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AN ANALYTICAL SOLUTION TO REASONABLE ROYALTY RATE CALCULATIONS

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SUMMARY:

... This model can be used to supplement the often-used Georgia-Pacific factors to calculate a reasonable royalty rate in infringement cases. ... The determination of a reasonable royalty rate for a licensing agreement that doesn't exist - and never existed - is a formidable task for licensing experts and triers of fact. ... A Formal Analysis of a Reasonable Royalty Rate ... Under these conditions, bargaining for a reasonable royalty rate will not exist unless at least one of two broad conditions exists: 1) the infringer/licensee is able to serve markets that the patent holder/licensor is unable to access; and/or 2) the infringer/licensee produces at lower marginal cost per unit than the patent holder/licensor. ... In conclusion, the NBS results in an intuitively appealing reasonable royalty rate that reflects the economic conditions affecting the licensing agreement. ... After obtaining the present value of the total profits and the total opportunity cost from the DCF method, the patent holder and infringer can then use the NBS to calculate a reasonable royalty rate. ... By supplementing the Georgia-Pacific factors with the NBS as the template for a reasonable royalty rate calculation, reasonable royalty rate experts may now have an additional tool to use in constructing opinions regarding the profitability of the patented technology and the back-up alternatives of the parties in dispute. ...

TEXT:

I. Abstract

Today's courts are increasingly encouraging the use of more rigorous scientific approaches to royalty rate calculations. The technique proposed in this study applies a classic, peerreviewed game theory model to a hypothetical negotiation to yield an efficient and fair result. This model can be used to supplement the often-used Georgia-Pacific factors to calculate a reasonable royalty rate in infringement cases. n1 In the context of patent infringement litigation, this model will build on GeorgiaPacific by interpreting evidence and data in ways that reflect actual economic conditions affecting the outcome of the hypothetical negotiation.

II. Introduction

The determination of a reasonable royalty rate for a licensing agreement that doesn't exist - and never existed - is a formidable task for licensing experts and triers of fact. Since 1970, Georgia-Pacific has served as the conventional template for calculating reasonable royalty rates in such situations. n2 GeorgiaPacific established fifteen factors that can be considered as part of a "hypothetical negotiation" between a willing licensee and a willing licensor. These factors are used to consider what the parties would have contemplated if licensing had been pursued instead of infringement. n3 The timing of the "hypothetical negotiation" is the date when infringement began. n4

Misapplication of the Georgia-Pacific template can produce a royalty rate unsupported by economic theory. From our experience, it appears that licensing experts run down the list and identify some factors that support "high" royalty rates, while others identify those factors that support "low" royalty rates, whichever seems to benefit them most. When this happens, an unsound calculation, shrouded by "reliance" on the GeorgiaPacific factors, can occur. In *Gasser Chair Co. v. Infanti Chair Manufacturing Corp.*, n5 the court explained that "it would be an affectation of research to cite the countless cases which simply reiterate the 'Georgia-Pacific' factors to be considered in determining a reasonable royalty. . . . To set out those fifteen factors would also needlessly burden this decision." n6

The testimony of licensing experts can be strengthened by a consideration of economic theory, rather than solely the identification of which factors in the Georgia-Pacific list support "high" rather than "low" royalty rates. We are not suggesting that the Georgia-Pacific factors be abandoned, as they provide a good reference and starting point. Instead, we suggest that licensing experts should also include two economic concepts that are often central in licensing agreements: 1) the anticipated profitability of the technology; and 2) the relative bargaining power of the participants. If data permits, these two concepts should be closely examined and used to supplement the Georgia-Pacific factors.

