Profiting from Licensing without Royalties

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This paper examines how licensing affects an innovator's profit in a model where an innovator may license its technology to a rival that sells a homogenous product on the market. We find that there exists a demand stimulation such that the innovator's profit increases with licensing even without royalties. We find similar results with differentiated products.

Keywords: licensing, technology

Introduction

Firms are increasingly partnering in the development and marketing of new technologies and different explanations have been suggested to reflect the popularity of collaboration. Some authors suggest that collaboration may be a necessary condition for technological development given the increased complexity and the multidisciplinary nature of innovations (refer for instance to Häusler, Hohn & Lutz 1994). In this vein Zanfei (1993) notes that the convergence of computing and telecommunications has forced many firms from the telecommunications industry to combine efforts with firms with complementary technical competencies.

Furthermore, collaboration may prove to be essential to ensure the commercial success of a new product since innovative firms do not always possess the skills necessary for production and commercialization. Teece (1986) maintains that collaboration occurs most often following a technological discontinuity which renders the technological knowledge of an established firm obsolete without however diminishing their overall competencies. Such a firm becomes an ideal partner for emerging innovative firms which do not possess marketing experience. A large number of alliances of this kind have been concluded in the pharmaceutical industry following the growth of biotechnology (Hamilton 1990, Pisano 1990).

Such arguments are perfectly valid to explain the recourse to collaboration for a firm that does not have the possibility to rely on its own competencies to develop or bring a new product to the market. On the other hand, they provide only a partial explanation for the deliberate sharing of a technology such as in the case of Kodak that jointly developed the specifications of the Advanced Photo System with Fuji and its other main rivals and licensed the technology to most industry players (Boivin 2004).

Some authors incline towards the benefits of deliberate creation of competition which follows from technology sharing invoking demand-side considerations. Conner (1995), for example, shows that the existence of network externalities may stimulate demand enough to compensate for lost sales due to the presence of a rival. She demonstrates that to grant a license to a manufacturer of a clone turns out to be a profit-maximizing strategy for an innovator if the quality of the clones is inferior and network externalities are sufficiently strong. Shepard (1987) and Farrell and Gallini (1988) also view licensing as a way of stimulating demand by reassuring buyers that they will not be victims of a single supplier. Shepard (1987) maintains that licensing allows suppliers to guarantee the quality of their products. According to Farrell and Gallini (1988), granting a license is a means of convincing consumers that the price will not go up in the future and thus to eliminate the problems associated with the threat of opportunism on the part of suppliers.

Although building on the idea that licensing may stimulate demand, we take a different standpoint than Conner (1995) and Shepard (1987) and Farrell and Gallini (1988). First, contrary to Conner (1995), we show that licensing to a rival that offers a product of similar quality may be beneficial. Second, in order to avoid that part of the benefits of licensing are derived from royalties as in Shepard (1987) and Farrell and Gallini (1988), we assume that the technology is licensed for free and thus that the increased profit is due to market expansion.

We develop an analytical framework to evaluate the impact of technology sharing on profit and establish conditions such that licensing without royalties may increase profit. We concentrate on revenues and maintain that the variation in profit following technology sharing is the result of two contradictory effects: the market share effect, which is negative, and the market size effect, which is positive. If we disregard cost considerations, the impact of technology sharing on profit can therefore be analyzed by comparing the market share effect and the market size effect.

Market share and market size effects

The entry of a new competitor through licensing has an obvious negative impact on the profit of an incumbent by reducing its market share. This is what we call the *market share effect*. It may also be argued that licensing may result in an increase in the size of the market or what we call a *market size effect*. The positive impact of competition has been emphasized by Brandenburger and Nalebuff (1996). In their view, many firms can succeed only if others are also succeeding at the same time. Even though this idea is most evident in the case of complementary firms (such as Microsoft and Intel), it may equally apply to rival firms. Brandenburger and Nalebuff mention, for example, the case of universities which compete to attract students but whose efforts are complementary in the creation of a market for higher education.

The market size effect depends on the variation in demand resulting from an increase in the number of firms on the market. Some empirical evidence points to the fact that demand may not be independent from the number of firms on a market. For instance, Mahajan, Sharma and Buzzell (1993) estimated that the entry of Kodak into the instant cameras market in 1976 (when Polaroid held a monopoly position) resulted in a 37 percent expansion of the market. Some theoretical arguments may also be used. As already mentioned in the introduction, demand may be stimulated by the presence of network externalities (Conner 1995) and a decreased threat of opportunism (Shepard 1987, Farrell & Gallini 1988).

