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FIXED-FEE LICENSING OF INNOVATIONS AND COLLUSION*

PING LIN

Unlike other types of licensing agreements such as those with output restrictions, market division clauses, or output royalties, licensing contracts with only a fixed-fee have been perceived as having no anticompetitive consequences. This paper illustrates that fixed-fee licensing may facilitate collusion by enhancing the licensee's ability to credibly punish deviations from the collusive outcome on the part of the licenser. Antitrust implications of the result and potential ways of detecting collusion-motivated licenses are discussed.

I. INTRODUCTION

PATENT licensing is a main channel through which dissemination of innovations takes place. A major concern among economists and policy-makers regarding patent licensing is that it may also have anti-competitive conseqences. It is well recognized that certain types of licensing agreements among horizontally-related firms may facilitate collusion in the product market. According to the Antitrust Guidelines for Licensing of Intellectual Property issued by the US Department of Justice and the Federal Trade Commission in 1995, restraints in licensing agreements are per se illegal if they involve naked price-fixing, output restrictions, or market division among horizontal competitors. Moreover, cross-licensing or pooling agreements may be challenged, for they are potentially capable of promoting collusion. A licensing contract with output royalties can also facilitate collusion because it enables the licenser to manipulate the marginal cost of the licensee and, hence, its output level (Shapiro [1985]). On the other hand, it is almost taken for granted that licensing contracts with only an up-front fixed fee paid by the licensee cannot possibly have any anti-competitive effect.

This paper makes the point that although containing no restrictions at all, fixed-fee licensing contracts can make collusion between the licenser and the licensee easier. My point of departure is the well-known view that firms can achieve a collusive outcome by adopting proper punishment schemes. Whether such schemes work or not depends crucially, among other things, on the retaliation strategies firms can use in a credible manner. Licensing agreements, even with only a fixed fee, change the

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firms' relative strengths and, hence, affect their punishing strategies. In a simple model with Bertrand firms interacting repeatedly, it is shown that tacit collusion is more likely to happen if licensing occurs. Absent licensing, the high-cost firm (the would-be licensee) is not strong enough to prevent the low-cost firm (the would-be licenser) from cheating on the collusive outcome, since the latter can still enjoy an acceptable flow profit in the punishing periods. The larger the cost difference, the more tempted the low-cost firm will be to cheat. Licensing, however, enhances the ability of the licensee to credibly punish the licenser and thus provides a stronger disciplining mechanism. Indeed, I found that for large cost differences, collusion, which otherwise would not take place, occurs in the presence of licensing. When this happens, the licensing contract can be viewed as a substitute for an arrangement whereby the low-cost firm bribes the high-cost firm to leave the industry. While such side-payments may not be legal, they can nevertheless be disguised in a technological transfer agreement.

The point of the paper is consistent with the conventional view that cost asymmetry may hamper firms' ability to tacitly collude (see, e.g., Tirole [1990]). According to this view, firms with different costs may have difficulty finding a focal point in setting their price and output. In my paper, collusion is harder to sustain in the absence of licensing for a different reason: the low-cost firm can cheat on the collusive outcome without fearing too much about retaliation by the high-cost firm. The work of Eswaran [1993], who showed that cross-licensing of competing patents can facilitate collusion, is very close to the present paper. In Eswaran, cross-licensing enhances the degree of collusion by credibly introducing the threat of increased rivalry in the market for each firm's product. Whereas in my paper, licensing makes firms' costs symmetric and increases the licensee's scope of retaliation. Finally, my paper can also be related to the literature on excess capacity (see, e.g., Benoit and Krishna [1987] and Davidson and Deneckere [1990]). It has been recognized that by building excessive capacity, a firm enhances its punishment ability and, consequently, can more effectively prevent other firms from cheating on the collusive arrangements. In my model, collusion is more likely to occur after licensing as the licenser enlarges the licensee's set of threats rather than its own.

