Licensing under Bargaining

Chun-Chieh Wang, Assistant Professor, National Sun Yat-Sen University, Taiwan

ABSTRACT

To relax the assumption that licensees have no bargaining power, which is prevalent in the licensing literature, the Rubinstein bargaining model is integrated with a duopoly licensing model in this paper. The licensor always licenses the best technology regardless of whether the technology advances are negotiated or solely determined by the licensor. Further, royalties prove to be the only payment method. Otherwise, the choice of the payment methods depends on the licensor’s market entry decision and firms’ bargaining powers in some cases. Finally this paper presents a simple framework for analyzing the effect of the licensee bargaining power on licensing behavior.

INTRODUCTION

Innovation plays an essential role in economic development (Schumpeter, 1934). The institution of intellectual property is necessary to encourage innovation. Licensing is a popular way of acquiring existing technology, and licensing has become an important topic in the field of industrial organization since Arrow (1962). Payment methods, advances in licensed technology, and the market entry decisions under licensing, all considered in this paper, are important issues discussed in the literature.

From the licensor’s perspective, (specific) royalties are typically preferable to fixed fees (Wang, 1998). There are two reasons for this. First, licensors can take weaken the licensee’s competence by royalties. Second, industry profits can be expanded due to the resultant decrease in the competition. However, fixed fees may create more profits for the licensor when some firms in the industry are not licensed (Sen, 2005a; Sen and Tauman, 2007). In the case of uncertainty in market demand or in the licensee’s production cost, two-part tariffs should be considered (Bousquet et al., 1998). Information asymmetry between the licensor and the licensee makes the fixed fee policy superior to the royalty policy in some cases (Gallini and Wright, 1990; Sen, 2005b). In addressing advances in licensed technology, most of relevant studies, such as Li and Song (2009), suggest that licensors should license the best technology if there is no threat of imitation. It is clear that the need to expand industry profits is a major reason for licensing the best technology.

Studies such as those mentioned above, which focus exclusively on the issue of licensing, simply assume that the licensor makes take-it-or-leave-it offers to the licensees and do not consider that licensee may have a certain degree of bargaining power. In contrast, potential licensees often have bargaining power in practice. Only a few papers, mainly addressing the issues of foreign market entry or the R&D activities, ever relate the bargaining process to licensing activities. Contractor (1985) mainly discusses the choice between joint ventures and licensing. That study simply uses rules of thumb to model the bargaining process that occurs between local and foreign partners. d’Aspremont et al. (2000) use the mechanisms of direct bargaining to analyze the negotiation between two research labs. However, the scenario they analyze is not related to production, which is the focus of this paper. Gans and Stern (2000) creatively consider both R&D activities and competition in the market by introducing an iterative bargaining process into the model. However, because they focus on the link between R&D and market competition, they do not address the issue of how the licensee bargaining power affects licensing behavior.

Indeed, the effects of the licensee bargaining power on licensing behavior cannot be easily determined without deliberate investigation. It is unclear whether licensors will still use royalties to exploit or license their best technology once licensees have bargaining power. Licensees who have bargaining power may reject the license contracts with the payment method of royalties, causing the licensors to choose not to license the best technology because the licensees’ competence cannot be weakened enough by royalties.

Kishimoto and Muto (2011) is the first paper to explore licensing under bargaining. Kishimoto and Muto (2011)
simply integrate the Nash bargaining model with the duopoly licensing model proposed by Wang (1998). They show that royalties are always preferable to fixed fees from the licensor’s perspective, and are also superior from consumers’ perspective in some cases. Unlike Kishimoto and Muto (2011), this paper uses a more general way of constructing the payoff possibility frontier and replaces the Nash bargaining model with the Rubinstein alternatively offering bargaining process.1 With this framework, it is easy to discuss the effect of licensees’ bargaining power on licensing behavior. Furthermore, this paper uses the same framework to analyze partial licensing and market entry under licensing. It emerges that the licensor will still offer the best technology regardless of whether technology advances are solely decided by the licensor or negotiated by the licensor and the licensee..

