Patent Protection with Licensing

Che, Xiaogang and Yang, Yibai
Faculty of Business and Economics, The University of Sydney

19. December 2009

Patent Protection with Licensing

Xiaogang Che Yibai Yang*

Faculty of Business and Economics
The University of Sydney

December 2009

Abstract

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

JEL classification: O32, O34, O38
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

*Corresponding author: Discipline of Economics, Faculty of Economics and Business, The University of Sydney, NSW, Australia, 2006. Tel: +61-2-9351 5625. Fax: +61-2-9351 4341. *E-mail addresses:* x.che@econ.usyd.edu.au (X.Che), yyan7045@mail.usyd.edu.au (Y.Yang).

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 licensee (firm 2) to the licenser (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

$$G(c', c) = \pi_2(c', c') - \pi_2(c', c) = \pi_1(c', c') - \pi_1(c, c'). \tag{1}$$

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

$$\begin{aligned} &\frac{1}{2}\left[(p_{(c',c')} - c')q_1(c', c') + G(c', c)\right] + \frac{1}{2}\left[(p_{(c',c')} - c')q_1(c', c') - G(c', c)\right] - F \\ &\qquad = \frac{1}{2}\pi_1(c', c') + \frac{1}{2}\pi_1(c', c') - F = \pi_1(c', c') - F. \end{aligned} \tag{2}$$

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

	R&D	No R&D
R&D	$\pi_1(c', c') - F$, $\pi_2(c', c') - F$	$\pi_1(c', c') + G(c', \tilde{c}) - F$, $\pi_2(c', \tilde{c})$
No R&D	$\pi_1(\tilde{c}, c')$, $\pi_2(c', c') + G(\tilde{c}, c') - F$	$\pi(c, c)$, $\pi(c, c)$

Table 4.1 payoffs under patent protection

	R&D	No R&D
R&D	$\pi_1(c', c') - F$, $\pi_2(c', c') - F$	$\pi_1(c', c') + G(c', c) - F$, $\pi_2(c', c') - G(c', c)$
No R&D	$\pi_1(c', c') - G(c, c')$, $\pi_2(c', c') + G(c, c') - F$	$\pi(c, c)$, $\pi(c, c)$

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 $S(NP) = \pi(c', c') - \pi(\tilde{c}, c') - F$. 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:

$$S(L) - S(NP) = \pi_1(\tilde{c}, c') - \pi_1(c, c') > 0. \tag{3}$$

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

$$N(L) - N(NP) = G(c', c) - G(c', \tilde{c}) = \pi_1(c', \tilde{c}) - \pi_1(c, c') > 0 \tag{4}$$

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. □

Acknowledgment

We are grateful to Arijit Mukherjee for the helpful comments and suggestions.

References

Chowdhury, P. R. (2005): "Patents and R&D: The Tournament Effect," *Economics Letters*, 89(1), 120–126.

Mukherjee, A. (2006): "Patents and R&D With Imitation and Licensing," *Economics Letters*, 93(2), 196–201.

Rockett, K. (1990): "The Quality of Licensed Technology," *International Journal of Industrial Organization*, 8(4), 559–574.

Wang, X. H. (1998): "Fee versus Royalty Licensing in a Cournot Duopoly Model," *Economics Letters*, 60(1), 55–62.