Licensing Best Practices

Strategic, Territorial, and Technology Issues

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CHAPTER 17

APPLICATION OF GAME THEORY TO INTELLECTUAL PROPERTY ROYALTY NEGOTIATIONS

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INTRODUCTION

One of the most important elements of intellectual property licensing negotiations is the determination of the compensation to be paid to an owner for access to his or her intellectual property. Unfortunately, in many cases, relatively little time or effort is devoted to determining the appropriate level of compensation. As noted by Gregory Battersby and Charles Grimes, "Frequently, the inquiry starts and ends with the last license granted by that property owner for the same or similar property."[2] Alternatively, the parties simply rely on "customary" royalty rates for particular industries. Both of these approaches can provide *some* useful guidance for intellectual property licensing negotiations, but historical and/or customary royalty levels sometimes are not enough. Compensation needs to be driven by the particular facts of each situation.

The goal of this chapter is to provide intellectual property licensing professionals with another systematic approach to thinking about what the "right" payment might be[3] and to offer them insights into critical parameters to consider in that approach. "Game theory" constitutes the basis for the approach and the source of the insights.

USEFULNESS OF GAME THEORY

Game theory is the branch of social science that studies strategic decision making. In this field, a "game" can be described as "any interaction between agents that is governed by a set of rules specifying the possible moves for each participant and a set of outcomes for each possible combination of moves."[4] It studies how rational actors behave when their separate choices interact to produce payoffs to each player, i.e., when the benefit that a player will receive depends not only on his or her own choice but on choices made by others.[5]

The licensing of intellectual property is undoubtedly a situation in which the benefits available to each side, i.e., inventor and manufacturer, depend critically on the choices made by each party. A game theoretic approach is extremely helpful in and of itself in thinking about the "right" price for the intellectual property given the strategies and outcomes available to both negotiators. Also, it effectively supplements other common intellectual property pricing methods by encouraging the evaluation of negotiation-specific and intellectual property-specific factors that are critical to a fair outcome.

One common pricing tool is to adopt a rate that has been used in a previous setting, either from a party's own experience or from the experience of others in the industry. The usefulness of such an approach depends on the availability of comparable transactions. If such technologies can be found, then the royalties reflected in those transactions are likely to provide valuable guidance in setting the price for the intellectual property under consideration. However, there are at least two potential limitations. First, it can be difficult to find sufficiently similar technologies and transactions. The greater the differences between the benchmark transaction/intellectual property and the transaction/intellectual property under consideration, the less useful the benchmark. Second, even if the benchmark used is close, the adoption of a royalty based on this benchmark may simply replicate the results of the earlier negotiation, regardless of whether the price reflected in the benchmark is sensible or not. If the initial intellectual property was underpriced because of the weakness of the bargaining position of the seller, then reliance on this royalty rate in a subsequent agreement may perpetuate this result—even if the seller in the subsequent negotiation was in a stronger bargaining position.

Another common tool focuses on the expected profits (or cash flows) that are likely to be generated by use of the intellectual property in question. The basic idea behind "income" methods for establishing a royalty is that parties to a licensing negotiation seek to find a mutually agreeable way to "share" the benefits from making, using, or selling products embodying the technology at issue. The owner of the technology is entitled to compensation for the portion of the benefits of the product or process owing to the intellectual property. The manufacturer should retain certain benefits derived from other attributes of the product or process that incorporate the technology at issue. A commonly used profit-based method is the Profit Split Rule, which provides that the manufacturer should pay one-fourth to one-third of its expected operating profits for products incorporating the patented technology.[6]

The foundation of income approaches is specific to the intellectual property, i.e., the profits that are expected to be made from the intellectual property at issue. However, there are at least two potential limitations. First, it can be difficult to isolate the true incremental benefits associated with use of the intellectual property at issue. Second, the income approach provides limited guidance on how those benefits should be allocated between the inventor and manufacturer. For example, the Profit Split Rule is a rule of thumb and may not reflect the actual contributions and/or negotiating positions of the parties involved.

A third approach to establishing a royalty focuses on the costs required to construct or purchase an alternative technology that performs the same function as the patented technology but that does not infringe on the intellectual property.[7] According to cost approaches, a user of certain patented technology would pay no more for access to that technology than the additional costs that it would incur if it were not able to use the technology.

A common problem with this tool is that most cost approaches focus on avoided out-of-pocket capital expenditures. Such examinations tend to underestimate the true value of assets, including intellectual property assets. According to Reilly and Schweihs:

> Costs describe what the intangible asset owner spent in the original production process, or what the owner would have to spend as of a certain date to recreate that production process. Cost, by itself, does not tell us how much a buyer would pay to acquire the intangible asset, or how much a seller would seek to motivate the sale of the intangible asset....[8]

Among the "economic" costs that need to be considered are the costs of unsuccessful design attempts, the period of the design-around, and the going forward impacts of the alternative. In short, out-of-pocket costs may not measure either fair value or fair price for the intellectual property at issue or for the parties involved in the negotiation.[9]

As noted above, a game-theoretic approach permits consideration of both intellectual property- and negotiation-specific considerations in setting royalty rates.

As a general matter, game theory assumes that all the players involved in a given situation are "rational"—in the sense that they will seek to maximize their own rewards (e.g., profits, income, or other benefit) in the circumstances they face. In particular, each of the players involved in the game is assumed to adopt the strategy that will yield the maximum benefits to him or her, given the rules governing interactions within the game and given the strategy that the other player has chosen or is expected to choose.

A game-theoretic approach to licensing negotiations requires both sides to think through the "rules of the game" and the payoffs that each party can expect under the scenarios that could play out during the course of negotiations. Armed with this knowledge, the negotiators will be in a much better position to determine the "right" price for the intellectual property because the focus is placed on likely outcomes and provides guidance as to how to bargain to those outcomes.

BARGAINING BASICS

The prototypical bargaining game involves two players who must negotiate over the allocation of a "pie."[10] In most bargaining games, access to "pie" for both parties is contingent on an agreement (i.e., no agreement, no pie for anyone).

Three aspects of bargaining games are particularly worthy of note. First, the players in a bargaining game are faced with an interesting challenge: They want to make the most favorable agreement that they can, while avoiding the risk of no agreement at all.[11] Second, delays in reaching an agreement are costly, which encourages both parties to reach an agreement as quickly as possible. Third, in order to reach an agreement, both parties should approach the bargaining by "looking ahead and reasoning back."[12]

A SIMPLE BARGAINING GAME. Our Example 1 assumes that two families—the Hatfields and the McCoys—are spending the afternoon at the beach. A gallon of (still frozen) ice cream washes up on the beach, and both families try to claim it. As the families start to argue, a lifeguard walks by and agrees to help resolve the dispute. The lifeguard notices that the ice cream is melting at a rate of one quart every 15 minutes, so the ice cream will be gone at the end of an hour. The lifeguard decides to let the Hatfields and the McCoys negotiate for the ice cream under the following rules.

There will be four rounds of offers made. The first offer is to be made by the Hatfields immediately (when there is one gallon of ice cream to be divided). The McCoys are free to accept or reject this offer. If it is accepted, then the ice cream is divided and the negotiation stops. If it is rejected, the McCoys will make an offer in 15 minutes (when there are three quarts of ice cream to be divided). The Hatfields are free to accept or reject this offer. Once again, if it is accepted, then the ice cream is divided and the negotiation stops. If it is rejected, the Hatfields will make an offer in 30 minutes (when there are two quarts of ice cream to be divided). The McCoys are free to accept or reject this offer. If it is accepted, then the ice cream is divided and the negotiation stops. If it is rejected, the McCoys will make an offer in 45 minutes (when there is only one quart of ice cream to be divided). The Hatfields are free to accept or reject this offer. Once again, if it is accepted, then the ice cream is divided and the negotiation stops. If it is rejected, neither family gets any ice cream.

