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Insider Patentee and Transnational Licensing with Trade Barriers under Cournot Competition

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Abstract

This paper develops a two-country duopolistic model and takes into account trade barriers in exploring the insider patentee's optimal licensing contract, as firms produce a homogeneous product and engage in Cournot competition in each market. The focus of the paper is on the impact of cost advantage generated by the innovation size and the rent created by trade barriers. The paper shows that mixed licensing contract is optimal as the innovation size relative to the innovation size is large under non-drastic innovation, while royalty licensing is optimal, otherwise. Moreover, it also shows that the optimal licensing contract is mixed licensing under drastic innovation.

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1. Introduction

Patent licensing is a very common practice in the real world. Two types of patentee, the outsider and the insider patentee, are frequently studied in the literature. An insider patentee is defined as a patent owner who competes with the licensees in the market, while an outsider patentee stands outside the market and does not compete with the licensees in the market. Since the cases of an insider patentee are more likely to occur in the real world, this paper explores the insider patentee's optimal licensing contract. Real example on insider patentee includes Qualcomm is an innovator of advanced wireless technologies, products and services, while MediaTek is a big company for wireless communications. MediaTek produces chips for cell phones widely used by producers in mainland China. It is reported that Qualcomm licenses the patents on the technologies of CDMA and WCDMA to MediaTek in November 20, 2009.[1]

Transnational licensing is quantitative significance in international trade. This quantitative significance becomes evident from the following figures. Mottner and Johnson (2000) indicate that U.S. income from international licensing had an average annual increase of 12 percent in the 1990s; Vishwasrao (2007) points out that in 2002 the receipts of royalties and fees collected by U.S. companies from their foreign subsidiaries and unaffiliated firms in foreign countries have roughly doubled over the last decade, and Nadiri (1993) states that for Japan and the U.K. the total transactions in transnational licensing between the 1970's and the late 1980's increased by about 400 percent, for France and the U.S. by about 550 percent, and for West Germany by over 1,000 percent. Moreover, Kabiraj and Marjit (2003) argue that, until 1991, many developing countries were observed to have encouraged innovation licensing, while maintaining tariffs on foreign products. Hence, transnational innovation licensing in the presence of trade barriers, such as tariffs and transportation costs, is crucial and commonly exists in practical applications.

A study of transnational technology licensing includes contributions by Kabiraj

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1 Please refer to the following website: http://news.softpedia.com/news/Qualcomm-and-MediaTek-Announce-Patent-Agreement-127494.shtml

and Marjit (2003) and Mukherjee and Pennings (2006). Kabiraj and Marjit (2003) explore an issue where a strategic tariff policy induces the foreign firm to transfer its superior technology to the domestic rival. They show that such a tariff raises consumers' surplus relative to the free trade situation. Mukherjee and Pennings (2006) also examine a strategic tariff policy in inducing the foreign technology transfer by extending the work of Kabiraj and Marjit (2003) to the discussion of royalty and fixed fee licensing instead of a fixed fee only. The patent holder in these two papers is assumed to compete with the licensee in the market referred to as an insider patentee. Moreover, both papers study the issue where a strategic tariff policy induces the foreign firm to transfer its superior technology to the domestic rival. However, a study on the insider patentee's optimal transnational licensing contract involving domestic and foreign markets has not been touched upon yet. This paper aims to fill this gap.

Based on the above analysis, the purpose of this paper is to explore the following issue by taking into account trade barriers with an insider patentee, as firms produce a homogeneous product and engage in Cournot competition in each market. What is the insider patentee's optimal transnational licensing contract in terms of fixed-fee, royalty and mixed (i.e. a fixed-fee plus a linear per unit output royalty) licensing?

The existing literature indicates that a royalty licensing arrangement will be superior to fixed-fee licensing for the insider patentee under the conditions that firms produce a homogeneous product and the innovation is non-drastic. See for example Kamien and Tauman (1986), Kamien et al. (2002), Wang (1998, 2002), Wang and Yang (1999). Moreover, they also show that the insider patentee will choose not to license out its innovation if the innovation is drastic. By contrast, the main contributions of the paper are as follows. Firstly, mixed licensing contract is optimal as the innovation size relative to the innovation size is large under non-drastic innovation, while royalty licensing is optimal, otherwise. Secondly, the insider patentee would license a drastic innovation to its rival by choosing mixed licensing.

