Bargaining Power in a Licensing Negotiation: Application of Game Theory
Developing a Quantitative Licensing Strategy

- A major consumer electronics manufacturer seeking assistance with licensing.
- Thought existing royalty terms were victims of inertia and sought guidance on whether better terms were possible.
- Concerned that some negotiations drag on and result in unnecessary costs of delay and litigation.
- Interested in a more rigorous quantitative template of licensing to aid in the art of licensing.

<table>
<thead>
<tr>
<th>Situation</th>
<th>Actions Taken</th>
<th>Results</th>
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<tbody>
<tr>
<td>◆ Developed a Nash Bargaining framework as a starting quantitative framework.</td>
<td>◆ Identified licenses where royalties were out of line with the Nash solution.</td>
<td>◆ Identified economic drivers of the royalty.</td>
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<tr>
<td>◆ Introduced familiar income approaches into the framework.</td>
<td>◆ Identified areas where bargaining power could be most advantageously leveraged.</td>
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<tr>
<td>◆ Applied Monte Carlo simulation to provide generate complete distribution of possible outcomes.</td>
<td>◆ Reviewed a sample of existing licenses to evaluate royalties with Nash solutions.</td>
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Common IP Valuation Techniques

The value of the intellectual property should drive licensing decisions.

Value is dependent upon successful commercialization and, when done properly, reflects opportunities and risks.

How much can I make from this technology?  

Income Approach

What are others paying for this technology or comps?  

Market Approach

How much would it cost me to re-create a similar, non-infringing technology?  

Cost Approach
How Would Valuations Work in a Negotiation?

- **Income Approach**: How much can I make from this technology?
- **Market Approach**: What are others paying for this technology or comps?
- **Cost Approach**: How much would it cost me to re-create a similar, non-infringing technology?
Can We Model the Negotiation?

**Income Approach**
How much can I make from this technology?

**Market Approach**
What are others paying for this technology or comps?

**Cost Approach**
How much would it cost me to re-create a similar, non-infringing technology?
**Game Theory**

- Branch of mathematics commonly applied to economics, biology, political science, and philosophy.

- Formalization of strategic behavior.

- Interactive decision-making where the outcome for each participant or “player” depends on the actions and perceptions of all.

- Focus on the other party’s competitive actions and needs rather than just one’s own position.
John von Neumann - Father of Game Theory

- Regarded as one of the greatest mathematicians in modern history.
- Pioneering work in mathematics, physics, economics, statistics, computer science, nuclear weapons, ...
- At last count, 7 Nobel prizes grew from his ideas, including game theory
- Principal member of the Manhattan Project and developed the implosion method for the atomic bomb.
- Worked out steps involved in thermonuclear reactions and the hydrogen bomb.
- Inspiration for Dr. Strangelove.
- Original faculty (along with Einstein and Gödel) at the Institute for Advanced Study.
- Invented the first modern computer.
- Created game theory with Oskar Morgenstern.
John Nash – A Beautiful Mind

- Nobel Prize in Economics.
- Developed the Nash Equilibrium and the Nash Bargaining Solution as a Ph.D. student in mathematics at Princeton.
- Significant contributions in the field of mathematics.
- Suffered from paranoid schizophrenia.
- Nash Equilibrium advanced game theory beyond “zero sum” games to more realistic and general cases making it more applicable to the areas of economics, business, biology, law, and diplomacy.
- Nash Bargaining Solution is the seminal model in bargaining and has been widely used to this day in studies of labor negotiations, baseball arbitration, international trade, and patent licensing.
Not All Fun and Games
Today’s Focus is on Bargaining Over Intellectual Property
Introduction to Bargaining

• Bargaining situation: A number of individuals have a common interest to cooperate but a conflicting interest on how to cooperate

• Key tradeoff: Players wish to reach an agreement rather than disagree but each player is self-interested

• Bargaining theory studies these situations, their outcome, and the bargaining process
Nash Bargaining

Nash’s approach

• *When presented with a bargaining problem, how can we pick a reasonable outcome?*

• *Interested in the outcome rather than the process*

Axiomatic approach and is considered as one of the key foundations of bargaining problems
Why Nash’s Bargaining Solution was Important

$60,000
Why Nash’s Bargaining Solution was Important

$60,000

$80,000
Why Nash’s Bargaining Solution was Important
Why Nash’s Bargaining Solution was Important

Bargaining Range

$60,000 -> $70,000 -> $80,000
Why Nash’s Bargaining Solution was Important

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$60,000 \downarrow \ $70,000 \uparrow \ $80,000
Why Nash’s Bargaining Solution was Important

Bargaining Range

$60,000 \downarrow \quad $70,000 \quad \uparrow \quad $80,000$

We say that a pair of payoffs $(v_1^*, v_2^*)$ is a **Nash bargaining solution** if it solves the following optimization problem:

$$\max_{(v_1, v_2)} \quad (v_1 - d_1)(v_2 - d_2)$$

subject to

$$(v_1, v_2) \in U$$

$$v_1, v_2 \geq (d_1, d_2)$$

We use $f^N(U, d)$ to denote the Nash bargaining solution.