The benchmark case is presented in Section 2, I investigate partial licensing in Section 3, and Section 4 concludes the paper.

**THE BENCHMARK CASE**

In the benchmark case, I use a more generalized treatment on the payment method to reproduce the payoff frontier in Kishimoto and Muto (2011). Instead of the Nash bargaining model, the Rubinstein alternatively offering bargaining process will be integrated with a duopoly model because the feasible set is not convex in some cases.

Both I and Kishimoto and Muto (2011), based on Wang (1998), assume that only two firms, both producing homogeneous goods without fixed costs, exist in the market. A Cournot duopoly faces the inverse market demand, \( P = a - Q \), where \( P \) and \( Q \) denote the market price and the market quantity demanded, respectively; \( a \) is a constant. Firm 1 is the potential licensor, whose unit production cost is fixed at \( c - \varepsilon, 0 < \varepsilon < c \); the potential licensee, Firm 2, produces goods at a unit production cost \( c \). According to Wang (1998), Firm 2 will be driven out if drastic innovation occurs, \( \varepsilon \geq a - c \), and Firm 1 will enjoy monopoly profits \( \pi_m = (a - c + \varepsilon)^2/4 \). In the case of non-drastic innovation, \( \varepsilon < a - c \), Firm 1’s and Firm 2’s profits are \( \pi_1^{dl} = (a - c + 2\varepsilon)^2/9 \) and \( \pi_2^{dl} = (a - c - \varepsilon)^2/9 \), respectively.

Two firms will participate in Rubinstein’s alternately offering bargaining process to negotiate regarding fixed fees \( F \geq 0 \) and royalties \( r \geq 0 \) before deciding their quantities, \( q_1 \) and \( q_2 \), on their own. Unlike Kishimoto and Muto (2011), this paper directly considers two-part tariffs as the generic payment method although this payment method may degenerate to a simpler one which only contains royalties or fixed fees. Clearly, the treatment on the payment method in this paper is more generalized than in Kishimoto and Muto (2011).

During the bargaining stage, it is assumed that the licensor will make an offer first.2 After the licensee receives an offer, it can accept the offer, make a counteroffer, or withdraw from bargaining. Two firms make offers alternately until one firm accepts the other’s offer or withdraws from bargaining. If the latter occurs, licensing does not occur. Because only the firm that receives an offer can choose to quit, the payoffs of the outside option (the profits that accrue when no licensing occurs) does not matter unless the bargaining results in a lower payoff than the outside option. Note that the profits for two firms will decrease if the bargaining lasts for more than one round. \( \delta_i \) denoting Firm \( i \)’s discount factor for one round, can also be considered to indicate Firm \( i \)’s bargaining power. A higher \( \delta \) represents more bargaining power. The difference of bargaining power may be resulted in many reasons. For example, a firm with a high debt ratio may be more eager for closing the negotiation early and paying interest back.

In the benchmark case, once licensing occurs, Firm 2’s unit production cost must become \( c - \varepsilon \). Let \( \pi_i \) denotes Firm \( i \)’s profits after licensing.

\[
\begin{align*}
\pi_1 &= (a - q_1 - q_2 - (c - \varepsilon))q_1 + r \cdot q_2 + F, \\
\pi_2 &= (a - q_1 - q_2 - (c - \varepsilon) - r)q_2 + F.
\end{align*}
\]

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1 In some cases of partial licensing and licensing under market entry, the feasible set of payoffs may not be convex. However, the Nash bargaining model requires a convex feasible set (Nash, 1950). Hence, in this paper, I use the alternately offering bargaining process proposed by Rubinstein (1982).

2 The order in which offers are made offers has no effects on the results of the comparatively static analysis.
Given \((F, r)\), the optimal quantities for Firm 1 and Firm 2 are \((a - c + \varepsilon + r)/3\) and \((a - c + \varepsilon - 2r)/3\).

