Trade and mergers in the presence of firm heterogeneity

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We investigate the role of firm heterogeneity in considering the profitability and desirability of mergers in the international economy. We characterize the discrepancy between the profitability and desirability of mergers depending on the types of mergers. We show that the desirability of a profitable merger between heterogeneous firms depends on whether it is cross-border or domestic, and that the desirability of a profitable merger between homogeneous firms depends on whether it is between efficient firms or between inefficient firms. Furthermore, we proove that whether a merger leads to merger waves depends on the types of firms involved. It is also demonstrated that larger firm heterogeneity can reduce the discrepancy between the profitability and desirability of mergers when the trade cost is sufficiently low.

Key words: *M&As, trade, firm heterogeneity, Cournot competition*

1. Introduction

During the past two decades, we have observed a worldwide proliferation of mergers and acquisitions (M&As). The number of M&As worldwide in excess of one million dollars during 2000-2001 is more than twice that during 1990-1991 (Hijzen *et al.*[16]). This trend is common for both domestic and cross-border M&As: from 1990-1991 to 2000-2001, the number of domestic M&As rose from 6,281 to 13,557, and the number of cross-border M&As, from 2,161 to 5,319. It is then worth investigating the causes and consequences of this proliferation of both types of mergers in a unified framework.

In investigating these, we can safely say that the trade of produced goods and services plays an important role in M&A decisions. In the presence of trade, a cross-border merger provides better access to a foreign market and reduces the trade costs, which is called a "tariff-jumping" effect and leads to merger incentives. Hijzen *et al.*[16] showed this effect empirically, and several studies, including those by Horn and Persson[18], Fumagalli and Vasconcelos[13], and Salvo[32], did so theoretically.[1]

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[1] The effects of trade costs on merger incentives are not as simple as they may appear at first sight. For example, Bjorvatn[6] showed that economic integration may trigger cross-border M&As by reducing the business stealing effect and by reducing the reservation price of the target firm. Chaudhuri and Benchekroun[9] demonstrated that marginal and non-marginal reductions in trade costs have different effects on the social desirability of mergers.

In the meantime, researchers of international trade have uncovered the importance of firm heterogeneity in shaping trade patterns. Given the new established facts regarding differences in the performance of firms in the trade environment (see Bernard and Jensen[4)5)], among others), the impact of trade in the presence of heterogeneous firms has been intensively investigated by Melitz[24)], Helpman *et al.*[14)], Melitz and Ottaviano[25)], and Antras and Helpman[1)2)3)]. These scholars developed monopolistic competition models with heterogeneous firms and showed the impacts of trade on the industrial structure and firms, including the fact that trade in the presence of firm heterogeneity leads to self-selection of firms: efficient firms sell goods both domestically and internationally, whereas inefficient firms sell goods only domestically. These results show the possibility that firm heterogeneity has a significant impact on the causes and consequences of M&As by determining trade patterns.

In this paper, we introduce firm heterogeneity into a Cournot oligopoly model with trade in the manner of Brander[7)] and Brander and Krugman[8)]. We examine the profitability (i.e., causes) and desirability (i.e., consequences) of M&As in the international economy.[4] This modeling strategy fits quite well into the analysis of M&As because there is a tradition of industrial organization literature that uses Cournot models

in analyzing M&As. Salant *et al.*[31)] established the well-known "Cournot merger paradox," which claims that mergers between identical firms are unprofitable unless the merged firm produces a very high proportion of pre-merger industry output over 80% when the firms engage in Cournot competition and the demand function is linear. Subsequent studies showed that mergers are possible in Cournot competition once additional factors, such as cost synergies (see Farrell and Shapiro[12)]), fixed stock of production factors (see Perry and Porter[29)]), spatial competition (see Levy and Reitzes[21)]), and demand uncertainty (see Qiu and Zhou[30)]), are introduced.[5]

In the model developed in this study, we consider two countries in which each firm is different in its marginal cost of production. Although firms can sell their products in the domestic market without trade costs, they have to bear trade costs when they sell their products abroad. We consider horizontal M&As, and there is no upstream and downstream distinction among firms. We assume the perfect spillover of technology, and once heterogeneous firms merge, the merged firm can produce goods at a low cost. Hence, the "technology spillover" and "tariff-jumping" can be the motive to form a merger in addition to the reductions in competition among firms à la Salant *et al.*[31)]. We investigate how the cost difference could interplay with trade environments, such as trade costs, to determine the profitability and desirability of mergers.