Especially in the case of experience goods, consumers may not be initially able to judge the quality of a product because information is transmitted both by the use of the product and by word of mouth. Such uncertainty inclines consumers to be cautious and demand is thus lower (Waldman & Jensen 1997). Since information on product quality is spread with time to potential buyers by individuals who have purchased the product (Vettas 1998), a greater number of firms may stimulate demand early on and continue to generate gradual increases in demand through the circulation of positive information.

Variety generally increases with the number of firms. Scherer (1996) maintains that monopolistic competitors are better able to offer a greater variety of products than a single vendor. Moreover, since product differentiation is based both on the real characteristics of the product and the perceived differences, two products physically identical offered by distinct firms can be considered different by consumers because of their brand name or the reputation of the companies. If one assumes that each consumer has a set of preferred features, an increase in variety necessarily results in an increase in demand. In fact, when a variation of the product is introduced, the willingness to pay of some individuals to pay increases as well since the variant meets their needs better than the existing variants (see for example Pepall, Richards & Norman 1999).

The positive impact of licensing on the size of the market may compensate for the negative impact on market share. It may then be profitable for an incumbent to induce entry by offering a license to a potential entrant. In order to present the underlying logic of our arguments more formally, we use a simple theoretical example. This setting enables us to distinguish between the market size effect and the market share effect of licensing on a firm's profit. We also determine conditions such that technology licensing increases profit by comparing the magnitude of the two effects.

Model

We develop a model of a firm (firm 1) which holds a monopoly position because it has the property rights to a technology that cannot be imitated. The firm has the choice between keeping the exclusivity of its technology and licensing it to a rival firm (firm 2). In order to focus on the impact of demand stimulation caused by the increased competition on the market, we assume that there are no royalties and that costs are not affected by the decision to license or not.

In the case firm 1 keeps the exclusivity on the technology, it gets monopoly profit and faces the inverse demand curve $D_m = a - bQ$ where $a > 0$ and $b > 0$ are parameters and $Q = q_1$ is aggregate output. If firm 1 licenses the technology to firm 2, market demand becomes $D_d = ax - bQ$ where $Q = q_1 + q_2$ and $x > 0$ is a parameter that represents the impact of licensing on demand. If $x < 1$ demand decreases with licensing, if $x > 1$ demand increases with licensing, and, if $x = 1$ demand is not modified with licensing. Firm 1 faces a unit cost of production C_1 while firm 2 faces a unit cost of production C_2. R&D costs are considered as sunk costs and as such do not influence the decision to license the technology and thus are not included in the model.

In the case the innovator does not license the technology and acts as a monopoly it maximizes the following profit function (with $b = 1$):

$$\Pi_m(Q) = (a - Q)Q - C_1 Q \tag{1}$$

First-order condition for profit maximization yield:

$$Q^* = \frac{a - C_1}{2}$$

(2)

Replacing (2) in (1) yield monopoly profit[1] Π_m^*. Firm 2's profit is zero since it cannot enter the market without a license.

$$\Pi_m^* = \Pi_m\left(Q^*\right) = \frac{\left(a - C_1\right)^2}{4} \tag{3}$$

In what follows, we derive conditions such that licensing may increase profit in two different settings: (i) when the innovator and the licensee have non-differentiated products and (ii) when the innovator have differentiated products.

Non-differentiated products

If the innovator licenses its technology to firm 2 that produces a non-differentiated product, firm 1 maximizes the following profit function (again with $b = 1$):

$$\Pi_1\left(q_1; q_2\right) = \left(ax - q_1 - q_2\right)q_1 - C_1 q_1 \tag{4}$$

While firm 2 maximizes the following profit function:

$$\Pi_2\left(q_2; q_1\right) = \left(ax - q_2 - q_1\right)q_2 - C_2 q_2 \tag{5}$$

Firm 1 chooses quantity q_1 which maximizes (4) while firm 2 chooses quantity q_2 which maximizes (5). We thus obtain[2]:

$$q_1^* = \frac{ax - 2C_1 + C_2}{3} \tag{6}$$

and

$$q_2^* = \frac{ax - 2C_2 + C_1}{3} \tag{7}$$

We use (6) and (7) to substitute in (4) and (5) to obtain each firm's profit associated with licensing Π_{d1} for firm 1 and Π_{d2} for firm 2[3].

$$\Pi_{d1} = \Pi_1\left(q_1^*, q_2^*\right) = \frac{\left(ax - 2C_1 + C_2\right)^2}{9}$$

(8)

$$\Pi_{d2} = \Pi_2\left(q_2^*, q_1^*\right) = \frac{\left(ax - 2C_2 + C_1\right)^2}{9}$$

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[1] Price elasticity of demand at equilibrium is $\frac{a + C_1}{a - C_1}$. Demand is thus elastic if $C_1 > 0$.