Before solving the bargaining problem, it is necessary to construct the \(\pi_1-\pi_2\) possibility frontier as follows: given a predetermined level of \(\pi_2\), Firm 1 chooses \((F, r)\) to maximize its profits such that Firm 2’s profits are no less than \(\pi_2\). Equation (2) can be rewritten as

\[
F = (a - q_1 - q_2 - (c - \varepsilon) - r)q_2 - \pi_2. \quad (3)
\]

After substituting \(q_1\) and \(q_2\), Equation (3) can be rewritten as

\[
F = (a - c + \varepsilon - 2r)^2/9 - \pi_2 \quad (4)
\]

Substituting Equation (4) into Equation (1) emerges that

\[
\pi_1 = (a - c + \varepsilon + r)^2/9 + r \cdot (a - c + \varepsilon - 2r)/3 + (a - c + \varepsilon - 2r)^2/9 - \pi_2 \quad (5)
\]

Because \(q_2 \geq 0\), \(\partial \pi_1/\partial r = (a - c + \varepsilon - 2r)/9 \geq 0\).

Hence, given \(\pi_2\) and the assumption of a non-negative fixed fee, Firm 1 should choose to make \(r\) as large as possible. However, based on Equation (4) \(\partial F/\partial r < 0\). Under \(F \geq 0\), the largest \(r\) Firm 1 can chooses is the one such that \(F = 0\). Based on Equation (4), it emerges that \((a - c + \varepsilon - 2r)^2/9 = \pi_2\).

Namely, on the \(\pi_1-\pi_2\) possibility frontier,

\[
F = 0, r = (a - c + \varepsilon - 3\sqrt{\pi_2})/2. \quad (6)
\]

**Lemma 1** In the benchmark case (full-licensing case), once licensing occurs, the licensor will not require fixed fees. Royalties are the only payment method and must decrease with the increase in the licensee’s profits.

The same as in Wang (1998) and Kishimoto and Muto (2011), royalties are always superior to fixed fees, and now the conclusion is valid from both the licensor’s and the licensee’s perspectives. No matter how great the licensee’s bargaining power is, once licensing occurs, it will accept a license contract in which royalties are the only payment method. Although royalties worsen the licensee’s marginal conditions, the licensee benefits from the increase in industry profits. It is clear to the licensee that the benefits of using royalties outweigh the costs. Substituting Equation (6) into Equation (5) yields that \(\pi_1 + 5/4\pi_2 = (a - c + \varepsilon)^2/4\).

**Proposition 1** In the benchmark case (full-licensing case), the \(\pi_1-\pi_2\) possibility frontier can be expressed as \(\pi_1 + 5/4\pi_2 = (a - c + \varepsilon)^2/4\).

**Corollary 1** Licensing never occurs in the case of drastic innovation.

![Figure 1: The \(\pi_1-\pi_2\) Possibility Frontier in the Benchmark Case (Full-Licensing case).](image-url)
The possibility frontier is depicted in Figure 1. The negative slope of the possibility frontier demonstrates the conflicts between the licensor and the licensee, which must be resolved via negotiation. However, Panel (a) of Figure 1 shows that the entire possibility frontier is below the disagreement point when drastic innovation occurs. The negotiation cannot result in an outcome that enhances the licensor’s profits. No negotiation occurs in this case, and Corollary 1 can be easily confirmed. Hence, non-drastic innovation will be assumed in later discussions. Further, the possibility frontier is steeper than 45-degree line because a non-negative fixed fee prohibits a royalty higher than the degree of innovation.

In the case of non-drastic innovation, the disagreement point is

\[ \pi_1^d = (a - c + 2e)^2 / 9, \pi_2^d = (a - c - e)^2 / 9. \]

The possibility frontier in this case is located higher than the disagreement point instead. \( L_i \) in Panel (b), Figure 1 represents the case in which Firm \( i \) enjoys full bargaining power. The results of negotiation must lie on the possibility frontier between \( L_1 \) and \( L_2 \).