Pareto efficiency: This follows immediately from the fact that the objective function of problem (1) is increasing in $v_1$ and $v_2$.

Symmetry: Assume that $d_1 = d_2$. Let $v^* = (v_1^*, v_2^*) = f^N(U, d)$ be the Nash bargaining solution. Then, it can be seen that $(v_2^*, v_1^*)$ is also an optimal solution of (1). By the uniqueness of the optimal solution, we must have $v_1^* = v_2^*$, i.e., $f^N(U, d) = f^N(U, d)$.

Let $z = f^N(U, d)$, and define the set

$$U' = \{a'v + \beta | v \in U, a' + \beta = (1/2, 1/2) \},$$

i.e., we map the point $z$ to $(1/2, 1/2)$ and the point $d$ to $(0, 0)$. Since $f(U, d)$ and $f^N(U, d)$ both satisfy axiom 3 (invariance to equivalent payoff representations), we have $f(U, d) = f^N(U, d)$ if and only if $f(U', 0) = f^N(U', 0) = (1/2, 1/2)$. Hence, to establish the desired claim, it is sufficient to prove that $f(U', 0) = (1/2, 1/2)$.

Let us show that there is no $v \in U'$ such that $v_1 + v_2 > 1$.

Assume that there is a $v \in U'$ such that $v_1 + v_2 > 1$. Let $t = (1 - \lambda)(1/2, 1/2) + \lambda(v_1, v_2)$ for some $\lambda \in (0, 1)$. Since $U'$ is convex, we have $t \in U'$. We can choose $\lambda$ sufficiently small so that $t_1t_2 > 1/4 = f^N(U', 0)$, but this contradicts the optimality of $f^N(U', 0)$, showing that for all $v \in U'$, we have $v_1 + v_2 \leq 1$. 
Why Nash’s Bargaining Solution was Important

Axiomatic Approach
1. Feasibility
2. Pareto efficiency
3. Symmetry
4. Invariance to linear transformation
5. Independence of irrelevant alternatives

$60,000 \rightarrow $70,000 \rightarrow $80,000
Why Nash’s Bargaining Solution was Important

$70,000 \rightarrow \$75,000 \rightarrow \$80,000
Why Nash’s Bargaining Solution was Important

Fairness is subjective here. Jim has more bargaining power than Dwight so he can better threaten to stop the deal.

Disagreement point is a benchmark and its selection is very important in a problem.
Nash Bargaining Solution Opened the Door for the Study of Bargaining

THE BARGAINING PROBLEM

BY JOHN F. NASH, JR.

A new treatment is presented of a classical economic problem, one which occurs in many forms, as bargaining, bilateral monopoly, etc. It may also be regarded as a nonzero-sum two-person game. In this treatment a few general assumptions are made concerning the behavior of a single individual and of a group of two individuals in certain economic environments. From these, the solution (in the sense of this paper) of the classical problem may be obtained. In the terms of game theory, values are found for the game.

INTRODUCTION

A two-person bargaining situation involves two individuals who have the opportunity to collaborate for mutual benefit in more than one way. In the simpler case, which is the one considered in this paper, no action taken by one of the individuals without the consent of the other can affect the well-being of the other one.

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This is the classical problem of exchange and, more specifically, of bilateral monopoly as treated by Cournot, Bovley, Tichner, Fellner, and others. A different approach is suggested by von Neumann and Morgenstern in Theory of Games and Economic Behavior which permits the identification of this typical exchange situation with a nonzero sum two-person game.

In 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.