What portion of the ice cream should the Hatfields offer to share with the McCoys at the start of these negotiations? To answer this question, it is necessary to look forward to the end of the negotiation and reason back to the beginning of the negotiations.

During the last offer period (45 minutes from now), there will be only one quart of ice cream remaining, and the McCoys have the right to decide how much to offer the Hatfields. If the Hatfields do not agree to the McCoys' offer, then neither party would get any ice cream. Therefore, during the last period, the Hatfields would be better off accepting *any* amount of ice cream (e.g., one spoonful) offered by the McCoys.[13] Thus, the division of ice cream in the last period would be one quart (less one spoonful) of ice cream for the McCoys and one spoonful of ice cream for the Hatfields.

Given this division at the 45-minute point, the best deal that the Hatfields can expect to get when it makes an offer at the 30-minute point (when there will be two quarts of ice cream left) is to offer to give the McCoys one quart of ice cream and to keep one quart for itself. If the Hatfields were to offer any less than one quart to the McCoys, then the McCoys would simply reject the offer and obtain one quart at the end of the negotiations.

Given this division at the 30-minute point, the best deal that the McCoy family can expect to get when it makes an offer at the 15-minute point (when there will be three quarts of ice cream left) is to offer to give the Hatfields one quart of ice cream and to keep two quarts for itself. If the McCoys were to offer any less than one quart to the Hatfields, then the Hatfields would simply reject the offer and obtain one quart when they make an offer at the 30-minute point.

Finally, given this division at the 15-minute point, the best deal that the Hatfield family can expect to get when it makes an offer immediately (when there is one gallon of ice cream left) is to offer the McCoys two quarts of ice cream and to keep two quarts for itself. If the Hatfields were to offer any less than two quarts to the McCoys, then the McCoys would simply reject the offer and obtain two quarts when they make an offer at the 15-minute point.

Based on this analysis, it can be concluded that an agreement will be reached immediately, as the Hatfields offer two quarts of ice cream to the McCoys and keep two quarts for themselves. By looking forward and reasoning back, the parties are able to reach an agreement that minimizes losses caused by delays and ensures that neither party could do better by delaying an agreement.

AN INTELLECTUAL PROPERTY LICENSING GAME. In a typical intellectual property licensing situation, one of the players (the inventor) owns a piece of intellectual property (e.g., a patent, copyright, or trademark) that the other player (the manufacturer) seeks to use. The "pie" at issue is the profits/cash flows that are expected to be generated as a result of the use of the technology by the manufacturer.

To understand the insights provided by game theory for intellectual property licensing, we have developed Example 2. Inventor is an individual. He or she has developed a new product, the Widget. The intellectual property to be licensed includes a patent covering the Widget and all know-how required to manufacture and bring the Widget to market. The potential Manufacturer is a company that possesses all the resources, i.e., manufacturing facilities, work force, sales force, and so on, necessary to manufacture and commercialize this product. Given its resources and capabilities, Manufacturer is believed to be the most promising developer of Inventor's intellectual property.

The remaining life of the patent is four years. Both Inventor and Manufacturer believe that the price of Widgets will be $200 each and that the costs associated with manufacturing and selling Widgets is $100 each. In addition, 1,000 Widgets are expected to be sold each year. Thus, total revenues (ignoring discounting, for now) associated with making and selling Widgets are expected to be $200,000 per year, and profits are expected to be $100,000 per year.

In this example, Inventor and Manufacturer take turns making offers—with only one offer being made each year. In Year 1 (when there are four years remaining in the life of the patent), Inventor extends an offer to give Manufacturer rights to manufacture and sell Widgets for the remaining life of the patent. Manufacturer is free to accept or reject this offer. If the offer is rejected, Manufacturer will have an opportunity to make an offer to Inventor in Year 2 (when only three years of patent life remain). Inventor is free to accept or reject this offer. If the offer is rejected, Inventor will have an opportunity to make an offer to Manufacturer in Year 3 (at which time only two years of patent protection remain).

This process continues until Year 4—the final year of patent protection. In Year 4, Manufacturer has the right to make an offer. If this offer is rejected by Inventor, then negotiations end, and both parties get nothing. Therefore, it is in Inventor's best interest to accept *any* amount of money offered by Manufacturer in Year 4, because the alternative would be to get nothing.

Following the logic developed in examining Example 1 (the Hatfields and McCoys), the offers that should be extended by Inventor and Manufacturer can be determined by looking forward and reasoning back.

Manufacturer's offer in Year 4 would give virtually all the available profits to Manufacturer. Inventor would be offered (and would be expected to accept) the smallest possible amount (e.g., one penny) in Year 4 because the only alternative would be to reject the offer and get nothing for its Widget invention.

Given these results in Year 4, Inventor's licensing offer in Year 3 would have to allocate at least $100,000 to Manufacturer—because $100,000 is the amount that Manufacturer will get in Year 4 if no agreement is reached in Year 3. An agreement in Year 3 would generate $200,000 in profits ($100,000 in both Years 3 and 4), so Inventor's offer in Year 3 would give Manufacturer $100,000 and would give Inventor $100,000. In Year 2 (when $300,000 in total profit is available if an agreement is reached), Manufacturer's offer would allocate $100,000 to Inventor (the amount that Inventor could get in Year 3 if Inventor rejected Manufacturer's Year 2 offer) and keep $200,000 for itself. Details regarding all the offers that would be extended in these four-year-long negotiations are provided in Exhibit 17.1.

In this situation, an agreement will be reached in Year 1, based on an offer made by Inventor in which $200,000 is allocated to Manufacturer and $200,000 is allocated to Inventor. In other words, the license to which Inventor and Manufacturer are expected to agree provides for an even split of the profits generated by the commercialization and sale of Widgets. Moreover, no losses caused by an inability to reach an agreement are expected.

Year	Years of Protection	Annual Profit	Total Profit	Offeror	Inventor Share		Manufacturer Share	
					Total	Annual	Total	Annual
1	4	$100,000	$400,000	Inventor	$200,000	$50,000	$200,000	$50,000
2	3	100,000	300,000	Manufacturer	100,000	33,333	200,000	66,667
3	2	100,000	200,000	Inventor	100,000	50,000	100,000	50,000
4	1	100,000	100,000	Manufacturer	0.01	—	100,000	100,000

EXHIBIT 17.1 NEGOTIATION OFFERS

A more formal exploration (and explanation) of a game-theoretic approach reflecting the previous discussion follows, based on sound economic principles as well as common sense; it is applicable to many licensing situations. Its bases and conclusions can be extremely useful in helping negotiators arrive at a more informed and sensible price for the intellectual property to be shared.

THE NASH BARGAINING SOLUTION (NBS)

DESCRIPTION. In the early 1950s, Nobel Prize winner John Nash formally examined issues raised in bargaining games.[14] Instead of providing descriptive or normative observations on the bargaining process, he, in essence, asked: "What would a good bargaining solution look like?" He reasoned:

> [O]ne can attack the [bargaining] problem axiomatically by stating general properties that 'any reasonable solution' should possess. By specifying enough such properties one excludes all but one solution.[15]

The general properties of a bargain that were identified as critical by Nash were the following.