Under \( \pi_2 \geq \pi_2^d \), it is easy to verify that \( r \leq \epsilon \). Two firms cannot enjoy the largest profits due to the assumption of a non-negative fixed fee. This assumption is commonly used in the licensing literature, and a negative fee will be considered to be proof of collusion. Clearly, this assumption plays an essential role in the model. If a positive transfer from the licensor to the licensee is allowed, the royalties will be higher, and the transfer can compensate the licensee’s loss. Furthermore, without a suitable \( r \) to lower Firm \( 2 \)’s competence, industry profits will depressed due to severe competition caused by licensing. Clearly, the larger the \( \pi_2 \), the more different industry profits are from monopoly profits, \( (a - c - e)^2 / 4 \) (please refer to Panel (b), Figure 1).

Let \( \pi_1^j \) denote Firm \( i \)'s profits under the offer by Firm \( j \). Given the concept of stationary subgame perfect equilibrium, the bargaining solution can be determined using Equation (7) to Equation (10).

\[ \begin{align*}
\pi_1^j &= \delta_2 \pi_2^j; \\
\pi_2^j &= \delta_1 \pi_1^j; \\
\pi_1^j + 5/4 \pi_2^j &= (a - c + e)^2 / 4; \\
\pi_2^j + 5/4 \pi_1^j &= (a - c + e)^2 / 4;
\end{align*} \]

**Proposition 2** If \( \delta_1 \) and \( \delta_2 \) support the interior bargaining solutions, and each firm's profits under the bargaining solution are greater than each firm’s profits when no agreement is reached, then the bargaining solution is

\[ \begin{align*}
\pi_1^j &= (1 - \delta_2)/(1 - \delta_1 \delta_2) \cdot (a - c - e)^2 / 4, \\
\pi_2^j &= \delta_2 (1 - \delta_1)/(1 - \delta_1 \delta_2) \cdot (a - c - e)^2 / 5, \\
\pi_1^j &= \delta_1 (1 - \delta_2)/(1 - \delta_1 \delta_2) \cdot (a - c - e)^2 / 4, \\
\pi_2^j &= (1 - \delta_1)/(1 - \delta_1 \delta_2) \cdot (a - c - e)^2 / 5.
\end{align*} \]

It is easy to verify that \( \partial \pi_1^j / \partial \delta_j > 0 \) and \( \partial \pi_2^j / \partial \delta_j < 0 \).

**Corollary 2** In the benchmark case (full-licensing case), a more patient negotiator or a firm with more bargaining power is rewarded more.

**Corollary 3** In the benchmark case (full-licensing case), a firm is rewarded more when it makes an offer first.

Corollary 2 and Corollary 3 are intuitive and unsurprising. However, it is worth noting that the results of Corollary 2 are robust to the order in which offers are made. Based on Corollary 3, it emerges that \( (\pi_1^1, \pi_1^2) \) is always located higher and leftier on the \( \pi_1^2 - \pi_2^2 \) possibility frontier than \( (\pi_2^1, \pi_2^2) \).

Furthermore, as \( \delta_1 > \delta_2, \pi_1^1 > \pi_2^1 \) and \( \pi_2^1 > \pi_1^2 \). In other words, the licensor has more advantages in negotiation than the licensee. Note that the licensor’s advantages do not result from the asymmetric disagreement payoffs; the disagreement point has no direct effect on the bargaining solution. The advantage instead comes from the licensor’s use of royalties to partly appropriate the benefits of innovation originally shared by the licensee.

**Corollary 4** In the benchmark case (under full licensing), when \( \delta_1 = \delta_2, \pi_1^1 > \pi_2^2 \) and \( \pi_2^1 > \pi_1^2 \).

In the benchmark case, royalties are superior as a payment method from the licensee’s perspective as well. Industry profits decrease with the licensor’s bargaining power because lower royalties encourage more intense competition in the market. Finally the licensor has more advantages in the bargaining process than the licensee.
THE PARTIAL-LICENSING CASE

