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NASH BARGAINING SOLUTION AND ITS GENERALIZATIONS IN INTELLECTUAL PROPERTY LITIGATION: VIRNETX AND AN ANALYSIS OF THE COURT'S DECISION

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I. ABSTRACT

The purpose of this article is to explain the Nash Bargaining Solution and its generalizations, especially in the presence of asymmetric bargaining power. The article discusses the pros and cons in the context of intellectual property litigation. Furthermore, it provides a description and detailed analysis of the Court's decision in VirnetX from this perspective.

KEYWORDS: Nash Bargaining Solution – Generalizations – Asymmetric Bargaining Power – Intellectual Property – Litigation – VirnetX

II. INTRODUCTION

This paper discusses the Nash Bargaining Solution, as initially posited by the legendary Nobel Laureate John Nash,¹ arguably the father of modern economics, and generalized by John Harsanyi,² Reinhard Selten,³ Lloyd Shapley,⁴ Ehud Kalai and Meir

* Mailing address: Mailing address: Professor Rajeev Bhattacharya, Johns Hopkins University, 1717 Massachusetts Avenue, Washington, DC 20036., U.S.A. I acknowledge, with gratitude, the very helpful comments from John Greenberg; the usual caveats apply. I have not received any substantial funding for this research and have no conflicts of interest.

¹ John Nash, *The Bargaining Problem*, 18 *ECONOMETRICA* 155, (1950); John Nash, *Two Person Cooperative Games*, 21 *ECONOMETRICA* 128, (1953); *Press Release*, NOBELPRIZE.ORG (Oct. 11, 1994) http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1994/press.html (Professor Nash was awarded the Nobel Prize in Economics in 1994).

² See John C. Harsanyi, *A Bargaining Model for the Cooperative n-Person Game*, 4 *INT'L ECON. R.* 194 (1959). See generally John Harsanyi, *Biographical*, NOBELPRIZE.ORG <https://www.nobelprize.org/prizes/economic-sciences/1994/harsanyi/facts/> (last visited Feb. 28, 2020) (Professor Harsanyi was awarded the Nobel Prize in economics in 1994).

³ See Reinhard Selten, *Valuation of n-Person Games*, 52 *ANNALS OF MATHEMATIC STUD.* 577 (1964); See generally Reinhard Selten, *Facts*, NOBELPRIZE.ORG <https://www.nobelprize.org/prizes/economic-sciences/1994/selten/facts/> (last visited Feb. 28, 2020) (Professor Selten was awarded the Nobel Prize in economics in 1994).

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Smorodinsky,⁵ Ehud Kalai,⁶ Roger Myerson,⁷ Ariel Rubinstein,⁸ Alvin Roth,⁹ Ken Binmore,¹⁰ and Ken Binmore, Ariel Rubinstein, and Asher Wolinsky,¹¹ especially in the presence of asymmetric bargaining power, is explained throughout the entirety of this article. The applications of the Nash Bargaining Solution and its generalizations to intellectual property litigation are discussed as well. In addition, the academic and practitioner work supporting and opposing the use of the Nash Bargaining Solution and its generalizations in such litigation are summarized. Finally, the recent Court decision in *VirnetX* is analyzed in detail using the Nash Bargaining Solution perspective.¹²

For this article, the willingness of the parties involved in these hypothetical negotiations, to obtain the relevant bargaining range, is assumed. Accordingly, this article does not address the issue of whether the royalty base should include only the “smallest salable unit,” or should encompass the “entire market value.” Nor does this article address the issue of whether a patentee may balance out an “unreasonably” high royalty base simply by asserting a “low enough” royalty rate.

III. THE BARGAINING PROBLEM AND THE AXIOMS

In a situation where both parties to a bargaining situation are equally well-informed and the contract is enforceable, a two-person bargaining problem can be described in utility space as follows: let entity 1's disagreement utility be d_1 and entity 2's disagreement utility be d_2 , these are the levels of utility that the entities get if they fail to agree. These levels of utility are referred to as BATNA (Best Alternative to a Negotiated Agreement) status quo,

⁴ Lloyd S. Shapley, *Utility Comparison and the Theory of Games*, in THE SHAPLEY VALUE: ESSAYS IN HONOR OF LLOYD S. SHAPLEY 307, 312-313 (Alvin E. Roth ed., 1998); See generally Lloyd Shapley, *Facts*, NOBELPRIZE.ORG <https://www.nobelprize.org/prizes/economic-sciences/2012/shapley/facts/> (last visited Feb. 28, 2020) (Professor Shapley was awarded the Nobel Prize in economics in 2012).