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Visual Aid to the Nash Bargaining Solution

Profit with the Technology

- Patentee’s Profit Under Next Best Alternative
- Infringer’s Profit Under Next Best Alternative

Bargaining Range

Economic gains from licensing.
Visual Aid to the Nash Bargaining Solution

- Profit with the Technology
- Infringer’s Profit Under Next Best Alternative
- Patentee’s Profit Under Next Best Alternative
- Bargaining Range
- Royalty
Visual Aid to the Nash Bargaining Solution

![Diagram showing the Nash Bargaining Solution]

- **Profit with the Technology**
- **Patentee's Profit Under Next Best Alternative**
- **Infringer's Profit Under Next Best Alternative**
- **Bargaining Range**
- **Royalty**

50/50?
Rubinstein Bargaining Process

- Two players $A$ and $B$ bargain over the division of a cake of size 1

- Alternating-offers process
  - At time 0, $A$ makes an offer to $B$
  - If $B$ accepts, the game ends, otherwise
  - $B$ rejects and makes a counter offer at time $\Delta > 0$
  - The process continues infinitely until an agreement is reached

- The payoff of a player $i$ at any time is $x_i \delta^t$
  - $x_i$ is the share of the cake for player $i$, $0 < \delta < 1$ a discount factor and $t$ is the number of time intervals $\Delta$ elapsed
  - The discount factor is also function of a discount rate
Rubinstein Bargaining Process

- At the equilibrium the shares of the players are

\[ x_A^* = \frac{1}{1 + \delta}, \quad x_B^* = \frac{\delta}{1 + \delta} \]

- At date \( t = 0 \), player \( A \) offers \( x_A \), player \( B \) accepts and the game ends
- First-mover advantage, player \( A \) gets more than player \( B \) but the result is Pareto efficient
- As \( \delta \) increases (the interval \( \Delta \) decreases) this advantage starts to disappear
- **The solution depends highly on the relative discount rates**
Rubinstein Bargaining Process

• Rubinstein (1982) modeled this process as an extensive form non-cooperative game

• When making an offer the player’s strategy is the value of the share he requests

• When responding to an offer the strategy is either accept or reject the offer (as a function of the history of the game so far)
Rubinstein Bargaining Process

- Rubinstein showed that the game has a unique subgame perfect equilibrium that is Pareto efficient
Rubinstein Bargaining Process

- The Rubinstein model shows that being more patient increases your bargaining power!

- The smaller the cost of “haggling”, the more waiting time you can sustain, the higher is your bargaining power

- We reach Nash as $\Delta$ goes to 0
Drivers of Bargaining Power

- Patience confers bargaining power
- Greater risk aversion affects bargaining power adversely.
- Outside option enhances bargaining power if and only if it is attractive and credible.
- Higher costs of backing down can increase bargaining power.
- Credible communication can reduce the risk of failure of negotiations or of costly delay.
- Bargaining strength goes to the better informed negotiator.
Application to Licensing

- Patent holder and licensee try to engage in a mutually beneficial agreement but have conflicting interests over the terms of trade (e.g., royalty, scope, exclusivity, etc.).

- Gains from cooperation (i.e., economic surplus) are reflected in quantitative (e.g., new products, new markets) and qualitative gains (e.g., validation of technology, signal to the market).

- Process can be time consuming, and the parties may reach an agreement only after costly delay (e.g., litigation, lost market opportunity or market share).

- What are practical strategies to maximize the share of the surplus (e.g., favorable royalty) and minimize the costs of negotiations (e.g., delays, litigation or trial)?
Quantifying the Opportunity – Income Approach

**Value:**
Present value of the expected future incremental income stream.

**Theory:**
Licensee willing to pay some portion of its economic gain from using the intellectual property

Focus on the incremental income stream attributable to the to patents, trademarks, etc.

Incremental value is the difference between income with and without the use of the intellectual property.
Income Approach: DCF Method

Discounted Cash Flow ("DCF") is a common method

Based on the future cash flows discounted to a present value.

Discounted present value of intellectual property is a function of the incremental income streams:

• Cash flow with IP less cash flow without IP.
• Must account for all costs including capital expenditures and working capital requirements.

Risk associated with cash flow streams must be accounted for.

Primary method for valuing patents and technology.
Income Approach: DCF Method

Revenue Drivers:
- Market size
- Market segmentation
- Market growth rate
- Life cycle
- Market share
- Product pricing

Less Expense Drivers:
- R&D requirements
- Capital investment
- Cost to manufacture
- Operating expenses

Risk (Discount Rate)
- Market risk
- Development risk (will it work?)
- Technology risk (will it be adopted?)
- Contingencies (e.g., regulatory approval)

Total Cash Flow to be Apportioned

Discount Total Cash Flow:
Yields net present value
Risk Adjusted Cash Flows and Present Value

\[
DCF = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \cdots + \frac{CF_n}{(1+r)^n}
\]
Quantifying the Opportunity

\[
DCF = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \cdots + \frac{CF_n}{(1+r)^n}
\]

Profit with the Technology
... Or Using a Distribution of Outcomes – Monte Carlo
Incremental Income

