E C O N O M I C S B U L L E T I N

Cross-border merger and domestic welfare

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Abstract

We consider the welfare effect of cross-border merger in presence of international RDcompetition. Cross-border merger increases domestic welfare if the bargaining power of the foreign firm and the slope of the marginal cost of RDare sufficiently low. Otherwise, domestic welfare is lower under cross-border merger.

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1. Introduction

A dominant form of foreign direct investment (FDI) in the advanced country and specially, in the US and Europe is mergers and acquisitions (M&A). As documented in JETRO (1996) and UNCTAD (1996), more than half of the foreign investment takes the form of M&A. As mentioned in Horn and Persson (2001), in 1994, more than 90% of the inward FDI in the US was in the form of M&A and the average over the period 1989 – 94 was 80%. Further, cross-border M&A in Western industrialized countries involving majority holdings were evaluated at 60% of total FDI.

The dominant nature of cross-border M&A has attracted attention from the trade theorists (see, e.g., Barros and Cabral, 1994, Long and Vousden, 1995, Head and Ries, 1997, Roy et al., 1999, Das and Sengupta, 2001, Horn and Levinsohn, 2001, Horn and Persson, 2001 and Mattoo et al., 2004). Though the previous works have addressed several issues on cross-border mergers, one common feature of them, except Mattoo et al. (2004), is to ignore the effects of endogenous technology choice due to merger.

This paper considers cross-border merger in presence of endogenous technology[1] choice and shows the effect on domestic welfare. We show that cross-border merger increases domestic welfare if the bargaining power of the foreign firm and the slope of the marginal cost of R&D are sufficiently low. Otherwise domestic welfare is lower under cross-border merger.

A recent paper by Mattoo et al. (2004) shows that cross-border merger increases domestic welfare if the slope of the marginal cost of R&D is sufficiently high. In our analysis, cross-border merger increases domestic welfare *only if* the slope of the marginal cost of R&D is sufficiently low.

Though both the present paper and Mattoo et al. (2004) consider the effect of cross-border merger on welfare in presence of endogenous technology choice, it is important to note that the present paper differs from Mattoo et al. (2004) in two important ways. First, we consider R&D by both domestic and foreign firms, while only the foreign firm does R&D in Mattoo et al. (2004). Hence, Mattoo et al. (2004) is more relevant for merger between the firms from developing and developed countries with different R&D capabilities, while this paper is more appropriate for merger between the firms from developed countries with similar R&D capabilities. Second, we consider bargaining between the firms and show the role of bargaining power, whereas their focus is on the intensity of product market competition. Hence, the present paper complements Mattoo et al. (2004) and extends this line of research.

The remainder of the paper is organized as follows. We describe the model and derive the results in section 2. Section 3 concludes.

2. The model and the results

Assume that there is a firm, firm 1, who wants to invest in a country, called domestic country. Firm 1 has to compete with a domestic firm, firm 2. Assume that the firms produce homogeneous products and the inverse market demand function is

$$P = a - q\,, \tag{1}$$

[1] We define the quality of technology by the marginal cost of production. Better technology implies lower marginal cost of production.

where the notations have usual meanings.

Assume that the firms have similar technologies at the beginning and each firm has the constant average cost of production c. However, both firms do R&D to reduce their own cost of production. Assume that x amount of investment in R&D by firm i, $i = 1,2$ reduces its cost of production to $(c - x_i)$. For simplicity, we restrict our attention to the situation where $c \geq x_i$. However, R&D is costly and the cost function for R&D is $C(x_i) = \frac{\tau x_i^2}{2}$. We assume that there are no other costs associated with either R&D or production.

We consider the following game. At stage 1, firm 1 decides whether to do FDI through direct entry or merger. If firm 1 does FDI through direct entry, both firms invest simultaneously in R&D at stage 2. Then, at stage 3, they compete like Cournot duopolists in the product market and the profits are realized. But, in case of merger at stage 1, firm 1 pays a transaction price, F, to firm 2 at stage 2. We assume that generalized Nash bargaining process determines the transaction price. At stage 3, firm 1 decides its R&D investment. At stage 4, firm 1 chooses its output and the profit is realized. We solve the game through backward induction.

