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Patent licensing in spatial models ☆

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ABSTRACT

We show that a two-part tariff licensing contract is always optimal to the insider patentee in spatial models irrespective of the size of the innovation or any pre-innovation cost asymmetries. The result provides a simple justification of the prevalence of two-part tariff licensing contracts in industries.

1. Introduction

Patent licensing is a fairly common practice that takes place in almost all industries. It is a source of profit for the innovator (also called licensor or patentee) who earns rent from the licensee by transferring a new technology using various licensing contracts. Among them a two-part tariff licensing contract is widely observed in reality. Typically, in a two-part tariff contract there is a fixed component and a variable component. The fixed component can be determined by a simple fixed fee or auction (depending on the number of licensees) and the variable part is determined by using per-unit or ad valorem royalty. Rostoker (1983) in an empirical work finds that royalty payments alone are used in 39% of the cases, a fixed fee alone in 13%, and both instruments together in 46%. Taylor and Silberston (1973) find similar percentages in their study. More recently, Macho-Stadler et al. (1996) find, using Spanish data, that 59% of the contracts have royalty payments, 28% have fixed fee payments, and 13% include both fixed and royalty fees.

In this paper, we show why a two-part tariff licensing consisting of a fixed fee and a per-unit royalty can be a dominant mode of licensing in the industries. We prove that in spatial models of competition with an insider patentee, the optimal licensing contract is always a two-part tariff scheme. Specifically, we show this result in Salop's circular city model and Hotelling's linear city model, the two most celebrated models in spatial competition in economics. Our result is robust to all possible innovations i.e. drastic or non-drastic; and all possible pre-innovation cost asymmetries between the patentee and licensee. Thus we provide a simple justification for the prevalence of two-part tariff licensing contracts.

The other aspect we would like to highlight in our analysis is the following. In the literature on insider patentees, the transfer of new technology is essentially studied in a framework where the competing firms are symmetric in terms of costs of production in the pre-innovation stage or when the patentee is more cost-efficient compared to the licensee. We depart from this standard framework to an environment where technology transfer can take place from a relatively cost-inefficient firm to its efficient counterpart. To motivate the analysis one can think of a situation of north–south technology transfer. In reality, technology transfer takes place from an R&D-intensive innovative firm to other firms where the recipient firms may be more cost-efficient than the patentee firm when it comes to the production of output. The R&D-intensive firms are typically based in high-wage (or high rent of fixed factors) northern countries whereas low-cost firms are based in low-wage (or low rent) southern countries. Thus, the R&D-intensive technologically advanced firms based in high-wage (or rent) countries are not necessarily the most cost-efficient ones in the industry for the production of output. However, the technology transfer takes place from the R&D-intensive technologically advanced firm to less (technologically) advanced firms based in low-wage (or rent) countries. Alternatively, in the context of a closed economy, one can also see the relevance of our analysis in the following way. Consider the situation in a single country with the same wage rate where two competing

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firms are asymmetric with respect to their pre-innovation costs. The asymmetry is because of the inefficiency of the high-cost firm in some stages of its production process. Now, assume that this high-cost firm brings about a cost-reducing innovation in some other stages of the production chain and is willing to license the new innovation to its efficient competitor. [1]This article provides a framework to analyze the optimal licensing contracts for this type of technology transfer in a closed economy as well as technology transfer through licensing from the northern to southern firms when they compete in a single market in an open economy.[2]

There is a vast literature (see Kamien (1992) for a survey on patent licensing, and Sen and Tauman (2007) for general licensing schemes), which focuses on the optimal licensing arrangement by the patentee under product differentiations. Previously, Muto (1993) considered licensing policies under price competition in a standard differentiated product framework with an external patentee and two potential licensees, and found that only royalty is optimal (compared to auction and fixed fee). On the other hand, Fauli-Oller and Sandonis (2002) considered a licensing game in differentiated product market with an insider patentee and proved optimality of a two-part tariff licensing under price and quantity competition. Mukherjee and Balasubramanian (2001) considered technology transfer in a Cournot duopoly market with horizontally differentiated products and also found optimality of two-part with insider patentee. More recently, Bagchi and Mukherjee (2014) considered an outsider patentee and showed the impact of product differentiation on optimal licensing. They again found optimality of royalty licensing for a certain range of product differentiation irrespective of Cournot and Bertrand competition. We note that most of these studies are done in a standard framework of price and/or quantity competition with differentiated products (i.e. the representative consumer approach of product differentiation) with symmetric pre-innovation production costs of (insider) patentee and licensees. The results are mixed regarding optimal licensing (i.e. either royalty or two-part tariff). In contrast, we consider our study in a spatial framework of product differentiation with both symmetric and asymmetric pre-innovation production costs of the patentee and licensee; and found that a two-part tariff licensing is always optimal.[3] We believe that the spatial models, like Salop and Hotelling, are an appropriate place to study the licensing behavior of firms in the industries where markets are already developed and not growing over time while the differentiation over the brands is well established and is not changing rapidly. In a typical location model, when the full market is always served, the quantity demanded at each price not sufficiently high does not change. We believe that this particular feature in a location model is important, when one compares across equilibrium outcomes (equilibrium prices, profits of the firms) under different licensing regimes as the market size (or aggregate demand) remains constant across the regimes.