Our attempt to narrow the focus on profitability and relative bargaining position is not novel to the discussion of reasonable royalty rate calculations. In *Honeywell, Inc. v. Minolta Camera Co.*, n7 the court replaced the twelfth Georgia-Pacific factor with the anticipated profits and losses that the parties reasonably would have anticipated had they consummated a licensing agreement. n8 Additionally, the court cited relative bargaining position as an important factor. n9 Furthermore, the first two Georgia-Pacific factors relating to established royalties and other comparable agreements were omitted from the Honeywell analysis. n10 The Honeywell modification of the Georgia-Pacific

factors represents an important evolution in reasonable royalty rate calculations. n11 The Honeywell factors should better aid licensing experts in determining "commercially realistic" royalty rates. n12

In this paper, we suggest that the two-person bargaining game described by John Nash n13 accommodates an exclusive reliance on the anticipated profitability of a patented invention and the relative bargaining power of the parties in calculating a reasonable royalty rate. The Nash Bargaining Solution ("NBS") has been called the most fundamental model in bargaining theory. n14 The NBS looks for a sharp prediction of the bargaining outcome based on the bargaining strengths of each side. n15 The NBS is well supported by economic theory and is regarded as one of the simplest, yet most fruitful, paradigms in game theory. n16 The analytical clarity of the NBS is an important justification for its use as a tool in calculating a reasonable royalty rate.

III. Nash Bargaining Solution

Nash obtained his solution by developing a set of conditions that any reasonable solution must satisfy. n17 These conditions include:

1. Pareto efficiency < -> there should be no other feasible allocation that is better than the solution for one negotiator and not worse than the solution for the other negotiator. n18
2. Negotiators must collectively behave in a rational manner such that neither side gets less in the bargaining solution than could be obtained in disagreement. n19
3. The solution is independent of any numeric specification. n20 When constructing a two-person bargaining problem, if the way profits are measured changes, the solution changes accordingly so it still corresponds to the same outcome. n21
4. Eliminating alternatives, other than the disagreement profits (i.e., the opportunity costs from licensing), that would not have been chosen, should not affect the solution. n22
5. If the disagreement profits of the two parties are equal in the bargaining problem, then the solution should also treat them equally. n23

Using an ingenious mathematical argument, Nash demonstrated that satisfying these conditions yields a unique solution; a solution where the bargaining outcome rests simply on each negotiator's alternative to negotiating and on the potential benefits of cooperation. n24 The NBS requires only knowledge or estimation of 1) the "disagreement" profits of both the licensee and licensor; and 2) the total profits from a licensing agreement. n25 Once these elements are determined, the NBS yields a unique and efficient compromise.

To solve for the NBS, we must first identify the disagreement payoff for the patent holder/licensor, the disagreement payoff for the infringer/licensee, and the total potential profit from licensing. We define d_1 as the disagreement payoff for the patent holder, where d_1 represents the profit the patent holder/licensor expects to receive if the negotiation fails.

Likewise, we define d_2 as the disagreement payoff for the infringer/licensee, where d_2 represents the profit the infringer/licensee expects to receive if negotiations fail. The exact functional form of these disagreement payoffs depends on specific assumptions about the two firms and the economic conditions present at the time of disagreement. The feasible payoff from licensing is represented by $\langle \text{capital } \pi \rangle$, where $\langle \text{capital } \pi \rangle$ is the total profit from licensing. We also define

π_1 as the profit for the patent holder/licensor from licensing, and π_2 as the profit for the infringer/licensee from licensing.

Nash demonstrated that the only point that satisfies the conditions outlined above is the one obtained by solving the following constrained maximization problem:

[SEE EQUATION IN ORIGINAL] (1)

subject to the following conditions:

[SEE EQUATION IN ORIGINAL] (2)

[SEE EQUATION IN ORIGINAL] (3)

[SEE EQUATION IN ORIGINAL] (4)

When transfer payments are permitted between the licensor and the licensee, the bargaining problem can be fully characterized by three factors: 1) the disagreement payoff for the patent holder/licensor; 2) the disagreement payoff for the infringer/licensee; and 3) the total transferable wealth available to the two firms from licensing. ⁿ²⁶ Thus, the conditions for the equilibrium payoffs are:

[SEE EQUATION IN ORIGINAL] (5)

[SEE EQUATION IN ORIGINAL] (6)

where π_1^* and π_2^* are the equilibrium payoffs for the licensor and licensee, respectively.

