Patent licensing by means of an auction: internal vs. external patentee. *

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Abstract

An independent research laboratory owns a patented process innovation that can be licensed by means of an auction to two Cournot duopolists producing differentiated goods. For large innovations and close enough substitute goods the patentee auctions off only one license, preventing the full diffusion of the innovation. For this range of parameters, however, if the laboratory merged with one of the firms in the industry, full technology diffusion would be implemented as the merged entity would always license the innovation to the rival firm. This explains that, in this context, a vertical merger is both profitable and welfare improving.

Keywords: Patent licensing, two-part tariff contracts, vertical mergers.

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1 Introduction

The patent licensing literature has focused on the analysis of optimal

licensing contracts with the laboratory being either an externa l or an internal patentee.[1] However, it seems interesting to endogenize market structure by analyzing whether the laboratory prefers to license the innovation as an external patentee or to merge with one of the firms in the industry, licensing the innovation as an internal patentee. Sandonís and Faulí-Oller (2005) deals with this issue in a setting with differentiated goods and two Cournot duopolists. They consider two-part tariff licensing contracts (a flat upfront fee plus a linear royalty) and get the strong result that all profitable vertical mergers reduce welfare. Thus, in that context, no vertical merger will occur in equilibrium if it has to be approved by a welfare maximizing antitrust authority.

It is well-known in the literature, however, that the patentee can extract more surplus when the upfront fee is not directly chosen by the patentee itself but it is determined through an auction (see Katz and Shapiro, 1985 and Sen and Tauman, 2005). An auction generates more competition for the license, increasing the firms' willingness to pay for it. Then, if an auction is feasible, the patentee would rather use an auction (plus royalty) policy instead of a two-part tariff contract. The main purpose of this paper is to check the robustness of the results in Sandonís and Faulí-Oller (2005) when we allow for the possibility of licensing by means of an auction.

Interestingly, things do change in a non-trivial way. We know that under a vertical merger the technology is always transferred to the rival firm. On the contrary, we show that for large innovations and close enough substitute goods an external patentee prefers to auction off only one license, precluding the full diffusion of the innovation. As a result,

[1] See Kamien and Tauman (1984, 1986, 2002), Katz and Shapiro (1986), Kamien et al. (1992), Kamien (1992), Saracho (2002), Wang (1998), Wang and Yang (1999).

in this case, a merger becomes profitable and increases welfare. In other words, in that case, we prescribe a lenient merger policy in order to promote technology diffusion.

In the next section we describe the model and obtain the results. We conclude in Section 3.

2 Model

We consider two firms, denoted by $i = 1, 2$, each producing a differentiated good (goods 1 and 2 respectively). They face inverse demand functions given by:

$$p_i = 1 - x_i - \gamma x_j, i, j = 1, 2, \; i \neq j \tag{1}$$

where $\gamma \in [0, 1]$ represents the degree of product differentiation. These demands are derived from the maximization problem of a representative consumer (see Singh and Vives (1984)), endowed with a utility function separable in money (denoted by m) given by:

$$u(x_1, x_2, m) = x_1 + x_2 - \frac{x_1^2}{2} - \frac{x_2^2}{2} - \gamma x_1 x_2 + m \tag{2}$$

The two firms have constant unit production costs of c. There exists an independent laboratory that have a patented process innovation that allows the production of the two goods at a lower marginal cost, that we assume, for simplicity, to be zero. Thus, c can also be interpreted as the size of the innovation.

Let us define the social welfare function as:

$$W(x_1, x_2) = u(x_1, x_2) - c_1 x_1 - c_2 x_2, \tag{3}$$

where $c_i = 0$, $i = 1, 2$, if the technology is licensed to firm i and $c_i = c$ otherwise.

We distinguish the case where the laboratory is an external patentee and where it merges with one of the firms in the industry, becoming an internal patentee. In the case of an external patentee the timing of the game is as follows. In the first stage, the laboratory announces its licensing policy. In the second stage, firms simultaneously set their bids. Finally, both firms compete in quantities.