2.1. Direct entry

Given the R&D investments at stage 2, firms 1 and 2 choose outputs to maximize the following expressions respectively:

$$\underset{q_1}{Max}(a - q - c + x_1)q_1 - \frac{\tau x_1^2}{2} \tag{2}$$

$$\underset{q_2}{Max}(a - q - c + x_2)q_2 - \frac{\tau x_2^2}{2}, \tag{3}$$

where q_1 and q_2 are the outputs of firms 1 and 2 respectively.

The equilibrium outputs of firms 1 and 2 are respectively

$$q_1 = \frac{(a - c + 2x_1 - x_2)}{3} \quad \text{and} \quad q_2 = \frac{(a - c + 2x_2 - x_1)}{3}. \tag{4}$$

The equilibrium net profits (i.e., profits excluding the R&D costs) of firms 1 and 2 are respectively

$$\pi_1^n = \frac{(a - c + 2x_1 - x_2)^2}{9} - \frac{\tau x_1^2}{2} \quad \text{and} \quad \pi_2^n = \frac{(a - c + 2x_2 - x_1)^2}{9} - \frac{\tau x_2^2}{2}. \tag{5}$$

At stage 2, firms 1 and 2 maximize the following expressions respectively to determine R&D investments:

$$\underset{x_1}{Max}\frac{(a - c + 2x_1 - x_2)^2}{9} - \frac{\tau x_1^2}{2} \tag{6}$$

$$\underset{x_2}{Max}\frac{(a - c + 2x_2 - x_1)^2}{9} - \frac{\tau x_2^2}{2}. \tag{7}$$

The equilibrium R&D investments are

$$x_1^n = x_2^n = \frac{4(a - c)}{(9\tau - 4)}. \tag{8}$$

Second order condition for maximization requires $\frac{8}{9} < \tau$ and we assume that it holds.

Note that $x_i^n \leq c$ (where $i = 1,2$) requires $\frac{4a}{9c} \leq \tau$, and it is assumed to hold.

Therefore, total R&D investment is

$$x^n = x_1^n + x_2^n = \frac{8(a-c)}{(9\tau - 4)}. \tag{9}$$

We find from (4) and (8) that the equilibrium outputs of firms 1 and 2 are

$$q_1^n = q_2^n = \frac{3\tau(a-c)}{(9\tau - 4)}. \tag{10}$$

Therefore, total output and consumer surplus are respectively

$$q^n = \frac{6\tau(a-c)}{(9\tau - 4)} \qquad \text{and} \qquad CS^n = \frac{18\tau^2(a-c)^2}{(9\tau - 4)^2}. \tag{11}$$

We find from (5) and (8) that the equilibrium net profits of firms 1 and 2 are

$$\pi_1^n = \pi_2^n = \frac{\tau(a-c)^2(9\tau - 8)}{(9\tau - 4)^2}. \tag{12}$$

The industry profit is

$$\pi^n = \pi_1^n + \pi_2^n = \frac{2\tau(a-c)^2(9\tau - 8)}{(9\tau - 4)^2}. \tag{13}$$

Under direct entry, domestic welfare (which is the sum of consumer surplus and net profit of the domestic firm) is

$$W^n = \frac{\tau(a-c)^2(27\tau - 8)}{(9\tau - 4)^2}. \tag{14}$$

2.2. Merger

Now, consider the game under the history of merger at stage 1.