The remainder of the paper is organized as follows. Section 2 sets up a benchmark model where the technology licensing is absent. Section 3 explores the insider patentee's optimal licensing contract. The final section concludes the paper.

2. The Benchmark Model

Consider a two-country duopolistic model, in which the countries, 1 and 2, are located at the opposite endpoints of a line segment with unit length, as shown in Figure 1.[2] Along the line segment, consumers reside in these two countries only, where market 1 and firm A are located in country 1 while market 2 and firm B are located in country 2.[3] Assume that firm A has a cost-reducing innovation ε so that firm A's and firm B's marginal cost are $c - \varepsilon$ and c, respectively. Firms produce a homogeneous product. The export of the product to the other country incurs trade costs consisting of tariffs and transportation costs. Assume further that firms engage in a Cournot quantity competition in each market and patent licensing is absent in the benchmark model.

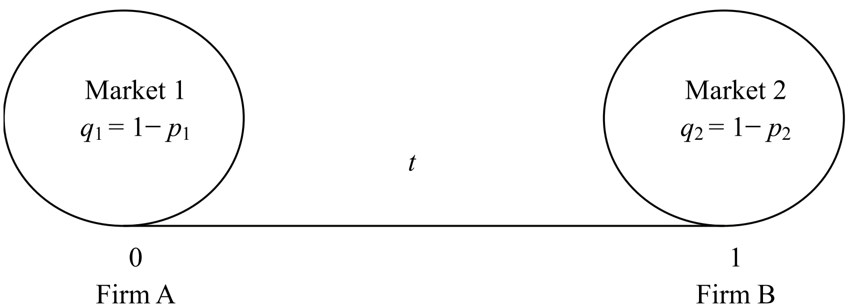

Figure 1: The Two-country Duopolistic Model

The demand function in market i takes a linear form as follows:

$$q_i = 1 - p_i, i = 1, 2, \tag{1}$$

where q_i, and p_i are the quantity demanded and the delivered price in market i.

Each firm's profit function is defined as the sum of the profits from markets 1 and 2 as follows:

[2] This kind of model can also be found in Liang *et al*. (2006).

[3] One can imagine the UK and France as these two countries, and there exist no consumers between them.

$$\pi_A^N = [1-(q_{1A}^N + q_{1B}^N) - (c-\varepsilon)]q_{1A}^N + [1-(q_{2A}^N + q_{2B}^N) - (c-\varepsilon+t)]q_{2A}^N, \tag{2.1}$$

$$\pi_B^N = [1-(q_{1A}^N + q_{1B}^N) - (c+t)]q_{1B}^N + [1-(q_{2A}^N + q_{2B}^N) - c]q_{2B}^N, \tag{2.2}$$

where the superscript "*N*" denotes the variables associated with the case where technology licensing is absent; q_{ij} (i =1, 2, j = A, B) is firm j's output in market i; and t is trade costs.

Maximizing each firm's profit function with respect to its output in the two markets and then solving these first-order conditions, we can obtain the following quantities:

$$q_{1A}^N = (1+t-c+2\varepsilon)/3, \tag{3.1}$$

$$q_{1B}^N = (1-2t-c-\varepsilon)/3 > (\leq) 0, \text{ if } t < (\geq)(1-c-\varepsilon)/2, \tag{3.2}$$

$$q_{2A}^N = (1-2t-c+2\varepsilon)/3 > 0, \text{ if } t < [(1-c+2\varepsilon)/2], \tag{3.3}$$

$$q_{2B}^N = (1+t-c-\varepsilon)/3 > (\leq) 0, \text{ if } t > (\leq)[\varepsilon - (1-c)]. \tag{3.4}$$

Substituting (3) into (2), we can obtain the reduced profit functions for firms A and B. These profits can be used as the opportunity cost for firms A to license its technology and for firm B to accept the license.