1. Any solution to a two-person bargaining problem should be feasible and Pareto efficient. That is, the outcome should be attainable and there should be no other feasible solution that is better than the solution for one player and not worse than the solution for the other player.
2. Neither party should get less *in* the bargain than it could get *without* a bargain. In other words, the benefit of the bargain for each player (Π_i) should be greater than or equal to that player's "disagreement" (or no bargain) profits (d_i).
3. The bargaining solution should be independent of the numeric specification of the utility function. That is, if payoffs are measured in a different way, the solution should stay the same. What should matter is the *relative utilities* of the bargainers, not the specific manner in which they are measured.
4. Eliminating alternatives other than the disagreement profits should have no effect on the outcome. If, in the first bargain, option A is chosen over B and C, in a second bargain, if C is eliminated, A should be chosen over B again.
5. If players 1 and 2 have an equal bargaining position, then the solution should treat them symmetrically (or equally).

Nash proved that in each bargaining situation, these properties lead to a unique (or single) bargaining outcome. That outcome has come to be known as the Nash Bargaining Solution (NBS), with the NBS a function of three variables. The first is the total amount of benefits available to be divided, i.e., the size of the pie. This is also referred to as transferable wealth. The second is each party's disagreement profits. This represents the benefits that a party can obtain in the event that no agreement is reached and corresponds to the benefits associated with the party's next best alternative. The third variable is each party's relative bargaining strength. Stronger parties receive larger slices of pie.

The NBS[16] provides that the optimal solution is one in which benefits/profits are split such that:

$$\Pi_1 = d_1 + \alpha(\Pi - d_1 - d_2) \quad (17.1)$$

$$\Pi_2 = d_2 + (1 - \alpha)(\Pi - d_1 - d_2) \quad (17.2)$$

$$\Pi = \Pi_1 + \Pi_2 \quad (17.3)$$

where:

Π_1: Player 1 Nash-bargained profits
Π_2: Player 2 Nash-bargained profits
d_1: Player 1 disagreement profits
d_2: Player 2 disagreement profits
α: Player 1 relative bargaining strength $0 \leq \alpha \leq 1$
Π: total profits

The intuition behind these results is relatively straightforward. In the allocation of the total pie available, each party is assigned an amount equal to that which it would be able to receive if no agreement were reached, i.e., Player 1 obtains at least d_1 and Player 2 obtains at least d_2. If this were not the case, it would not be in the interest of either party to enter into the agreement. After that, each party is entitled to a portion of total remaining profits $(\Pi - d_1 - d_2)$, which we will call the "agreement surplus." That "portion" is determined by the relative bargaining strength of each party. The parameter α reflects Player 1's negotiating power relative to Player 2 and ranges between 0 (when Player 2 enjoys overwhelming bargaining power) and 1 (when Player 1 enjoys overwhelming bargaining power).

When the negotiating parties are on an equal footing (which is Nash's original assumption and embodies the fifth property identified above), the value of α is $\frac{1}{2}$ and the NBS provides that:

$$\Pi_1 = d_1 + \tfrac{1}{2}(\Pi - d_1 - d_2) \quad (17.4)$$

$$\Pi_2 = d_2 + \tfrac{1}{2}(\Pi - d_1 - d_2) \quad (17.5)$$

$$\Pi = \Pi_1 + \Pi_2 \quad (17.6)$$

where:

Π_1: Player 1 Nash-bargained profits
Π_2: Player 2 Nash-bargained profits
d_1: Player 1 disagreement profits
d_2: Player 2 disagreement profits
Π: total profits

In Example 2 (Inventor/Manufacturer) discussed earlier, we assumed that both parties had zero disagreement profits ($d_1 = d_2 = 0$) and had equal bargaining power ($\alpha = \frac{1}{2}$). That resulted in an even split of the benefits associated with an agreement. There is an intuitive and mathematical appeal to such a result. However, in the real world, assumptions of no disagreement profits and equal bargaining power often do not hold.

In reality, Inventor may have been able to earn something on his or her intellectual property even if there were no agreement with Manufacturer. Assuming Inventor had the ability to earn $20,000 per year by manufacturing and selling Widgets on his or her own during any period in which there was no agreement with Manufacturer, the negotiated outcome would be different.

We begin, once again, at the end of the negotiating process. When Manufacturer is preparing to make its offer in Year 4, Manufacturer must give Inventor at least $20,000 (plus $0.01) in order to make it worthwhile for Inventor to agree to a license. Otherwise, Inventor would be better off rejecting Manufacturer's offer and selling Widgets on his or her own. Accordingly, the new Year 4 offer extended by Manufacturer would give $20,000 to Inventor and $80,000 to Manufacturer.

In light of these Year 4 results, Inventor's offer to Manufacturer in Year 3 would only need to give Manufacturer $80,000. Accordingly, Inventor's offer in Year 3 would allocate $120,000 to inventor and $80,000 to Manufacturer.

In Year 2, Manufacturer would need to offer Inventor the $120,000 that Inventor could obtain in a Year 3 deal—and an additional $20,000 to account for the profits that Inventor could obtain on his or her own in Year 2 if no agreement is signed.

A summary of the complete bargaining process is provided in Exhibit 17.2.

As shown in this exhibit, Inventor's ability to make money outside of an agreement fundamentally shifts the results of the negotiation. There is, once again, an agreement in Year 1, but now Inventor is able to claim most of the benefits generated by the license. Specifically, of the $100,000 per year generated by commercialization of the Widget, Inventor is able to lay claim to $60,000, while Manufacturer is limited to only $40,000.

The result can be easily derived using the NBS, with the following parameters: (1) $\alpha = \frac{1}{2}$; (2) d_I (Inventor) = 4 · $20,000 = $80,000; (3) d_M (Manufacturer) = 0; and (4) $\Pi = 4 \cdot \$100,000 = \$400,000$.

Year	Years of Protection	Annual Profit	Total Profit	Offeror	Inventor Share		Manufacturer Share	
					Total	Annual	Total	Annual
1	4	$100,000	$400,000	Inventor	$240,000	$60,000	$160,000	$40,000
2	3	100,000	300,000	Manufacturer	140,000	46,667	160,000	53,333
3	2	100,000	200,000	Inventor	120,000	60,000	80,000	40,000
4	1	100,000	100,000	Manufacturer	20,000	20,000	80,000	80,000

Exhibit 17.2 Summary of Bargaining Process

$$\Pi_I = d_I + \tfrac{1}{2}\,(\Pi - d_I - d_M) \tag{17.7}$$
$$= \$80{,}000 + \tfrac{1}{2}\,(\$400{,}000 - \$80{,}000 - \$0) \tag{17.8}$$
$$= \$80{,}000 + \tfrac{1}{2}\,(\$320{,}000) \tag{17.9}$$
$$= \$240{,}000 \tag{17.10}$$

$$\Pi_M = d_M + \tfrac{1}{2}\,(\Pi - d_I - d_M) \tag{17.11}$$
$$= \$0 + \tfrac{1}{2}\,(\$400{,}000 - \$80{,}000 - 0) \tag{17.12}$$
$$= \$0 + \tfrac{1}{2}\,(\$320{,}000) \tag{17.13}$$
$$= \$160{,}000 \tag{17.14}$$

A different result emerges if Manufacturer, rather than Inventor, has an alternative to licensing. Assume that Manufacturer could earn $50,000 per year in the absence of a license, while Inventor would earn nothing. Negotiations under these conditions are illustrated in Exhibit 17.3.