In Section 2, it emerges that royalties \( r \) decrease with the increase in the licensee’s bargaining power. The licensor cannot effectively use royalties to weaken the licensee’s competence. Hence, it is interesting to consider whether the licensor license the technology with lower advances to disadvantage the licensee at the cost of industry profits. With this in mind, this section presents the partial-licensing case, in which the licensor is allowed not to license the best technology to the licensee. When licensing occurs, Firm 2’s unit production cost becomes \( c - \varepsilon, 0 \leq \varepsilon' \leq \varepsilon \), and given \((\varepsilon', F, r)\). Firm 1’s and Firm 2’s optimal quantities are \((a - c + 2\varepsilon - \varepsilon' + r)/3\) and \((a - c - \varepsilon + 2\varepsilon' - 2r)/3\), respectively. Two different scenarios are discussed below. In Scenario 1, Firm 1 and Firm 2 immediately negotiate regarding \((\varepsilon, F, r)\). In Scenario 2, Firm 1 chooses \( \varepsilon' \) first, and then the two firms negotiate regarding \((F, r)\).

Scenario 1: Bargaining over \( \varepsilon' \) by two firms.

Similarly, the \( \pi_1-\pi_2 \) possibility frontier, given \((\varepsilon', F, r)\), should be constructed first by the same method in Section 2. The bargaining solution is determined later. \( \pi_1 \), given \((\varepsilon', F, r)\), is

\[
\pi_1 = (a - c + 2\varepsilon - \varepsilon' + r)^2/9 + (a - c - \varepsilon + 2\varepsilon' - 2r)/3 \cdot (a - c - \varepsilon + 2\varepsilon' + r)/3 - \pi_2.
\]

Accordingly,

\[
\frac{\partial \pi_1}{\partial r} = [(a - c - \varepsilon + 2\varepsilon' - 2r) + 6(\varepsilon - \varepsilon')]/9 \geq 0
\]

Hence, as the same as the benchmark case, the optimal \( r \) is

\[
r^* = a - c - \varepsilon + 2\varepsilon' - 3\sqrt{\pi_2}/2.
\]

Because \( \frac{\partial^2 \pi_1}{\partial \varepsilon^2} > 0 \), \( \varepsilon' \) can be either 0 or \( \varepsilon \). When \( \varepsilon' \) equals 0 (\( \varepsilon \)), this scenario is equivalent to the benchmark case. As seen in Section 2, the \( \pi_1-\pi_2 \) possibility frontier is higher than the disagreement point (in which licensing does not occur). Hence, although partial licensing is allowed, partial licensing cannot be the result of the negotiation regarding \((\varepsilon', F, r)\).

**Proposition 3** If Firm 1 and Firm 2 negotiate regarding \((\varepsilon', F, r)\), a full-licensing contract will result in the benchmark case.

Scenario 2: \( \varepsilon' \) is solely decided by the licensor.

In Scenario 1, two firms negotiate regarding \( \varepsilon' \). It is reasonable to question whether the full licensing contract in Scenario 1 is the result of the licensee bargaining power. Hence, the licensor is allowed to solely decide \( \varepsilon' \) before bargaining in Scenario 2.

Similarly, the \( \pi_1-\pi_2 \) possibility frontier, given \((\varepsilon', F, r)\), should be constructed first. However, the bargaining solution only contains \((F, r)\). Firm 1’s optimal \( \varepsilon' \) is determined last. Recall that, given \((\varepsilon', F, r)\),

\[
\pi_1 = (a - c + 2\varepsilon - \varepsilon' + r)^2/9 + (a - c - \varepsilon + 2\varepsilon' - 2r)/3 \cdot (a - c - \varepsilon + 2\varepsilon' + r)/3 - \pi_2.
\]

and \( \frac{\partial \pi_1}{\partial r} \geq 0 \). Hence, the optimal \( r \) is also

\[
\frac{\partial \pi_1}{\partial r} = 1/9 \cdot [2(a - c) - 8\varepsilon + 10\varepsilon' - 4r], \frac{\partial^2 \pi_1}{\partial \varepsilon^2} = 10/9 > 0
\]

Because \( \frac{\partial^2 \pi_1}{\partial \varepsilon^2} > 0 \), \( \varepsilon' \) can be either 0 or \( \varepsilon \). When \( \varepsilon' \) equals 0 (\( \varepsilon \)), this scenario is equivalent to the benchmark case. As seen in Section 2, the \( \pi_1-\pi_2 \) possibility frontier is higher than the disagreement point (in which licensing does not occur). Hence, although partial licensing is allowed, partial licensing cannot be the result of the negotiation regarding \((\varepsilon', F, r)\).