Profit with the Technology

\[ DCF = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \cdots + \frac{CF_n}{(1+r)^n} \]

Licensee’s “Normal” Profit without the Technology

\[ DCF = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \cdots + \frac{CF_n}{(1+r)^n} \]

Surplus from Technology

*Incremental Income: Benefits from Using the Technology*

*Non-infringing Alternative: Costs of Not Using the Technology*

*Royalty?*
Incremental Income: a Special Case of NBS

Profit with the Technology

Licensee’s “Normal” Profit without the Technology

Benefits from Using the Technology

Royalty = Willingness to Pay

Provides a good framework for examining outside opportunities, but it is one-sided in that it only looks at the situation from the licensee’s viewpoint.
What About the Patent Holder’s Opportunity Cost?

**Profit with the Technology**

- Patentees Profit Under Next Best Alternative
- Licensee’s Profit Under Next Best Alternative

**Bargaining Range**

**Royalty**
Litigation or Threat of Litigation Can Play an Important Role…

**Patentee’s opportunity cost:**
- Commercialize the technology using its products
- Negotiate exclusive or non-exclusive licenses with another party
- **Litigation**
  - Cost to litigate
  - Expected Outcome
Litigation costs and expected outcomes change the next-best alternatives for both parties.
…So It is Important to Understand Trends in Litigation

Patent Infringement Claims Closed in 2010

129 Claims

227 Claims
So it is important to understand trends in litigation.

Patent Infringement Claims Closed in 2010

Settle = \( \Phi(X'\beta_1) = \int_{-\infty}^{u_1} \phi(X'\beta_1)du_1 \)

Dismissal = \( \Phi(X'\beta_2) = \int_{-\infty}^{u_2} \phi(X'\beta_2)du_2 \)

Duration = \( X'\beta_3 + \varepsilon \)

129 Claims

227 Claims
...So It is Important to Understand Trends in Litigation

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\text{Settle} = \Phi(X'\beta_1) = \int_{-\infty}^{u_1} \phi(X'\beta_1)du_1 \\
\text{Dismissal} = \Phi(X'\beta_2) = \int_{-\infty}^{u_2} \phi(X'\beta_2)du_2 \\
\text{Duration} = X'\beta_3 + \epsilon
\]

227 Claims

Predict Litigation Outcomes and Duration (Cost) By:

- Judge
- Technology type
- Citations
- Patent age
- Plaintiff’s law firm
- Defendant’s law firm
- NPE vs. PE
- Industry
Putting it All Together

**Market Approach**
What are others paying for this technology or comps?

**Income Approach**
How much can I make from this technology?

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How much would it cost me to re-create a similar, non-infringing technology?

\[
DCF = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \cdots + \frac{CF_n}{(1+r)^n}
\]
Benefits of the Framework

• Forces examination of assumptions and alternative scenarios needed to establish a bargaining solution.

• Bargaining surplus identifies range of reasonable royalties.

• Bargaining solution serves as a reasonable solution from which to compare offers.

• Identification of key drivers of the bargaining solution.

• Identification of key drivers, if any, of royalties offered by other parties.
So what are the Pitfalls?
“What do you mean, it’s the wrong kind of right?”

Plaintiff expert opinion was excluded

• Seven patents cover use of entire Java platform for Android

• Damages based on entire market value of Android

• Unsupported hypothetical negotiation date

• Hypothetical negotiation with the wrong licensor

• No attempt to link damages to actual infringement

• Ignores real world comparables

• Relies on the Nash Bargaining Solution?
District Court comments on the NBS

• “Like any mathematical model, the Nash solution cannot describe real-world behavior unless the conditions on which it is premised are satisfied in the real world.”

• “It is no wonder that a patent plaintiff would love the Nash bargaining solution because it awards fully half of the surplus to the patent owner, which in most cases will amount to half of the infringer’s profit, which will be many times the amount of real-world royalty rates. There is no anchor for this fifty-percent assumption in the record of actual transactions.

• The Nash bargaining solution involves complex mathematical formulas and equations that would surely be incomprehensible to the average juror…[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.”
Was Nash Bargaining Solution the problem...

...or a case of throwing out the baby with the bathwater?
District Court in *Oracle v. Google* raised a valid concern…

“The Nash bargaining solution has never been approved by a judge to calculate reasonable royalties in litigation, at least in the face of objection. This is despite the fact that for decades it has been lurking in the field of economics.”