Solving equations (5) and (6) yields the NBS:

[SEE EQUATION IN ORIGINAL] (7)

[SEE EQUATION IN ORIGINAL] (8)

[SEE EQUATION IN ORIGINAL] (9)

Equations (7) and (8) have the following interpretation: when the entities bargain over the partition of total profits (π), they first agree to give each other the payment that they would respectively obtain from not reaching agreement and they next split the remaining profits equally. ⁿ²⁷ For each firm, the agreement payoff is greater when its own disagreement point is higher than its opponent's disagreement point. Therefore, the relative bargaining power will depend on the outside opportunities available to each side.

The fundamental insight of the NBS is that the alternatives to agreement that are available to each side will limit how good a bargain the opposing party can obtain in the negotiation. ⁿ²⁸ These alternatives also set a lower limit on the profit each side will accept. ⁿ²⁹ Under the NBS, the two parties will divide the bargaining surplus - bounded by each bargainer's threat point or minimum acceptable profit - down the middle, so that each has an equal share. ⁿ³⁰

An alternative way of thinking about the NBS is in the framework of "an (implicit) arbitrator who tries to distribute the gains from trade or, more generally, from cooperation in a manner that reflects 'fairly' the bargaining strength" of the two negotiators. ⁿ³¹ Once each side's disagreement payoffs are determined, an arbitrator would apply the NBS to obtain an efficient and fair solution. ⁿ³² In the following section, we apply the NBS to the calculation of a reasonable royalty rate.

IV. A Formal Analysis of a Reasonable Royalty Rate

A reasonable royalty rate is one "that a licensee would be willing to pay the inventor while still making a reasonable profit from use of the patented invention." n33 Many possibilities exist that can affect the relative bargaining positions between a patent holder/licensor and an infringer/licensee. Other things being equal, if the licensor has suitable alternative licensees, it can threaten to leave the bargaining table and deal with an alternative licensee to obtain the best deal. Likewise, if there are few available substitute technologies, the licensee has fewer outside opportunities and will correspondingly fare worse in the negotiation. We start with a simple case of a non-producing firm that owns a patent, with no substitutes, and only one licensee capable of producing the technology. We will later expand the model by introducing different assumptions about the firms to illustrate how they affect the solution.

A. Case 1: One-Supplier World

The simplest case is that of a research and development firm (licensor) that is incapable of manufacturing any product embodying its invention. Such a firm can earn profits only through licensing. Furthermore, assume only one company (infringer/licensee) has the production capabilities to exploit the licensor's invention. The NBS can determine how much the licensee can expect to pay in royalties.

Since the licensor earns nothing without the licensee, the licensor's bargaining position ultimately depends on the licensee's outside alternatives. If negotiations break down, and the licensee has viable alternatives to the licensor, the licensee has an opportunity to earn profits equal to its opportunity cost (i.e., profits lost to disagreement with the licensor). If the negotiation is successful, the joint profit from licensing is equal to the monopoly profit gained from commercializing the patented invention.

The NBS set-up and solution is straightforward. The licensor's disagreement payoff, d_1 , is zero, or:

[SEE EQUATION IN ORIGINAL] (10)

The licensee's disagreement payoff, d_2 , is equal to the licensee's opportunity cost, where the licensee's opportunity cost is the loss of return from not manufacturing the invention. Finally, the joint profits from licensing are equal to the monopoly profit:

[SEE EQUATION IN ORIGINAL] (11)

where $C_2(Q_m)$ represents the licensee's cost function, P_m represents price, Q_m represents quantity, and the subscript m refers to a monopoly. Additionally, $P_m Q_m$ represents the profit maximizing price and quantity for the licensing agreement in a monopoly market. Applying equations (7) through (9), the NBS for a licensing agreement for the licensor and licensee, respectively, are:

[SEE EQUATION IN ORIGINAL] (12)

[SEE EQUATION IN ORIGINAL] (13)

[SEE EQUATION IN ORIGINAL] (14)

To solve for the per-unit royalty, equations (12) and (13) can be rewritten as:

[SEE EQUATION IN ORIGINAL] (15)

[SEE EQUATION IN ORIGINAL] (16)

where r represents the per-unit royalty. Solving for r yields the following formula for a reasonable royalty rate:

[SEE EQUATION IN ORIGINAL] (17)

where AC_2 is the licensee's average total cost.