In order to derive these opportunity costs applying to the corresponding parts in the licensing cases, we need to define the following three licensing cases. Following the definition of drastic innovation in the traditional licensing literature, an innovation is drastic if the insider patentee can drive the rival out of the markets and meanwhile charge a monopoly price.[4] Thus, by setting $q_{2B}{}^N = 0$, the innovation is drastic as the innovation size ε relative to trade costs t is so large that $t \leq [\varepsilon - (1 - c)]$ in the paper. Moreover, we assume that the insider patentee is active in both markets. This implies that the restriction $t < [(1 - c + 2\varepsilon)/2]$ holds throughout the paper. In what follows, we use Figure 2 to illustrate the areas for the three licensing cases measured by the combinations of (t, ε), in which the horizontal axis denotes the innovation size ε and the vertical axis represents the trade costs t. First of all, the case of drastic innovation can be measured by the area MM in Figure 2, where $MM \equiv \{(t,\varepsilon) \mid t \leq \varepsilon - (1-c)\}$. Next, the

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4 See Arrow (1962).

case of non-drastic innovation is defined as the case where the insider patentee is unable to drive its rival out of the markets measured by the restriction where the innovation size ε relative to trade costs t is so small that $t < (1 - c - \varepsilon)/2$. This case can be measured by the area DD in Figure 2, where $DD \equiv \{(t,\varepsilon) \mid t < (1-c-\varepsilon)/2\}$. Lastly, the third case is defined as the case where the innovation size ε relative to trade costs t lies in the medium range such that the insider patentee can drive its rival out of market 1 but the rival can survive in market 2. This case is confined by the restrictions $t \geq (1 - c - \varepsilon)/2$ and $t > [\varepsilon - (1 - c)]$ measured by the area MD in Figure 2 where $MD \equiv \{(t,\varepsilon) \mid (1-c-\varepsilon)/2 \leq t \leq (1-c+\varepsilon)/2, \varepsilon-(1-c) < t\}$.

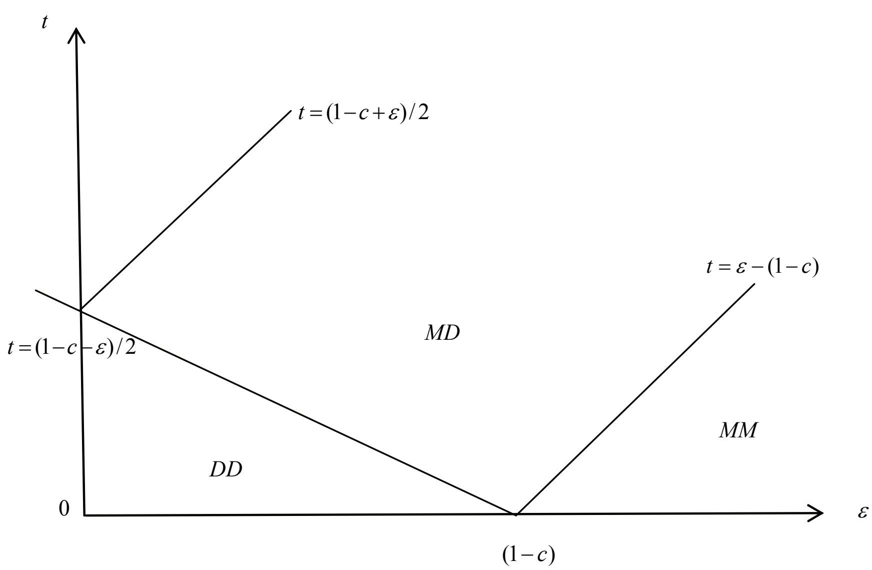

Figure 2: Areas under Three Alternative Licensing Cases

Based on the above analysis, the profit of firms A and B in the absent of licensing applying to the three licensing cases are derivable as:

$$\pi_A^N = [(1+t-c+2\varepsilon)/3]^2 + [(1-2t-c+2\varepsilon)/3]^2, \text{ for } (t,\varepsilon) \in DD, \tag{4.1}$$

$$\pi_B^N = [(1-2t-c-2\varepsilon)/3]^2 + [(1+t-c-\varepsilon)/3]^2, \text{for } (t,\varepsilon) \in DD, \tag{4.2}$$

$$\pi_A^N = [(1-c+\varepsilon)/2]^2 + [(1-2t-c+2\varepsilon)/3]^2, \text{ for } (t,\varepsilon) \in MD, \tag{5.1}$$

$$\pi_B^N = [(1+t-c-\varepsilon)/3]^2, \text{ for } (t,\varepsilon) \in MD, \tag{5.2}$$

$$\pi_A^N = [(1-c+\varepsilon)/2]^2 + [(1-t-c+\varepsilon)/2]^2, \text{ for } (t,\varepsilon) \in MM, \tag{6.1}$$

$$\pi_B^N = 0, \text{ for } (t,\varepsilon) \in MM. \tag{6.2}$$

3. The Insider Patentee's Optimal Licensing Contract

In this section, we explore the insider patentee's optimal licensing contract. The game employed in this paper is a three-stage game. In the first stage, firm A decides whether or not to license out its innovation and the amounts of fixed-fee and royalty rate to maximize its profit if it chooses to license. In the second stage, firm B decides whether or not to accept the licensing offered by firm A. In the final stage, firms engage in a Cournot quantity competition in each market. The sub-game perfect Nash equilibrium can be solved by backward induction, beginning with the final stage.