As one might expect, Manufacturer's ability to make money outside of an agreement with Inventor shifts the results of the negotiation in Manufacturer's favor. Under these conditions, an agreement is reached in Year 1, but now Manufacturer is able to claim $75,000 per year generated by commercialization of the Widget, whereas Inventor is able to obtain only $25,000.

This result could also be derived using the NBS, with the following parameters: (1) $\alpha = \frac{1}{2}$; (2) $d_I = \$0$; (3) $d_M = 4 \cdot \$50{,}000 = \$200{,}000$; and (4) $\Pi = 4 \cdot \$100{,}000 = \$400{,}000$.

$$\Pi_I = d_I + \tfrac{1}{2}\,(\Pi - d_I - d_M) \tag{17.15}$$
$$= 0 + \tfrac{1}{2}\,(\$400{,}000 - \$0 - \$200{,}000) \tag{17.16}$$
$$= 0 + \tfrac{1}{2}\,(\$200{,}000) \tag{17.17}$$
$$= \$100{,}000 \tag{17.18}$$

Year	Years of Protection	Annual Profit	Total Profit	Offeror	Inventor Share		Manufacturer Share	
					Total	Annual	Total	Annual
1	4	$100,000	$400,000	Inventor	$100,000	$25,000	$300,000	$75,000
2	3	100,000	300,000	Manufacturer	50,000	16,667	250,000	83,333
3	2	100,000	200,000	Inventor	50,000	25,000	150,000	75,000
4	1	100,000	100,000	Manufacturer	—	—	100,000	100,000

EXHIBIT 17.3 NEGOTIATIONS UNDER MANUFACTURER ALTERNATIVES

$$\Pi_M = d_M + \tfrac{1}{2}\,(\Pi - d_I - d_M) \quad (17.19)$$
$$= \$200{,}000 + \tfrac{1}{2}\,(\$400{,}000 - \$0 - \$200{,}000) \quad (17.20)$$
$$= \$200{,}000 + \tfrac{1}{2}\,(\$200{,}000) \quad (17.21)$$
$$= \$300{,}000 \quad (17.22)$$

Finally, we consider a situation in which both parties have viable options. For this analysis, we will assume that Inventor can earn \$20,000 per year and Manufacturer can earn \$50,000 per year in any year in which no license is in place. The negotiations under these circumstances are summarized in Exhibit 17.4.

Once again, this result could also be derived using the NBS, with the following parameters: (1) $\alpha = \frac{1}{2}$; (2) $d_I = 4 \cdot \$20{,}000 = \$80{,}000$; (3) $d_M = 4 \cdot \$50{,}0000 = \$200{,}000$; and (4) $\Pi = 4 \cdot \$100{,}000 = \$400{,}000$.

$$\Pi_I = d_I + \tfrac{1}{2}\,(\Pi - d_I - d_M) \quad (17.23)$$
$$= \$80{,}000 + \tfrac{1}{2}\,(\$400{,}000 - \$80{,}000 - \$200{,}000) \quad (17.24)$$
$$= \$80{,}000 + \tfrac{1}{2}\,(\$120{,}000) \quad (17.25)$$
$$= \$140{,}000 \quad (17.26)$$

$$\Pi_M = d_M + \tfrac{1}{2}\,(\Pi - d_I - d_M) \quad (17.27)$$
$$= \$200{,}000 + \tfrac{1}{2}\,(\$400{,}000 - \$80{,}000 - \$200{,}000) \quad (17.28)$$
$$= \$200{,}000 + \tfrac{1}{2}\,(\$120{,}000) \quad (17.29)$$
$$= \$260{,}000 \quad (17.30)$$

In this example, Manufacturer's alternative to licensing is more valuable than Inventor's alternative. Accordingly, Manufacturer is able to lay claim to a larger share of the annual profits of \$100,000 associated with the commercialization of Widgets—obtaining \$65,000 per year compared with \$35,000 per year for Inventor. As modeled above, differences in the alternative options available to a party involved in a negotiation are critical to the share of profits that might be claimed by each party. The party with the better alternative obtains a higher share of the profits.

Year	Years of Protec-tion	Annual Profit	Total Profit	Offeror	Inventor Share		Manufacturer Share	
					Total	Annual	Total	Annual
1	4	\$100,000	\$400,000	Inventor	\$140,000	\$35,000	\$260,000	\$65,000
2	3	100,000	300,000	Manufacturer	90,000	30,000	210,000	70,000
3	2	100,000	200,000	Inventor	70,000	35,000	130,000	65,000
4	1	100,000	100,000	Manufacturer	20,000	20,000	80,000	80,000

EXHIBIT 17.4 NEGOTIATIONS WITH BOTH PARTY OPTIONS

The allocation of agreement surplus (i.e., $\Pi - d_1 - d_2$), as noted earlier, is dependent on each party's bargaining strength, and much of that is driven by the relative costs of haggling to each party, i.e., the cost associated with delays in reaching an agreement.

In Example 1 (Hatfields and McCoys) discussed earlier, how might the division of ice cream change if the Hatfields' group consisted of one adult and six (impatient and hungry) children, whereas the McCoys' group included seven adults? Recall that, in the original analysis, the Hatfields offered two quarts of ice cream to the McCoys at the start of the negotiations, keeping two quarts for themselves. For their part, the McCoys were indifferent between accepting this offer right away and getting two quarts during the negotiation 15 minutes later. In the present case, the Hatfields are decidedly not indifferent between the immediate deal (two quarts for each party) and the deal that they could obtain in 15 minutes (in which they receive only one quart of ice cream). To avoid the possibility of the unpleasant outcome of receiving only one quart of ice cream in 15 minutes, the Hatfields are likely to sweeten the deal for the McCoys—giving them slightly more than two quarts, while keeping almost two quarts for the children. In this instance, the additional cost of haggling faced by the Hatfields (namely, unhappy children) causes them to weaken their negotiating demands.

Using the NBS structure, α (the bargaining power of the Hatfields) is likely to be much lower than that of the McCoys. In other words, α does not equal $\frac{1}{2}$. To the extent it is lower, the Hatfields are entitled to less than $\frac{1}{2}$ of the agreement surplus.

Applying unequal bargaining power to Exhibit 17.4 of Example 2 (Inventor/Manufacturer), and assuming $\alpha = \frac{1}{3}$, results in the following.

$$\Pi_I = d_I + \alpha\,(\Pi - d_I - d_M) \tag{17.31}$$
$$= \$80{,}000 + \tfrac{1}{3}\,(\$400{,}000 - \$80{,}000 - \$200{,}000) \tag{17.32}$$
$$= \$80{,}000 + \tfrac{1}{3}\,(\$120{,}000) \tag{17.33}$$
$$= \$120{,}000 \tag{17.34}$$
$$\Pi_M = d_M + (1 - \alpha)\,(\Pi - d_I - d_M) \tag{17.35}$$
$$= \$200{,}000 + \tfrac{2}{3}\,(\$400{,}000 - \$80{,}000 - \$200{,}000) \tag{17.36}$$
$$= \$200{,}000 + \tfrac{2}{3}\,(\$120{,}000) \tag{17.37}$$
$$= \$280{,}000 \tag{17.38}$$

With lower bargaining power, Inventor is awarded a smaller share of the annual profits associated with Widget sales. That share now becomes \$30,000 per year, versus the 50-50 case, in which he or she obtained \$35,000 per year.

