Cross-Licensing and Collusive Behavior *

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Abstract

Exchange of patents between firms increasingly influence competition. Such cross-licensing deals have traditionally raised antitrust concerns, since they can be used to control market shares and prices, and create entry barriers. We argue that cross-licensing is a device to establish multimarket contact and is likely to raise antitrust concerns only in so far multimarket contact does. Since cross-licensing typically occurs between similar firms in similar markets it is, as a first approximation, irrelevant for sustaining tacit collusion. We also point out the importance of incorporating the incentive to innovate into the analysis

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of the subtle relation between intellectual property and competition policies.

1 Introduction

On January 11, 2006, two large information and communications technology manufacturers, Nokia and Kyocera Wireless, announced a cross-licensing deal that ends the companies' two-year patent dispute. Under the terms of the agreement, Kyocera gets access to Nokia's patents for CDMA, PHS and PDC technology. Reciprocally, Nokia gets access to all of Kyocera's essential patents, including those that cover mobile phones, wireless modules and infrastructure products. Such cross-licensing agreements have become standard fare in many industries at the heart of modern economy such as biotechnology, information and communications technology, media, payment mediums, and software, where intellectual property rights reign supreme. Firms in these industries have to enter patent minefield where they risk inadvertent infringement of rivals' patents in trying to innovate new products or commercialize them. To overcome the problem the firms have resorted to extensive cross-licensing and patent pool deals where they grant each others a right to use their technologies. This has created an active market for technology where patents are used as bargaining chips (Arora, Fosfuri, and Gambardella, 2001).

While the emergence of such market has been praised by industry commentators, and it has certainly accelerated introduction of new products, it has raised antitrust concerns. It has been suggested that cross-licensing can stifle competition by raising rivals' costs, creating entry barriers, and expanding the scope for tacit collusion. In contrast to most prior literature we argue in this article that the concern for tacit collusion is likely to be irrelevant and, even if it were relevant, it could foster the pace of innovation. In this sense our findings justify the recent reform of the European Commission's competition policy regulation on technology transfer agreements, which invokes Article 81(3) of the EC Treaty to grant a block exception to technology transfer agreements from the European competition law (see European Commission, 2004a, 2004b). [1]

Our argument is based on two observations. First, cross-licensing essentially establishes multimarket contact between firms. Second, cross-licensing agreements typically occur between similar firms in similar markets.[2] Thus, it looks likely that the main conditions underlying the irrelevance of multimarket contact for the sustainability of tacit collusion (Bernheim and Whinston (1990)) are not violated in cross-licensing agreements. Indeed, we show that the celebrated irrelevance result in Bernheim and Whinston (1990) extends to the case in which the incentive to innovate and intellectual property rights are explicitly accounted for. Moreover, we show that even agreements involving side-payments or agreements where the transferred patent portfolios are of unequal size or economic importance need not warrant aggressive scrutiny by antitrust authorities.

Like Carlton and Gertner (2003) we also point out the need to take a broader view in the analysis of the subtle relation between intellectual property and competition policies. The vast literature of intellectual property protection (see, e.g., Denicolò, 1996, and Langinier and Moschini, 2002, for surveys) highlights the Nordhausian tradeoff between the incentive to inno-

[1] The main principles of the European regulation are broadly speaking similar to the U.S. Department of Justice's and the Federal Trade Commission's *Antitrust Guidelines for the Licensing of Intellectual Property* from 1995. They both view patent licensing, as generally procompetitive, but also indicate a number cases where licensing, including cross-licensing, agreements may cause antitrust concerns.

[2] Hard evidence mostly comes from semiconductor industry (see Arora et al., 2001, for a survey of the literature), but casual observations suggest that, e.g., telecommunications industry is not different.

vate and consumer surplus in the post innovation market. We show that there is no reason to ignore the tradeoff in the antitrust analysis: Failure to incorporate the incentive to innovate in the antitrust analysis of innovative industries can jeopardize technological progress.

Besides the above articles, our analysis is related to - surprisingly few - articles that explicitly deal with the antitrust concerns caused by cross-licensing agreements. In the seminal analysis, Fershtman and Kamien (1992) show that cross-licensing of complementary technologies may facilitate collusion. Eswaran (1994), like us, assumes that a major point of cross-licensing is to establish multimarket contact but his results are opposite to ours. In his model the firms sell differentiated commodities while in our model the firms sell commodities in independent markets. More recently the antitrust problems caused by cross-licensing or patent pools are highlighted by Shapiro (2001) and Lerner and Tirole (2004). On the one hand they argue that bundling of complementary technologies is an efficient way to overcome the hold-up power conferred to a single patent holder. On the other hand cross-licensing or pooling of substitute technologies may harm consumers by increasing the market power of patent holders. We also draw on the survey of the literature on tacit collusion by Ivaldi et al. (2003) to evaluate the robustness of our findings.