Let us consider a general licensing scheme involving both a fixed-fee and a linear royalty per unit of output. Note that fixed-fee licensing is a special case of this generalized licensing scheme as the royalty rate equals zero, and royalty licensing is also a special case as the fixed-fee is zero. Suppose that firm A decides to license the innovation by offering a contract (f, r), where f denotes the fixed-fee and r is the royalty rate per unit of output where $f \geq 0$, $r \geq 0$ and $r \leq \varepsilon$. Then, the profit functions for firms A and B can be specified as follows: $\pi_A^L = [1-(q_{1A}^L + q_{1B}^L) - (c-\varepsilon)]q_{1A}^L + [1-(q_{2A}^L + q_{2B}^L) - (c-\varepsilon+t)]q_{2A}^L + r(q_{1B}^L + q_{2B}^L) + f$, and $\pi_B^L = [1-(q_{1A}^L + q_{1B}^L) - (c-\varepsilon+r+t)]q_{1B}^L + [1-(q_{2A}^L + q_{2B}^L) - (c-\varepsilon+r)]q_{2B}^L - f$, where the superscript "L" denotes variables associated with the case of technology licensing.

In the final stage, maximizing each firm's profit function with respect to its output in the two markets and then solving these first-order conditions, we can obtain firm A's and B's outputs in the licensing cases as follows:

$$q_{1A}^L = (1+t-c+\varepsilon+r)/3, \tag{7.1}$$

$$q_{1B}^L = (1-2t-c+\varepsilon-2r)/3 > 0, \text{ if } r < (1-2t-c+\varepsilon)/2, \tag{7.2}$$

$$q_{2A}^L = (1-2t-c+\varepsilon+r)/3, \tag{7.3}$$

$$q^L_{2B} = (1 + t - c + \varepsilon - 2r)/3 > 0, \text{ if } r < (1 + t - c + \varepsilon)/2, \tag{7.4}$$

Eqs. (7.2) and (7.4) show that the royalty rate can not be too high to ensure that the licensee's outputs in the two markets are positive.

Suppose that firm B accepts the licensing contract (*f*, *r*). Then, firm B's profit function can be rewritten as:

$$\pi^L_B = (q^L_{1B})^2 + (q^L_{2B})^2 - f. \tag{8}$$

In the second stage, firm B would accept the licensing contract if its licensed profit is no less than the profit under the absence of licensing, i.e., $\pi^L_B \geq \pi^N_B$. Thus, the maximal fixed-fee that firm A can charge is no greater than the difference in firm B's profit between taking and refusing the license. This fixed-fee can be expressed as:

$$\begin{aligned} f_{DD} = \{&[(1 - c - 2t + \varepsilon - 2r)/3]^2 + [(1 - c + t + \varepsilon - 2r)/3]^2\} - \\ &\{[(1 - c - 2t - \varepsilon)/3]^2 + [(1 - c + t - \varepsilon)/3]^2\}, \text{ for } (t, \varepsilon) \in DD, \end{aligned} \tag{9.1}$$

$$\begin{aligned} f_{MD} = \{&[(1 - c - 2t + \varepsilon - 2r)/3]^2 + [(1 - c + t + \varepsilon - 2r)/3]^2\} - \\ &[(1 - c + t - \varepsilon)/3]^2, \text{ for } (t, \varepsilon) \in MD, \end{aligned} \tag{9.2}$$

$$f_{MM} = \{[(1 - c - 2t + \varepsilon - 2r)/3]^2 + [(1 - c + t + \varepsilon - 2r)/3]^2\}, \text{ for } (t, \varepsilon) \in MM, \tag{9.3}$$

Eqs. (3) show that the maximal fixed-fees under the three licensing cases have the following relationship $f_{MM} > f_{MD} > f_{DD}$. Intuitively, we find from (6.2) that as the innovation size is so large that firm B will be driven out of the market and earns zero profit measured by area *MM* if it refuses the licensing, firm B's opportunity cost of taking the license is thus zero. Similarly, we find from (5.2) ((4.2)) that as the innovation size is in the medium range (so small) that profit will be driven out of market 1 but can survive in market 2 (can survive in both markets) measured by area *MD* (*DD*) and earns positive profit (larger profit than that in *MD*) if it refuses the licensing, firm B's opportunity cost of taking the license is positive (larger than that in *MD*). As a result, the maximal fixed-fee under *MM* case is larger than that under *MD* case, and then larger than that under *DD* case in that order.

