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Patent strength and optimal two-part tariff licensing with a potential rival

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HIGHLIGHTS

- We identify the optimal two part tariff licensing for an incumbent innovator.
- The incumbent and the entrant compete in a differentiated Cournot duopoly.
- Patent strength, market parameter and substitution coefficient are considered.
- A pure royalty licensing emerges under a weak patent.
- The optimal contract always involves a positive royalty in a competitive market.

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ABSTRACT

We investigate a two-part tariff licensing contract that enables an incumbent innovator to license the technology for a new product to a potential rival, who may alternatively develop a compatible technology for an imperfectly substitutable product. We identify the optimal two-part tariff licensing contract based on the development cost incurred by the rival, the market parameter, and the substitution coefficient.

1. Introduction

Patent licensing plays an important role in the development of technology. In particular, inward technology licensing has been used by firms as alternative sources of new product to internal R&D; see Atuahene-Gima (1992). Kulatilaka and Lin (2006) give some examples of licensing of new product technology in the pharmaceutical industry. We consider licensing by a patent-holding firm to its potential rival, who may invest in the technology innovation and enter the market of the new product. We examine the class of two-part tariff contracts consisting of a fixed fee plus a linear royalty per unit of output and identify the optimal two-part tariff contract for the patent holder. This depends on the cost of technology innovation incurred by the potential rival, the substitutability of goods, and the market parameter. We focus attention on the cost of technology innovation, which represents the strength of the patent.

The analysis of patent licensing was initiated by Arrow (1962). There are two streams of research on patent licensing. One concerns patent licensing by outsiders and focuses on the licensing of a cost-reducing innovation by a specialist R&D firm whose sole objective is to license the patent to other firms; see Kamien (1992) for a survey. In the other strand, the R&D environment is one in

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which the innovator is one of the incumbent firms in the industry (see, e.g., Taylor and Silberston, 1973). The issues addressed by researchers on licensing include asymmetric cost structures of firms in a duopoly (Gallini and Winter, 1985; Marjit, 1990), the impact of the magnitude of the cost-reducing innovation (Wang, 1998, 2002; Kamien and Tauman, 2002; Martín and Saracho, 2010),[1] and the cost of technology innovation (Kulatilaka and Lin, 2006; Kitagawa et al., 2013). These authors consider licensing based on a pure fixed fee or pure royalty licensing, and investigate the effectiveness of licensing. Based on his survey of corporate licensing in the United States, Rostoker (1984) finds that 46% of the licensing contracts use a down payment plus a running royalty, 39% use royalties alone, and 13% use a fixed fee alone. Combinations of fixed fees and royalties are most often observed in practice. There is little research on two-part tariff contracts in which the innovator is one of the incumbent producers. Two exceptions are Fauli-Oller and Sandonis (2002) and Sen and Tauman (2007),[2] both of which address the impact of the magnitude of the cost-reducing innovation. Fauli-Oller and Sandonis (2002) consider the two-part tariff licensing of a cost-reducing innovation in a differentiated Bertrand and Cournot duopoly. They conclude that the optimal contract involves a positive royalty for both types of duopoly. Sen and Tauman (2007) consider the licensing of a cost-reducing innovation when the innovator uses a two-part tariff licensing contract in a Cournot oligopoly of general size. They analyze the case of an outside innovator as well as an incumbent innovator, obtain the optimal licensing scheme for each case, and compare the incentives of the innovators to innovate.

Our approach is new in that we focus on two-part tariff licensing by an incumbent innovator who competes with a potential rival who may self-develop the technology. First, unlike most researchers in the literature, we assume that the incumbent innovator has a technology for a new good that can be licensed to a potential rival, who has the option of self-developing a compatible technology to produce an imperfect substitute for the new good without patent infringement. The main feature of our model is the cost of technology development. That is, we obtain results based on two types of scenarios for the development cost. When the potential rival does not have a license, it can enter the market by investing in technology development. However, if the development cost is high, such entry is not profitable for the rival. We call this cost scenario the high development cost scenario. The scenario in which this is not the case is termed as the low development cost scenario. The cost of technology development represents the strength of the patent because a strong patent implies that the cost of developing a compatible technology without patent infringement is high for the potential rival.[3] Second, we investigate the class of two-part tariff licensing contracts, which includes the two special cases of pure royalty and pure fixed-fee licensing. Thus, the optimal two-part tariff licensing contract analyzed in this paper weakly dominates the two special cases investigated by Kitagawa et al. (2013).

