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HOW TO PICK A WINNING PATENT

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TABLE OF CONTENTS

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I. Introduction

Determining which patents are valuable can seem a lot like picking winning lottery numbers. There were, as of 2014, approximately 2.5 million U.S. patents in force.[1] The number of new patent applications has risen steadily to more than 411,728 each year, and if the current trend continues, about 70 percent of those applications will become patents.[2] Like lottery tickets, most patents are worthless, but a precious few are worth billions.

Analytical valuation methods have become popular in distinguishing valuable patents from worthless ones. These methods estimate the value of a patent based on characteristics that have been correlated with the value of other patents in the past. I tested some of the most common patent characteristics used to predict value in a meta-analysis of prior empirical studies. I describe below how these analytical methods can be useful in picking a winning patent and when they are misleading.

II. Patent Valuation Methods

Empirical studies have found that 95 percent of patents have no apparent value.[3] They "pass their lives in complete idleness, gathering dust rather than revenues."[4] Including the vast majority with no value and the few that are valuable, the average value of a patent is between $7,500 to $25,000, which is typically less than the cost of patent acquisition.[5] As a result, many technology transfer programs that seek to transform research into profitable patents end up losing money.[6]

[1] Dennis Crouch, *The Number of U.S. Patents In Force*, PATENTLY-O (Oct. 25, 2014), http://patentlyo.com/patent/2014/10/number-patents-force.html.
[2] Jason Rantanen, *Patent Applications and Grants Holding Steady for FY 2016*, PATENTLY-O (Apr. 21, 2016), http://patentlyo.com/patent/2016/04/patent-applications-holding.html.
[3] Gideon Parchomovsky & R. Polk Wagner, *Patent Portfolios*, 154 U. PA. L. REV. 1, 5 n.3 (2005).
[4] *Id*. at 14.
[5] *Id*. at 5 n.3.
[6] Brian J. Love, *Do University Patents Pay Off? Evidence From a Survey of University Inventors in Computer Science and Electrical Engineering*, 16 YALE J.L. & TECH. 285, 294–95 (2014).

If a patent becomes valuable, it typically happens when it is sold or litigated. Among the relatively small number of patents that are sold each year, the average sale price is $422,000.[7] However, less than 1 percent of patents are ever litigated.[8] Nonetheless, the median damage award for those litigated in 2015 was $10.2 million, and, since 2012, at least three patent damage awards have exceeded $1 billion.[9] The potential for enormous infringement awards has driven patent applications and infringement suits to record numbers, and some have described this trend as a "lottery effect."[10]

Reducing uncertainty as to a patent's scope and validity can contribute as much to the patent's value as the initial grant of patent rights.[11] A mature, fully commercialized invention is more valuable than an invention that is still in its early stages.[12] Following this principle, important factors in patent valuation include a patent's relative novelty, its scope, the strength of protection that it affords, how much competition the patented invention faces, the commercialization costs of the underlying technology, and the future market for the patented product.[13]

Methods used to estimate a patent's value generally fall into four categories. The cost method predicts a patent's value based on the costs to replace or reproduce the patent.[14] The market-based method assesses value according to sales or other transactions of similar patents.[15] The income method measures a patent's value based on income earned by the patent or a similar technology.[16] Finally, the relief from royalty method estimates value according to the expected royalties derived from licensing of the patent.[17] Each of these methods involves their own qualitative judgments and may produce a wide range of estimates when applied to the same patent.

The limitations of these qualitative methods have prompted the development of analytical methods for patent valuation. Analytical methods estimate the value of a patent based on

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[7] Dennis Crouch, *Selling Patents*, PATENTLY-O (Feb. 13, 2013), http://patentlyo.com/patent/2013/02/selling-patents.html.
[8] Parchomovsky & Wagner, *supra* note 3, at 5 n.3.
[9] Chris Barry et al., *2016 Patent Litigation Study: Are We At An Inflection Point?*, PWC 2, 4 (May 2016), https://www.pwc.com/us/en/forensic-services/publications/assets/2016-pwc-patent-litigation-study.pdf.
[10] Love, *supra* note 6, at 329.
[11] Alan C. Marco & Saurabh Vishnubhakat, *Certain Patents*, 16 YALE J. L. & TECH. 103, 132 (2013).
[12] WESTON ANSON, FUNDAMENTALS OF INTELLECTUAL PROPERTY VALUATION: A PRIMER FOR IDENTIFYING AND DETERMINING VALUE 76 (Donna Suchy ed., 2005).
[13] *Id*. *See also* J. Timothy Cromley, *20 Steps for Pricing A Patent*, J. ACCOUNTANCY, Nov. 1, 2004, at 32–34.
[14] ANSON, supra note 12, at 33.
[15] *Id*. at 34.
[16] *Id*.
[17] *Id*. at 35. *See also* Georgia-Pacific Corp. v. United States Plywood Corp., 318 F. Supp. 1116, 1119–20 (S.D.N.Y. 1970*), modified*, 446 F.2d 295 (2d Cir. 1971); Unisplay, S.A. v. American Electronic Sign Co., Inc., 69 F.3d 512, 517 n.7 (Fed. Cir. 1995).