The first part of equation (17) stipulates that the royalty rate should be established at one-half of the difference between the price and the licensee's average total cost. Thus, the greater the mark-up of the patented technology, the greater the royalty rate for the patented technology. The second part of equation (17) demonstrates that the royalty rate will decrease with the licensee's opportunity cost. In other words, as the licensee's next best alternative becomes more lucrative, the royalty rate paid to the licensor will decrease.

B. Case 2: Two-Supplier World

An alternative patent infringement scenario concerns two firms - the patent holder and the infringer - where the patent holder possesses production capabilities, but has not initiated production at the time of infringement. Under these conditions, bargaining for a reasonable royalty rate will not exist unless at least one of two broad conditions exists: 1) the infringer/licensee is able to serve markets that the patent holder/licensor is unable to access; and/or 2) the infringer/licensee produces at lower marginal cost per unit than the patent holder/licensor. Without at least one of these conditions, the patent holder has no incentive to license its technology.

One scenario where these conditions exist is when the inventor does not possess a comparative advantage in production or sales (i.e., when licensees have access to better distribution facilities, sales staff, or marketing resources). Assume in this case, therefore, that: 1) the licensee can produce at lower costs; and 2) it is in the patent holder's best interest to license the entire market and withdraw from production itself.

Under these conditions, the disagreement payoff for the patent holder is the profit it can earn as the high-cost, sole producer of its patented product. The patent holder's disagreement payoff, d_1 , is represented by:

[SEE EQUATION IN ORIGINAL] (18)

where $C_1(Q_1)$ is the patent holder's cost function, P_1 is the profitmaximizing price for the patent holder absent the infringer, and Q_1 is the profit-maximizing quantity for the patent holder absent the infringer. The disagreement payoff for the licensee remains d_2 , as explained previously.

The joint profit from licensing is identical to the onesupplier case:

[SEE EQUATION IN ORIGINAL] (19)

where $C_2(Q_m)$ represents the licensee's cost function, P_m represents price, Q_m represents quantity, and the subscript m refers to a monopoly. Additionally, $P_m Q_m$ represents the profit maximizing price and quantity for the licensing agreement in a monopoly market.

It is assumed that $\pi_1 > d_1$ and that [SEE EQUATION IN ORIGINAL]. The NBS payoff for the licensor, π_2 , is:

[SEE EQUATION IN ORIGINAL] (20)

The NBS payoff for the licensee, π_1 , is:

[SEE EQUATION IN ORIGINAL] (21)

The total profit from licensing, π , is:

[SEE EQUATION IN ORIGINAL] (22)

The reasonable royalty, r , is equal to:

[SEE EQUATION IN ORIGINAL] (23)

Equation (23) provides the general framework for calculating the reasonable royalty rate in this situation. The first part of equation (23) is identical to the first part of equation (17) because the royalty rate increases with the mark-up of the patented technology. The second part of equation (23) factors in the relative bargaining positions of the parties.

If both sides have equal disagreement payoffs, then additional profits achieved from licensing are split equally. The royalty rate, however, correspondingly changes with differences in a party's relative disagreement point or bargaining position. Therefore, as one party's outside alternatives improve, the terms of the licensing agreement become more favorable to the party having those outside alternatives to licensing.

C. Alternative Cases

The solution obtained in equation (23) provides a clear and efficient method of determining a reasonable royalty rate. Additionally, it can be adapted to various situations that may affect the "hypothetical negotiation."