⁵ See Ehud Kalai & Meir Smorodinsky, *Other Solutions to Nash's Bargaining Problem*, 43 ECONOMETRICA 513, 514-517 (1975).

⁶ See Ehud Kalai, *Nonsymmetric Nash Solutions and Replications of 2-Person Bargaining*, 6 ECONOMETRICA 129 (1977).

⁷ See Roger Myerson, *Refinements of the Nash Equilibrium Concept*, 7 Int'l J. of Game Theory 73 (1978); See generally Roger Myerson, *Facts*, NOBELPRIZE.ORG <https://www.nobelprize.org/prizes/economic-sciences/2007/myerson/facts/> (last visited Feb 28, 2020) (Professor Myerson received the Nobel Prize in 2007).

⁸ See Ariel Rubinstein, *Perfect Equilibrium in a Bargaining Model*, 50 ECONOMETRICA 1 (1982).

⁹ See Alvin Roth, ed., *Game Theoretic Models of Bargaining*, CAMBRIDGE UNIVERSITY PRESS, 1985; See generally Alvin Roth, *Facts*, NOBELPRIZE.ORG <https://www.nobelprize.org/prizes/economic-sciences/2012/roth/facts/> (last visited Feb 28, 2020) (Roth received the 2012 Nobel Prize in economics for closely related work).

¹⁰ See KEN BINMORE, *Bargaining and Coalitions*, in GAME-THEORETIC MODELS OF BARGAINING, 269 (Alvin E. Roth ed., 1985).

¹¹ See Ken Binmore, Ariel Rubinstein, and Asher Wolinsky, *The Nash Bargaining Solution in Economic Modelling*, 17 THE RAND JOURNAL OF ECONOMICS 2 (Summer 1986).

¹² *VirnetX, Inc. v. Cisco Sys.*, 767 F. 3d 1308 (2014).

disagreement point, or threat point.¹³ Let u_1 and u_2 denote the utilities that entities 1 and 2 get if they can agree.

Like any other scientific model, the Nash Bargaining Solution relies on “idealizations” or abstractions.¹⁴ Nash points out that “[i]n general terms, we idealize the bargaining problem by assuming that the two individuals are highly rational, that each can accurately compare his desires for various things, that they are equal in bargaining skill, and that each has full knowledge of the tastes and preferences of the other.”¹⁵ If these abstractions do not hold, at least approximately, the conclusions of the Nash Bargaining Solution do not either. This criterion of “falsifiability” lies at the heart of any scientific discussion.¹⁶ A scientific theory must provide a set of facts, such that, if they were to eventuate, they would falsify the theory.¹⁷ The absence of such indicates that the theory belongs in the realm of faith, rather than science.¹⁸

Professor Nash proposed the following axioms to justify his solution to the two-person bargaining problem.¹⁹ He used expected utility theory to motivate the first five axioms, since these are not germane to the discussion of the Nash Bargaining Solution in the context of intellectual property litigation, they are not relevant to this article.²⁰ Instead, this article will focus on the additional axioms that Professor Nash makes to justify his solution.

Pareto Efficiency: If there is a utility pair that is better for both entities than another utility pair, the latter cannot be a solution.²¹ This is a fairly well understood and widely accepted requirement when both parties are equally well-informed about the bargaining at hand.²²

Independence of Irrelevant Alternatives: Adding sub-optimal pairs to the feasible set does not affect the solution.²³ This axiom was first introduced by Kenneth Arrow and is standard in neoclassical economics.²⁴ It has, however, been shown to be violated in experiments and has been questioned in the behavioral economics literature, for example,

¹³ See, e.g., ROGER FISHER & WILLIAM URY, *GETTING TO YES* 51 (Bruce Patton, 2d ed. 1991); Binmore et al., *The supra* note 11 at 176-77.

¹⁴ Nash *supra* note 1 at 155-156.

¹⁵ *Id.* at 155.