In the first stage, firm A's profit function can be rewritten as:

$$\pi^L_A = [(q^L_{1A})^2 + (q^L_{2A})^2] + r(q^L_{1B} + q^L_B) + f. \tag{10}$$

The first-term on the right-hand side of (10) is firm A's operating profit net of licensing revenue, the second-term is the royalty revenue and the third-term is the fixed-fee.

Substituting (7) and (9) into (10) gives the first-order condition for profit-maximization with respect to royalty rate as follows:

$$\partial\pi_A^L / \partial r = 1 - c + \varepsilon - (t/2) - 2r = 0. \tag{11}$$

Solving (11), we have:

$$r = [1 - c + \varepsilon - (t/2)]/2. \tag{12}$$

Since the royalty rate is subject to the restrictions $r \geq 0$ and $r \leq \varepsilon$, in what follows we examine the optimal royalty rate and then the optimal licensing contract under the three licensing cases.

3.1 The Optimal Licensing Contract under *DD* Case

Recall that this case is defined as the innovation is non-drastic so that firm B can survive in both markets as measured by area *DD* in Figure 2, where $DD \equiv \{(t,\varepsilon) \mid t < (1-c-\varepsilon)/2\}$. We find from (12) that $r \geq \varepsilon$ as $t \leq 2(1-c-\varepsilon)$. It follows that the optimal royalty rate equals the innovation size, i.e., $r^* = \varepsilon$, under *DD* case by the restriction $r \leq \varepsilon$. Substituting $r^* = \varepsilon$ into (9.1), we can obtain that the optimal fixed-fee is zero, i.e., $f_{DD}^* = 0$. As a result, the optimal royalty rate is positive while the fixed-fee equals zero, if the insider patentee chooses to license out its innovation.

Substituting $r^* = \varepsilon$, $f_{DD}^* = 0$ and the equilibrium outputs q_{ij}^{L*} into (10), we can derive firm A's equilibrium profit by taking licensing, π_A^{L*}, as follows:

$$\begin{aligned}\pi_A^{L*} &= \{[(1-c+t+2\varepsilon)/3]^2 + [(1-c-2t+2\varepsilon)/3]^2\} + \\ &\quad \varepsilon\{[(1-c-2t-\varepsilon)/3] + [(1-c+t-\varepsilon)/3]\}, \text{ for } (t,\varepsilon) \in DD.\end{aligned} \tag{13}$$

Subtracting (4.1) from (13), we have:

$$\begin{aligned}\pi_A^{L*} - \pi_A^N &= \varepsilon\{[(1-c-2t-\varepsilon)/3] + [(1-c+t-\varepsilon)/3]\} \\ &= \varepsilon(q_{1B}^N + q_{2B}^N) > 0, \text{for } (t,\varepsilon) \in DD.\end{aligned} \tag{14}$$

Eq. (14) demonstrates that the insider patentee would like to license its innovation by choosing a royalty licensing under *DD* case because the licensed profit is larger than the unlicensed profit. This result is illustrated by area DD^R in Figure 3, where the superscript "*R*" denotes variables associated with the case where optimal licensing contract is royalty licensing.