For instance, if viable and non-infringing substitutes exist for the patented product, then the elasticity of demand for the patented product is larger, and the patent's market power and profitability both decrease. When substitute goods exist in the marketplace, profits are reduced, as is the difference between price and average total cost in equation (23) [$P_m - AC_2$], thereby leading to a lower reasonable royalty rate. When the profitability of a patented technology is lower, the royalties the patent holder can charge in the licensing agreement are also lower. The existence of substitute products will also lower d_1 , the patent holder's disagreement payoff, which further decreases the royalty rate the patent holder can command. This result is consistent with, and quantifies, Culbertson and Weinstein's conclusion that a reasonable royalty rate "depends fundamentally upon the extent and nature of substitute products for the patented product." n34

In conclusion, the NBS results in an intuitively appealing reasonable royalty rate that reflects the economic conditions affecting the licensing agreement. By analyzing the total potential profit for licensing and the disagreement payoffs of both parties, the methodology of the NBS provides a clear way to quantify the fair value of a patent to the patent holder/licensor and the infringer/licensee.

V. NBS and the DCF Method

Thus far, the analysis has focused on a static situation. Although this provides an intuition for calculating a reasonable royalty rate, the analysis does not address the fact that the underlying value of a patent is based on the present value of future economic benefits. Some factors that can limit these benefits include the invention's market potential, the sensitivity of future profits to future production costs, and the period of time benefits will be enjoyed.

A popular choice for calculating future economic benefits is the Discounted Cash Flow ("DCF") method. The objective of the DCF method is to discount, into present value, the expected cash flow from a licensing agreement; then discount, into present value, the expected cash flows for the patent holder and the infringer in the absence of a licensing agreement. It is advantageous to use the DCF method because direct comparisons can be made between total profits and total opportunity costs because the present values of each are measured in today's dollars. After obtaining the present value of the total profits and the total opportunity cost from the DCF method, the patent holder and infringer can then use the NBS to calculate a reasonable royalty rate.

The application of the DCF method first requires an estimate of the net cash flows resulting from licensing a patented technology. To estimate these future net cash flows, two things must be known: (1) the specific time period over which the cash flows will be evaluated; and (2) the investment risk to be incurred over that time period. The DCF method covers the time period from the point in time when infringement began until the point in time when the patent expires. The determination of a reasonable royalty also incorporates a fair return on the amount of investment risk accepted in developing the patented technology. This determination of investment risk should consider advancing technology, competing technology, and government regulations that pertain to the patented technology.

The weighted average cost of capital ("WACC") can be used to discount cash flow in accordance with these considerations. n35 In general, cost of capital is the cost, measured as a percentage rate, of the various sources of capital required to finance investment, such as intellectual property. n36 A company's cost of capital will be the WACC of each type of capital. n37 Accordingly, WACC is the amount of return that that company must earn on its overall investment as comprised of the monetary assets, tangible assets, intangible assets, and contracts. n38 This expected return is considered a hurdle rate for capital investments. n39

The Capital Asset Pricing Model ("CAPM") can also be used to derive an appropriate return on investments. n40 The CAPM provides a framework for measuring market risk and the premium that investors demand in return for assuming such risk. n41 CAPM can be used to estimate the required rate of return for specific intellectual property by analyzing the required rates of return demanded by investors for stocks that operate within the same industry. n42

Applying the DCF to the NBS to obtain a reasonable royalty rate is straightforward. Equation (23) must be slightly modified to reflect future time periods and appropriate risks specific to the firms and the patented technology:

[SEE EQUATION IN ORIGINAL] (24)

where the variables δ_1 and δ_2 represent each firm's WACC, and δ_m reflects the risks associated with the patented technology itself. Equation (24) indicates that each firm's disagreement payoffs over time, d_{1t} , and d_{2t} , must be discounted by each firm's WACC.

The DCF method requires sufficient information about the estimated cash flows during the relevant period. In practice, the application of the DCF method requires accurate manufacturing, research, and marketing estimates, as close to the time of infringement as possible. Estimates of market size and realistic penetration are also required. Additional estimates concerning investment requirements for additional types and amounts of manufacturing facilities, as well as costs associated with designs and marketing, would be helpful.

