several areas where the damages expert's specific execution of the Patent Citation Analysis failed to align with the "facts of the case," including:

- Failure to account for the value of the accused features as a portion of the accused products;
- Failure to account for patent age in the citation analysis; and
- Failure to account for self-citations.³⁰

The court found that the damages expert's Patent Citation Analysis "does not account for the value of the accused features as a portion of the accused products."³¹ Finding further that,

use of the forward citation analysis . . . does not demonstrate the value of the asserted patents in the marketplace in relation to other patents that cover or potentially cover the infringing and non-infringing features of the accused products. The resulting apportionment demonstrates, at most, the asserted patents' relative value in the abstract, untethered to any of the facts in this case" and thus failed to "carefully tie proof of damages to the claimed invention's footprint in the market place."³²

The court also found that the damages expert's Patent Citation Analysis failed to properly account for self-citations and patent age, stating that "two of the patents-in-suit are related and many of [p]laintiff's patents reference one another. Surely a patent's objective quality cannot be based on the number of times an inventor cites himself in prosecuting related patents," and also noting that "the patent with the highest number of forward citations is (unsurprisingly) the oldest patent in this suit."³³ The court ultimately found that the expert's "straightforward application of a forward citation analysis without taking into consideration these potential problems renders the method unreliable."³⁴

29. *Id.* at *24.

30. *Id.* at *24–26; Note, self-citations are forward citations received from a patent owned by the same entity that controls the patent receiving the forward citation.

31. *Id.* at *24–25.

32. *Id.* at *26–27.

33. *Id.* at *25.

34. *Id.*

D. Better Mouse Co., LLC v. Steelseries ApS, et al.

In 2014, Better Mouse Co. sued Steelseries for allegedly infringing one of its patents related to computer controller mouse technology.³⁵ The defendant's damages expert conducted a Patent Citation Analysis for the patent-in-suit which the court declined to reject under the *Daubert* standard.³⁶

With respect to the overall reliability for Patent Citation Analysis as used in patent damages, the court opined that,

[t]o the extent Plaintiff claims that forward citation analysis is never relevant for patent valuation, the Court rejects that claim. No binding authority states that forward citation analysis is per se not relevant to the facts of any case. Instead, the Federal Circuit has said that 'damages models are fact-dependent,' *Commonwealth Sci. & Indus. Research Org. v. Cisco Sys., Inc.*, 2015-1066, 2015 WL 7783669, slip. op., at 11 (Fed. Cir. Dec. 3, 2015), and that it is the duty of the party offering a model to sufficiently tie the model to the facts of the case in which the model is being applied, *Summit 6*, 802 F.3d at 1296. Here, SteelSeries has submitted publications which show that citation numbers correlate with patent value in several fields. That at least provides some indication that the basic premises necessary for a forward citation analysis to apply are present in this case.³⁷

The Court also found that the expert described his analysis and that the analysis adjusted for the age and technology of the patents included in the analysis.³⁸

E. Comcast Cable Commc'ns LLC v. Sprint Commc'ns Co. L.P.

In 2012, Comcast sued Sprint alleging patent infringement.³⁹ The defendant's expert used a Patent Citation Analysis which the court declined to reject under the *Daubert* standard.⁴⁰

35. *Better Mouse Co., LLC v. Steelseries ApS, et al.*, No. 2:14-CV-198-RSP, 2016 WL 115686, at *1 (E.D. Tex. Jan. 9, 2016).

36. *Id.*

37. *Better Mouse Co., LLC v. Steelseries ApS, et al.*, No. 2:14-CV-198-RSP, 2016 WL 3611528, at *2 (E.D. Tex. Jan. 5, 2016).

38. *Id.* at *3.

39. *Comcast Cable Commc'ns LLC v. Sprint Commc'ns Co. L.P.*, 218 F. Supp. 3d 375, 379 (E.D. Pa. 2016).

40. *Id.* at 381.