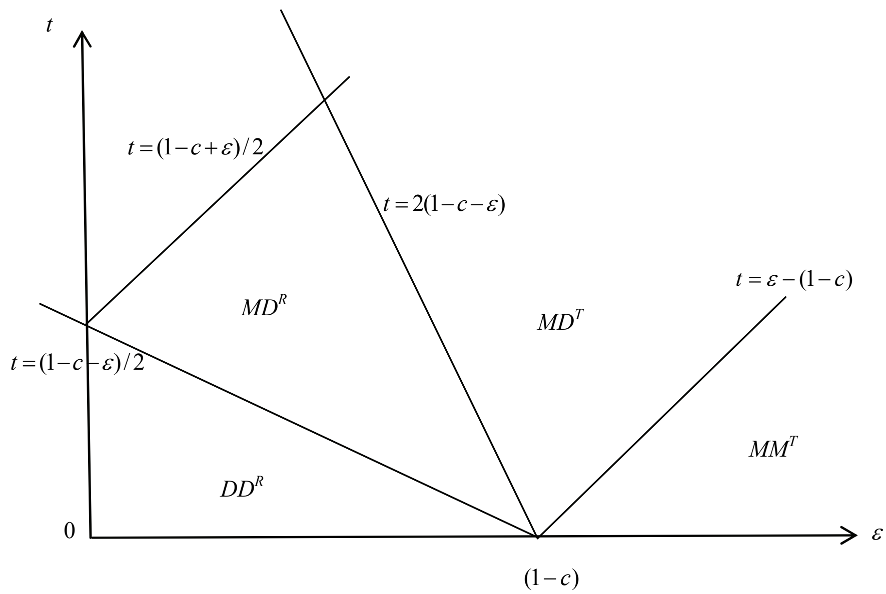

Figure 3: The Insider Patentee's Optimal Licensing Contracts

Based on the above analysis, we can establish the following proposition:

Proposition 1. *The insider patentee's optimal licensing contract is to provide a royalty licensing, as the innovation size relative to trade costs is so small that the licensee can survive in both markets in the absence of licensing.*

The intuition behind the result can be stated as follows. As the innovation size relative to trade costs is so small that the licensee can survive in both markets in the absence of licensing, it implies that the competition between firms is severe. Thus, the insider patentee would license to choose royalty licensing to make the licensee remain less competent by keeping its cost advantage.

3.2 The Optimal Licensing Contract under *MD* Case

Recall that this case is defined as the innovation lies in the medium range so that firm B is driven out of market 1 but can survive in market 2 as measured by area *MD* in Figure 2, where $MD \equiv \{(t,\varepsilon) \mid (1-c-\varepsilon)/2 \le t \le (1-c+\varepsilon)/2, \varepsilon-(1-c)<t\}$. We find from (12) that $r \ge \varepsilon$ as $t \le 2(1-c-\varepsilon)$. It follows that the optimal royalty rate equals the innovation size, i.e., $r^* = \varepsilon$, by the restriction $r \le \varepsilon$, as the innovation size is relatively small in area MD^R of Figure 3, where $MD^R \equiv \{(t,\varepsilon) \mid (1-c-\varepsilon)/2 \le t \le 2(1-c-\varepsilon), t<(1-c+\varepsilon)/2\}$. Substituting $r^* = \varepsilon$ into (9.2), we can obtain that the maximal fixed-fee is zero, i.e., $f_{MD}{}^* = 0$.[5] As a result, the optimal royalty rate is positive while the fixed-fee equals zero, if the insider patentee chooses to license out its innovation.

Substituting $r^* = \varepsilon$, $f_{MD}{}^* = 0$ and the equilibrium outputs $q_{ij}{}^{L*}$ into (10), we can derive firm A's equilibrium profit by taking licensing, $\pi_A{}^{L*}$, as follows:

$$\begin{aligned}\pi_A^{L*} = \{&[(1-c+\varepsilon)/2]^2 + [(1-c-2t+2\varepsilon)/3]^2\} + \\ &\varepsilon[(1-c+t-\varepsilon)/3], \text{ for } (t,\varepsilon) \in MD^R,\end{aligned} \tag{15}$$

Subtracting (5.1) from (15), we have:

$$\pi_A^{L*} - \pi_A^N = \varepsilon(q_{2B}^N) > 0, \text{for } (t,\varepsilon) \in MD^R. \tag{16}$$

Eq. (16) demonstrates that the insider patentee would like to license its innovation by choosing a royalty licensing for (t, ε) in area MD^R of Figure 3 because the licensed profit is larger than the unlicensed profit.