The principal problem associated with implementing the DCF method is the reliability of the data estimate inputs. From our experience, many internal financial projections, particularly those used to obtain financing, are reasonable sources of data. The analysis can be assisted through discovery concerning the parties' records and opinions at the time of infringement. Discovery can reveal financial projections, memoranda, marked research, and competitive analysis.

A cautionary note: not every forecast is reliable. Carefully discerning when the projections were made and what methods were undertaken should ensure the reliability of such reports. Independent market analyst reports produced by investment banks may also provide market projections that can supplement these internal market forecasts.

VI. Conclusion

The necessity to provide objective and sound determinations of reasonable royalty rates in patent infringement litigation provides reason to supplement the Georgia-Pacific factors with the approach outlined in this article. Data permitting, John Nash's two-person bargaining game represents a peerreviewed methodology that can be used to calculate a reasonable royalty rate from a hypothetical negotiation. The theoretical support for the NBS is overwhelming and, in the context of patent litigation, the reasonable royalty rate solution derived from the NBS is fair, efficient, and sensible.

The method of assigning weights to the Georgia-Pacific factors may produce a result that can be significantly improved and refined by the use of the NBS. Given the requirement that the parties conduct a "hypothetical negotiation" and agree to a hypothetical royalty rate, such a result is not surprising. By supplementing the Georgia-Pacific factors with the NBS as the template for a reasonable royalty rate calculation, reasonable royalty rate experts may now have an additional tool to use in constructing opinions regarding the profitability of the patented technology and the back-up alternatives of the parties in dispute. The NBS technique may thus contribute to improving patent infringement litigation fact-finding and damages calculations in the future.

FOOTNOTES:

n1 *Georgia-Pacific Corp. v. United States Plywood Corp.*, 318 F. Supp. 1116, 166 U.S.P.Q. (BNA) 235 (S.D.N.Y. 1970). The Georgia-Pacific factors are:

1. The royalties received by the patentee for the licensing of the patent in suit, proving or tending to prove an established royalty.
2. The rates paid by the licensee for the use of other patents comparable to the patent in suit.
3. The nature and scope of the license, as exclusive or non-exclusive; or as restricted or non-restricted in terms of territory or with respect to whom the manufactured product may be sold.
4. The licensor's established policy and marketing program to maintain his patent monopoly by not licensing others to use the invention or by granting licenses under special conditions designed to preserve that monopoly.
5. The commercial relationship between the licensor and licensee, such as, whether they are competitors in the same territory in the same line of business; or whether they are inventor and promoter.

6. The effect of selling the patented specialty in promoting sales of other products of the licensee; that existing value of the invention to the licensor as a generator of sales of his non-patented items; and the extent of such derivative or convoked sales.

7. The duration of the patent and the term of the license.

8. The established profitability of the product made under the patent; its commercial success; and its current popularity.

9. The utility and advantages of the patent property over the old modes or devices, if any, that had been used for working out similar results.

10. The nature of the patented invention; the character of the commercial embodiment of it as owned and produced by the licensor; and the benefits to those who have used the invention.

11. The extent to which the infringer has made use of the invention; and any evidence probative of the value of that use.

12. The portion of the profit or of the selling price that may be customary in the particular business or in comparable businesses to allow for the use of the invention or analogous inventions.

13. The portion of the realizable profit that should be credited to the invention as distinguished from nonpatented elements, the manufacturing process, business risks, or significant features or improvements added by the infringer.

14. The opinion testimony of qualified experts.

15. The amount that a licensor (such as the patentee) and a licensee (such as the infringer) would have agree upon (at the time the infringement began) if both had been reasonably and voluntarily trying to reach an agreement; that is, the amount which a prudent licensee -- who desired, as a business proposition, to obtain a license to manufacture and sell a particular article embodying the patented invention -- would have been willing to pay as a royalty and yet be able to make a profit and which amount would have been acceptable by a prudent patentee who was willing to grant a license.