intrinsic factors that have been correlated with the value of other patents in the past.[18] They look to the number of prior art references in the patent, the number of citations by subsequent patents, the number of claims in the patent, the number of jurisdictions where patent protection was sought, and similar metrics.[19] Some analytical methods also look to characteristics that the patent acquires after it has been issued, such as the number of times that it changes ownership.[20]

Analytical valuation has become popular because of its apparent consistency, objectivity, and speed.[21] While any two qualitative estimates of value for a patent may differ depending on who provides them, an analytical method produces the same estimate of patent value, assuming the same formula is used. Moreover, because analytical methods can be automated, they are especially attractive as a means of quickly valuing a large number of patents.[22]

However, analytical methods have their own limitations and biases. For example, while citations and references are two of the most common indicia in analytical valuation, patent applicants often use them strategically to reduce their costs and litigation risks.[23] In other cases, examiners add citations and references out of habit or even by mistake. [24] As a result, the relationship between a patent's intrinsic traits and its value has not been clear or consistent.

III. Meta-Analysis and Results

The results of empirical studies are often inconsistent because no single study has adequate statistical power to provide a definitive result. "Meta-analysis is a method of pooling study results to arrive at a single figure to represent the totality of the studies reviewed."[25]

In a meta-analysis, the results or "effect sizes" of relevant studies are converted to a common metric. This metric is then used to perform a meta-analysis that weights the studies according to sample size, statistical significance, and similar factors.[26] The result is a kind of weighted average effect size that summarizes the relationship between or among the variables in the

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[18] Michael S. Kramer, *Valuation and Assessment of Patents and Patent Protection Portfolios Through Analytical Techniques*, 6 J. MARSHALL REV. INTELL. PROP. L. 463, 467 (2007).
[19] Marco & Vishnubhakat, *supra* note 11, at 110.
[20] *Id*. at 111.
[21] *See generally* John E. Dubiansky, *An Analysis for the Valuation of Venture Capital-Funded Startup Firm Patents*, 12 B.U. J. SCI. & TECH. L. 170, 181–82 (2006) (discussing the benefits of statistical approaches to patent valuation).
[22] Colleen V. Chien, *Predicting Patent Litigation*, 90 TEXAS L. REV. 283, 289 (2011).
[23] Petra Moser, Joerg Ohmstedt & Paul W. Rhode, *Patent Citations and the Size of the Inventive Step: Evidence from Hybrid Corn*, (Nat'l Bureau of Econ. Research, Working Paper No. 21443, 2015), http://www.nber.org/papers/w21443.pdf.
[24] *Id*.
[25] FEDERAL JUDICIAL CENTER, REFERENCE MANUAL ON SCIENTIFIC EVIDENCE, 606–07 (3d ed. 2011), https://www.fjc.gov/sites/default/files/2015/SciMan3D01.pdf.
[26] *Id.* at 607.

analysis, supported by the weight and power of the combined sample.[27] Robert Rosenthal, one of the inventors of meta-analysis, observed, "[t]he simpler the meta-analysis, the more likely it is to be accurate; it is not possible to present one that is too simple."[28]

To obtain relevant studies, I searched Google Scholar, JSTOR, the Social Science Research Network, and Westlaw using the term "patent" with valuation terms such as "value," "valuation," "price," and so on. I also examined the bibliographies and footnotes in the sources that I found to identify additional studies.

With one exception, all original studies that reported a relationship between the number of citations in a patent, its number of claims, its family size, or its number of references and the monetary value of the patent were included in the meta-analysis.[29] I found six such studies and converted their effect sizes to correlation coefficients (Pearson's *r*), the simplest and most common metric used in meta-analysis. While all six studies examined the effects of citations on patent value, some did not examine references, family size, or number of claims. The studies and effect sizes included in the meta-analysis are summarized in Table 1 below.

Study Name	Cites	Claims	Family	Refs	N	Valuation Method
Bessen	0.26	0.01	--	0.03	56816	Monte Carlo simulation
Gambardella, Harhoff & Verspagen	0.35	0.18	--	0.16	8217	Inventor survey
Hall, Jaffe & Trajtenberg	0.48	--	--		19706	R&D expenditures
Harhoff, et. al.	0.30	--	--	--	192	Owner min. sale price
Mazzeo, Hillel & Zyontz	0.09	0.11	0.09	--	340	Infringement awards
Sneed & Johnson	0.13	0.05	0.13	0.05	101	Auction value
RESULT	**0.28**	**0.09**	**0.10**	**0.08**		

Table 1 – Studies and Effect Sizes in the Meta-Analysis[30]

[27] *Id.* at 261 (explaining correlation).

[28] Robert Rosenthal & M. Robin DiMatteo, *Meta-Analysis: Recent Developments in Quantitative Methods for Literature Reviews*, 52 ANN. REV. PSYCHOL. 59, 68 (2001).