Next, we find from (12) that the optimal royalty rate is smaller than the innovation size, i.e., $r^* = [1-c+\varepsilon-(t/2)]/2 < \varepsilon$, as the innovation size is relatively large in area MD^T of Figure 3, where $MD^T \equiv \{(t,\varepsilon) \mid 2(1-c-\varepsilon) < t < (1-c+\varepsilon)/2, t > \varepsilon-(1-c)\}$, and the superscript "*T*" denotes variables associated with the case where optimal licensing contract is mixed licensing. Substituting (12) into (9.2), we have $f_{MD}{}^* = (t^2/4) - [(1-c+t-\varepsilon)/3]^2 > 0$. As a result, both the optimal royalty rate and fixed-fee are positive if the insider patentee chooses to license out its innovation.

Substituting $r^* = [1-c+\varepsilon-(t/2)]/2$, $f_{MD}{}^* = (t^2/4) - [(1-c+t-\varepsilon)/3]^2$ and the equilibrium outputs $q_{ij}{}^{L*}$ into (10), we can derive firm A's equilibrium profit by taking licensing, $\pi_A{}^{L*}$, as follows:

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[5] Given $r^* = \varepsilon$ and the constraint $(1-c-\varepsilon)/2 \le t \le 2(1-c-\varepsilon)$, we have $q_{1B}{}^{L*} = q_{1B}{}^N = 0$, for $(t, \varepsilon) \in MD$. Therefore, $f_{MD}{}^* = (q_{1B}{}^{L*})^2 = (q_{1B}{}^N)^2 = 0$ for $(t, \varepsilon) \in MD$.

$$\pi_A^{L*} = [(1-c+\varepsilon)/2]^2 + \{2(1-c+\varepsilon)-3t]/2\}^2 + t[2(1-c+\varepsilon)-t)/8]\} + [(t/2)^2 - [(1-c+t-\varepsilon)/3]^2, \text{ for } (t,\varepsilon) \in MD^T. \tag{17}$$

Subtracting (5.1) from (17), we have:[6]

$$\pi_A^{L*} - \pi_A^N = 49t^2 - 56t(1-c) + [12(1-c)^2 + 56\varepsilon(1-t-c) + 21\varepsilon^2]/48 > 0, \quad \text{for } (t,\varepsilon) \in MD^T. \tag{18}$$

Eq. (18) shows that firm A would license to license its innovation by choosing a mixed licensing for (t, ε) in area MD^T of Figure 3.

Based on the above analysis, we can establish:

Proposition 2. *Suppose that the innovation size relative to trade costs lies in the medium rage so that the licensee is driven out of market 1 but can survive in market 2 in the absence of licensing. The insider patentee's optimal licensing contract is to provide a mixed licensing as the innovation size is relatively large, while provide a royalty licensing, otherwise.*

Proposition 2 is sharply different from the result derived in related literature, in which royalty licensing is always optimal for the insider patentee producing a homogenous product and competing with a Cournot quantity competition. The intuition behind the results in Proposition 2 can be stated as follows. Firstly, as the innovation size is relatively large, the insider patentee owns larger cost advantage so that the competition between firms is less severe. Moreover, both firms can earn extra rent caused by the existence of trade barriers. Thus, the insider patentee would like to choose a mixed licensing in order to enlarge the licensee's output for capturing this extra rent by charging the maximal fixed-fee of the licensee. Next, the same intuition as that described in Proposition 1 carries over to the case where the innovation size is relatively small.

3.3 The Optimal Licensing Contract under *MM* Case

Recall that this case is defined as the innovation is drastic so that firm B is driven out of

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6 The proof is available from the authors upon request.

both markets as measured by area *MM* in Figure 2, where $MM \equiv \{(t,\varepsilon) \mid t \leq \varepsilon - (1-c)\}$. We find from (12) that the optimal royalty rate is smaller than the innovation size, i.e., $r^* = [1 - c + \varepsilon - (t/2)]/2 < \varepsilon$, as the innovation size is relatively large in area *MM* of Figure 3. Substituting (12) into (9.3), we have $f_{MM}^* = t^2/4 > 0$. As a result, both the optimal royalty rate and fixed-fee are positive if the insider patentee chooses to license out its innovation.

Substituting $r^* = [1 - c + \varepsilon - (t/2)]/2$ and $f_{MM}^* = t^2/4$ into (10), we can derive firm A's equilibrium profit by taking licensing, π_A^{L*}, as follows:

$$\pi_A^{L*} = [(1-c+\varepsilon)/2]^2 + \{2(1-c+\varepsilon)-3t]/2\}^2 + \{t[2(1-c+\varepsilon)-t]/8\} + (t^2/4), \quad \text{for } (t,\varepsilon) \in MM. \tag{19}$$

Subtracting (6.1) from (19), we have:

$$\pi_A^{L*} - \pi_A^N = 7t^2/16 > 0, \text{for } (t,\varepsilon) \in MM. \tag{20}$$

Eq. (20) shows that firm A would license to firm B by choosing mixed licensing, as the innovation is drastic measured by area MM^T in Figure 3.

