Patent Protection with Licensing

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Abstract

This note gives a short proof that both fixed-fee and royalty licensing under patent protection can always create higher R&D investment.

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Keywords: R&D investment; Patent protection; Licensing

In Mukherjee (2006) (Henceforth MU), royalty licensing is introduced as a regime under patent protection to always increase R&D investment irrespective of the tournament effect, which is considered in Chowdhury (2005). Then we have the following result for both fixed-fee and royalty licensing schemes

Proposition 1. Both fixed-fee and royalty licensing under patent protection can always create higher R&D investment.

Proof. According to Wang (1998), fixed-fee licensing for the patent-holding firm is inferior to royalty licensing when the cost-reducing innovation is non-drastic. This result is implicitly implied in Rockett (1990), which considers both fixed-fee
and royalty licensing and concludes that in equilibrium, fixed-fee is zero and only output royalty is positive. MU already proves that royalty licensing under patent protection may always induce higher R&D investment. Now, we need to show that fixed-fee licensing also has this effect.

Fixed-fee licensing has a net profit transferred from the licenee (firm 2) to the licensor (firm 1). The optimal level of fixed-fee charged by firm 1 should be the amount that makes firm 2 indifferent between licensing and no licensing, which is

$$G(c', c) = \pi_2(c', c') - \pi_2(c', c) = \pi_1(c', c') - \pi_1(c, c').$$

As a result, the net profit transfer from the licenee to the licensor when license is sold, yields the following payoff of firm 1 as

$$\frac{1}{2} \left[ (p(c', c') - c')q_1(c', c') + G(c', c) \right] + \frac{1}{2} \left[ (p(c', c') - c')q_1(c', c') - G(c', c) \right] - F = \frac{1}{2} \pi_1(c', c') + \frac{1}{2} \pi_1(c', c') - F = \pi_1(c', c') - F. \quad (2)$$

The fixed-fee $G(c', \tilde{c})$ under no patent protection with licensing is calculated using the same logic as Eq.(1), implying $G(c', \tilde{c}) = \pi_2(c', c') - \pi_2(c, \tilde{c}) = \pi_1(c', \tilde{c}) - \pi_1(c', c')$. Consequently, the game matrices can be written as

Table 3.1 payoffs under no patent protection

<table>
<thead>
<tr>
<th>R&amp;D</th>
<th>No R&amp;D</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D</td>
<td>$\pi_1(c', c') - F, \pi_2(c', c') - F$</td>
</tr>
<tr>
<td>No R&amp;D</td>
<td>$\pi_1(c', c') - G(c, c'), \pi_2(c', c') + G(c, c') - F$</td>
</tr>
</tbody>
</table>

Table 4.1 payoffs under patent protection

<table>
<thead>
<tr>
<th>R&amp;D</th>
<th>No R&amp;D</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D</td>
<td>$\pi_1(c', c') - F, \pi_2(c', c') - F$</td>
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<tr>
<td>No R&amp;D</td>
<td>$\pi_1(c', c') - G(c, c'), \pi_2(c', c') + G(c, c') - F$</td>
</tr>
</tbody>
</table>

where in both tables, the strategies of firm 1 and firm 2 are labeled vertically and horizontally. For every payoff vector, the first and second expressions represent the net equilibrium payoff of firm 1 and firm 2, respectively.

Thus, from Table 3.1, we know that the non-strategic and strategic incentives for R&D under no patent protection with licensing for each firm are $N(NP) = \pi(c', c') - \pi(c, c) + G(c', \tilde{c}) - F$ and $S(NP) = \pi(c', c') - \pi(c, c') - F$. Meanwhile,
Table 4.1 yields the non-strategic and strategic incentives for R&D under patent protection with licensing for each firm as

\[ N(L) = \pi(c', c'') - \pi(c, c) + G(c', c) - F \]

and \( S(L) = G(c', c) - F \). A direct comparison between \( S(L) \) and \( S(NP) \), and the optimal licensing fixed-fee give:

\[ S(L) - S(NP) = \pi_1(\tilde{c}, c') - \pi_1(c, c') > 0 \]  \hspace{1cm} (3)

Similarly, the comparison between \( N(L) \) and \( N(NP) \) gives:

\[ N(L) - N(NP) = G(c', c) - G(c', \tilde{c}) = \pi_1(c', \tilde{c}) - \pi_1(c, c') > 0 \]  \hspace{1cm} (4)

This result implies that fixed-fee licensing also generates higher R&D investment, and it then completes the proof with the effect of royalty licensing in MU.

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**References**