¹⁶ KARL POPPER, *THE LOGIC OF SCIENTIFIC DISCOVERY* 18 (Taylor & Francis Group 2005).

¹⁷ *Id.* at 280.

¹⁸ See *id.* at 18.

¹⁹ See Nash *supra* note 1 at 159.

²⁰ See, e.g., Paul J. H. Shoemaker, *The Expected Utility Model: Its Variants, Purposes, Evidence and Limitations*, 20 J. OF ECON. LITERATURE 529, 529 (1982) (explaining that the expected utility framework is somewhat standard in classical economics and finance). But see Mark J. Machina, *Dynamic Consistency and Non-Expected Utility Models of Choice Under Uncertainty*, 27 J. OF ECON. LITERATURE 1622, 1622-1623 (1989) (discussing that generalizations and variations have been proposed in light of experimental evidence that entities do not always maximize expected utility).

²¹ See, e.g. Kenneth Arrow, *A Difficulty in the Concept of Social Welfare*, 58 J. OF POL. ECON. 328, (1950).

²² See Stephen Ross, *The Economic Theory of Agency: The Principal's Problem*, 63 AM. ECON. REV. 134,136 (1973).

²³ See, e.g. Arrow, *supra* note 21.

²⁴ John Nash, *The Bargaining Problem*, *ECONOMETRICA*, 1950.

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Amos Tversky and Daniel Kahneman²⁵ and an application to finance by Shlomo Benartzi and Nobel Prize-winner, Richard Thaler.²⁶

Symmetry: If the collection of feasible utility pairs is symmetric for the two entities, then so is the solution.²⁷ The generalization of the symmetry axiom in economics literature is an important factor to account for different bargaining skills.²⁸

IV. THE NASH BARGAINING SOLUTION

The Nash Bargaining Solution is given by the utility pair that satisfies the axioms listed above.²⁹ It is the utility pair that maximizes the product $(u_1 - d_1) \times (u_2 - d_2)$ (the difference in entity 1's utility from its disagreement point times the difference in entity 2's utility from its disagreement point) which turns out to be the pair that splits the incremental (from the disagreement point) surplus equally *in utility space*.³⁰ Also, if the entities are risk neutral³¹ regarding money, the Nash Bargaining Solution, from the disagreement point in the money space that splits the incremental surplus, equally is equal to the pair.³²

A. The Nash Program

Cooperative game theory, which includes the bargaining problem, models situations where entities can make binding commitments.³³ In contrast, non-cooperative game theory, or more appropriately, strategic game theory, models the rational choice of entities in the

²⁵ Amos Tversky and Daniel Kahneman, *Rational Choice and the Framing of Decisions*, 59 J. OF BUS. S251, S254 (1986).

²⁶ Shlomo Benartzi and Richard Thaler, *How Much is Investor Autonomy Worth*, 57 J. OF FIN. 1593, 1594 (2002).

²⁷ Ariel Rubenstein et al., *On the Interpretation of the Nash Bargaining Solution and Its Extension to Non-Expected Utility Preferences*, 60 ECONOMETRICA 1171, 1172 (1992).

²⁸ See *id.*

²⁹ *Id.*

³⁰ See Nash *supra* note 1.

³¹ See MARTIN T. SCHULTZ ET AL., DECISION MAKING UNDER UNCERTAINTY, 20 (U.S. Army Corps of Engineers ed., 2010) (An entity is risk-neutral if it is indifferent between two risky outcomes, as long as the average outcome remains the same. In such a case, the utility function is a linear function of the outcome).

³² See Nash *supra* note 1.

³³ See Roth *supra* note 9.

absence of binding commitments, see for example, John Nash,³⁴ Reinhard Selten,³⁵ and Roger Myerson.³⁶ As Professor Nash points out:

We give two independent derivations of our solution of the two-person cooperative game. In the first, the cooperative game is reduced to a non-cooperative game. To do this, one makes the players' steps in negotiations in the cooperative game become moves in the non-cooperative model. ... The second approach is by the axiomatic method. One states as axioms several properties that would seem natural for the solution to have, and then one discovers that the axioms actually determine the solution uniquely. The two approaches to the problem, via the negotiation model or via the axioms, are complementary. Each helps to justify and clarify the other.³⁷