Id. at 1120, 166 U.S.P.Q. at 238.

n2 See, e.g., *Joy Technologies, Inc. v. Flakt, Inc.*, 954 F. Supp. 796, 806-07, 42 U.S.P.Q.2d (BNA) 1042, 1050-51 (D. Del. 1996), *Trio Process Corp. v. L. Goldstein's Sons, Inc.*, 612 F.2d 1353, 1357, 204 U.S.P.Q. (BNA) 881, 883 (3d Cir. 1980). See also Robert Goldscheider, *The Employment of Licensing Expertise in the Arena of Intellectual Property Litigation*, 36 *IDEA* 159, 170 (1996).

n3 See *Georgia-Pacific*, 318 F. Supp. at 1120, 166 U.S.P.Q. at 238 (inferring from the fifteenth Georgia-Pacific factor).

n4 See *id.* at 1125, 166 U.S.P.Q. at 242.

n5 943 F. Supp. 201, 40 U.S.P.Q.2d (BNA) 1554 (E.D.N.Y. 1996).

n6 *Id.* at 216, 40 U.S.P.Q.2d at 1566 (implying that it was unnecessary to list the well-known Georgia-Pacific factors in the opinion even though they were being applied by the court) (citations omitted).

n7 Nos. CIV.A.87-4847, 88-1624, jury instruction at 69 (D.N.J. Jan. 28, 1992).

n8 Id.

n9 See id.

n10 See id. See also *Goldscheider*, *supra* note 3, at 170.

n11 See *Goldscheider*, *supra* note 3, at 171.

n12 Id. at 171.

n13 See generally John Nash, The Bargaining Problem, 18 *Econometrica* 155 (1950) [hereinafter referred to as Nash 1]; John Nash, Two-Person Cooperative Games, 21 *Econometrica* 128 (1953) [hereinafter referred to as Nash 2].

n14 See Alvin Roth, Axiomatic Models of Bargaining 1, 1 (M. Beckmann & H. P. Kunzi eds., 1979).

n15 See generally Nash 1, *supra* note 13; Nash 2, *supra* note 13.

n16 See Roth, *supra* note 14.

n17 See Nash 2, *supra* note 17, at 136-37.

n18 See id. See also Roger B. Myerson, Game Theory: Analysis of Conflict 377-78 (1991) (explaining axiom 8.1).

n19 See id. (explaining axiom 8.2).

n20 More formally, the solution is independent of any numeric risk-neutral utility specification.

n21 See id. (explaining axiom 8.3).

n22 See id. (explaining axiom 8.4).

n23 See id. (explaining axiom 8.5).

n24 See Myerson, *supra* note 22, at 375.

n25 See id. at 375-76.

n26 See Myerson, *supra* note 22, at 375. Transfer payment is an important assumption that can guarantee the given scale factors in a game will also be the natural scale factors for the NBS. Risk neutrality is also an important assumption when we use transfer payments; however, in the context of firms negotiating over an agreement, the assumption is plausible.

n27 See Abhinay Muthoo, *Bargaining Theory with Applications* 15-16 (1999).

n28 See id. at 105.

n29 See id.

n30 See id. at 15-16.

n31 Andrew Mas-Colell et al., *Microeconomic Theory* 838 (Oxford University Press 1995).

n32 See id.

n33 See *Black's Law Dictionary* 1330 (7th ed. 1999).

n34 John D. Culbertson and Roy Weinstein, Product Substitutes and the Calculation of Patent Damages, 70 J. Pat. & Trademark Off. Soc'y 749, 750 (1988).

n35 See Gordon V. Smith & Russell L. Parr, Valuation of Intellectual Property and Intangible Assets 558-62 (John Wiley & Sons 3d ed. 2000) (providing a detailed application of WACC).

n36 See id.

n37 See id.

n38 See id.

n39 See id.

n40 See id. at 552-55.

n41 See id.

n42 See id. at 553.