Given the transaction price, F^*, and the R&D investment of firm 1, firm 1 chooses output to maximize the following expression:

$$\underset{q}{Max}(a - q - c + x)q - \frac{\tau x^2}{2} - F^*. \tag{15}$$

The equilibrium output of firm 1 is

$$q^{aq} = \frac{(a-c+x)}{2}. \tag{16}$$

The Equilibrium net profits of firms 1 and 2 are respectively

$$\pi_1^{aq} = \frac{(a-c+x)^2}{4} - \frac{\tau x^2}{2} - F^* \qquad \text{and} \qquad \pi_2^{aq} = F^*. \tag{17}$$

At stage 3, firm 1 maximizes the following expression to determine R&D investment:

$$\underset{x}{Max}\frac{(a-c+x)^2}{4} - \frac{\tau x^2}{2} - F^*. \tag{18}$$

The equilibrium R&D investment is

$$x^{aq} = \frac{(a-c)}{(2\tau - 1)}. \tag{19}$$

Second order condition for maximization requires $\frac{1}{2} < \tau$ and this is satisfied since we have already assumed $\tau > \frac{8}{9}$. Further, the restriction $x^{aq} \le c$ requires $\frac{a}{2c} \le \tau$, and it is assumed to hold.

Since $\frac{a}{2c} > \frac{4a}{9c}$, we have two restrictions on τ: (i) $\tau > \frac{8}{9}$ and (ii) $\tau > \frac{a}{2c}$. We get that $\frac{8}{9} \gtreqless \frac{a}{2c}$ for $a \lesseqgtr \frac{16c}{9}$, and therefore, the relevant values of τ for the following analysis are $\tau > Max\{\frac{8}{9}, \frac{a}{2c}\}$.

We get from (16) and (19) that total output and consumer surplus under merger are respectively

$$q^{aq} = \frac{\tau(a-c)}{(2\tau-1)} \qquad \text{and} \qquad CS^{aq} = \frac{\tau^2(a-c)^2}{2(2\tau-1)^2}. \tag{20}$$

We find from (17) and (19) that the equilibrium profits of firms 1 and 2 are respectively

$$\pi_1^{aq} = \frac{\tau(a-c)^2}{2(2\tau-1)} - F^* \qquad \text{and} \qquad \pi_2^{aq} = F^*. \tag{21}$$

The industry profit is

$$\pi^{aq} = \frac{\tau(a-c)^2}{2(2\tau-1)}. \tag{22}$$

2.2.1. Determination of the transaction price

We get F^* by maximizing the following expression:

$$\underset{F}{Max}\left(\frac{\tau(a-c)^2}{2(2\tau-1)} - F - \frac{\tau(a-c)^2(9\tau-8)}{(9\tau-4)^2}\right)^{\alpha}\left(F - \frac{\tau(a-c)^2(9\tau-8)}{(9\tau-4)^2}\right)^{(1-\alpha)}, \tag{23}$$

where α and $(1-\alpha)$ are the bargaining powers of firms 1 and 2 respectively, and $\alpha \in [0,1]$. The profits under direct entry are the reservation payoffs for the firms while bargaining for F.

Maximizing (23), we get

$$F^* = \left(\frac{\tau(a-c)^2}{2(2\tau-1)} - \frac{\tau(a-c)^2(9\tau-8)}{(9\tau-4)^2}\right) - \alpha\left(\frac{\tau(a-c)^2}{2(2\tau-1)} - \frac{2\tau(a-c)^2(9\tau-8)}{(9\tau-4)^2}\right). \tag{24}$$

2.3. Comparison between direct entry and merger

Comparison of (8) and (19), and (9) and (19) give the following results immediately.

Proposition 1: *(i) Firm 1's R&D investment is higher under merger than its own R&D investment under direct entry.*
(ii) Total R&D investment is higher under direct entry than merger.

Since quality of the technology under direct entry depends on the R&D investment of the individual firm, we have the following corollary.

Corollary 1: *Relatively superior technology is always used under merger than direct entry.*

Merger increases concentration in the product market and, for a given R&D investment, it increases profit compared to direct entry. The higher profit under merger tends to increase R&D investment. On the other hand, there is a strategic effect under direct entry. If a firm invests more in R&D, its market share and profit

increase. The strategic effect tends to increase R&D investment under direct entry. The effect of market concentration dominates the strategic effect of direct entry and generates higher R&D investment of firm 1 under merger than direct entry. However, total R&D investment is higher under direct entry than merger.

Corollary 1 contrasts Mattoo et al. (2004), where the effect of merger on the quality of technology is ambiguous.