Since non-cooperative models are significantly more widely understood and accepted in academics and litigation, providing cooperative game theoretic models (including the Nash Bargaining Solution) with support from non-cooperative game theory has become the Holy Grail, referred to as the "Nash Program."³⁸ According to Roberto Serrano:

[s]imilar to the microfoundations of macroeconomics, which aim to bring closer the two branches of economic theory, the Nash program is an attempt to bridge the gap between the two counterparts of game theory (cooperative and non-cooperative). This is accomplished by investigating non-cooperative procedures that yield cooperative solutions as their equilibrium outcomes.³⁹

Professor Serrano provides a description of the progress that has been made since 1953 in providing the Nash Bargaining Solution with the foundations in non-cooperative game theory.⁴⁰ In particular, Ken Binmore, Ariel Rubinstein, and Asher Wolinsky show that under reasonable conditions in strategic models of alternating offers, the unique outcomes approximate the Nash Bargaining Solution, and that, "[t]he results provide a guide for the application of the Nash bargaining solution in economic modelling."⁴¹ On the other hand,

³⁴ See John F. Nash, *Equilibrium Points in n-Person Games*, 36 PROC. OF THE NAT'L. ACAD. OF SCI. OF U. S. 48 (1950). (describing what is now known as the Nash Equilibrium in non-cooperative games and is the foundational concept in game theory and industrial economics. This was the work primarily for which Professor Nash was awarded the Nobel Prize in Economics in 1994).

³⁵ See Reinhard Selten, *Spieltheoretische Behandlung eines Oligopolmodells mit Nachfrageträgheit*, 121 J. OF INSTITUTIONAL AND THEORETICAL ECON. 301 (1965); See also Reinhard Selten, *Reexamination of the Perfectness Concept for Equilibriu, Points in Extensive Games* 1-5 (Bielefeld Universität Institute of Mathematical Economics, Working Paper No. 23, 1974). (This body of work was primarily mentioned for Professor Selten's 1994 Nobel Prize in Economics).

³⁶ See Myerson, *supra* note 10.

³⁷ Nash, *Two Person Cooperative Games*, *supra* note 1 at 129.

³⁸ See Binmore, *supra* note 10.

³⁹ Roberto Serrano, *Fifty Years of the Nash Program, 1953-2003*, 29 INVESTIGACIONES ECONÓMICAS, 219, 219-20 (2005).

⁴⁰ *Id.*

⁴¹ Binmore et al., *supra* note 11, at 176.

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Ariel Rubinstein shows that under different but reasonable conditions, the Nash Bargaining Solution is not achieved through non-cooperative equilibrium in a strategic alternating offers model.⁴² The differences in these results underscore the necessity, in the context of expert opinion in litigation, of robustness by checking how sensitive the expert's conclusions are to different models.⁴³

B. Examples of Academic and Practitioner Work in Intellectual Property Using the Nash Bargaining Solution

The following are examples of academic and practitioner work in intellectual property that use the Nash Bargaining Solution: William Choi and Roy Weinstein,⁴⁴ Claude Crampes and Corinne Langinier,⁴⁵ Reiko Aoki and John Small,⁴⁶ Shin Kishimoto and Shigeo Muto,⁴⁷ Jim Bergman,⁴⁸ William Choi, Scott Dalrymple, and Daniel Jackson,⁴⁹ and others. These papers argue that the Nash Bargaining Solution, when used correctly, can provide guidance in estimating the outcome of a hypothetical negotiation between a patentee and a potential licensee.

C. Examples of Academic and Practitioner Work in Intellectual Property that Argue Against Using the Nash Bargaining Solution

Professors Kalai and Smorodinsky⁵⁰ replace Nash's controversial Independence of Irrelevant Alternatives axiom with a "Monotonicity" axiom "that if, for every utility level that player 1 may demand, the maximum feasible utility level that player 2 can simultaneously reach is increased, then the utility level assigned to player 2 according to the solution should also be increased," and propose a different solution, called the "Monotonic Solution," which was also suggested by Robert Rosenthal.⁵¹

⁴² See Rubinstein *supra* note 8, at 101-102.

⁴³ See Roberto Serrano, *Reinterpreting the Kernel*, 77 J. OF ECON. THEORY 58, 71-74 (1997).