When considering the plaintiff's objections to the defendant's expert's use of Patent Citation Analysis, the Court addressed several issues, including:

- Evidence for patent citations as an indicator of patent value in the academic literature,
- The reliability of Patent Citation Analysis for patent damages analysis, and
- Potential adjustments that can be made to the citation analysis.⁴¹

With respect to the academic literature on Patent Citation Analysis and its admissibility under the *Daubert* standard, the court noted that

the forward citation method of analysis has been recognized in the academic literature as reliable since the 1990s. Indeed, one meta-analysis of published research on forward citation analysis . . . found 'forward citation intensity is, in fact, correlated with economic value.' In short, courts have not rejected forward citation analysis outright.⁴²

With respect to the reliability of Patent Citation Analysis for patent damages, the Court addressed the plaintiff's reference to *Finjan* (described above)—where an expert's Patent Citation Analysis was excluded—noting that *Finjan* does not reject forward citation analysis outright—rather, that case recognizes that “a qualitative analysis of asserted patents based upon forward citations may be probative of a reasonable royalty in some instances.”⁴³

The Court also found that the defendant's expert's Patent Citation Analysis sufficiently took into consideration the “facts of the case” by adjusting for patent age and technology.⁴⁴ To support this conclusion, the Court contrasted the defendant's expert's Patent Citation Analysis with the Patent Citation Analysis that was excluded in *Finjan*, noting that in *Finjan*,

the expert was excluded because he failed to ‘tie the methodology to the facts of the case’ and failed to consider ‘potential problems’ with his method of forward-citation analysis. For example, “many of the [p]laintiff's patents reference one another,” and the court observed that patent value should not be based on ‘the number of times an

41. *Id.* at 382–84.

42. *Id.* at 383.

43. *Id.*

44. *Id.* at 384.

inventor cites himself in prosecuting related patents.’ In contrast, [the defendant’s expert] tied his analysis to the facts in this case by adjusting the forward citation method to account for the age and category of the ‘870 patent and the other patents covered by the Nokia-Comcast Agreement.⁴⁵

Therefore, the Court found that defendant’s expert made the necessary adjustments for age and technology to sufficiently tie the Patent Citation Analysis to the “facts of the case,” concluding that there was no justification for rejecting the defendant’s expert’s Patent Citation Analysis under the *Daubert* standard.⁴⁶

III. ADDRESSING THE ISSUES RAISED BY THE COURT: TYING THE PATENT CITATION ANALYSIS TO THE FACTS OF THE CASE

The court orders provided above contain both affirmations and condemnations of Patent Citation Analysis, and have, on occasion, resulted in the exclusion of expert opinions on Patent Citation Analysis under the *Daubert* standard. In my opinion, the reasons offered by the court for these exclusions are to be interpreted generally as finding fault in each excluded expert’s specific execution of Patent Citation Analysis and not indicative of any inherent unreliability in the generalized analysis itself. From this perspective, the totality of the courts’ findings indicates that the connection between patent citation counts and patent value is well-established in the academic literature, and that Patent Citation Analysis is a reliable method to estimate patent damages under certain conditions when adequate controls are put in place by tying the analysis to the “facts of the case.”⁴⁷

The remainder of this Section discusses these issues in the context of the relevant court orders where the reliability of Patent Citation Analysis was challenged under the *Daubert* standard. Therein, I address several of the issues raised by the courts, including:

- Accounting for the value of the patent(s)-in-suit in the marketplace for the accused products as distinct from the value of the patent;
- Controlling for other observable characteristics of each patent including:
- Patent age,

45. *Id.* (quoting *Finjan, Inc. v. Blue Coat Sys., Inc.*, No. 13-CV-03999-BLF, 2015 WL 4272870, at *8 (N.D. Cal. July 14, 2015).

46. *Id.*

47. *See supra* Section III.E, where the court found that evidence of a correlation between patent citation counts and value has been recognized in the academic literature since the 1990s.

- Field of patent technology,
- Self-citations; and
- How to treat citation counts for re-issued patents.

The discussion of these issues demonstrates existing methods of Patent Citation Analysis that address the courts' concerns under certain conditions.