In the next section we outline the model. In section 3 we study the economy without patents and cross-licensing as a benchmark. There we derive the standard rule for the sustainability of collusion. Section 4 forms the core of our analysis, since there we add patents and multimarket contact via cross-licensing and show that, as a first approximation, they do not affect the standard rule for the sustainability of collusion. Section 5 is devoted to the analysis of ex ante licensing deals and the incentive to innovate.

Although it seems hard to be able to analyze the impacts of intellectual property rights without taking into account the incentive to innovate, in the previous literature the incentive to innovate plays a major role only in Fersthman and Kamien (1992). Section 6 concludes.

2 Model

There are two identical firms investing in R&D. For brevity, we assume that the firms can invest only once. Since we are after a symmetric equilibrium, it suffices to focus on one firm. Our firm chooses probability $p \in [0,1]$ of being successful in R&D. The cost of choosing p is given by a strictly convex function c with $c(0) = c'(0) = 0$ and $\lim_{p\to 1} c'(p) = \infty$. The probability that the rival is successful is denoted by q.

We assume that upon success, a firm can keep its innovation secret with probability α. With probability $1-\alpha$, the secret leaks out and the innovation becomes public so that the rival can use it for free. Competition in duopoly markets is of the Bertrand type so that if a leakage occurs, production is at the perfectly competitive level. Without loss of generality we assume that the innovation can become public only at the beginning of the period in which it is developed. For the time being we assume that innovations cannot be patented.

Let π be the one period (monopoly) profit and let the infinite stream of discounted profits be $\Pi \equiv \pi/(1-\delta)$ where δ is the discount factor. To address multimarket contact we postulate that our firm may be active in other markets, too. Different markets are assumed independent, and there is potentially a large number of them. A market becomes active, i.e., there is production in the market, when an innovation that satisfies the demand in that market is made.[3] Let there be l_p (l_q) active markets where our firm (the rival) encounters no competition by the rival (by our firm) and k active markets where both firms already produce.

The timing of events is the following: First the firms invest in R&D, then new innovations become either public or remain proprietary, then profits accrue to those who possess innovations.

3 Collusion without patents

Let us first study one potential market in isolation and assume that the firms have no other innovations, i.e., assume that $l_p = l_q = k = 0$. Suppose that the firms try to sustain tacit collusion in the market for a new product. This means that the firms share profits on the equilibrium path if both succeed in innovating, and reverse to stage game Nash equilibrium if either of them deviates. With Bertrand competition this constitutes the optimal punishment strategy (Abreu, 1988). Note that we consider only collusion in the pricing of the product not in the innovation stage where the firms independently decide on how much to invest in R&D. Note also that if a firm considers deviation it may choose a different level of R&D investment.

At the R&D stage the firm's problem is to

$$\max_p pq\alpha\frac{\Pi}{2} + p\left(1-q\right)\alpha\Pi - c\left(p\right),$$

[3] The U.S. 1995 *Guidelines* extend the concept of "market" beyond the traditional definition of production and sales of goods to 2technology markets" and "innovation markets". Technology markets are markets for licensing IPRs and innovation markets are markets for conducting R&D. When we refer to these extended concepts, we use them explicitly, reserving the word "market" for the traditional use.

or, after regrouping terms, to

$$\max_{p} p\left(1-\frac{q}{2}\right)\alpha\Pi - c\left(p\right).$$

The first order condition is

$$\left(1-\frac{q}{2}\right)\alpha\Pi = c'\left(p^{*}\right). \tag{1}$$

The assumptions on $c(p)$ guarantee that we have an interior solution. The equilibrium payoff from following the equilibrium strategy is thus

$$p^{*}c'\left(p^{*}\right) - c\left(p^{*}\right), \tag{2}$$

where p^{*} is the optimal R&D investment (i.e., the probability of success).