⁴⁴ William Choi and Roy Weinstein, *An Analytical Solution to Reasonable Royalty Rate Calculations*, 41 IDEA: THE J. OF L. & TECH. 49, 52 (2001).

⁴⁵ Claude Crampes and Corinne Langinier, *Litigations and Settlement in Patent Infringement Cases*, 33 THE RAND J. OF ECON. 258, 264 (2002).

⁴⁶ Reiko Aoki & John Small, *Compulsory Licensing of Technology and the Essential Facilities Doctrine*, 16 INFO. ECON. AND POL'Y 13, 26-28 (2004).

⁴⁷ Shin Kishimoto & Shigeo Muto, *Fee Versus Royalty Policy in Licensing Through Bargaining: An Application of the Nash Bargaining Solution*, 64 BULL. OF ECON. RES. 293, 294 (2012).

⁴⁸ Jim Bergman, *Why Nash Bargaining is a Good Tool for Patent Damages*, Law360 (May 28, 2014, 10:16 AM), <https://www.law360.com/articles/540447/why-nash-bargaining-is-a-good-tool-for-patent-damages>.

⁴⁹ William Choi, Scott Dalrymple & Daniel Jackson, *Don't Shoot the Methodology: Misuse of Nash Bargaining*, Law360 (Mar. 12, 2014, 12:46 PM), <https://www.law360.com/articles/511405/don-t-shoot-the-methodology-misuse-of-nash-bargaining>.

⁵⁰ See Kalai & Smorodinsky, *supra* note 5 at 514-517.

⁵¹ *Id.*; See also Robert Rosenthal, *An Arbitration Model for Normal-Form Games*, MAT. OF OPERATIONS RES., (1976). (Some experiments conducted lead to the Monotonic Solution rather than to the Nash Bargaining Solution.)

Professor Kalai⁵² introduced the nonsymmetric (sic) generalization of the Nash Bargaining Solution, in which the product $(u_1 - d_1)^p \times (u_2 - d_2)^{1-p}$ is maximized to get the solution, instead of maximizing the product $(u_1 - d_1) \times (u_2 - d_2)$ as is done for the Nash Bargaining Solution (shown earlier in this article).⁵³ The parameter p has been interpreted as a measure of the relative bargaining power of the two players in the bargaining game.⁵⁴ If $p = 0.5$, Professor Kalai's solution corresponds to the situation where the differences in the bargaining power of the parties are *entirely* captured by the differences in the disagreement points and the collection of the feasible utility pairs – in which case, the solution is the same as the Nash Bargaining Solution.

Thomas Varner⁵⁵ and Doug Kidder and Vince O'Brien⁵⁶ are examples of practitioner work that argue against using the Nash Bargaining Solution, for the various reasons argued in this paper.

D. Summary of Description of the Nash Bargaining Solution

As Professor Rubinstein puts it:

[p]redictions from economic theory are not nearly as accurate as those offered by the natural sciences ... Although I have never heard an economist seriously claim that the Nash bargaining solution is a good predictor of bargaining in real markets, this solution is a standard tool in modeling interactions among negotiators. Economic theory lacks a consensus as to its purpose and interpretation.⁵⁷

V. VIRNETX: DESCRIPTION AND ANALYSIS

VirnetX brought action against the mobile phone manufacturer Apple, alleging the infringement of patent regarding a virtual private network (VPN).⁵⁸ The patent described the method of transparently creating virtual private network (VPN) between client computer and target computer and patents disclosing secure domain name service.⁵⁹ The United States District Court for the Eastern District of Texas “construed the disputed claim terms”, and

⁵² See Kalai & Smorodinsky, *supra* note 5.

⁵³ See John C. Harsanyi, *A Bargaining Model for the Cooperative n-Person Game*, 4 INT'L ECON. R. 194 (1959); See Reinhard Selten, *Valuation of n-Person Games*, 52 ANNALS OF MATHEMATIC STUD. 577 (1964); See also Lloyd S. Shapley, *Utility Comparison and the Theory of Games*, in THE SHAPLEY VALUE: ESSAYS IN HONOR OF LLOYD S. SHAPLEY (Alvin E. Roth ed., 1998); See also Robert J. Aumann & Michael Maschler, *Some Thoughts on the Minimax Principle*, 18 MGMT. SCI. 54, 54-55, 58, 62 (1972).