When the laboratory auctions off one license, the patentee first announces non-negative royalties r_i, $i = 1, 2$, that will be paid by the winner of the auction, namely, the firm with the highest bid[2]. When the patentee auctions off two licenses, the patentee first announces royalties r_i, $i = 1, 2$ and minimum bids b_i, $i = 1, 2$. The auction has to include minimum bids as, otherwise, firms would get the technology for free. The technology is awarded to firm i whenever its bid is not lower than b_i.

In the case of an internal patentee, things are much simpler, because its only choice is whether or not to license the innovation to the rival firm. Observe that, in this case, the auction must again include a minimum bid.

In Sandonís and Faulí-Oller (2005), the same game is analyzed for the case of two-part tariff contracts (a flat fee plus a linear royalty contract). It is intuitive that, whenever there is competition for the license, an auction plus royalty policy is superior for the patentee to a two part tariff contract: an auction generates more competition that increases firms' willingness to pay for the license. When the patentee auctions off licenses to all firms, however, there is no competition for the license and the choice of minimum bids and royalties in the auction policy is equivalent to the choice of flat-fees and royalties in the two-part tariff policy. Therefore, the optimal auction plus royalty policy for the case of an internal patentee and for the case of an external patentee licensing to all firms is already analyzed in Sandonís and Faulí-Oller (2005). Thus, we

[2]We assume that, in case of equal bids, the technology is awarded to the firm with the lowest royalty. If both firms have the same royalty the technology is awarded randomly.

have to formally analyze only the case of an external patentee auctioning off one license.

First of all, let us specify the third stage equilibrium outputs and profits. If both firms have a license, they are given by:

$$\begin{aligned} X_i(r_i, r_j) &= \max\{\min\{\frac{1-r_i}{2}, \frac{(2-\gamma)-2r_i+\gamma r_j}{4-\gamma^2}\}, 0\}, \\ \pi_i(r_i, r_j) &= X_i^2, i, j = 1, 2, i \neq j, \end{aligned} \tag{4}$$

where $\frac{1-r_i}{2}$ represents the monopoly output of firm i and the second term represents the duopoly output. When any firm i has no license, we have to replace r_i by c in the above expression.

The willingness to pay for the patent by a firm is the difference between its profits when it gets the technology and its profits when the rival gets the technology. Assume that $r_i \geq r_j$. In this case, the willingness to pay is higher for firm j, because $\pi_j(r_j, c) - \pi_j(c, r_i) \geq \pi_i(r_i, c) - \pi_i(c, r_j)$.[3] Then, the equilibrium bids are equal to firm i's willingness to pay $\pi_i(r_i, c) - \pi_i(c, r_j)$. Given the tie-breaking rule, the patent is awarded to firm j. Thus, the problem for the patentee is given by:

$$\begin{aligned} &\underset{r_i, r_j}{Max}\, \pi_i(r_i, c) - \pi_i(c, r_j) + r_j X_j(r_j, c) \\ &s.t\ c \geq r_i \geq r_j \geq 0 \end{aligned}$$

Observe that that the objective function is decreasing in r_i. Therefore, the patentee will set $r_i = r_j = r$. Then, the problem can be rewritten as a function of r and it is direct to see that its optimal value is $r^* = 0$.

In order to choose the optimal auction plus royalty policy, the external patentee has to compare the profits of licensing to one or two firms.

[3] Observe that this can be written as: $\pi_i(c, r_j) + \pi_j(r_j, c) \geq \pi_i(r_i, c) + \pi_j(c, r_i)$. This inequality holds, because $\frac{\partial(\pi_i(c, r) + \pi_j(r, c))}{\partial r} < 0$ for $r \leq c$.

This comparison leads to the following result, which is proved in the Appendix.