Deviation yields

$$p_{d}q\alpha\pi + p_{d}\left(1-q\right)\alpha\Pi - c\left(p_{d}\right)$$

which simplifies to

$$p_{d}\left(1-\delta q\right)\alpha\Pi - c\left(p_{d}\right),$$

The best deviation p_{d} solves

$$\max_{p} p\left(1-\delta q\right)\alpha\Pi - c\left(p\right).$$

The first order condition reads as

$$\left(1-\delta q\right)\alpha\Pi = c'\left(p_{d}\right). \tag{3}$$

Thus the deviator's equilibrium payoff is given by

$$p_d c'(p_d) - c(p_d). \tag{4}$$

Convexity of $c(p)$ has two important implications. First, the expression $pc'(p) - c(p)$ in (2) and (4) is strictly increasing in p everywhere. Since (2) and (4) give the payoffs from collusion and deviation, we only need to compare p_d to p^* to evaluate whether or not the deviation is profitable. Second, whether p_d is larger or smaller than p^* depends on whether the left hand side of (3) is larger or smaller than that of (1). As a result, we can conclude that $p_d > p^*$ if and only if $\delta < \frac{1}{2}$, i.e., deviation is not profitable if $\delta \geq \frac{1}{2}$. As known, $\delta \geq \frac{1}{2}$ is also the condition that determines whether it is possible to sustain collusion in the standard Bertrand duopoly.

To summarize, we have

Proposition 1 *With no patents and no multimarket contact the firms can sustain tacit collusion if and only if $\delta \geq \frac{1}{2}$. This condition does not depend on market size π, nor the spillover parameter α. Furthermore, this condition is exactly the same condition that determines whether it is possible to sustain collusion in the standard Bertrand duopoly without investments and intellectual property rights.*

4 Collusion with patents: Irrelevance of cross-licensing

Let us now introduce the patent system in the economy. In principle, a patent provides an innovator an option to try to exclude rivals from using the innovation. Hence, following Lemley and Shapiro (2005), it is realistic to think that patents provide probabilistic property rights over an innovation. Since our main objective here is to evaluate whether cross-licensing of patents can be used to facilitate collusive behavior, we simply reinterpret α of being the strength of patent protection.[4] With probability α the patent cannot be infringed and with probability $1-\alpha$ the patent is found invalid or it can be infringed by the rival, driving the profits from the innovation to zero. More relevant to our article is that the option of trying to exclude rivals provided by the patent system is a tradeable commodity. In our model as well as in practice this feature gives firms a possibility to establish multimarket contact via cross-licensing of patents.

We focus on the question of whether cross-licensing makes the sustainability of collusion more or less difficult. For the moment, we do not allow the firms to collude in the R&D stage. In case both firms are successful in R&D, it is important to distinguish various actual patent regimes that obtain across the world. First, we may allow the firms to make a joint patent application. The firms thus commit ex ante to share the patent in case they both are successful but not if only one of them succeeds. Such patent sharing agreements are close to cross-licensing, and do exist in practice. But they can be difficult to enforce since both successful innovators clearly have an incentive to apply for a patent alone. Second, we can think that joint patent applications are infeasible, but that the patent system is based on the first-to-file principle augmented with prior-user-rights as in Europe, or that the patent system is based on the first-to-invent principle as in the US. Assuming that both independent inventors can be interpreted to be first-inventors or prior users, the first-to-invent is equivalent to first-to-file with prior user rights in our model. The third possibility is pure first-to-file without joint patent applications. In such a case the patent system increases the incentive to break collusion as the deviator can apply to a patent alone and

[4] In our complementary paper, Kultti, Toikka and Takalo (2004), we analyse how patent strenght can be used to control the firms' ability to sustain tacit collusion.

be protected from punishment as long as the patent remains in force. Since this is a property of the patent system independent of cross-licensing and since we have analyzed this case extensively in our complementary paper (Kultti, Takalo, Toikka, 2004; cf. footnote 2), we here concentrate on the first two regimes. In our model they are equivalent: In the absence of the joint application, the firms have an equal chance of getting the patent, which results in the same expected profits as the joint application.

We first consider the case in which the firms posses symmetric patent portfolios by assuming that, before cross-licensing occurs, $l_p = l_q = \frac{k}{2} > 0$. The firms give each others access to all of their patents so that after cross-licensing the firms are in a duopoly situation in k markets. Now tacit collusion means that the firms not only share profits on the new innovation if they both are successful, but also in the k duopoly markets. As before, the optimal punishment is to revert to the stage game Nash equilibrium in all markets in case of deviation.

At the R&D stage our firm solves

$$\max_{p} p\left(1-\frac{q}{2}\right)\alpha\Pi - c\left(p\right) + k\frac{\Pi}{2}. \tag{5}$$

Since profit in the k other markets is independent of p, the solution to (5) is the same as to (1).