We first build our arguments on a simple case in which there are two firms in each country; one is efficient and can produce at a lower cost; and the other is inefficient and produces at a higher cost. This simple setting enables

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[2] Mannase and Turrini[22)] considered a model in which the heterogeneity of firms arises from differences in the skills of entrepreneurs and obtained results regarding industrial changes due to trade openness that were similar to those of Melitz[24)].

[3] For recent surveys, see Baldwin[2)], Greenaway and Kneller[11)], and Helpman[15)].

[4] Of course, in the enormous amount of trade literature, there are studies that introduce firm heterogeneity into a Cournot model with trade. Very recent examples include those by Ishikawa and Komoriya[19)], who examined the effects of countervailing duties when subsidies provided in exporting countries cause serious injuries.

[5] For further details on this literature, see Huck *et al*[17)] and Chapter 16 of Pepall *et al.*[28)].

us to fully investigate the profitability and desirability of a merger.

We show that it is likely that larger firm heterogeneity makes both domestic and cross-border mergers more profitable, whereas larger trade costs increase the profitability only of cross-border mergers. We then explore whether such profitable mergers are desirable from the welfare point of view. Specifically, we show that (i) a profitable merger between heterogeneous firms is desirable if it is cross-border. (ii) If it is domestic, it is desirable only when the cost difference is sufficiently large. (iii) A profitable cross-border merger between efficient firms is desirable if trade cost is sufficiently high. (iv) A profitable cross-border merger between inefficient firms is always desirable. The difference between (i) and (ii) stems from the difference in how a merger weakens competition among firms. For consumers in each country, a cross-border merger implies reductions in imports from abroad. In contrast, a domestic merger implies reductions in supply of goods by domestic firms. The latter has larger impacts in reducing competition among firms within a country, leading to larger reductions in the consumer surplus than the former. Similar arguments hold true regarding the difference between (iii) and (iv): a cross-border merger between efficient firms has a larger effect of reducing the consumer surplus than that between inefficient firms. In order for the former to be desirable, the tariff-jumping effect must be sufficiently large.

We also extend the basic model into two directions. First, we examine whether or not the first pairwise merger leads to merger waves and show that it depends on the type of firms involved in it. Second, we explore the possible effects of the asymmetry between countries regarding firm heterogeneity by assuming that the share of efficient firms can be different between countries.

Existing studies, such as Barros[3] and Neary[27], have shown that mergers between firms with different marginal costs could be profitable even under Cournot competition. However, they consider a world without trade costs.[6] In contrast, our primary focus is on the case in which trade costs play an important role. Of course, as reported above, several existing studies have already investigated the role of trade costs in M&As. Among others, Salvo[32] examined the profitability of mergers with both trade costs and international difference in quality of goods. He showed that higher trade costs and larger quality difference lead to higher incentives of mergers. His results are consistent with those obtained in this study. The important departure of our analysis from his is that we consider firm heterogeneity within each country, which yields much richer results. Moreover, we provide welfare arguments that are absent in Salvo[32]. In this sense this paper and Salvo[32] complement each other.

This paper is organized as follows. In Section 2, we present a basic model and uncover the trade patterns. Section 3 is a full analysis of the simple pairwise mergers. Section 4 is an extension of the analysis into two ways. One focuses on the merger waves, and the other explores the role of asymmetry between countries regarding firm heterogeneity. Section 5 is the conclusion.