[29] One study was excluded because its authors noted that "While the data analyzed here is unique, there may be concern about how representative it is of the entire patent universe." David S. Abrams, Ufuk Akcigit, & Jillian Popadak, *Patent Value and Citations: Creative Destruction or Strategic Disruption?* (Penn Inst. Econ. Res., Research Paper No. 13-23, PIER Working Paper No. 13-065, 2013), http://www.ssrn.com/abstract=2351809.

[30] James Bessen, *The Value of U.S. Patents by Owner and Patent Characteristics*, (BU School of Law Working Paper Series, Law and Econ. Working Paper No. 06-46, 2006), http://ssrn.com/abstract_id= 949778, *reprinted in* James Bessen, *The Value of U.S. Patents by Owner and Patent Characteristics*, 37 RES. POL'Y. 932 (2008); Alfonso Gambardella, Dietmar Harhoff & Burt Verspargen, *The Value of European Patents*, 5 EUROPEAN MGMT. REV. 69 (2008); Bronwyn H. Hall, Adam Jaffe & Manuel Trajtenberg, *Market Value and Patent Citations*, 36 RAND J. ECON. 16 (2005); Dietmar Harhoff, Francis

Three frequently used patent characteristics had little or no correlation with a patent's value. There was no statistically significant relationship between the number of claims or the number of references in a patent and the patent's value. There was a slight correlation ($r = 0.1$) between a patent's family size and its value that was statistically significant ($p < 0.05$).[31]

The number of citations to a patent by subsequent patents proved to be a stronger predictor. There was a moderate correlation ($r = 0.28$) between the number citations to a patent and the patent's value that was highly significant ($p < 0.01$).

However, there was an unexpected difference in the influence of citations on financial estimates of value (such as values derived from research spending), and negotiated outcomes or "real world" estimates (such as auction prices). In the latter circumstances, the relationship between the number of citations in a patent and its value was reduced by about half ($r = 0.17$) but remained statistically significant ($p < 0.01$).

IV. Implications for Valuation in the Future

Claims and references were not predictors of patent value, and family size predicted value poorly. Moreover, while there was a stronger correlation between the number of citations to a patent and its value, the relationship diminished significantly in real-world situations.

These results are somewhat surprising, but they are also consistent with recent research concerning patent litigation outcomes. A 2014 study found that "the observable characteristics of the patents don't seem to have much, if any, bearing on the outcome of the cases involving those patents."[32] In the study, there was no statistically significant relationship between citations or references, and win rates, validity, or infringement.[33] The study's authors observed, "[t]hat is remarkable given how much effort economists have spent measuring the value of innovation by patent citation counts."[34]

So why is there any correlation between a patent's characteristics and its value? There are at least two explanations. The first is that the likelihood of litigation is an intervening variable. Multiple studies have found a correlation between patent citations, references, claims, or family

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Narin, Frederic M. Scherer & Katrin Vopel, *Citation Frequency and the Value of Patented Innovatio*n, 81 REV. ECON. & STAT. 511 (1999); Michael J. Mazzeo, Jonathan Hillel & Samantha Zyontz, *Explaining the"Unpredictable": An Empirical Analysis of U.S. Patent Infringement Awards*, 35 INT'L REV. L. & ECON. 58 (2013); Katherine A. Sneed & Daniel K. N. Johnson, *Selling Ideas: The Determinants of Patent Value in an Auction Environment*, 39 R&D MGMT. 87 (2009).

[31] *See generally* FEDERAL JUDICIAL CENTER, *supra* note 25, at 249 (explaining *p*-values).
[32] John R. Allison, Mark A. Lemley & David L. Schwartz, *Understanding the Realities of Modern Patent Litigation*, 92 TEX. L. REV. 1769, 1798–99 (2014).
[33] *Id*. at 1799.
[34] *Id*.

size and the likelihood that a patent will be litigated.[35] While patent characteristics may not predict value, they do seem to predict which patents will be litigated, the outcome of which is likely to affect the patent's value.

A related explanation is that analytical valuation may be a partially self-fulfilling prophecy. Analytical methods are often used to sort through large numbers of patents and identify those that are worth a closer look.[36] Patents identified using these methods may be more likely to be sold or litigated simply because they were chosen for valuation in the first place. It may be that analytical valuation is used primarily for patents that are already believed to be valuable when the patent holder is considering a sale or an infringement suit, and the results confirm what the patent holder already believes.

V. Conclusion

Patent characteristics can help identify patents that may become valuable in the future through sale or in litigation, but they are not good predictors of value themselves. The number of claims in the patent and its number of references are not significantly correlated with a patent's value. Patent family size is only slightly correlated. The number of citations in a patent is moderately correlated with value, but it predicts better on paper than in real-world situations. Patent characteristics can provide a starting point for estimating a patent's value, but they cannot pick a winning patent by themselves.

[35] John R. Allison, Mark A. Lemley, Kimberly A. Moore & R. Derek Trunkey, *Valuable Patents*, 92 GEO. L.J. 435, 436-38 (2004); Anne Kelley, *Practicing in the Patent Marketplace*, 78 U. CHI. L. REV. 115, 125-26 (2011); Chien, *supra* note 22, at 289–90, 298-99.
[36] Chien, *supra* note 22, at 289–90.