EXTENSION TO LICENSING. In a paper published in July 2000, William Choi and Roy Weinstein posited that the basic or symmetrical NBS (i.e., the NBS shown in Equations (17.4), (17.5), and (17.6)) can be usefully applied to reasonable royalty determinations in intellectual property litigation. They wrote that:

> The NBS is well supported by economic theory and is regarded as one of the simplest yet most fruitful paradigms in game theory. The analytical clarity of the NBS also is an important justification for its use as another useful tool in calculating a reasonable royalty.[17]

In their article, Choi and Weinstein converted the Nash Bargaining Solution into a per unit royalty. A summary of this conversion, and their conclusion, is provided below.

Per Unit Royalty. Total profits are those generated by Manufacturer in the event that an agreement is reached. They can be expressed as:

$$\Pi_M = P_M \cdot Q_M - C_M(Q_M) \qquad (17.39)$$

where:

P_M: Manufacturer price per unit
Q_M: Manufacturer quantity
$C_M(Q_M)$: Manufacturer total cost function
Π_M: Manufacturer profits

The amount of profit received by Inventor under an agreement will be equal to a royalty rate multiplied by the total volume of sales of the relevant products. Therefore:

$$\Pi_I = rr_u \cdot Q_M \qquad (17.40)$$

where:

Π_I: Inventor profits
rr_u: royalty rate per unit
Q_M: Manufacturer quantity

Incorporating Equations (17.39) and (17.40) with (17.4), (17.5), and (17.6) (and assuming equal bargaining power) permits the calculation of a royalty per dollar based on the NBS.

$$\Pi_I = d_I + \tfrac{1}{2}\,(\Pi - d_I - d_M) \qquad (17.41)$$

$$= rr_u \cdot Q_M \qquad (17.42)$$

$$\Pi_M = d_M + \tfrac{1}{2}\,(\Pi - d_I - d_M) \qquad (17.43)$$

$$= \Pi - \Pi_I \qquad (17.44)$$

where:

Π_I: Inventor Nash-bargained profits
Π_M: Manufacturer Nash-bargained profits
d_I: Inventor disagreement profits
d_M: Manufacturer disagreement profits
Π: total profits

Combining Equations (17.43) and (17.44), Manufacturer's profits can be written:

$$d_M + \tfrac{1}{2}\,(\Pi - d_I - d_M) = \Pi - \Pi_I \tag{17.45}$$

$$d_M + \tfrac{1}{2}\,(\Pi - d_I - d_M) = \Pi - \mathrm{rr_u} \cdot Q_M \tag{17.46}$$

That results in:

$$\mathrm{rr_u} \cdot Q_M = \Pi - d_M - \tfrac{1}{2}\,(\Pi - d_I - d_M) \tag{17.47}$$

$$\mathrm{rr_u} \cdot Q_M = \tfrac{1}{2}\,\Pi + \tfrac{1}{2}\,(d_I - d_M) \tag{17.48}$$

Incorporating Equation (17.39) into Equation (17.48):

$$\mathrm{rr_u} \cdot Q_M = \tfrac{1}{2}\,(P_M \cdot Q_M - C_M\,(Q_M)) + \tfrac{1}{2}\,(d_I - d_M) \tag{17.49}$$

Dividing both sides by Q_M:

$$\mathrm{rr_u} = \tfrac{1}{2}\,[P_M - AC_M] + \tfrac{1}{2}\,Q_M\,[d_I - d_M]^{18} \tag{17.50}$$

where:

$\mathrm{rr_u}$: royalty rate per unit
P_M: Manufacturer price per unit
AC_M: Manufacturer average costs per unit
Q_M: Manufacturer quantity
d_I: Inventor disagreement profits
d_M: Manufacturer disagreement profits

Choi and Weinstein noted that the first part of Equation (17.50) provides that, as a starting point, a royalty rate should be one-half of the licensee's (or Manufacturer's) profits. The greater the Manufacturer returns, the greater the royalty.

The second part of Equation (17.50) provides that the royalty rate should be adjusted up or down depending on the disagreement profits of the two parties. If Inventor is not in the business and has no alternative, the rate may be adjusted down. If, on the other hand, Inventor is in the business and has relatively little to gain from a bargain, the royalty rate may be adjusted upward. If the two parties have equal disagreement profits, the licensing profits should be split equally, as the basic (or symmetric) Nash model suggests.

For Example 3, let us assume that the price of the product is \$3.50 per unit, the average cost is \$1.00 per unit, and the expected quantity demanded is 40 units. This implies that expected Manufacturer profits ($\Pi = \Pi_M$) are 40 · (\$3.50 – \$1.00) = \$100. Let us also assume that a non-bargain nets Manufacturer (d_M) \$40 and a non-bargain nets Inventor (d_I) \$0. Assuming equal bargaining power, the basic NBS royalty rate per unit is:

$$rr_u = \frac{1}{2}\ [\$3.50 - \$1.00] + \frac{1}{2(40)}\ [\$0 - \$40] \qquad (17.51)$$

$$= \$1.25 - \left[\frac{\$40}{80}\right] \qquad (17.52)$$

$$= \$1.25 - \$0.50 \qquad (17.53)$$

$$= \$.75 \qquad (17.54)$$

Applying that royalty rate to the Manufacturer's projected units result in a royalty payment by Manufacturer to Inventor of:

$$\Pi_I = \$.75 \cdot 40 \qquad (17.55)$$

$$= \$30 \qquad (17.56)$$

A royalty payment (or transfer of wealth) from the manufacturer of $30 results in a unique bargaining solution. Inventor is granted one-half of the agreement surplus, which is half of the difference between total bargaining profits ($100) and total disagreement profits ($40). Manufacturer retains $70—its disagreement profits ($40) plus one-half of the agreement surplus ($30).

A variant of Example 3 is one in which Inventor and Manufacturer are both in the business. Although they generally compete, it must be the case that Manufacturer will expand the market place beyond that which would have existed (either through price advantages or product enhancements). Otherwise, licensing would be irrational.

Again, for illustrative purposes, let us make the same assumptions as earlier, except that Inventor's non-bargain outcome (d_I) is $30. The resulting NBS royalty rate per unit is:

$$rr_u = \frac{1}{2}\ [\$3.50 - \$1.00] + \frac{1}{2(40)}\ [\$30 - \$40] \qquad (17.57)$$

$$= \$1.25 + \left[\frac{-\$10}{80}\right] \qquad (17.58)$$

$$= \$1.25 - \$0.125 \qquad (17.59)$$

$$= \$1.125 \qquad (17.60)$$

That results in a royalty payment of:

$$\Pi_I = \$1.125 \cdot 40 \qquad (17.61)$$

$$= \$45 \qquad (17.62)$$

Here, the royalty payment is higher than in the earlier example. That is because Inventor disagreement profits are positive. In other words, Inventor can generate profits from the patent without granting a license to the Manufacturer. Therefore, the royalty fee he or she commands is higher. Adjusting for that, each party does receive an amount that is equivalent to its disagreement profit plus one-half of the agreement surplus. Inventor profits are \$45 (\$30 + \$15). Manufacturer profits are \$55 (\$40 + \$15).