When contemplating deviation, our firm needs to decide on how many markets to cheat the collusion partner. Because the punishment is independent from the number of the markets where deviation occurs, the best deviation is to cheat in every market. The optimal deviation then yields

$$p_d\left(1-\delta q\right)\alpha\Pi - c\left(p_d\right) + k\pi, \tag{6}$$

where the deviator's success probability p_d is as in (3). Thus, it suffices to compare the constant terms $k\Pi/2$ and $k\pi$ in (5) and (6). As a result, collusion in all markets can be sustained, if and only if

$$k\frac{\Pi}{2} \geq k\pi,$$

which, after recalling that $\Pi \equiv \pi/(1-\delta)$, simplifies to

$$\delta \geq \frac{1}{2}.$$

In other words, collusion can be sustained with k markets if and only if it is possible to sustain collusion in each market separately. Since we have exactly the same cut-off without patents (Proposition 1), we have shown that if the firms have symmetric patent portfolios, cross-licensing is irrelevant for the firms' ability to sustain tacit collusion. But the argument accommodates asymmetric portfolios. To see this, assume that $l_p > l_q$. If our firm exchanges with its rival $l_q + x$ patents where $x \in [0, l_p - l_q]$ against the rival's l_q patents, we should substitute $l_q + x$ for k and add term $(l_p - x)\Pi$ in both (5) and (6). Since these terms are independent of p and cancel out in comparison, the incentive to deviate from collusion does not change. The argument is analogous if $l_p < l_q$.

The above analysis is summarized in the following proposition.

Proposition 2 *Cross-licensing is irrelevant for the firms' ability to sustain tacit collusion.*

Clearly the irrelevance result comes close to the one in Bernheim and Whinston (1990). From their work we can infer the conditions under which the irrelevance may or may not fail. The main assumptions underlying the irrelevance result are identical firms and markets. Multimarket contact can facilitate collusion if the firms can soften asymmetries between them or between markets. But similar firms and markets are hall-marks of the cross-licensing activity. Moreover, our argument tolerates some asymmetry since the markets and the patent portfolios need not be of equal size or economic importance, and cross-licensing agreements can involve side-payments that reflect the strength of each party's patent portfolio. In the next section we show that Proposition 2 does not change even if the introduction of patents and cross-licensing changes the incentive to innovate. This suggests that as a first approximation, cross-licensing agreements should not cause antitrust problems in so far as tacit collusion is concerned.

In assessing the reliability of the observations here, a caveat should be borne in mind. Our conclusion runs against the general view according to which multimarket contact facilitates collusion (see Ivaldi et al. (2003)). In particular, Eswaran (1994) argues that the view applies to cross-licensing. This argument is based on two observations. First, by establishing multimarket contact the firms may be able to expand the scope for punishment, for example, by transferring slack in the sustainability of collusion from one market to facilitate collusion in another market. In our model the threshold that determines the sustainability of collusion is the same in all markets so that there is no slack to be transferred. We do not claim that such transfers are impossible but just that they require a more complicated environment than we have outlined. Ultimately the question is whether one should interpret the main result in Bernheim and Whinston (1990) to be the irrelevance or the possibility that in some circumstances multimarket contact may facilitate collusion. Our reading is more in line with the former interpretation. Moreover, in contrast to Eswaran (1994) we allow the firms to use the optimal punishment strategies, which decreases the impact of cross-licensing agreements in facilitating collusion.

Second, it is thought that multimarket contact accelerates the frequency of interactions between firms which raises the possibilities to sustain collusion. But especially in the case of cross-licensing agreements this need not hold. Indeed, a rationale for cross-licensing agreements is to ensure that firms can continue to use their own technologies, not that they could begin using rivals' technologies. This view is supported by Eswaran (1994) who shows that cross-licensing allows specialization in distinct products.[5]

5 Ex-ante cross-licensing, collusion and the incentive to innovate

So far we have taken the viewpoint of antitrust authorities and focused on the tension between competition and patent laws that prevails in the market after the innovation is made. The viewpoint abstracts from the effects of cross-licensing and collusion on the incentive to innovate, which is a fundamental question in the literature on the patent policy. We now look at this issue in more detail.