A. *Value of the Patent(s)-in-Suit in the Marketplace for the Accused Products*

In *Finjan*, the court opined that the damages expert for the plaintiff failed to connect her Patent Citation Analysis to the value of the asserted patents in the marketplace for the accused products, noting that:

use of the forward citation analysis . . . does not demonstrate the value of the asserted patents in the marketplace in relation to other patents that cover or potentially cover the infringing and non-infringing features of the accused products. The resulting apportionment demonstrates, at most, the asserted patents' relative value in the abstract, untethered to any of the facts in this case.⁴⁸

Therefore, the court found that the expert's Patent Citation Analysis did not capture the value of the asserted patents in the marketplace because the analysis was not linked in any way to values of inventions as they exist in the accused products or other comparable products that practice the patents.⁴⁹ I share the court's concerns on this issue. In the remainder of this section, I discuss how these concerns may be addressed within Patent Citation Analysis through extant licenses to the patent(s)-in-suit—licenses that would typically be considered under *Georgia-Pacific* Factor 1.⁵⁰

A previous license that specifies a royalty for use of the patent(s)-in-suit, that covers products that are comparable to the defendant's accused products, is often the best starting point for a reasonable royalty analysis.^{51,52} However, in some cases, the patent(s)-in-suit are not licensed in absolute isolation within previous licenses, but instead bundled together with rights

48. *Finjan, Inc. v. Blue Coat Sys., Inc.*, No. 13-CV-03999-BLF, 2015 WL 4272870, at *8 (N.D. Cal. July 14, 2015).

49. *Id.*

50. The fifteen *Georgia-Pacific* factors are the most common framework for determining reasonable royalties. The first factor is the royalties the patentee receives for licensing the patent in suit. See Zelin Yang, *Damaging Royalties: An Overview of Reasonable Royalty Damages*, 29 BERKELEY TECH. REV. 647, 651 (2014).

51. *Id.* at 669.

52. The circumstances of a potentially comparable license and the claimed technology must be scrutinized to ensure that the licenses are actually sufficiently comparable (*See id.* at 669).

to other patents in a portfolio of patents (a “Patent Portfolio”), which is licensed at a clearly defined royalty (the “Patent Portfolio Royalty”)⁵³ that covers products that are comparable to the accused products.⁵⁴ In these circumstances, the Patent Portfolio Royalty becomes the link between the Patent Citation Analysis and the “facts of the case” with respect to the value of asserted patents in the marketplace for the accused products.⁵⁵

The Patent Portfolio Royalty gives the expert important information about the value of the patent(s)-in-suit as embodied in the accused products. Without this information, even if an expert estimates the absolute value of the patent(s)-in-suit using Patent Citation Analysis alone, the expert would still need to apportion the value of the patent in the abstract to the value of the patent as embodied within the accused products without any straightforward method to conduct this apportionment.

Furthermore, calculating the absolute value of the patent in the abstract places a much stronger burden on the precision of the calibration of known distributions of patent values to address the particular patent(s)-in-suit.⁵⁶ Finding a published, comparable estimate of the distributions of value for patents relating to a particular technology at a particular point in time may prove difficult.

Alternatively, with the Patent Portfolio Royalty in hand, estimating the value of the patent(s)-in-suit simplifies to an apportionment of the known value of the entire Patent Portfolio to the individual member patents.⁵⁷ This basic apportionment methodology using Patent Citation Analysis was employed by the defendant’s expert in *Comcast Cable Commc’ns*, which the court allowed under the *Daubert* standard.^{58,59}

53. The Patent Portfolio Royalty can be defined as a lump-sum, percentage of sales, or per-unit amount.

54. Patent Citation Analysis is limited in that it can only establish the value of patents, so in order for a Patent Portfolio to be useful for Patent Citation Analysis, the Patent Portfolio Royalty must apply only for the use of licensed patents (unless there exists a reliable method to apportion the Patent Portfolio Royalty to the amount that covers the licensed patents as distinct from other elements covered by the license).

55. In some cases, licenses to the patent(s)-in-suit, even though portfolio licenses, may not exist. In these cases, experts may attempt to use a comparable license to a comparable patent(s). Once comparability has been established, if the comparable patent(s) exists within a portfolio, then the methods for valuing the comparable patent(s) within a portfolio are essentially the same as the methods described below for valuing the patent(s)-in-suit within a portfolio.

56. For example, by estimating the value of patent(s)-in-suit by taking the percentile rank of citation counts and linking them to the percentiles of patent values available in the economic literature, without using any additional information about the value of patent(s)-in-suit.