⁵⁴ See, e.g., Masao Nakamura, *Joint Venture Instability, Learning and the Relative Bargaining Power of the Parent Firms*, 14 INT'L BUS. REV. 465, 475-78 (2005).

⁵⁵ Thomas Varner, *Nash Bargaining May Not Be Right for Patent Damages*, Law360 (Apr. 18, 2014, 9:37 PM),

<https://www.law360.com/articles/529437/nash-bargaining-may-not-be-right-for-patent-damages>.

⁵⁶ Doug Kidder & Vince O'Brien, *The Nash Bargaining Solution*, 49 LES NOUVELLES 1, 4-5 (2014).

⁵⁷ Ariel Rubinstein, *John Nash: The Master of Economic Modeling*, *Scandinavian J. of Econ.*, (1995).

⁵⁸ *VirnetX, Inc. v. Cisco Sys.*, 767 F.3d 1308, 1314 (1st Cir. 2014).

⁵⁹ *Id.*

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denied manufacturer's post-trial motions, after the jury returned verdict in patentee's favor. Manufacturer appealed.⁶⁰

Weinstein also offered two... estimates of the damages . . . Both of these estimates relied on the Nash Bargaining Solution. Weinstein began by determining 'incremental or additional profits that are associated with the use of the patented technology.' ... Having thus purported to determine those profits, Weinstein then testified about how the parties would split those incremental profits. To do this, he began with the assumption that each party would take 50% of the incremental profits, invoking the Nash Bargaining Solution, and then adjusted that split based on 'the relative bargaining power of the two entities.' J.A. 1632. ... Apple argues that the invocation of a 50/50 starting point based on the Nash Bargaining Solution is akin to the '25 percent rule of thumb' that we rejected in *Uniloc* as being insufficiently grounded in the specific facts of the case.⁶¹

There are two substantial distinctions between the 25% rule and the Nash Bargaining Solution.⁶² The first distinction is that the Nash Bargaining Solution splits the incremental profits, while the 25% rule is applied to the entire operating profit.⁶³ The second distinction is that the Nash Bargaining Solution has substantial, although not unanimous, support in economic theory, whereas the 25% rule has no support in economic theory.⁶⁴ However, the 25% rule has some empirical basis because it is often the starting point of real-life licensing negotiations.⁶⁵

The *VirnetX* court provides a list of recent decisions where experts have relied upon expert testimony regarding the Nash Bargaining Solution:

Compare Robocast, Inc. v. Microsoft Corp., No. 10-1055, 2014 U.S. Dist. LEXIS 10745, 2014 WL 350062 (D. Del. Jan. 29, 2014) (excluding expert testimony based on Nash Bargaining Solution because it was not sufficiently tied to the facts of the case); *Dynetix Design Solutions, Inc. v. Synopsys, Inc.*, No. 11-5973, 2013 U.S. Dist. LEXIS 120403, 2013 WL 4538210, at *4-5 (N.D. Cal. Aug. 22, 2013) (excluding expert testimony on royalty rate that began from a starting point of a 50/50 split because the

⁶⁰ *Id.* at 1316 (1st Cir. 2014).

⁶¹ *VirnetX, Inc.*, 767 F.3d at 1331.

⁶² *Id.* at 1333.

⁶³ *Id.* at 1333-1334. ("the Nash Bargaining Solution does offer at least one noticeable improvement over the 25% rule: where the 25% rule was applied to the entire profits associated with the allegedly infringing product, the Nash theory focuses only on the *incremental* profits earned by the infringer from the use of the asserted patents. But while we commend parties for using a theory that more appropriately (and narrowly) defines the universe of profits to be split[.]")

⁶⁴ *See id.* at 1332.