As noted, Choi and Weinstein examined the basic (or symmetrical NBS). In real-world licensing negotiations, however, bargaining power often is not equal.[19] In order to account for such inequality, one can derive a per unit royalty rate based on the Nash Bargaining Solution shown in Equations (17.1), (17.2), and (17.3). Using that construct, a royalty rate per unit is:

$$rr_u = \alpha\,[P_M - AC(Q_M)] + (1 - \alpha)\; d_I/Q_M - d_M/Q_M \qquad (17.63)$$

where:

rr_u: royalty rate per unit
P_M: Manufacturer price per unit
AC_M: Manufacturer average costs per unit
Q_M: Manufacturer quantity
d_I: Inventor disagreement profits
d_M: Manufacturer disagreement profits
α: Inventor relative bargaining strength $0 \le \alpha \le 1$

The per unit royalty rate when there is unequal bargaining strength consists of three elements. First, Inventor receives a portion of the per unit profit, with the portion equal to his or her relative bargaining strength. Second, Inventor receives a share of his or her own per unit disagreement profits, with the share equal to 1 minus his or her relative bargaining strength. Third, the royalty rate is reduced by a share of the Manufacturer's per unit disagreement profits, with that share equal to Inventor's relative bargaining strength.

If Inventor is in a commanding negotiating position, i.e., $\alpha = 1$, Inventor will receive all the per unit profit less Manufacturer's per unit disagreement profits. Remember, an optimal outcome is one in which each party receives at least what it could receive with no bargain. If Inventor has no bargaining power i.e., $\alpha = 0$, then the licensor's return will be limited to his or her own per unit disagreement profit. As Inventor's bargaining power falls, he or she obtains less and less of the agreement surplus.

Per Dollar Royalty. Equation (17.63) expresses the royalty in per unit terms. In fact, most royalties are expressed as a percent of revenues. As a result, it is useful to consider a per dollar royalty rate.

Such a calculation can be done using the procedure outlined in Equations (17.39) to (17.50). In that analysis, however, Equation (17.40) should be replaced with the following:

$$\Pi_I = rr_d \cdot (P_M \cdot Q_M) \qquad (17.64)$$

where:

Π_I: Inventor profits
rr_d: royalty rate per dollar
P_M: Manufacturer price per unit
Q_M: Manufacturer quantity

In words, the amount of profit received by Inventor under an agreement will be equal to a royalty rate (expressed as a percentage of total revenue) multiplied by total revenues generated by the sales of the relevant products. Using Equation (17.64) in the analysis outlined above, we get:

$$rr_d = rr_u/P_M \quad (17.65)$$

$$= \alpha\,[P_M - AC(Q_M)]/P_M + (1-\alpha)\,d_I/(P_M Q_M) - d_M/(P_M Q_M) \quad (17.66)$$

where:

rr_d: royalty rate per dollar
rr_u: royalty rate per unit
P_M: Manufacturer price per unit
AC_M: Manufacturer average costs per unit
Q_M: Manufacturer quantity
d_I: Inventor disagreement profits
d_M: Manufacturer disagreement profits
α: Inventor relative bargaining power $0 \leq \alpha \leq 1$

Equation (17.66) shows that there are three components to the royalty rate per dollar indicated by the asymmetric NBS. The first component is a share (α) of the percentage mark-up charged by Manufacturer. The mark-up is profit per dollar of revenue. The share is equal to Inventor's relative bargaining strength. The second component is a share ($1-\alpha$) of the percentage of total bargaining revenues that Inventor could receive in the absence of an agreement. The share is equal to Manufacturer's relative bargaining strength. The royalty rate increases with both of these components. The per dollar royalty rate decreases with the third component, which is a share (α) of the percentage of total revenues that are available to Manufacturer in the absence of an agreement. The share is equal to Inventor's relative bargaining strength.

For Example 3, we assumed that the price of the product is \$3.50 per unit, the average cost is \$1.00 per unit, and the expected quantity demanded is 40 units. This implies that expected Manufacturer profits ($\Pi = \Pi_M$) are 40 · (\$3.50 – \$1.00) = \$100. We also assumed that a non-bargain nets Manufacturer (d_M) \$40, and a non-bargain nets Inventor (d_I) \$0. In Equation (17.54), we derived a royalty rate per unit of \$.75. Given that the selling price was \$3.50, that equated to a royalty rate per dollar of 21.4%. Assuming unequal bargaining power, say, $\alpha = .6$, a different result is obtained.

$$rr_d = .6\ [\$3.50 - \$1.00]/\$3.50 + .4\ \frac{\$0}{\$140} - .6\ \frac{\$40}{\$140} \qquad (17.67)$$

$$= .6\ [.71] - .6\ [.29] \qquad (17.68)$$

$$= .43 - .176 \qquad (17.69)$$

$$= .257 \qquad (17.70)$$

$$= 25.7\% \qquad (17.71)$$

Increased Inventor bargaining power increases the royalty rate per dollar. In this example, the rate increased (from 21.4 to 25.7%), roughly proportionate with the increase in bargaining power.

ESTIMATION OF NBS

The NBS is highly stylized yet versatile. If well understood and carefully applied, it can provide extremely useful intellectual property pricing bounds. Nonetheless, it is not without limitations.

The basic insight of the NBS can be understood geometrically, as shown in Exhibit 17.5. Total profits represent the benefits that are to be allocated between Inventor and Manufacturer. It is also said to represent the level of transferable wealth. The starting point for the allocation of profits is that each party must receive at least as much from a deal as he or she would receive if no deal were reached. Accordingly, Inventor must receive at least d_I in an agreement, and Manufacturer must receive at least d_M. The remaining profits (Total Profits $- d_I - d_M$) are allocated based on the relative bargaining power of the parties. The stronger party is allocated more of the surplus.

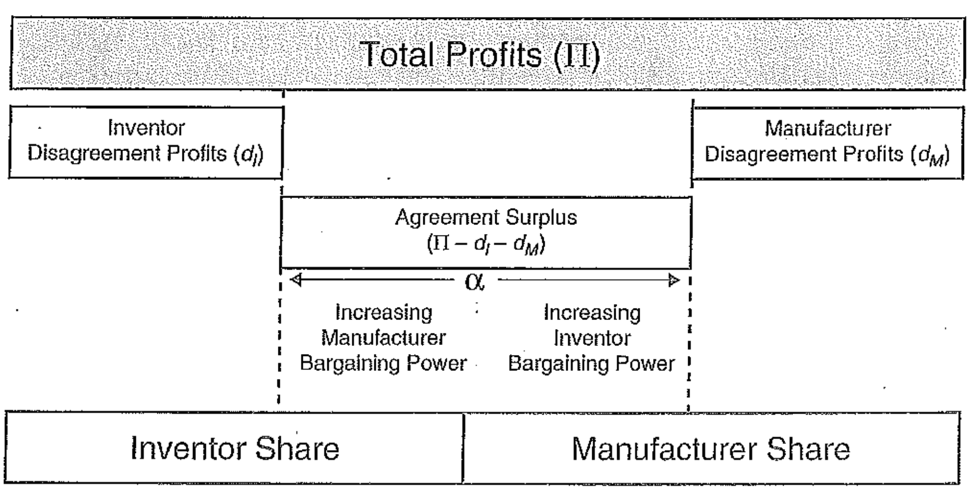

EXHIBIT 17.5 BASIC INSIGHT OF THE NBS

Although reasonably simple in concept, there are practical issues related to the understanding and application of each of the three relevant parameters.

DISAGREEMENT PROFITS (d_i). Each party needs to assess the benefits that can be expected *for both parties* if no deal is consummated. In other words, the value of each trading party's next best alternative should be determined.

In principle, that is simply the net present value of all future direct and indirect inflows associated with the course of action that would be chosen by each party in the event that no agreement is reached. That is often done, or do-able, by licensing professionals and economists. There are challenges, however. One is the identification of what the next best alternative might be—particularly for the other party. Generally speaking, negotiating parties will have a fair sense of their own options but a limited sense of the other party's. Furthermore, parties are often reluctant to share (or confirm) what their alternatives might be. This information asymmetry can make it difficult to develop reasonable estimates of d_I and d_M.