Proposition 1 *Whenever* $\gamma > 0.94$ *and* $c \in (\underline{c}, \overline{c})$ *the patentee optimally auctions off one license.*

The intuition behind the result is as follows: on the one hand, auctioning off only one license has the advantage of generating competition for the patent, increasing the willingness to pay for it. On the other hand, the patentee loses the potential revenues from selling one additional license. However, for large innovations and close substitute goods, the output of the non-licensee is small and, therefore, the lost revenues from not licensing are also small. In this case, the first effect dominates, which explains the result. Observe that this dominance is very clear precisely in the case where the non-licensee does not produce. Consider the extreme case of homogeneous goods and a drastic innovation ($\gamma = 1$, $c = \frac{2-\gamma}{2}$). In this case, the most any firm is willing to bid in the auction is the monopoly profits, given that the loser firm will be driven out of the market. Thus, an auction allows the patentee to get the whole monopoly profits, whereas under two-part tariff contracts, the external patentee is not able to monopolize the market (it can do it only for greater values of c, in particular, for $c \geq \frac{4+2\gamma-\gamma^2}{4(1+\gamma)}$, where $\frac{4+2\gamma-\gamma^2}{4(1+\gamma)} > \frac{2-\gamma}{2}$). As a result, an auction must be superior. The result also holds for values of γ slightly below 1 and for values of c around $\frac{2-\gamma}{2}$. Observe that $\underline{c} < \frac{2-\gamma}{2} < \overline{c}$. For $c > \overline{c}$, the external patentee would prefer to license to both firms. The intuition is clear for values of $c \geq \frac{4+2\gamma-\gamma^2}{4(1+\gamma)} \geq \overline{c}$. In this case, the external patentee would get the full monopoly profits when licensing to both firms and the monopoly profits in one market when auctioning off only one license. The result also holds for values of c in the interval $(\overline{c}, \frac{4+2\gamma-\gamma^2}{4(1+\gamma)})$.

Recall that the case where licensing to both firms is optimal is already analyzed in Sandonís and Faulí-Oller (2006), because auctioning off two licenses is equivalent to a two-part tariff licensing policy. In this case, we know that all profitable vertical mergers are welfare-reducing. Thus, the antitrust authority should forbid them.

When auctioning off one license is optimal, we have to derive the results on profitability and welfare.

As far as welfare is concerned, the result is straightforward: a vertical merger increases welfare, because it favors technology diffusion. On the one hand, whereas under a vertical merger, both firms end up producing with the new technology (see Sandonís and Faulí-Oller, 2005), the external patentee only auctions off one license, and thus one firm produces inefficiently (at cost c). On the other hand, the vertical merger stimulates competition, because the royalty imposed by the merged entity to the rival firm is lower (or equal) than c.

Regarding profitability, we also have a clear-cut result, namely, that the vertical merger is always profitable (the joint profits of the external laboratory and one of the firms are lower than the profits of the merged entity). For the case of a drastic innovation, the result is straightforward. In the case of an external patentee, the patentee gets the monopoly profits in one market ($\frac{1}{4}$) and the firms get zero profits. An internal patentee can guarantee itself at least the same level of profits ($\frac{1}{4}$) by setting $r = c$. However, as it is shown in Sandonís and Faulí-Oller (2005), for $\gamma < 1$, the merged firm can improve by setting a lower royalty that allows the rival firm to produce. For the case of a non-drastic innovation, the joint profits of the external patentee and one of the firms is $\pi_i(0, c)$. The merged firm could achieve a higher level of profits by simply setting $r = 0$: $\pi_i(0, c) + cX_i(0, c)$. Observe that $X_i(0, c) > 0$, because we are dealing with the case of a non-drastic innovation.

The next proposition summarizes the above results:

Proposition 2 *Whenever $\gamma > 0.94$ and $c \in (\underline{c}, \overline{c})$ a vertical merger is profitable and increases welfare.*

Observe that the result in the proposition is strict, except when the good is homogenous and the innovation is drastic. In this case, both the internal and the external patentee lead to the same market outcome, namely, monopolization of the market.

From the point of view of competition policy we can prescribe, in our context, to allow for vertical mergers only when the goods are not very differentiated and the innovation is large enough. It is interesting to note that vertical mergers should be allowed when the market is more competitive (when γ is high), which is counterintuitive. The reason is that it is precisely in this case when the external patentee finds it profitable to auction off only one license, which precludes full technology diffusion, compared with the internal patentee which always licenses the technology to the rival firm. In other words, in our context, a vertical merger can be seen as an instrument to favor technology diffusion.