⁶⁵ *See, e.g.*, Robert Goldschedier, John Jarosz & Carla Mulhern, *Use of the 25 Per Cent Rule in Valuing IP*, 37 LES NOUVELLES 123, 127 (2002); Stephen Degnan & Corwin Horton, *A Survey of Licensed Royalties*, LES NOUVELLES 91, 92 (1997).

expert's methodology was "indistinguishable from 25% rule") [There, the expert 'failed to take into account any analogous license offers in the industry . . . or the nature of the patented feature . . .']; *Oracle Am., Inc. v. Google Inc.*, 798 F. Supp. 2d 1111, 1119-21 (N.D. Cal. 2011) (excluding testimony based on Nash Bargaining Solution because it "would invite a miscarriage of justice by clothing a fifty-percent assumption in an impenetrable façade of mathematics" [That kind of evidence is deemed too confusing and hard for a jury to follow], with *Mformation Techs., Inc. v. Research in Motion Ltd.*, No. 08-4990, 2012 U.S. Dist. LEXIS 56784, 2012 WL 1142537, at *3 n.19 (N.D. Cal. Mar. 29, 2012) (declining to exclude Weinstein's testimony based on Nash Bargaining Solution because he used it only "as a check" in addition to the Georgia-Pacific analysis, rather than in lieu of it [This testimony was allowed because the Nash Bargaining Solution was used in addition to the Georgia-Pacific analysis, rather than in lieu of it]); *Gen-Probe Inc. v. Becton Dickinson & Co.*, No. 09-2319, 2012 U.S. Dist. LEXIS 189388, 2012 WL 9335913, at *3 (S.D. Cal. Nov. 26, 2012) (permitting testimony based on Nash Bargaining Solution because calculation was sufficiently tied to the facts of the case, "including the competitive environment and Gen-Probe's policy of exploiting its own patents"); *Sanofi-Aventis Deutschland GmbH v. Glenmark Pharms. Inc., USA*, No. 07-5855, 2011 U.S. Dist. LEXIS 10512, 2011 WL 383861, at *12-13 (D.N.J. Feb. 3, 2011) (determining that expert's testimony asserting a 50/50 profit [***1130] split was based on the specific facts of the case); *Amakua Dev. LLC v. Warner*, No. 05-3082, 2007 U.S. Dist. LEXIS 49952, 2007 WL 2028186, at *20 (N.D. Ill. July 10, 2007) (permitting reliance on Nash [**52] because the "[d]efendants ha[d] not challenged the reliability of Nash's theories, and the assessment of whether the theory persuasively can be applied in the context of this case is for the jury") . . . we agree with the courts that have rejected invocations of the Nash theorem without sufficiently establishing that the premises of the theorem actually apply to the facts of the case at hand.⁶⁶

The *VirnetX* court has raised four issues specific to the Nash Bargaining Solution above.⁶⁷ The first issue *VirnetX* raised was whether the Nash Bargaining Solution is akin to the 25% rule of thumb.⁶⁸ As previously discussed, there are fundamental distinctions between the two.⁶⁹ Another issue raised was whether the assumptions underlying the Nash Bargaining Solution are met in a particular case.⁷⁰ As the *VirnetX* court opined:

[t]he Nash theorem arrives at a result that follows from a certain set of premises. It itself asserts nothing about what situations in the real world fit those premises. Anyone seeking to invoke the theorem as applicable to a

⁶⁶ *VirnetX, Inc. v. Cisco Sys.*, 767 F.3d 1308, 1332 (1st Cir. 2014).

⁶⁷ *Id.*

⁶⁸ *Id.* at 1331.

⁶⁹ *Id.* at 1332

⁷⁰ *Id.*

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particular situation must establish that fit, because the 50/50 profit-split result is proven by the theorem only on those premises.⁷¹

As I have discussed above, this is a valid criticism of the Nash Bargaining Solution *per se*, but the generalization called the “Monotonic Solution” by Professor Kalai, as described earlier, takes such asymmetry into account.⁷²

The third issue raised by *VirtneX* was whether the Nash Bargaining Solution is mathematically sophisticated.⁷³ In *Oracle Am., Inc. v. Google Inc.*, William Alsup rejected Iain Cockburn’s expert analysis using the Nash Bargaining Solution because “[n]o jury could follow this Greek or testimony trying to explain it. The Nash Bargaining Solution would invite a miscarriage of justice by clothing a fifty-percent assumption in an impenetrable façade of mathematics.”⁷⁴ Judge Alsup’s opinion was not based on Professor Cockburn’s use of Greek or mathematics in explaining the Nash Bargaining Solution, but rather Drs. Choi and Weinstein’s use of Greek letters and mathematics.⁷⁵