The rest of the paper is organized as follows. Licensing in Salop's model is discussed in Section 2, where we start with the symmetric pre-innovation cost case and then go for the asymmetric cost case. Licensing in Hotelling's model is discussed in Section 3. Section 4 concludes with a discussion.

2. Salop's model

Consider a circular city with unit circumference. Two firms produce a homogeneous good, located symmetrically on the city and compete in prices. Suppose firm A is located at 0 and firm B is located at 1/2. Consumers are uniformly distributed over the circular rim and each buys exactly one unit of the good either from firm A or firm B. The transportation cost per unit of distance is t.[4] The utility function of a consumer located at x and buying from firm A is

$$\begin{aligned} U_A &= v-p_A-tx && \text{if } x\in[0,1/2],\\ &= v-p_A-t(1-x) && \text{if } x\in[1/2,1]. \end{aligned}$$

The utility function of a consumer located at x and buying from firm B is

$$\begin{aligned} U_B &= v-p_B-t(1/2-x) && \text{if } x\in[0,1/2],\\ &= v-p_B-t(x-1/2) && \text{if } x\in[1/2,1]. \end{aligned}$$

Assume that the market is fully covered. It is straightforward to derive the demand for firms A and B, which is given below:

$$\begin{aligned} Q_A &= \frac{1}{2}+\frac{p_B-p_A}{t} && \text{if } p_B-p_A\in\left[-\frac{t}{2},\frac{t}{2}\right],\\ &= 0 && \text{if } p_B-p_A<-\frac{t}{2},\\ &= 1 && \text{if } p_B-p_A>\frac{t}{2}, \end{aligned}$$

and

$$Q_B = 1-Q_A.$$

2.1. Pre-innovation

Denote the marginal costs of production of Firms A and B by c_A and c_B respectively and define $\delta = c_A - c_B$. We need to assume $-\frac{3t}{2}<\delta<\frac{3t}{2}$ so that the less efficient firm's equilibrium quantity is positive before the innovation takes place. The equilibrium prices, demands and profits are given by the following:

$$p_A = \frac{1}{6}(3t+4c_A+2c_B) = c_A+\frac{1}{6}(3t-2\delta), \tag{1}$$

$$p_B = \frac{1}{6}(3t+2c_A+4c_B) = c_B+\frac{1}{6}(3t+2\delta), \tag{2}$$

$$Q_A = \frac{1}{6t}(3t-2\delta), \tag{3}$$

$$Q_B = \frac{1}{6t}(3t+2\delta), \tag{4}$$

[1] Note that in this analysis we also implicitly assume that all stages of (efficient) production technique may not be feasible to license. Consequently, we do not consider licensing possibility at the pre-innovation stage from the efficient firm if costs are asymmetric. Licensing possibility starts only after the new innovation takes place and only the cost-reducing innovation itself is available to license. Obviously, this situation does not arise if pre-innovation costs are symmetric.

[2] See also Poddar and Sinha (2010) which is related to this discussion.

[3] See also the research papers by Caballero et al. (2002), Poddar and Sinha (2004) and Matsumura and Matsushima (2008) for licensing in spatial framework. Caballero et al. (2002) considered the case of outsider patentee with two price-setting firms located on a circumference and found that royalty is optimal regardless of the size of the innovation. Matsumura and Matsushima (2008) considered a standard linear city model with two firms and studied how licensing activities affect the locations of the firms (i.e., the degree of product differentiation) and the incentive for R&D investment. The relation of our present analysis with Poddar and Sinha (2004) is discussed in footnote 8.

[4] We have used symmetric location of firms and linear transport cost to simplify the analysis.