3 Conclusion

Vertical mergers are very controversial regarding their effects on social welfare. The antitrust trade-off consists on comparing their effects on competition with their efficiency gains. In this paper, we identify a new efficiency effect of vertical mergers taken place in intensive technological sectors. In this context, we have shown that vertical mergers can be seen as an instrument for technology diffusion. When competition is high and we consider an auction plus royalty policy, an independent laboratory prefers to restrict the number of licenses to generate competition among the potential licensees. In this particular case, a vertical merger between the laboratory and one of the firms in the industry is shown to be both profitable and welfare improving because it achieves full diffusion of the innovation.

This result should be compared with the results in Sandonís and Faulí-Oller (2005). They consider two-part tariff licensing contracts (a flat upfront fee plus a linear royalty) and get the strong result that all profitable vertical mergers reduce welfare. This highlights the fact that the optimal merger policy is very sensitive to the type of licensing contracts used in reality by firms. Although existing empirical papers point out that most of the contracts include an upfront fee and a royalty (see, for example, Macho-Stadler et al., 1996, Rostocker, 1984, and Taylor and Silberston, 1973), they do not specify if the upfront fee is determined through an auction or fixed by the patentee. A direct implication of our results is that this information would be very relevant for antitrust purposes.

4 Appendix

Proof of Proposition 1:

We have to distinguish four different regions:

i) if $c \in (0, \dfrac{\gamma(2-\gamma)}{4}]$, the optimal royalty when licensing to both firms is equal to 0. In this case, we have to sign $2(\pi_i(0,0) - \pi_i(c,0)) - (\pi_i(0,c) - \pi_i(c,0))$. It can be checked that this difference is positive.

ii) if $c \in (\dfrac{\gamma(2-\gamma)}{4}, \dfrac{2-\gamma}{2})$, the optimal royalty when licensing to both firms is $r^* = \dfrac{\gamma(4c+\gamma(-2+\gamma))}{2(4-2\gamma^2+\gamma^3)}$ and the innovation is still non-drastic. In this case we have to sign $2(\pi_i(r^*, r^*) - \pi_i(c, r^*)) - (\pi_i(0,c) - \pi_i(c,0))$. It is direct to check that if $\gamma \leq 0.940834$ this difference is positive. If $\gamma > 0.940834$, it is negative when $c > \underline{c}$ and positive otherwise, where $\underline{c} = \frac{16-2\gamma(4+\gamma(4+\gamma(-2+\gamma)))+\sqrt{2}\sqrt{(2+\gamma)(4+\gamma^2(-2+\gamma))(16+\gamma(-24+8\gamma+\gamma^4))}}{2(8-\gamma(-4+4\gamma+\gamma^3))}$.

iii) if $c \in [\dfrac{2-\gamma}{2}, \dfrac{4+2\gamma-\gamma^2}{4(1+\gamma)})$, the optimal royalty when licensing to both firms is $r^* = \dfrac{\gamma(4c+\gamma(-2+\gamma))}{2(4-2\gamma^2+\gamma^3)}$ and the innovation is drastic.This means that when licensing to one firm, the patentee gets the monopoly profits in one market ($\frac{1}{4}$). In this case, we have to sign $2(\pi_i(r^*, r^*) - \pi_i(c, r^*)) - \frac{1}{4}$. It is direct to check that if $\gamma \leq 0.940834$ this difference is positive. If $\gamma > 0.940834$, it is negative when $c > \overline{c}$ and positive otherwise, where $\overline{c} = \frac{8+2\gamma(2-\gamma)-\sqrt{2}\sqrt{(1-\gamma)(2+\gamma)^2(4+\gamma^2(-2+\gamma))}}{8(1+\gamma)}$.

iv) if $c \geq \dfrac{4+2\gamma-\gamma^2}{4(1+\gamma)}$, the optimal royalty when licensing to both firms is $r^{**} = \dfrac{\gamma}{2(1+\gamma)}$. With this royalty, the patentee gets the monopoly profits in both markets. This is higher than $\frac{1}{4}$, the profits obtained when licensing to only one firm, except when $\gamma = 1$, that they are equal.

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