There are two sub-issues here. First, economics is a mathematical field, and the Choi and Weinstein article involves substantially less mathematics than almost any publication in modern economics.⁷⁶ If a particular case involves economic issues and guidance is needed from publications in economics, mathematics will be relevant.⁷⁷ Second, just because something is sophisticated does not mean it ought to be excluded. By Judge Alsup’s logic, any expert testimony involving the theory of relativity needs to be excluded; indeed, it is the extreme of anti-intellectualism to assert, in effect, that “I don’t get it, so it must be wrong.” As Isaac Asimov put it:

There is a cult of ignorance in the United States, and there always has been. The strain of anti-intellectualism has been a constant thread winding its way through our political and cultural life, nurtured by the false notion that democracy means that ‘my ignorance is just as good as your knowledge.’⁷⁸

The fourth and final issue raised by the *VirtneX* Court was whether and how the Nash Bargaining Solution is linked to the Georgia Pacific factors, is up for determination.⁷⁹ The *VirtneX* Court opined that Weinstein “ultimately determined that a 10% deviation – resulting in a 45/55 split – was appropriate ‘to reflect the fact that Apple would have additional bargaining power over *VirtneX* back in [...] 2009.’”⁸⁰ Asymmetric bargaining

⁷¹ *Id.* at 1332.

⁷² Kalai, *supra* note 6.

⁷³ See *VirtneX, Inc. v. Cisco Sys.*, 767 F.3d 1308, 1332 (1st Cir. 2014).

⁷⁴ *Oracle Am., Inc. v. Google, Inc.*, 798 F. Supp. 2d 1111, 1120 (N.D. Cal. 2011).

⁷⁵ See Choi & Weinstein, *supra* note 44 at 56-60; see also *Oracle Am., Inc.*, 798 F. Supp. 2d at 1120.

⁷⁶ See generally RANGARAJAN SUNDARAM, A FIRST COURSE IN OPTIMIZATION THEORY (Cambridge University Press, 1996).

⁷⁷ *Id.*

⁷⁸ Vladimir Nabokov, *A Cult of Ignorance*, NEWSWEEK, Jan. 21, 1980, at 19.

⁷⁹ *VirtneX, Inc. v. Cisco Sys.*, 767 F.3d 1308, 1333 (1st Cir. 2014).

⁸⁰ *Id.*

power of the two entities involved in bargaining has been addressed in the game theory literature. Dr. Weinstein was correct in adjusting the split of the surplus to reflect the asymmetric bargaining power of the two entities.⁸¹ However, his method of adjustment was *ad hoc* and not based on economic theory. Conversely, the Monotonic Solution of Professor Kalai rigorously analyzes such asymmetry.⁸²

VI. CONCLUSION

This article summarized the Nash Bargaining Solution, as initially posited by Professor Nash⁸³ and generalized by Professors Harsanyi,⁸⁴ Selten,⁸⁵ Shapley,⁸⁶ Kalai and Smorodinsky,⁸⁷ Kalai,⁸⁸ Myerson,⁸⁹ Rubinstein,⁹⁰ Roth,⁹¹ Binmore,⁹² and Binmore, Rubinstein, and Wolinsky.⁹³ The applications of the Nash Bargaining Solution and its extensions to intellectual property litigation are discussed. Further, academic and practitioner work supporting and opposing the use of the Nash Bargaining Solution and its generalizations in such litigation are discussed. Finally, the recent Court decision in *VirnetX* is analyzed from this perspective.

⁸¹ See Choi & Weinstein, *supra* note 44.

⁸² See See Kalai, *supra* note 6.

⁸³ See Nash, *supra* note 1.

⁸⁴ See Harsanyi, *supra* note 2.

⁸⁵ See Reinhard Selten, *supra* note 3.

⁸⁶ See Shapley, *supra* note 4.

⁸⁷ See Kalai & Smorodinsky, *supra* note 5.

⁸⁸ See Kalai, *supra* note 6.

⁸⁹ See Myerson *supra* note 7.

⁹⁰ See Rubinstein *supra* note 8.

⁹¹ See Roth, *supra* note 9.

⁹² See Binmore, *supra* note 10.

⁹³ See Binmore et. al, *supra* note 11.