It follows from (12), (21) and (24) that the net profits of both firms are higher under merger compared to direct entry if and only if

$$\frac{\tau(a-c)^2}{2(2\tau-1)} > \frac{2\tau(a-c)^2(9\tau-8)}{(9\tau-4)^2} \tag{25}$$

or $$(9\tau-4)^2 - 4(2\tau-1)(9\tau-8) > 0\,, \tag{26}$$

which holds for the relevant values of τ. Hence, the firms are better off under merger than direct entry, and merger occurs if it is not prevented by the domestic government.

Unlike profits, comparison of (11) and (20) shows that consumer surplus is higher under direct entry than merger. Relatively superior technology is used under merger, which creates a positive impact on consumer surplus. But, merger increases market concentration, which creates a negative impact on consumer surplus. The market concentration effect dominates the technology effect and makes consumers worse-off under merger than direct entry.

Hence, it is not clear a priori whether a welfare-maximizing domestic government favors direct entry or merger. Domestic welfare under merger is

$$W^{aq} = \frac{\tau^2(a-c)^2}{2(2\tau-1)^2} + F^*. \tag{27}$$

Proposition 2: *If* $\frac{11+\sqrt{41}}{10} > \frac{a}{2c}$, *welfare of the domestic country is higher under merger if bargaining power of firm 1 (i.e., the foreign firm) is sufficiently low and* $\tau \in (Max\{\frac{8}{9}, \frac{a}{2c}\}, \frac{11+\sqrt{41}}{10})$. *Otherwise, welfare of the domestic country is higher under direct entry.*

Proof: Comparing (14) and (27) we find that if $\alpha = 1$, (14) is always greater than (27). But, if $\alpha = 0$, we get that (27) is greater (less) than (14) if and only if

$$0 > (<) 5\tau^2 - 11\tau + 4\,. \tag{28}$$

We find that $\tau = \frac{11-\sqrt{41}}{10}$ and $\tau = \frac{11+\sqrt{41}}{10}$ are the roots of the equation $5\tau^2 - 11\tau + 4 = 0$. Since, we consider $\tau > Max\{\frac{8}{9}, \frac{a}{2c}\}$, $\tau = \frac{11+\sqrt{41}}{10}$ is the only feasible root for our analysis. Though $\frac{11+\sqrt{41}}{10}$ is greater than $\frac{8}{9}$, it may or may not be grater than $\frac{a}{2c}$. Further, we get that $5\tau^2 - 11\tau + 4$ is negative at $\tau = \frac{8}{9}$, and it is

continuous and convex in τ for $\tau \geq \frac{8}{9}$. Therefore, if $\frac{11+\sqrt{41}}{10} > \frac{a}{2c}$, (27) is greater than (14) at $\alpha = 0$ for $\tau \in (Max\{\frac{8}{9}, \frac{a}{2c}\}, \frac{11+\sqrt{41}}{10})$.

It follows from (24) and (27) that welfare of the domestic country under merger is continuous and negatively sloped in $\alpha \in [0,1]$. Hence, welfare is greater under merger when α and τ are sufficiently low. Otherwise, (14) is greater than (27) and welfare is higher under direct entry. Q.E.D.

In contrast to Mattoo et al. (2004), which shows that merger increases domestic welfare if the slope of the marginal cost of doing R&D is sufficiently high, the above result shows that domestic welfare is higher under merger *only if* τ is sufficiently low. When τ is low, it reduces the cost of R&D and therefore, increases R&D investment. Further, lower bargaining power of the foreign firm implies that most of the benefit from merger is extracted by the domestic firm, which raises domestic welfare. Combination of these effects creates higher domestic welfare under merger than direct entry.

3. Conclusion

We show that domestic welfare is higher under cross-border merger if bargaining power of the foreign firm and slope of the marginal cost of R&D are sufficiently low. Otherwise, domestic welfare is higher under direct entry. Our result is in contrast to the previous work where only the foreign firm does R&D.

Like Mattoo et al. (2004), we assume away uncertainty in R&D. Further, we have focused on non-cooperative R&D only, while the firms often do R&D cooperatively. These issues are in our future research agenda.

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