Our main findings can be summarized as follows. The technology of the patent holder is licensed except for the case of homogeneous goods with a high development cost. The optimal two-part tariff involves a positive royalty rate, except when the two products do not compete, in which case, pure fixed-fee licensing prevails. These findings are consistent with the analysis of Fauli-Oller and Sandonis (2002) for the case of a cost-reducing innovation. When the patent is weak, the incumbent offers a pure royalty contract. Furthermore, the optimal royalty rate and the optimal fixed fee are nondecreasing in the development cost.

2. The model

Suppose that the incumbent (firm 1) with a technology for a new product uses two-part tariff licensing to license its own technology to a potential rival (firm 2), who may alternatively self-develop the technology for an imperfectly substitutable product.

Under the two-part tariff contract, firm 2 pays a lump sum of $\varphi \geq 0$, which is independent of the level of production, and a royalty rate of $r \geq 0$ per unit of production. Hereafter, we denote such a two-part tariff contract by (r, φ). In period 0, firm 1 decides whether to offer licensing to firm 2. If firm 1 does not offer licensing to firm 2, firm 2 has two options in period 1. Firm 2 may stay out of the market or enter the market by self-developing the technology. If firm 2 invests in its own technology development, it incurs a cost of $J > 0$,[4] and the development succeeds without patent infringement. If firm 1 offers licensing, firm 2 may accept or reject this offer in period 1. In the latter case, firm 2 may refrain from competition or may enter the market by self-developing the technology. We assume that firm 2 accepts the offer if firm 2 is indifferent between accepting and rejecting the offer. We also assume that firm 2 enters the market if firm 2 is indifferent between entering and not entering. For analytical convenience, we further assume that firm 1 does not offer a contract if firm 1 is indifferent between offering and not offering one.

In period 2, if firm 2 enters the market, both firms engage in the Cournot competition. Otherwise, firm 1 monopolizes the market. Even if the two firms have identical technology, the products of the two firms may be differentiated. Firm i's product demand q_i, $i = 1, 2$, is given by the inverse demand function $P_i = \theta - q_i - aq_j$, $i, j = 1, 2$, $j \neq i$, where P_i is the price of firm i's product. We call the parameters $\theta > 0$ and $a \in [0, 1]$ the market parameter and the substitution coefficient, respectively. If firm 2 accepts firm 1's offer (r, φ), then firm 1 charges firm 2 a licensing fee of $rq_2 + \varphi$.

3. Analysis

Let $\Pi_i^N(j)$ be firm i's profit under the "no license" policy in scenario j, where $j \in \{\ell, h\}$ denotes "low" and "high", respectively. Let $\hat{J} \equiv \frac{\theta^2}{(a+2)^2}$. Lemma 1 below shows that when no license is offered, firm 2 enters the market if and only if the development cost J is less than or equal to $\hat{J}$. Hereafter, $J > (\leq) \hat{J}$ characterizes the high (low) development cost scenario. Moreover, we say that the patent is strong (weak) in the high (low) development cost scenario.

Consider the subgame that starts after firm 1 chooses not to license in period 0. If firm 2 stays out of the market, firm 1 monopolizes the market and maximizes its payoff $\Pi_1 = (\theta - q_1)q_1$ by choosing optimal output of $q_1^* = \theta/2$. The payoffs of the firms are given by $(\Pi_1, \Pi_2) = (\frac{1}{4}\theta^2, 0)$. If firm 2 enters the market, the two firms engage in the Cournot competition and have payoff functions of $\Pi_1 = (\theta - q_1 - aq_2)q_1$ and $\Pi_2 = (\theta - q_2 - aq_1)q_2$. The equilibrium outputs are $q_1^* = q_2^* = \frac{\theta}{a+2}$ with payoffs of $(\frac{\theta^2}{(a+2)^2}, \frac{\theta^2}{(a+2)^2} - J)$. Thus, we obtain the following lemma.

[1] A cost-reducing innovation is said to be drastic if the monopoly price under the new technology does not exceed the competitive price under the old technology; see Arrow (1962).

[2] For the case of outside innovators, optimal two-part tariff contracts are investigated by, e.g., Erutku and Richelle (2007), Sen and Tauman (2007), and Sen and Stamatopoulos (2009).

[3] Thus, the high development cost scenario and the low development cost scenario roughly reflect the cases of drastic and nondrastic innovations, respectively, identified by Arrow (1962).

[4] When $J = 0$, our model is reduced to the Cournot duopoly.