Are Partial Ownership Arrangements Advantageous?

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Abstract
Using a two-stage differentiated-production Cournot duopoly model with technological spillovers, this paper investigates the effect partial ownership arrangements (POAs) among rivals has on the market outcome when firms also compete in a non-production activity, R&D. When products are differentiated, POAs do not affect the market outcome. As goods become more homogenous, the effect POAs has is dependent on the size of technological spillovers. When they are not large, POAs increase firms' R&D effort and output; when they are large, POAs decrease output. POAs are also found to decrease firms' profit levels.

Keywords: partial ownership arrangements, R&D, technological spillovers, production differentiation, Cournot competition.

JEL classification numbers: D43, L13, L15.
1. Introduction

Firms may acquire a proportion of their rivals' stock for a variety of reasons and this is becoming increasingly common in a number of industries. Given that the purchase of a rival's stock is not subject to the antitrust scrutiny that horizontal mergers are, the effect cross-shareholding among rivals has on the market outcome needs examination.

For many firms, partial ownership arrangements (POAs) allow them to gain many of the benefits of a merger while still retaining their autonomy. They facilitate the transfer of technology and managerial skills between firms while allowing firms the opportunity to capture some of the profits yielded by the transfer. When technological spillovers occur, firms also have an incentive to enter into a POA to capture some of its rivals' profits yielded by its own R&D activities. Accordingly, POAs may not only facilitate the transfer of technology, but the existence of technological spillovers may also encourage them. Firms also have an incentive to enter into a POA to reduce the amount of competition in the market to increase profits. As the more homogenous the market, the more competitive the market is likely to be; we would expect POAs are more likely to be formed to reduce market competition and in more homogenous markets.

Given that firms compete not only in the product markets, but also in other non-production activities such as research and development (R&D); inter-firm relationships that influence firms' behavior in the product markets, is also likely to affect non-production activities. Thus it is necessary to investigate not only how POAs affect production behaviour, but also the effect it has on firms' non-production activities.

2. The basic model

We assume an industry that consists of two identical firms producing a differentiated product that engage in upstream R&D and downstream production activities. It is assumed each firm may also own a share of its rival. When it does, it is assumed to act as a silent (passive) partner. Each firm, however, also realizes that their output decisions affect their rival and take this into consideration when choosing their output level. Firm $i$'s output and R&D effort are denoted by $q_i$ and $x_i$ ($i = 1, 2$) respectively. For simplicity cross-shareholdings are assumed to be mutual and denoted by $s$; where $0 \leq s \leq 0.5$.

The representative consumer's utility function is assumed to be given by $U = u(q_1, q_2) + Z$ where $Z$ is a numeraire good. Assuming $u(q_1, q_2) = a(q_1 + q_2) - \frac{1}{2}b(q_1^2 + q_2^2 + 2\gamma q_1 q_2)$, for ($a, b > 0$) and the inverse of $\gamma \in [0,1)$ indicates the degree of product differentiation. When $\gamma = 1$, firms produce homogeneous products; when $\gamma = 0$ products are independent. It is straightforward to derive the inverse demand functions:
\[ p_i = a - b(q_i + \gamma q_j) \]  
(1)

for \( i, j = 1,2 \) and \( j \neq i \). Each Firm \( i \)'s production cost function is assumed to take the form

\[ (c - x_i + \beta x_j)q_i \]  
(2)

where \( c \) is a positive constant and the parameter \( \beta \in [0,1] \) measures the spillover effect. Accordingly, each firms R&D effort determines not only each firm's marginal cost, but also the marginal cost of its rivals. When \( \beta = 0 \), Firm \( i \)'s R&D affects only its own production cost and the greater its research efforts, the lower its costs. When \( \beta = 1 \), spillovers are perfect and accordingly, greater research efforts by Firm \( j \) lowers the costs of Firm \( i \). The cost of Firm \( i \)'s R&D is assumed to be \( \delta q_i^2 / 2 \), where \( \delta > 0 \) is a constant.

3. The two-stage game

As is standard, the model is solved backwards beginning from the second stage in which firms chose output. Assuming firms act in a Cournot fashion, then Firm \( i \)'s output level \( q_i \) to maximize profits \( (1-s)\pi_i + s\pi_i \). It is straightforward to show that Firm \( i \)'s output, as a function of R&D efforts, is given by

\[ q_i(x_i, x_j) = \frac{(1-s)(2(1-s) - \gamma)A + (2(1-s) - \beta \gamma x_i + (2(1-s) \beta - \gamma) x_j}{(2(1-s) - \gamma)(2(1-s) + \gamma)b} \]  
(3)

where \( A = a - c > 0 \).

Having derived the second-stage output as a function of R&D effort, we can now derive the subgame perfect equilibria level of R&D effort, output and profits. This allows us to drop the subscripts when denoting equilibrium values and assuming a symmetric equilibrium with regards to \( x \), (3) simplifies to

\[ q(x) = \frac{(1-s)[A + (1+\beta)x]}{(2(1-s) + \gamma)b} \]  
(4)

Using (3) we can now derive the subgame perfect equilibria values of per-firm R&D effort, output and profits. These are

\[ x = \frac{A}{\mu}(1-s)(2(1-s) - \gamma)(2(1-s)^2 (2 - \beta \gamma) + 2s(1-s) \gamma - s(1 + \beta) \gamma^2} \]  
(5)

\[ q = \frac{\delta A}{\mu}(1-s)(2(1-s) - \gamma)^2 (2(1-s) + \gamma) \]  
(6)
\[
\pi = \frac{\delta A^2 \phi}{\mu^3}
\]

where \(\mu = (2(1-s) - \gamma)^2 (2(1-s) + \gamma)^2 b \delta - (1-s)(1+\beta) \{4(2-(1+\beta)\gamma)(1-s)^3 - 2(1-s) (2s - (1-2s)\beta)\gamma^2 + s(1+\beta)\gamma^3\} \) and \(\phi = (2(1-s) - \gamma)^2 \{(2(1-s) - \gamma)^2 (2(1-s) + \gamma)^2 (1-s)b \delta - (1-s)^2(2(1-s)^2(2-\beta \gamma) + 2s(1-s)\gamma - s(1+\beta)\gamma^2)^2/2\} \).

How POAs, product differentiation and technological spillovers affect firms' R&D activities, output levels and profits is shown graphically in Figure 1.

4. Conclusion

It was found when firms also compete in non-production activities such as R&D, regardless of the level of POAs, when products are highly differentiated, larger technological spillovers result in higher R&D, output and profit levels. As products become more homogenous, the effect POAs have on R&D efforts and output is dependent on the size of technological spillovers. When they are not large, POAs have a positive effect; when they are large, POAs have a negative effect on output levels. As POAs do not appear to increase firms' profit levels, from an antitrust perspective, POAs are advantageous in industries where products are not highly differentiated and technological spillovers are not large as this results in greater R&D efforts and higher output levels.

Main References


Figure 1: Relative levels of R&D, Output and Profits