[2] Note that $q_1^* > 0$ if $x > \frac{2C_1 - C_2}{a}$ and that $q_2^* > 0$ if $x > \frac{2C_2 - C_1}{a}$.

[3] With $C_1 = C_2 = C$ price elasticity of demand at equilibrium is $\frac{ax + 2C}{2x - 2C}$. Thus demand is elastic if $C > \frac{ax}{4}$.

(9)

In order to analyze the impact of licensing on the innovator's profit, we distinguish two effects: the market share effect and the market size effect. An innovator that licenses its technology to a rival loses its monopoly position and its market share is reduced. We define the market share effect as the variation in profit due to licensing. It is computed as the difference between the monopoly profit and a firm's duopoly profit keeping demand at its initial level[4], D_m. For firm 1:

$$\textit{Market share effect} = \prod_{d1}(D_m) - \prod_{d1}(D_m) \tag{10}$$

Since competition may stimulate demand, the market size effect shows the variation in profit due to the change in the size of the market following licensing. It is computed as the difference between a firm's duopoly profit with the new demand and a firm's duopoly profit keeping the demand at its initial level. For firm 1:

$$\textit{Market size effect} = \prod_{d1}(D_d) - \prod_{d1}(D_m) \tag{11}$$

Consequently, from firm 1's point of view:

$$\textit{Market size effect} + \textit{Market share effect} = \prod_{d1}(D_d) - \prod_{m}(D_m) \tag{12}$$

When firm 1 licenses the technology to firm 2 that offers a non differentiated product and $x > 1$, the market size effect $\frac{(ax - 2C_1 + C_2)^2 - (a - 2C_1 + C_2)^2}{9}$ is positive[5] while the market share effect $\frac{(a - 2C_1 + C_2)^2}{9} - \frac{(a - C_1)^2}{4}$ is negative[6]. The magnitude of these contrary effects determines the profitability of licensing strategy: the innovator's profit increases (decreases) with licensing when the market size effect is greater (is lower) than the market share effect. These results may be summarized by the following proposition:

Proposition 1: *With non-differentiated products, there exists a demand stimulation (x') such that profit from licensing $\prod_{d1}$ is greater than monopoly profit $\prod_m$.*

Proof 1: *Comparing equation (8) to equation (3), profit from licensing is greater than monopoly profit if the following condition is satisfied:*

$$x' > \frac{1.5a + 0.5C_1 - C_2}{a} \tag{13}$$

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[4] In other words, duopoly profits are computed by assuming $x = 1$.

[5] In the case demand is not modified with technology licensing ($x = 1$), the market size is zero since $\prod_d(D_d) = \prod_d(D_m)$.

[6] The market share effect is negative if $C_1 = C_2$ since it simplifies to $\frac{-5(a-C)^2}{36}$. If C_1 is different from C_2, the market share effect is negative if $C_1 > 2C_2 - a$.

Condition (13) states that the demand stimulation must be greater than a minimum level in order for licensing to be a more profitable option than keeping the exclusivity on a technology. An appropriate choice of parameters guarantees that (13) holds.

Consider a numerical example with $a = 10$ and $C_1 = C_2 = 7$. The innovator's profit increases with licensing if $x > 1.15$ since the market share effect is -1.25 while the market size effect is greater than 1.25. Consequently, the market size effect dominates the market share effect if the demand stimulation (x) is greater than 1.15.

Differentiated products

For products sold on the same market, the degree of substitution decreases with product differentiation. In order to evaluate the impact of the degree of substitution, we consider a situation in which firm 1 licenses a technology to firm 2 that offers a differentiated product which implies that a firm's demand is more sensitive to a variation in its own level of production than to variations in its rival's production level. In order to simplify the problem, we assume that $C_1 = C_2 = C$. Firm 1's profit function is:

$$\Pi_1(q_1; q_2) = (ax - bq_1 - eq_2)q_1 - Cq_1 \tag{14}$$

where e and b are parameters such that $0 < e < b$, while firm 2's profit function is:

$$\Pi_2(q_2; q_1) = (ax - bq_2 - eq_1)q_1 - Cq_2 \tag{15}$$

Firm 1 chooses quantity q_1 which maximizes (14) while firm 2 chooses quantity q_2 which maximizes (15). We assume that $b = 1$ and consequently $e < 1$, and obtain:

$$q_1^{'} = q_2^{'} = \frac{(ax - C)(2 - e)}{4 - e^2} \tag{16}$$

Replacing (16) in (14) and (15) yield profit from licensing with differentiated products $\Pi_d^{'}$ for both firms:

$$\Pi_d^{'} = \Pi_1(q_1^{'}, q_2^{'}) = \Pi_2(q_2^{'}, q_1^{'}) = \left[\frac{(ax - C)(2 - e)}{(4 - e^2)}\right]^2$$

(17

This leads to the following proposition:

Proposition 2: *With differentiated products, there exists a demand stimulation (x^e) such that profit from licensing ($\Pi_d^{'}$) is greater than monopoly profit (Π_m).*

Proof 2: *Comparing equation (17) to equation (3), profit from licensing is greater than monopoly profit if the following condition is satisfied:*

$$x^e > \frac{\frac{(a-C)(4-e^2)}{2(2-e)}}{a} + \frac{C}{a} \tag{18}$$

Consider a numerical example with $a = 10$, $C = 7$ and $e = 5$. The innovator benefits from technology licensing if $x > 1.075$ since the market share effect, $\left[\frac{(a-C)(2-e)}{4-e^2}\right]^2 - \frac{(a-C)^2}{4}$, is equal to -0.81 while the market size effect, $\left[\frac{(ax-C)(2-e)}{4-e^2}\right]^2 - \left[\frac{(a-C)(2-e)}{4-e^2}\right]^2$, is greater than 0.81. Consequently, the market size effect dominates the market share effect when the demand stimulation (x) is greater than 1.075.

The reader may refer to the preceding numerical example where $a = 10$, $C_1 = C_2 = 7$ and $e = 1$ to conclude that the market share effect seems smaller with product differentiation. In fact, the smaller the value of e, the more firm 1's demand is isolated from firm 2's demand (Carlton & Perloff 1994) and licensing has less impact on profit. This result may be generalized in the following proposition:

Proposition 3: *The demand stimulation such that profit from licensing is greater than monopoly profit is smaller the greater the product differentiation.*

Proof 3: *Let x^{e*} the critical value of demand stimulation such that profit from licensing is equal to monopoly profit. According to equation (18), we have:*

$$x^{e*} = \frac{\frac{(a-C)(4-e^2)}{2(2-e)}}{a} + \frac{C}{a} \tag{19}$$

The sensitivity of x^{e*} to a variation in product variation (i.e. $\partial x^{e*} / \partial e$) must be positive in order to verify the proposition.

$\partial x^{e*} / \partial e = \frac{2(a-C)}{a(4-2e)}\left[-e + \frac{4-e^2}{4-2e}\right] > 0$ *if* $\frac{(4-2e^2)}{4-2e} > e$ *since* $0 < e < 1$ *and* $a > C > 0$. *This condition simplifies to* $4 + e^2 > 4e$ *and is satisfied for all values of e such that* $0 < e < 1$ *+e²>4e i.e. the greater the product differentiation (or the smaller is e), the smaller is x^{e*}.*

Conclusion

In this paper, we analyze the profitability of technology licensing without royalties and cost savings. We develop a conceptual framework that identifies the impact of technology licensing on profit. According to our framework, the profitability of technology licensing may be evaluated by comparing the magnitude of two contrary effects of licensing on profit: the market share effect and the market size effect. The market share effect is negative because of the erosion in market share of a firm that shares a technology and the market with a rival. The market size effect is positive and takes into account the impact of variables such as greater variety that may result in a stimulation of demand due to an increase in the number of firms on a market.

Our framework provides guidelines for firms elaborating strategies for technology commercialization. Rather than only focusing on how much is given up to a rival by inducing (or not stopping) entry, we contend that a firm should also evaluate the impact on demand. The framework is particularly relevant to explain why some firms deliberately choose to share a technology through cooperation on research and development, licensing, or cross-licensing. For example, Kodak jointly developed the specifications of the Advanced Photo System and licensed the technology to most of the industry players in order to ensure its adoption and thus the creation of a market for the new technology. Moreover, it can be argued that the success of the VHS technology against Beta on the videocassette market was directly linked to the use of licenses by VHS patent holders.

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