57. The methods for calculating this apportionment are described below (*See infra* Section IV.C).

58. *Comcast Cable Commc’ns LLC. v. Sprint Commc’ns Co. L.P.*, 218 F. Supp. 3d 375, 381 (E.D. Pa. 2016).

59. An analogous apportionment method was employed by the defendant’s expert in *Better Mouse Co., LLC* to value patents in an existing portfolio license that were comparable to the patent-in-suit, which

The Patent Citation Analysis apportionment exercise described above requires that the expert determine the ranking (in terms of citation counts) of the patents in the Patent Portfolio relative to other similar patents.⁶⁰ This ranking provides a means to assess the relative value of the patents in the Patent Portfolio. However, before citation counts can be compared across a sample of patents, the expert must account for factors that may impact the number of citations a patent receives.

B. Adjustments for Patent Technology and Age

Several of the court rulings discussed above refer to the adjustments that can be made to improve comparisons of forward citation counts across patents.⁶¹ In particular, the courts have noted experts' methods (or lack thereof) for accounting for technology and age.⁶²

Left unaccounted for, a patent's age (time elapsed since issuance) may bias its forward citation count because, as the time since issuance increases, there are more opportunities for the patent to accumulate forward citations from subsequently issuing patents. Similarly, a patent's field of technology may affect the estimated relationship between a patent's age (time since issuance) and the patent's forward citation frequency, as patents from different fields of technology may accumulate citations at fundamentally different rates. Therefore, when choosing a sample of patents (a "Patent Sample") with which to conduct a Patent Citation Analysis, an expert should include patents of comparable age and from similar or related fields to the patents in the Patent Portfolio.⁶³

For the purposes of assessing the technological comparability of candidate patents for the Patent Sample, a useful set of benchmarks is provided by organizational patent classification systems.⁶⁴ For example, the U.S. Patent Classification System is a system for organizing all U.S. patent documents and other technical documents into relatively small collections

the Court declined to reject under the *Daubert* standard. See *Better Mouse Co., LLC v. Steelseries ApS*, et al., No. 2:14-CV-198-RSP, 2016 WL 115686, at *4–5 (E.D. Tex. Jan. 9, 2016).

60. This ranking method is noted in the Court's ruling in *Comcast Cable Commc'ns*. See *Comcast Cable Commc'ns LLC*, 218 F. Supp. at 382.

61. *Oracle Am., Inc. v. Google Inc.*, No. C 10-03561 WHA, 2012 WL 877125, at *2 (N.D. Cal. Mar. 15, 2012); *Better Mouse Co., LLC*, 2016 WL 115686, at *3; *Finjan, Inc. v. Blue Coat Sys., Inc.*, 13-CV-03999-BLF, 2015 WL 4272870, at *6–8 (N.D. Cal. July 14, 2015).

62. *Oracle Am., Inc.*, 2012 WL 877125, at *2 (N.D. Cal. Mar. 15, 2012); *Better Mouse Co., LLC*, 2016 WL 115686, at *3; *Finjan, Inc.*, 2015 WL 4272870, at *8.

63. BRONWYN H. HALL ET. AL, THE NBER PATENT CITATIONS DATA FILE: LESSONS, INSIGHTS AND METHODOLOGICAL TOOLS 29–32 (Discussion paper No. 3094, 2001).

64. *Id.* at 26.

based on common subject matter.⁶⁵ Another classification system, which is particularly useful for more recent patents, is the Cooperative Patent Classification (“CPC”). The CPC is an endeavor by the European Patent Office and the U.S. Patent and Trademark Office to harmonize their classification systems.⁶⁶

In the absence of other information, an expert can rely on these classifications to construct a Patent Sample to include patents in similar or related fields compared to the patents in the Patent Portfolio.⁶⁷ A potential starting point in this endeavor is to determine all of the patent classes represented in the Patent Portfolio and then include all of the patents in those classes.

To account for any potential bias in age, the expert should choose a Patent Sample that is representative of the Patent Portfolio in terms of age of the member patents (given the constraints on technological comparability discussed above).⁶⁸ To account for any remaining age bias within the Patent Sample, the expert may run a regression⁶⁹ of citation counts on time elapsed since issuance, where each patent in the Patent Sample provides a single observation to fit the regression model.