**Although …**

- The court denied in part plaintiff’s motion to strike the damages expert's reliance on “a 50% profit sharing rule”

*Sanofi-Aventis Deutschland GmbH v. Glenmark Pharms., Inc., USA*
- Plaintiff’s expert’s methodology was not akin to the 25% Rule but based on specific facts of the case and denied defendant’s *Daubert* motion

*Mformation Techs., Inc. v. RIM*
- Use of NBS as a “check” permitted

*Eolas v. Adobe*
- Denied motion *in limine* to exclude Nash Bargaining

*Inventio AG v. Otis Elevator Co.*
- Bargaining range and split based on GP factors was not a rule of thumb.
Recent developments in case law

- Lucent v. Gateway, 580 F.3d 1301 (Fed Cir. 2009)
- ResQNet.com, Inc. v. Lansa, Inc., 594 F.3d 860 (Fed. Cir. 2010)
- Wordtech System Inc. v. Integrated Networks Solutions Inc., et al., 609 F.3d 1308 (Fed. Cir. 2010).
- Uniloc USA v. Microsoft Corp., 632 F.3d 1292, 1315 (Fed. Cir. 2011).
Uniloc v. Microsoft, CAFC, January 4, 2011

The end of the 25% Rule

“This court now holds as a matter of Federal Circuit law that the 25 percent rule of thumb is a fundamentally flawed tool for determining a baseline royalty rate in a hypothetical negotiation.”

“Evidence relying on the 25 percent rule of thumb is thus inadmissible under Daubert and the Federal Rules of Evidence, because it fails to tie a reasonable royalty base to the facts of the case at issue.”

“Beginning from a fundamentally flawed premise and adjusting it based on legitimate considerations specific to the facts of the case nevertheless results in a fundamentally flawed conclusion.”

“…carefully tie proof of damages to the claimed invention’s footprint in the market place.”
Did Oracle’s expert properly set the bargaining range…

Profit with the Technology

Patentee’s had zero opportunity cost?  Licensee had zero opportunity cost?

Bargaining Range?
...and was the royalty not grounded in the incremental value of IP

“It is no wonder that a patent plaintiff would love the Nash bargaining solution because it awards fully half of the surplus to the patent owner, which in most cases will amount to half of the infringer's profit, which will be many times the amount of real-world royalty rates...The Nash bargaining solution “would invite a miscarriage of justice by clothing a fifty-percent assumption in an impenetrable façade of mathematics.”

“The asserted patent claims purport to disclose only incremental improvements to the efficiency and security of the Java system.”
Compare to the 25% Rule

Profit with the Technology

Royalty
Or with the 50% Rule

Profit with the Technology

Royalty
Compare to the Appropriate Framework

Profit with the Technology

- **GP Factors:** 8, 3, 6, 7
- **NBS Axioms:** 2, 4

Patentee's Profit Under Next Best Alternative
- **GP Factors:** 4, 5
- **NBS Axioms:** 2, 4

Infringer's Profit Under Next Best Alternative
- **GP Factors:** 9, 10, 11
- **NBS Axioms:** 2, 4

Bargaining Range
- **GP Factor:** 13
  - Who suffers less from delay?
  - Which party can injure the other more?
- **NBS Axiom:** 5

Royalty
- **NBS Axioms:** 1, 3
- **GP Factor:** 15
Compare to the Appropriate Framework

**Patentee’s Profit Under Next Best Alternative**
- **GP Factors:** 4, 5
- **NBS Axioms:** 2, 4

**Infringer’s Profit Under Next Best Alternative**
- **GP Factors:** 9, 10, 11
- **NBS Axioms:** 2, 4

**Bargaining Range**
- **GP Factor:** 13
  - Who suffers less from delay?
  - Which party can injure the other more?
  - **NBS Axiom 5**

**Royalty**
- **NBS Axioms:** 1, 3
- **GP Factor:** 15

*Energy Transportation Group, Inc. v. William Demant Holdings A/S*

“Once again, this court does not endorse Georgia-Pacific as setting forth a test for royalty calculations, but only as a list of admissible factors informing a reliable economic analysis.”
Improper vs. Proper Theory

50% Rule

Profit with the Technology

Royalty

NBS

GP Factors: 8, 9, 10, 11
NBS Axioms 2, 4

Infringer's Profit Under Next Best Alternative

Bargaining Range

GP Factors: 4, 5
NBS Axioms 2, 4

Patentee's Profit Under Next Best Alternative

GP Factors: 12
Who suffers loss from delay?
Which party can injure the other more?
NBS Axiom 8

Royalty

NBS Axioms 1, 3
GP Factor 15
Improper vs. Proper Theory

50% Rule

NBS

"facts of the case"
Questions?