**Figure 2:** The \( \pi_1-\pi_2 \) Possibility Frontier in the Case Partial-Licensing

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\[ r^* = (a - c - \varepsilon + 2\varepsilon' - 3\sqrt{\pi_2^2})/2. \]

Accordingly, the \( \pi_1, \pi_2 \) possibility frontier in this scenario is
\[ \pi_1 = (a - c - \varepsilon)(\varepsilon - \varepsilon')/4 - (\varepsilon - \varepsilon')\sqrt{\pi_2^2} - 5/4\pi_2. \]
\[ \partial \pi_1 / \partial \pi_2 = -1/2 (\varepsilon - \varepsilon')\pi_2 1/2 \pi_2 - 5/4 < 0, \partial^2 \pi_1 / \partial \pi_2^2 = 1/4 (\varepsilon - \varepsilon')\pi_2^{-3/2} > 0. \]

Compared to the \( \pi_1, \pi_2 \) possibility frontier in the benchmark case, Equation (11) is lower and bowed to the disagreement point (please refer to Figure 2). Because Firm 2 may not be able to use the best technology, the feasible set of \((\pi_1, \pi_2)\) is smaller than the full-licensing case. One might conclude that Firm 1 must choose \( \varepsilon' = \varepsilon \) because a high \( \varepsilon' \) can enhance the \( \pi_1, \pi_2 \) possibility frontier. However, the expansion of the possibility frontier occurs along with the reshaping. A higher frontier cannot guarantee the licensor higher profits after negotiation. Firm 1’s choice of \( \varepsilon' \) cannot be easily concluded without investigating the bargaining solution.

The bargaining solution can be solved from
\[ \pi_2^1 = \delta_2^2, \] (12)
\[ \pi_2^1 = \delta_1^1, \] (13)
\[ \pi_1^1 + 5/4 \pi_1^1 = (a - c + \varepsilon)^2/4 - (\varepsilon - \varepsilon')\sqrt{\pi_2^1} - 5/4\pi_1^1; \] (14)
\[ \pi_2^1 + 5/4 \pi_2^1 = (a - c + \varepsilon)^2/4 - (\varepsilon - \varepsilon')\sqrt{\pi_2^1} - 5/4\pi_2^1. \] (15)

It is not easy to solve the simultaneous equations, Equation (12)-(15), in the analytic form. However, Firm 1’s choice of \( \varepsilon' \) can still be analyzed. Rearranging Equation (12)-(15) yields that
\[ 5/4 [\delta_1 (1 - \delta_2)/(1 - \delta_1) + \delta_2] \pi_2^1 + \left[ \delta_1 \left(1 - \delta_2^2\right)/(1 - \delta_1) + \delta_2^2\right] (\varepsilon - \varepsilon')\pi_2^1 - (a - c - \varepsilon)^2/4 = 0 \] (16)

For simplicity, let \( A \) denote \( 5/4 [\delta_1 (1 - \delta_2)/(1 - \delta_1) + \delta_2] > 0 \) and \( B \) denote \( [\delta_1 (1 - \delta_2^1)/(1 - \delta_1) + \delta_2^1]. \) Totally differentiating Equation (16) with \( \varepsilon' \) and \( \pi_2^1 \) indicates that
\[ d\pi_2^1 / d\varepsilon' = \left[ A + B (\varepsilon - \varepsilon') \cdot (1/2) \pi_2^{-1/2} \right] / B \pi_2^{1/2} > 0 \]
\[ d^2 \pi_2^1 / d\varepsilon'^2 = \left[ (-1/2) B \pi_2^{-3/2} - (1/4) \pi_2^{-1} A (\varepsilon - \varepsilon') d\pi_2^1 / d\varepsilon' \right] A \pi_2^{1/2} \]
\[ \pi_2^1 - [A + (1/2) B (\varepsilon - \varepsilon') \pi_2^{-1/2}] (1/2) A \pi_2^{-1} d\pi_2^1 / d\varepsilon' / B^2 \pi_2^3 < 0 \]

Accordingly, \( d\pi_2^1 / d\varepsilon' > 0, d^2 \pi_2^1 / d\varepsilon'^2 < 0. \)

**Lemma 2** In the case in which Firm 1 can solely determine the technology to be licensed, Firm 2’s profits must increase with the advances in the licensed technology; however, the marginal effect is diminishing.