For example, consider the following regression model:

$$Citations_i = f(age_i | \beta) + \varepsilon_i$$

Where f is a function capturing the relationship between age and citations, β is the set of parameters to be estimated for f , and for each patent i $Citations_i$ is the unadjusted citation count, age_i is the time elapsed since issuance, and ε_i is the error term.

Once the model parameters have been estimated ($\hat{\beta}$), the i th residual from this regression ($\hat{\varepsilon}_i$) is then the “age-adjusted citation count” for each

65. *Overview of the U.S. Patent Classification System (USPC)*, UNITED STATES PATENT AND TRADEMARK OFFICE (Mar. 1, 2017, 2:22pm), <https://www.uspto.gov/sites/default/files/patents/resources/classification/overview.pdf>.

66. *Overview of the U.S. Patent Classification System (USPC)*, UNITED STATES PATENT AND TRADEMARK OFFICE (Mar. 2, 2017, 2:24pm), <https://www.uspto.gov/patents-application-process/patent-search/classification-standards-and-development>.

67. The courts reference experts’ uses of patent classes (*See Oracle Am., Inc.*, 2012 WL 877125, at *3; *see Comcast Cable Commc’ns LLC. v. Sprint Commc’ns Co. L.P.*, 218 F. Supp. 3d 375, 382 (E.D. Pa. 2016).

68. In *Oracle Am., Inc.*, the court noted that the expert “considered patents that were issued within three years before or after the subject patent’s issue date.” *Oracle Am., Inc.*, WHA, 2012 WL 877125, at *2. Similarly, in *Comcast Cable Commc’ns*, the court noted that the expert included patents published “within six months before and after” publication of the patent-in-suit. *Comcast Cable Commc’ns LLC.*, 218 F. Supp. at 382.

69. Regression analysis is a commonly used statistical tool that estimates the relationship between observed variables. (*See Reference Manual on Scientific Evidence* 1, 260–68 (Fed. Judicial Ctr., 3d ed. 2011).

patent i . For example, if the model predicts an average patent aged 4 years at the end of 2012 should have 21 citations, but that patent actually has 25 citations, the adjusted citation count for that patent is 4 (= 25 - 21).

C. Valuing the Patents in the Patent Portfolio using Adjusted Citation Counts

The age-adjusted forward citation counts provide a means to calculate a percentile ranking for each patent in the Patent Sample.⁷⁰ The expert can then match these rankings to percentile rankings of absolute patent values derived from observations provided in the literature,⁷¹ thus assigning each patent i 's adjusted citation count a value θ_i . The resulting relative value portion for each patent " j " in the Patent Portfolio is then v_j , such that $v_j = (\theta_j / \sum \theta_i) * V$, where $\sum \theta_i$ is the sum total of all value estimates θ_i over each patent in the Patent Portfolio, and V is the total Patent Portfolio Royalty.⁷²

Therefore, given an estimated value v_j for each patent-in-suit j , the estimated royalty is simply v_j when the Patent Portfolio Royalty is a lump sum. In the case where the Patent Portfolio Royalty is given as a percentage of sales, the estimated royalty for each patent-in-suit is calculated by multiplying v_j , for each patent-in-suit j , by the appropriate measure of total sales ("Sales") of the accused products sold during the damages period such that the total royalty estimate for each patent-in-suit is equal to ($v_j \times \text{Sales}$), or in the case where the Patent Portfolio Royalty is a per-unit amount, multiplying v_j by the number of accused units ("Units") sold during the damages period ($v_j \times \text{Units}$).

D. Accounting for Patent Re-issues

In *Oracle America, Inc.*, the court found the expert's implementation of Patent Citation Analysis to be "fatally flawed" because the expert failed to

70. In *Comcast Cable Commc'ns LLC.*, the court noted that the expert percentile ranked each patent in the Patent Portfolio as the basis for approximating the value of the patents in the Patent Portfolio. (See *Comcast Cable Commc'ns LLC.*, 218 F. Supp. at 383).

71. For an available distribution of patent values, an expert can turn to estimates of patent values reported by percentile in Schankerman (1998) (See Mark Schankerman, *How Valuable is Patent Protection? Estimates by Technology Field*, 29 RAND J. OF ECON. 77-107 (1998)). The patent values by percentile reported in Schankerman can be used to simulate and percentile rank many observations of patent values for the matching process.