Based on the above analysis, we can establish:

Proposition 3. *Suppose that the innovation size relative to trade costs is so large that the innovation is drastic. The insider patentee's optimal licensing contract is to provide a mixed licensing.*

Similarly, the result derived in Proposition 3 is significantly different from that derived in related literature, in which royalty licensing is always optimal for the insider patentee. The same intuition as that described in Proposition 2 applies to this case.

4. Concluding Remarks

This paper has developed a two-country duopolistic model and has taken into account trade barriers in exploring the insider patentee's optimal licensing contract as firms produce a homogeneous product and engage in Cournot competition in each market. Several striking results are derived as follows.

First of all, we show that mixed licensing is optimal for the insider patentee under

Cournot competition as the innovation size relative to trade costs is relatively large, while royalty licensing is optimal, otherwise. This result is significantly different from that derived in related literature. Secondly, the related literature indicates that the insider patentee would not license out its innovation as the innovation is drastic under Cournot competition with a homogenous product. However, we show that the insider patentee would choose a mixed licensing as the innovation size relative to trade costs is so large that the innovation is drastic.

REFERENCES

Arrow, K. (1962), “Economic Welfare and the Allocation of Resources for Invention,” in Nelson, R. R. (ed.), *The Rate and Direction of Inventive Activity*, Princeton University Press.

Kabiraj, T. and S. Marjit (2003), “Protecting Consumers through Protection: The Role of Tariff-induced Technology Transfer,” *European Economic Review*, 47, 113-124.

Kamien, M. and Y. Tauman (1986), “Fees versus Royalties and the Private Value of a Patent,” *Quarterly Journal of Economics*, 101, 471-491.

Kamien, M., S. S. Oren and Y. Tauman (1992), “Optimal Licensing of Cost-reducing Innovation,” *Journal of Mathematical Economics*, 21, 483-508.

Liang, W. J., H. Hwang and C. C. Mai (2006), “Spatial Discrimination: Bertrand vs. Cournot with Asymmetric Demands,” *Regional Science and Urban Economics*, 36, 790-802.

Mukherjee A. and E. Pennings (2006), “Tariffs, Licensing and Market Structure,” *European Economic Review*, 50, 1699-1707.

Mottner, S. and J. P. Johnson (2000), “Motivations and Risks in International Licensing: A Review and Implications for Licensing to Transitional and Emerging Economies,” *Journal of World Business*, 35, 171-188.

Nadiri, M.I. (1993), “Innovations and Technological Spillovers,” *NBER* working paper 4423.

Vishwasrao, S. (2007), “Royalties vs. Fees: How Do Firms Pay for Foreign Technology?” *International Journal of Industrial Organization*, 25, 741-759.

Wang, X. H. (1998), “Fee versus Royalty Licensing in a Cournot Duopoly Model,” *Economics Letters*, 60, 55-62.

Wang, X. H. (2002), “Fee versus Royalty Licensing in a Differentiated Cournot Duopoly,” *Journal of Economics and Business*, 54, 253-266.

Wang, X. H. and B. Yang (1999), “On Licensing under Bertrand Competition,” *Australian Economic Papers*, 38, 106-119.

在 Cournot 競爭下存在貿易障礙的產業內授權廠商與跨國授權

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摘　要

本文考慮存在貿易障礙，建立一個兩國雙占廠商模型，探討當廠商生產同質產品且在各個市場從事 Cournot 數量競爭時，產業內授權廠商的最適授權策略。本文的重點聚焦於研發技術強度 (Innovation Size) 產生的成本優勢及貿易障礙產生的獨占租 (Rent) 的作用。本文証明若研發爲非劇烈創新，當研發技術強度相對貿易成本夠高時，最適授權策略爲混合授權；反之，當研發技術強度相對貿易成本夠低時，最適授權策略爲單位權利金授權。再者，本文也証明若研發爲劇烈創新，最適授權策略爲混合授權。

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關鍵詞：貿易障礙、產業內授權廠商、跨國授權、Cournot 數量競爭

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