Even if parties are aware of one another's options, the valuation of such options can be difficult. Judgment is required, and consensus can be difficult to obtain.

Third, as a general matter, parties will tend to overvalue their own alternatives and undervalue those of the other party. Such biases make it difficult to reach a meeting of the minds on disagreement profits.

A fourth challenge to the valuation of each party's next best alternative is the fact that the alternatives may be constantly changing and evolving. Faced with the prospect of a potentially substantial license fee, licensees often mobilize their best subject-matter scientists to design-around the intellectual property at issue. Also, faced with a recalcitrant partner, licensors often "shop around" their technology to others. Thus, d_I and d_M can be moving targets, particularly in licensing negotiations that take time.

A fifth challenge is that the disagreement profit calculation for each party should often include indirect considerations, which are difficult to estimate. For example, consider a manufacturer that frequently licenses-in technology. For such a company, the outcome of a given negotiation may have an impact on future negotiations—and one effect of an "unsuccessful" negotiation over one piece of intellectual property might contribute to a reputation for tough dealing that will save money in later negotiations. For an inventor, the failure of a given negotiation may contribute to improved results in subsequent negotiations owing to a similar reputation of toughness. Such considerations may be hard to quantify—adding further complexity to the determination of d_I and d_M.

Despite these challenges, it is important to put effort into estimating d_I and d_M as accurately as possible. Because the agreement surplus is calculated as total profits (Π) minus d_I and d_2, failure to estimate both the latter two variables leads to a nondeterministic outcome.

TOTAL PROFITS (Π). The next critical piece of the NBS analysis is estimating the profits to be generated by the agreement under consideration. As a general matter, the tools used to prepare such estimates are a normal part of the licensing professional's (or economist's) toolbox, and one would expect that such estimates would be routinely prepared by both parties involved in an intellectual property licensing negotiation. For the purposes of applying the NBS, however, three points should be made about estimates of the profits to be generated by the agreement.

First, although one would expect both parties to have prepared an estimate of the profits to be generated by the agreement, the parties may not have reached the same conclusion, particularly if the intellectual property at issue is a new technology for which substantial uncertainty exists with regard to its value. As before, information asymmetries (and beliefs) lead to differences in assessing the pie to be split, which lead to differences in proposed slices of pie.

Second, total profits (Π), and their estimates, increase or decrease over time as the future becomes closer and less uncertain. As more is learned about a potential market opportunity—such as the size of the penetrable market, the likely degree of penetration, the competitive landscape (i.e., possible competitors), the market clearing prices, and supplier cost structures—expectations of bargaining profits become more refined. Even if beliefs are symmetric, Π changes over time.

Third, total profits may not be independent of the outcome of the licensing negotiations at hand. After all, the licensing terms may alter the incentives of the parties (particularly the licensee) in ways that influence total profits.

In Example 3, we assumed that the price of the product is $3.50 per unit, the average cost of production is $1.00 per unit, and the expected quantity demanded is 40 units. Those assumptions implied that expected Manufacturer profits ($\Pi = \Pi_M$) are $40 · ($3.50 – $1.00) = $100. In that example, with equal bargaining power, we determined that the royalty rate would be 21.4%.

The royalty fee can be accounted for by the manufacturer in a number of ways. First, it could treat the total royalty to be paid—$21.40—as a fixed cost of doing business. In such an event, the royalty would not affect the pricing decisions of the manufacturer.

Alternatively, the manufacturer could pass the entire cost increase (or some portion) through to its customers. Because demand curves are downward sloping, a price increase will be greeted by a quantity reduction. Depending on the point on the demand curve at which transactions are occurring (i.e., depending on the price elasticity of demand), that price increase may be more than offset by a quantity reduction, such that total revenues fall. In addition, it may be greeted by a less than proportional quantity reduction. In either case, Π is unlikely to remain constant. As the size of the total pie changes, the expected royalty rate may also change, which may, in turn, alter the size of the pie.

As before, it is important to estimate Π as accurately and consistently as possible. The size of the agreement surplus is driven by that estimation.

BARGAINING POWER (α). The third element of the NBS analysis, α, is the *relative* bargaining power of the negotiating parties.[20] It reflects the forces at work in a given negotiation (such as the rules of the game, the tactics employed by the bargainers, the information structure, and the players' discount rates) that can shift the outcome toward the interests of one party over another.

Unlike Π and d_i, the estimation of α does not derive from the tools normally used or developed by licensing professionals, rather, estimation of α involves more subjective assessments of the bargaining strength of the parties involved.

Absent additional information, one might reasonably expect relative bargaining strength to be equal, i.e., $\alpha = \frac{1}{2}$. The question, therefore, becomes: What might make α different from $\frac{1}{2}$?

One of the main forces that moves α away from $\frac{1}{2}$ is time. More specifically, it is the different ways in which the parties involved in the negotiation react to the passage of time.

As noted earlier, and as is well understood by those in the profession, real-world license negotiations typically do not involve such one-time, simultaneous offers as suggested by the NBS. Instead, real-world negotiations take time. Also, while such negotiations are taking place, neither of the parties to the (potential) agreement are enjoying the benefits of the agreement. Moreover, as time passes, the likelihood grows that the value of the intellectual property under consideration could change because of other developments (e.g., the emergence of an alternative technology or a shift in consumer tastes). The relative costs and dangers faced by each party owing to delays in reaching an agreement can be expected to have a direct impact on each party's patience for delaying an agreement and, consequently, its relative bargaining strength.

In the early 1980s, Ariel Rubinstein published a paper describing a (sequential or time-consuming) model of bargaining in which the players take turns making offers to each other over the division of a "pie" until agreement is reached.[21] This paper explored the drivers of the division of the pie between the negotiating parties. Rubinstein showed that the division of the pie depends on two parameters: (1) the time between offers and (2) the negotiating parties' relative discount rates.

Rubinstein showed that to the extent that there is a delay between the time one offer is rejected and the next offer can be made, the offering party has an advantage and will be able to extract a greater share of the pie. This advantage flows from the fact that value is being lost during the period between offers, and the offering party should be able to capture this value. Of course, as the time between offers diminishes, the extent of such losses declines and a first mover advantage is neutralized.

With regard to the negotiating parties' relative discount rates, the less patient party is "rewarded" with a smaller share of the pie. In fact, when offers and counteroffers are essentially instantaneous, the allocation of the pie between the parties depends only on the ratio of their discount rates. If a party is more patient, his or her bargaining power is greater. Mathematically, it is:

$$\alpha = \frac{r_2}{r_1 + r_2} \qquad (17.72)$$

where:

α: Player 1 bargaining power
r_1: Player 1 discount rate
r_2: Player 2 discount rate

If $r_1 = 10$ percent and $r_2 = 20$ percent, then $\alpha = .67$. Player 1 has twice as much power because he or she is twice as patient.

It should be noted that the "discount rate" reflects the cost of bargaining to each party.[22] Such costs include each party's time value of money, as well as the expected costs associated with potential adverse market developments, costs associated with lost "patent time," and any other cost that makes an immediate agreement preferable to an agreement at some point in the future. Some new technologies have very broad windows of opportunity for Manufacturers and are not easily displaced. Their discount rates are quite low. Other technologies have very limited opportunities. Their discount rates are high. Moreover, a prospective Inventor with limited licensing-out opportunities may view the pie as shrinking at a much faster rate than an Inventor with a myriad of licensing-out opportunities in a very crowded marketplace.