72. In *Comcast Cable Commc'ns LLC.*, the court noted that the expert estimated the value of the patent-in-suit as a percentage of the Patent Portfolio Royalty. (See *Comcast Cable Commc'ns LLC.*, 218 F. Supp. at 383).

account for the fact the patent-in-suit was re-issued twice, and therefore failed to include citation counts to its predecessor patents.⁷³

In its order, the court found that “Patents are not cited for their claim language; instead, patents are cited if they disclose important ideas material to a later application’s patentability. That is why the citations are to the entire patent, which is largely composed of specifications and drawings, not claims.”⁷⁴ The predecessor patents to the ‘104 patent had the same specifications and drawings. Not counting citations to these predecessor patents is error.⁷⁵ In light the court’s perspective, an expert should include citation counts from predecessor patents in the total citation counts of each patent-in-suit and the other patents in the Patent Portfolio (to the extent this information is readily available).

E. Self-Citations

The court’s order in *Finjan* raises the issue of potential bias as a result of counting self-citations—a forward citation received by an older patent from a newer patent when the same commercial entity controls both patents—in the same manner as any other citation.⁷⁶ To this point, the court stated that “[s]urely a patent’s objective quality cannot be based on the number of times an inventor cites himself in prosecuting related patents.”⁷⁷

The court’s order in *Finjan* does not provide any evidence, empirical or intuitive, as to why self-citations should cause Patent Citation Analysis to be significantly biased in any systematic way.⁷⁸ Indeed, the court’s order seemed to imply that forward self-citations should be discounted by some factor (relative to forward non-self-citations or “forward organic citations”) or run the risk of biasing the results.

At the outset, it is prudent to note that, while there is limited research on the value of forward organic citations compared to forward self-citations, some evidence suggests that the impact is relatively modest, and that perhaps surprisingly, that self-cited forward citations are worth somewhat more than organic forward citations.⁷⁹

73. See *Oracle Am., Inc. v. Google Inc.*, No. C 10-03561 WHA, 2012 WL 877125, at *2 (N.D. Cal. Mar. 15, 2012).

74. *Id.* at *2.

75. *Id.* at *2.

76. *Finjan, Inc. v. Blue Coat Sys., Inc.*, No. 13-CV-03999-BLF, 2015 WL 4272870, at *7–8 (N.D. Cal. July 14, 2015).

77. *Id.*

78. *Id.*

79. See Bronwyn H. Hall et. al, *Market Value and Patent Citations*, 36 RAND J. OF ECON. 28–31 (2005).

Furthermore, even if an expert were to assume self-citations are a source of potential bias, an expert may address the issue by analyzing the Patent Portfolio to see if there is evidence of bias in the number of self-citations.⁸⁰ The distinction between self-citations and organic citations should have a relatively limited impact on the analysis unless there is a large discrepancy in forward self-citations, measured as a percentage of all forward citations, for the most frequently cited patents within the Patent Portfolio.⁸¹

Given the available evidence, I believe that the court's fears about the impact of self-citations are somewhat overstated generally and nevertheless potentially addressable with additional analysis. In short, an expert should remain vigilant for sources of significant bias, but not assume *a priori*, that any specter of unexplained variation in the data gives cause to abandon the analysis.

IV. CONCLUSIONS

Patent Citation Analysis is an important tool for courts to determine reasonable royalty awards under certain conditions. The discussion presented above provides the intuition and methods behind Patent Citation Analysis. This paper also discusses the issues raised by the courts about Patent Citation Analysis and the methods used to address them. Hopefully, these discussions will strengthen courts' understandings of Patent Citation Analysis, and aid assessments of the appropriateness of its use in a variety of circumstances.

80. For example, the expert could remove all self-citations from the counts of forward citations, and see if this has a significant impact on the results of the analysis.

81. The value of the Patent Portfolio will be weighted toward the most cited patents because of the lognormal distribution of patent values. For a discussion on the assumption that patent values follow a lognormal distribution, see Jonathan A. Barney, *A Study of Mortality Rates: Using Statistical Survival Analysis to Rate and Value Patent Assets*, 30 AIPLA Q. J., 317, 326-337.