II. A SIMPLE MODEL

I use a Bertrand duopoly model to illustrate the main point of the paper. Two firms produce a homogeneous product at time $t = 0, 1, \ldots, +\infty$, the demand for which is given by $D(p)$, where p is the price of the good. Initially, firm i has constant marginal cost $c_i, 0 \leq c_1 < c_2$. Firm 1's more efficient technology can be thought of as a result of its past R&D activity and is assumed to be protected by a perfect patent system with infinite patent length. Thus, the only way for firm 2 to use the c_1-technology is through a license arrangement. Let p_1^m denote the monopoly price associated with the c_1-technology. Assume that $p_1^m > c_2$, that is, the cost advantage of firm 1 is not big enough for it to drive firm 2 out of the market by charging p_1^m. At the beginning of time 0, the firms decide whether or not to strike a licensing agreement. Following this, they compete in the product market repeatedly in all time periods by setting prices. If licensing occurs at time 0, the firms play the subsequent infinitely repeated games each having marginal cost c_1. Otherwise, they compete with cost profile (c_1, c_2). Let Π_1^m denote the monopoly profit associated with c_1 and $\lambda(c_2)$ denote the ratio between firm 1's static Bertrand equilibrium profit and Π_1^m. That is, $\Pi_1^m \equiv (p_1^m - c_1)D(p_1^m)$ and $\lambda(c_2) \equiv (c_2 - c_1)D(c_2)/\Pi_1^m$. Also assume that $\lambda(c_2)$ is an increasing function for $c_2 < p_1^m$. The common discount factor is $\delta \in (0, 1)$.

Since the monopoly price p_1^m is a "focal point" upon which the firms choose to collude if licensing occurs, I will investigate how licensing might affect the firms' ability to sustain this price level.[1] If the firms "agree" to charge p_1^m every period, they need to find a way of sharing the market demand $D(p_1^m)$. Let s_1 denote the "agreed-upon" market share of firm 1. Firm 2's market share is $s_2 \equiv 1 - s_1$.

Consider the following, typical, trigger strategies designed to support the above collusive outcome: "Each firm i charges p_1^m and produces $s_iD(p_1^m)$ as long as both have complied with this rule earlier. If one firm has deviated in the past, both firms revert to Bertrand behavior forever." Note the asymmetry that is present here if licensing does not occur. Under the strategy profile, if firm 2 deviates from the collusive price p_1^m at a certain point of time, its future profits will be zero, as firm 1 would retaliate by reverting to the static Bertrand equilibrium. However, because of its cost advantage, firm 1 can still make a positive profit (equal to $\lambda(c_2)\Pi_1^m$) after it unilaterally deviates from p_1^m. In a sense, reverting to the static Bertrand strategies is more punitive to firm 2 than to firm 1.

For the above strategy profile to constitute a subgame perfect equilibrium in the repeated games, it must be that neither firm finds it profitable to unilaterally deviate from the specified strategy. If both firms adopt the trigger strategy, firm 1 realizes a per period profit of $s_1\Pi_1^m$, while firm 2 realizes $(p_1^m - c_2)s_2D(p_1^m)$. Now consider the most profitable deviation for each firm. For firm 1 it consists of charging $p_1^m - \varepsilon$ in the deviating period. Firm 1 makes a gain in the deviating period equal to (almost) $\Pi_1^m - s_1\Pi_1^m$. Following the deviation, firm 2 retaliates by charging c_2 for all the remaining periods, reducing firm 1's flow profit from $s_1\Pi_1^m$

[1] If the firms were allowed to form a cartel in the absence of licensing, the efficient agreement would require that firm 1 supply the whole market at price p_1^m and pay firm 2 a fee to shut down.