Totally differentiating Equation (14) with \( \varepsilon' \) and \( \pi_1^1 \) yields that
\[ d\pi_1^1 / d\varepsilon' = \pi_2^{1/2} - (1/2) (\varepsilon - \varepsilon') \pi_2^{-1/2} (d\pi_2^1 / d\varepsilon') - (5/4) (d\pi_2^1 / d\varepsilon') \] (17)

Based on Equation (17), Firm 1’s choice of \( \varepsilon' \) is related to industry profits as well as market competition. When \( \varepsilon' \) increases, the first term on the right-hand side of Equation (17) suggests that the licensor’s profits benefit from the increase in industry profits, and the last two terms suggest that the licensor’s profits decrease due to severe market competition. However,
\[ d^2 \pi_1^1 / d\varepsilon'^2 = (1/2) \pi_1^1 (d\pi_2^1 / d\varepsilon') - (5/4) (d\pi_2^1 / d\varepsilon^2) + (1/2) \pi_2^{-1/2} \cdot (d\pi_2^1 / d\varepsilon^2) - (1/4) \cdot (\varepsilon - \varepsilon') \pi_2^{-1/2} - (1/2) \]
\[ (\varepsilon - \varepsilon') \pi_2^{-1/2} \cdot (d^2 \pi_2^1 / d\varepsilon'^2) > 0 \]

Accordingly, \( d^2 \pi_1^1 / d\varepsilon'^2 > 0. \) The same as in Scenario 1, Firm 1 chooses \( \varepsilon' = \varepsilon. \) It is clear that the effect of expanding industry profit is dominant.

**Proposition 4** In the scenario in which Firm 1 can solely determine the technology to be licensed and the two firms negotiate regarding \((F, r),\) the equilibrium is same as in the benchmark case.

Based on the discussions in this section, it emerges that the full-licensing contract occurs no matter whether \( \varepsilon' \) is
negotiated by the two firms or decided solely by the licensor. The U shape of the profit curve against the technology advance is not altered by the licensee’s bargaining power in either scenario. Without the threat of imitation, the effect of the technology advances on industrial profit is dominant. The best technology is licensed in equilibrium.

CONCLUSIONS

I introduce the Rubinstein bargaining process into the licensing model to investigate whether licensee bargaining power affects the choice of the payment methods, the advances in licensed technology, and the market entry decisions. It emerges that the licensor will license the best technology. Furthermore, it is also found that licensee bargaining power lowers royalties in license contracts and decrease industry profits relative to those achieved under monopoly when royalties are the only payment method. The latter conclusion implies that consumers benefit from the licensee bargaining power although this clear and intuitive conclusion is not derived explicitly in this paper.

As seen in this paper, the bargaining power does play an important role in determining the choice of the payment methods, the amount of the licensee fee, and market entry decisions in some cases. Without investigating the licensee bargaining power, we cannot understand the complete picture of licensing behavior. For example, except for difference in the discount factors, the licensee bargaining power may come from the competition among licensors. Through an auction, the potential licensee determines whether and from whom to buy the technology. The issue of competition among licensors must receive more attention after the licensee bargaining power is addressed.

Most conclusions achieved in the licensing literature are based on the assumption that licensees have no bargaining power. Those conclusions may be altered after taking the licensee bargaining power into account. This paper provides a simple but useful framework to integrate the bargaining process with the licensing model for future studies. It is also shown in this paper that the feasible set may not be convex in many cases. The Rubinstein bargaining model provides necessary flexibility in studying licensing behavior than the Nash bargaining model.

REFERENCES

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