Furthermore, the importance of generating cash flows in general, and these project flows in particular, will be a function of each party's current and projected business and financial position. An individual Inventor with limited financial resources and limited licensing prospects will, holding all else constant, be more inclined to reach a deal (and faster) than will be a large multinational corporation with a myriad of prospective projects. Relatively large and profitable projects, holding all else constant, increase the cost of delaying access to those projects.

Relative bargaining power can also depend on the nature of the relationship between the parties. For example, if Manufacturer is a major "customer" of Inventor, this circumstance is likely to provide Manufacturer with some degree of negotiating leverage that would affect relative bargaining power. Alternatively, if Manufacturer has already made a substantial investment in a project and requires a license to complete the project, this can diminish Manufacturer's bargaining strength.

Relative bargaining strength can also be affected by the nature of the negotiations. For example, an Inventor who is seeking to license a piece of intellectual property is likely to have much more bargaining power if he or she is able to have two potential licensees competing for the license than he or she would have if the licensing options were limited.

Estimating α (or the relative costs of haggling) is extremely difficult for several reasons. First, it is not at all clear what should be included in the determination or how to weigh each factor. "Relative bargaining strength" is not a concept that is often quantified by licensing professionals or economists.

Second, not only is there often a lack of full (and symmetric information), but the relative costs change over time. Moreover, parties are often motivated to present biased information to their potential partner.

Third, the distinction between d_i and α is unclear. Disagreement profits are drivers of bargaining power. A high d_i is often associated with a high α. The influences need to be disentangled. Estimating α requires consideration of the entire circumstances involved in the negotiation and a realistic assessment of the strengths of each party. Fortunately, such assessments are commonly made by licensing professionals; they are just not usually made as explicitly (or perhaps consciously) as they should be in applying the NBS framework. Thinking more systematically about such issues will improve one's ability to apply the NBS and, thereby, think about the "right" price for the intellectual property that one is seeking to license.

CONCLUSIONS

The NBS construct does not attempt to explain the results of licensing negotiations. The underlying work was theoretical in nature. Moreover, the predictive value is virtually impossible to test because of the largely private and/or subjective nature of the expected total profits (Π), disagreement profits (d_i), and relative bargaining power (α).

On the other hand, the NBS is a reasonable outcome in the face of sensible properties. It also might be thought of as what a fully rational and informed arbitrator might conclude, being armed with the relevant facts (and expectations) surrounding a real-world license negotiation.

At the very least, it provides useful insights as to a reasonable outcome and the steps needed to get there. Both parties should seek to obtain, assess, and share (to the extent feasible) certain important information. Such an approach may lead to an individually and collectively optimal solution. Information should be sought and agreement reached (or as close as possible) with regard to three important parameters. The first is the projected benefits (mostly to Manufacturer) flowing from a consummated license. The second is the disagreement profits (or next best alternatives) available to each party if a license is not consummated. The third is the objective bargaining strength of each party, with that driven primarily by each party's discount rate.

In virtually all licensing situations, there will be violations as to optimal (and consistent) rationality, full (and consistent) information, equivalent (and consistent) expectations, accurate (and consistent) views of next best alternatives, and reasonable (and consistent) views of bargaining power. Nonetheless, reducing those violations will result in movement toward an optimal license fee. That fee is one that gives each party to the license a fee equivalent to its benefits of not entering the license plus an equitable share of the net benefits of the bargain.

Endnotes

1. We are grateful to Abhinay Muthoo, Christopher Borek, and Joshua Fougere for their valuable insights and assistance. Richard Peeks and Mark Pietrzykoski did a masterful job in preparing the document. The views and errors here are the authors'.
2. Gregory J. Battersby and Charles W. Grimes, *Licensing Royalty Rates 5* (Gaitherburg and New York: Aspen Law & Business, 2002), 5.
3. The focus of this paper will be on the determination of a running royalty form of compensation. That, however, can be fairly easily converted into a lump-sum payment, milestone payments, or any number of hybrids.
4. Shaun P. Hargreaves Heap and Yanis Varoufakis, *Game Theory: A Critical Introduction 1* (London and New York: Routledge, 2000), 1.
5. Howard Raiffa, John Richardson, and David Metcalfe, *Negotiation Analysis: The Science and Art of Collaborative Decision Making* 53 (Cambridge and London: Belknap Press, 2002), 53.
6. See, e.g., Robert Goldscheider, "Litigation Backgrounder for Licensing," *Les Nouvelles* 29 (March 1994): 20; Robert Goldscheider and Michael A. Epstein, "Determining the Value of Technology and Setting Royalty Rates," *The Journal of Proprietary Rights* 4 (October 1992); Robert Goldscheider, John Jarosz, and Carla S. Mulhern, "Use of the 25 Percent Rule in Valuing IP," *Les Nouvelles* 37 (December 2002): 123; and Richard Razgaitis, *Valuation and Pricing of Technology-Based Intellectual Property* (Hoboken, NJ: John Wiley & Sons Inc., 2003), 145–178.
7. Robert F. Reilly and Robert P. Schweihs, *Valuing Intangible Assets* (New York: McGraw-Hill, 1999), 97.
8. Ibid., 97, 121.
9. Ibid., 120: "It is worth reiterating that cost, price, and value are three separate and distinct valuation concepts. It is naïve and usually incorrect to assume that 'cost equals price equals value.' In fact, the reverse is often more likely to be true; that is, 'cost does not equal price does not equal value'."
10. The "pie" could be a specific amount of money or any other benefit that is to be divided between the negotiating parties.
11. Morton D. Davis, *Game Theory: A Nontechnical Introduction* (New York: Dover Publications, Inc., 1983), 119.
12. Avinash K. Dixit and Barry J. Nalebuff, *Thinking Strategically: The Competitive Edge in Business, Politics, and Everyday Life* (New York and London: W.W. Norton & Co., 1991), 85.
13. This, again, assumes rationality, i.e., spite is not a factor.
14. John F. Nash, "The Bargaining Problem," *Econometrica* 18 (1950): 155–172; John F. Nash, "Two-Person Cooperative Games," *Econometrica* 21 (1953): 128–140.
15. Ibid., 1953, 109.
16. To be accurate, Equations (17.1) to (17.3) represent the bargaining outcome for a generalized or asymmetric Nash Bargaining Solution, one that relaxes the fifth property above. See Abhinay Muthoo, *Bargaining Theory with Applications* (Cambridge: Cambridge University Press, 1999), 35–36.
17. William Choi and Roy Weinstein, "An Analytical Solution to Reasonable Royalty Rate Calculations," *Idea: The Journal of Law and Technology* 41 (July 2000): 49, 52.
18. Choi and Weinstein's formulation implicitly assumes that price and quantity remain constant. Such an assumption, for reasons noted later, may be unrealistic.
19. Muthoo (1999), 35.

20. In the NBS analysis, α_I plus α_M is set equal to 1. Accordingly, we define $\alpha_I = \alpha$, and $\alpha_M = (1\alpha)$.
21. Ariel Rubinstein, "Perfect Equilibrium in a Bargaining Model," *Econometrica* 50 (1982): 110–150.
22. The discount rate used here is not equivalent to a project's financial discount rate, i.e., the rate at which the holder of an asset is indifferent between a lump sum paid today and the prospect of receiving future cash flows out into the future. In fact, that rate should already have been accounted for in calculating total profits and each party's disagreement profits.

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