to $\lambda(c_2)\Pi_1^m$. So, the long-term loss of firm 1 is

$$\frac{\delta}{1-\delta}(s_1\Pi_1^m - \lambda(c_2)\Pi_1^m).$$

Thus, firm 1 will not deviate from the collusive outcome if and only if the gain is no higher than the loss or, equivalently, if and only if

$$(1) \qquad 1 - s_1 \leq \frac{\delta}{1-\delta}(s_1 - \lambda(c_2)).$$

Firm 2's optimal deviation is also to undercut p_1^m slightly and capture the whole market. It then realizes a short-term gain of (almost) $(p_1^m - c_2)s_1D(p_1^m)$ in the deviating period. The long-term loss for firm 2 is simply its forgone future profits, which are equal to

$$\frac{\delta}{1-\delta}(p_1^m - c_2)s_2D(p_1^m).$$

Thus, firm 2 will not deviate from the specified strategy if and only if

$$(p_1^m - c_2)s_1D(p_1^m) \leq \frac{\delta}{1-\delta}(p_1^m - c_2)(1-s_1)D(p_1^m),$$

that is,

$$(2) \qquad s_1 \leq \frac{\delta}{1-\delta}(1-s_1), \quad \text{or,} \quad s_1 \leq \delta.$$

Therefore, conditions (1) and (2) are necessary and sufficient for p_1^m to prevail in equilibrium. The lemma below states the conditions in terms of δ and c_2 alone.

Lemma 1. Suppose the firms have the cost profile (c_1, c_2), $c_1 < c_2 < p_1^m$. The monopoly price p_1^m can be sustained in equilibrium by the above trigger strategies if and only if

$$(3) \qquad \frac{1-\delta}{\delta} \leq 1 - \lambda(c_2).$$

Proof. Combining (1) and (2) yields

$$1 \leq \frac{\delta}{1-\delta}(s_1 - \lambda(c_2)) + s_1 \leq \frac{\delta}{1-\delta}(\delta - \lambda(c_2)) + \delta = \frac{\delta}{1-\delta}(1 - \lambda(c_2)).$$

So, condition (3) is satisfied.

Now let us start with inequality (3) and let $s_1 = \delta$. Then condition (2) holds (with equality), and so does condition (1) because

$$\frac{\delta}{1-\delta}(s_1 - \lambda(c_2)) = \frac{\delta}{1-\delta}(\delta - \lambda(c_2)) = \frac{\delta}{1-\delta}(1 - \lambda(c_2)) - \delta,$$

which is no smaller than $1 - s_1$ by inequality (3). Q.E.D.

By assumption, $\lambda(c_2)$ is an increasing function of c_2 with $\lambda(c_1) = 0$ and $\lambda(p_1^m) = 1$. So, condition (3) never holds for $\delta < 1/2$. For $\delta \geq 1/2$, let c^* be defined by $(1 - \delta)/\delta = 1 - \lambda(c^*)$. Clearly, $c_1 < c^* < p_1^m$ and condition (3) is valid if and only if $c_2 \in [c_1, c^*]$. Thus, the interval $[c_1, c^*]$ is the set of c_2 that can support p_1^m in equilibrium. For $c_2 \in (c^*, p_1^m)$, the trigger strategies fail to constitute an equilibrium. The intuition for this can be seen as follows. If firm 1 deviates from the monopoly price p_1^m at time t, its per period profit from time $t + 1$ on will drop from $s_1\Pi_1^m$ to $(c_2 - c_1)D(c_2)$. If $c_2 > c^*$, the lost profits are not big enough to deter firm 1 from deviation. (Note that condition (2) says that for firm 2 not to cheat on p_1^m, firm 1's market share cannot be too big.) Therefore, for any discount factor (no matter how close it is to unity) there exists a range of values of c_2 such that p_1^m cannot be supported by the trigger strategies regardless of how the firms share the market.

However, if firm 1 licenses its technology to firm 2 at time 0, firm 2's marginal cost becomes c_1. Then, $\lambda = 0$. In this case, condition (3) holds for all $\delta \geq 1/2$, and thus the monopoly price p_1^m prevails every period.[2] To summarize, we have the following result.

Proposition.
(i) For $\delta < 1/2$, the monopoly price p_1^m cannot be sustained in a subgame perfect equilibrium (SPE) by the above trigger strategies with Bertrand punishment, whether or not licensing occurs; and
(ii) For $\delta \geq 1/2$, the monopoly price p_1^m can be sustained in a SPE by the trigger strategies for all $c_2 \in (c_1, p_1^m)$ if licensing occurs and, in the absence of licensing, it can be supported in a SPE if and only if $c_2 \in [c_1, c^*]$.