First, recall that as a function of p the expression $pc'(p) - c(p)$ in (2) and (4) is strictly increasing. This implies that the deviation is unprofitable iff $p_d < p^*$. This makes sense: the higher the payoff, the higher the investment. The observation suggests that collusion can be welfare-enhancing, since it

[5]Here the competitive effects of the recent EU technology transfer block exemption (Regulation (EC) 772/2004) are ambiguous. On the one hand clauses that limit licensee's ability to use own technology or engage in R&D are prohibited, which should facilitate specialization. On the other hand, specialization in itself can be illegal if it leads to the division of markets or customers. That is, the EU regulation can force cross-licensing partners to multimarket contact and thereby to increase their interaction frequency.

fosters innovation.[6] Thus, even if cross-licensing increased the scope for tacit collusion, it should enhance the incentive to innovate and thereby social welfare. However, proper welfare comparison of collusive and non-collusive regimes requires careful consideration of the harmful effects of higher prices and is left for further research.

Second, we can think that the patent system makes collusive firms able to make ex-ante licensing deals over undeveloped inventions. This is realistic especially if we stick to the assumption that the firms can commit to joint patent applications in case they both succeed. In other words, let us assume that firms share the profits from new innovation even if only one of them is successful. Under such an assumption, (5) should be rewritten as

$$\max_p \left[pq + p(1-q) + q(1-p)\right]\frac{\alpha\Pi}{2} - c(p) + k\frac{\Pi}{2},$$

which simplifies to

$$\max_p \left[p(1-q) + q\right]\frac{\alpha\Pi}{2} - c(p) + k\frac{\Pi}{2}.$$

The solution is given by

$$\frac{(1-q)\,\alpha\Pi}{2} = c'(p^*), \qquad (7)$$

and the equilibrium payoff can be written as

$$p^* c'(p^*) - c(p^*) + (k + q\alpha)\frac{\Pi}{2}. \qquad (8)$$

[6] A related result is obtained by Fershtman and Pakes (2000) who show that firms in a collusion offer larger product variety and better product qualities to consumers than competitive firms. Similarly, Green and Scotchmer (1995) and Denicolò (2002) argue that collusion among successive patentees is often socially beneficial as it boosts incentives to innovate

The best deviation yields

$$[p_d (1-q) + q]\, \alpha\pi - c(p_d) + k\pi$$

where p_d solves

$$(1-q)\, \alpha\pi = c'(p_d)\,. \tag{9}$$

The deviator's equilibrium payoff is

$$p_d c'(p_d) - c(p_d) + (k + q\alpha)\, \pi. \tag{10}$$

From (7), (8), (9), and (10), it is evident that we only need to compare terms $\Pi/2$ and π to see whether it is profitable to deviate or not. Since the comparison yields the very same condition $\delta \geq \frac{1}{2}$ as before, allowing for ex-ante licensing is irrelevant for the firms' ability to sustain tacit collusion. However, comparing (1) and (7) shows that permitting ex-ante licensing agreements reduces the incentive to innovate due to well-known free-riding possibility. But we should not make long reaching conclusions from this observation since it is equally well-known that ex-ante agreements can be beneficial in the sense that they facilitate follow-up innovations (see Green and Scotchmer, 1995). If nothing else, this shows that our conclusion about the irrelevance of cross-licensing for the sustainability of collusion is robust to the changes in the incentives to innovate caused by licensing opportunities.

6 Conclusion

Modern view considers intellectual property and antitrust laws different means promoting the same goal, consumer welfare (see, e.g., The U.S. Department of Justice and the Federal Trade Commission, 1995, the Federal

Trade Commission, 2003, and European Commission, 2004b). In this paper we provide some analytic foundations for this view: we argue that cross-licensing is a mechanism to establish multimarket contact and it can facilitate collusion only in so far as multimarket contact does. We show that adding intellectual property rights and incentive to innovate does not change the basic message arising form Bernheim and Whinston (1990). In particular, since cross-licensing typically occurs between similar firms which operate in similar markets, we think that as a first approximation the irrelevance result of multimarket contact established by Bernheim and Whinston (1990) applies to cross-licensing. Moreover, our argument accommodates unequal market sizes or patent portfolios, and even cross-licensing agreements with side-payments need not cause antitrust problems. Our conclusion runs against much of the prior literature and has thus some usual caveats. For example, multimarket contact can increase the frequency of the interaction between the firms, and so cross-licensing may nonetheless facilitate collusion. But even if this were the case, it could stimulate the incentive to innovate. Antitrust authorities are therefore likely to spend their resources more efficiently in suspecting other corporate dealings than cross-licensing.

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