The proposition states that licensing facilitates collusion since it enlarges the parameter space that supports collusion. In particular, if c_2 is larger than c^*, the firms cannot successfully collude on p_1^m in the absence of licensing whereas they can with licensing. With the old technology, the maximum punishment that firm 2 can credibly impose when firm 1 deviates is to price at c_2. Any price below c_2 would put firm 2 into a loss situation during the punishing period and, thus, it would not be in its best interest to indeed carry out such punishment. With licensing, however, firm 2's punishing ability is enhanced; it can set price equal to c_1 without incurring losses. Facing more severe potential punishments, the players (especially firm 1) are more disciplined. Collusion is more likely to occur.

When the monopoly price p_1^m prevails in equilibrium following licensing, both firms earn profits $\Pi_1^m/2$ per period. Since they can never realize collective profits of Π_1^m in the absence of licensing, the firms have an

[2] This is simply the standard result in symmetric repeated games with Bertrand players. See, e.g., Tirole ([1990], Ch. 6).

incentive to reach a licensing agreement at time 0. In general, the fixed-fee will be chosen so that they split the gain from trade. After firm 2 pays the fee at time 0, the industry behaves like a monopoly in the repeated games. One can view the net gain from licensing to firm 2, namely $\Pi_1^m/[2(1-\delta)]$ less the licensing fee less its reservation payoff, as the side-payments from firm 1 to bribe the firm 2 to "exit" the industry. Such side-payments may not be allowed by antitrust authorities, but they could be hidden in patent licensing agreements.[3]

Before ending this section, I would like to emphasize that my finding for the simple model should not be taken to imply that licensing always enhances firms' ability to collude. There are instances where licensing may hinder tacit collusion. For example, the firm with the lowest cost in an industry may be seen by other producers as a natural "industry leader". Other producers may look to this firm to take the lead in setting price or output. That is, the presence of a leader makes collusion easier. Such a coordination device may vanish if the low-cost firm licenses its technology to its rivals.[4]

III. TESTING COLLUSION-MOTIVATED LICENSING AGREEMENTS

If certain fixed-fee licensing arrangements are indeed designed to promote collusion, how can one go about detecting them? One way to proceed is to look at the prices before and after an agreement. A common explanation of fixed-fee licensing is that it reduces the costs of the licensee and, hence, can be mutually beneficial to the licenser and the licensee. Following a cost-saving license, the prices of the product should decline as the firms' costs of production are lower. In the case of a collusion-motivated agreement, my paper suggests, one would observe relatively low prices or periodic price wars prior to the deal, but higher and quite stable prices afterwards. By looking at the pattern of price changes, one may be able to distinguish cost-saving licensing agreements from those designed to fix prices.

Collusion-motivated agreements might also be related to mergers. For instance, rival firms may use licensing agreements to accomplish a failed merger. In the model I have considered here, one can imagine a situation where the low-cost firm wants to acquire the high-cost firm, but the

[3] In models with two firms differing in costs, the most efficient way to collude is for the low-cost firm to pay the high-cost firm to exit the market and then charge p_1^m afterwards. Because side-payments are not legal, the traditional approach to collusion between asymmetric firms looks at the "constrained" efficient outcomes, assuming no side-payments (Schmalensee [1987], Harrington [1991]). My result suggests that firms can achieve the "first-best" outcome by hiding side-payments in licensing agreements.

[4] In the same setting as in this paper, except with Cournot firms facing linear demand, Lin [1996] shows that licensing actually makes tacit collusion harder.

proposed merger is blocked by the antitrust authorities. It is conceivable that in this case the firms might strike a fixed-fee licensing contract. Such an agreement could support the same price as the merger, but involves no antitrust risk under the current regulation. Thus, a licensing contract following a failed merger attempt, together with an increased post-licensing price level, could perhaps be taken as evidence of a collusion-motivated licensing agreement.

PING LIN,
Department of Economics.
Southern Methodist University,
Dallas, TX 75275-0496

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