2. Basic setup

(1) Model
We first derive the trade patterns and then examine the profitability and desirability of

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[6] Barros[3] considered only domestic mergers. Neary[27] considered two countries. In one, all firms produce at lower costs, and in the other, all firms produce at higher costs. Moreover, Neary[27] assumed no trade costs.

mergers. We consider two countries, H (home) and F (foreign) in each, two firms (1 and 2) are playing the Cournot competition. Within each country, firms are heterogeneous in the sense that they differ in their marginal cost: firm 1 has lower marginal cost, which is normalized to zero, whereas the marginal cost of firm 2 is $c > 0$. For the moment, we assume that two countries are symmetric and the cost distribution is the same across two countries.[7]

We assume that the demand for homogeneous good Q is determined by a simple linear demand function:

$$P = 1 - Q, \tag{1}$$

where P is the price. Let us assume that $c < 1/2$, under which both firms 1 and 2 obtain positive operating profits in the closed economy. Firms can export goods to a foreign market incurring trade cost $\tau > 0$ as well as supply goods in a domestic market with no trade cost. When τ is sufficiently high, no firms export, and the economy is in autarky. When all firms are supplying in both countries, firms' profits in country j ($j = H, F$) are given as

$$\pi_{1j} = P_j q_{1jj} + (P_k - \tau) q_{1jk}$$
for firm 1,
$$\pi_{2j} = (P_j - c) q_{2jj} + (P_k - c - \tau) q_{2jk} \tag{2}$$
for firm 2,

where q_{ijj} and q_{ijk} represent the supply of goods of firm i located at country j in country j (i.e., in a domestic market) and that in country k ($k \neq j$, $k = H, F$) (i.e., in a foreign country). Here, the total supply Q in country j is given by $Q_j = q_{1jj} + q_{2jj} + q_{1kj} + q_{2kj}$. Each firm supplies goods whenever the price exceeds the cost of supply:

$$r_{1jd} \equiv P_j > 0 \Rightarrow q_{1jj} > 0,$$
$$r_{1jx} \equiv P_k - \tau > 0 \Rightarrow q_{1jk} > 0,$$
$$r_{2jd} \equiv P_j - c > 0 \Rightarrow q_{2jj} > 0,$$

$$r_{2jx} \equiv P_k - c - \tau > 0 \Rightarrow q_{2jk} > 0. \tag{3}$$

r_{ijd} and r_{ijx} represent the profits per unit supply from domestic sales and exports, respectively. Exploring these conditions, we can see how trade patterns emerge according to the level of the trade cost τ.

(2) Trade and supply patterns

We consider the following possibilities that are relevant to our analysis.[8] Pattern (i): All firms supply goods in both countries. Pattern (ii): All firms supply goods in a domestic market, but only efficient firms export. Pattern (iii): only efficient firms are active, and they supply goods in both countries. Pattern (iv): all firms supply goods in a domestic market, but no firms export (i.e., autarky). When the cost difference between firms is small ($0 < c \leq 1/3$), patterns (i), (ii), and (iv) appear for different values of τ. When the cost difference is large ($1/3 < c < 1/2$), we observe patterns (ii), (iii), and (iv).

We start from the case in which the cost difference is small by assuming that $0 < c \leq 1/3$. In pattern (i), firms' profits are given by (1), leading to the following supply:

$$q_{1jj} = \frac{1 + 2c + 2\tau}{5}, \qquad q_{1jk} = \frac{1 + 2c - 3\tau}{5},$$
$$q_{2jj} = \frac{1 - 3c + 2\tau}{5}, \qquad q_{2jk} = \frac{1 - 3c - 3\tau}{5}.$$

From (3), we can see that, for this pattern to hold true, $r_{ijd} > 0$ and $r_{ijx} > 0$ must be satisfied for both firms. Substituting the above equations into (1), we obtain that $r_{ijd} > 0$ holds true for all positive values of τ because $0 < c \leq 1/3$. Furthermore, we have

$$r_{1jx} > 0 \Leftrightarrow \tau < \frac{1 + 2c}{3},$$
$$r_{2jx} > 0 \Leftrightarrow \tau < \frac{1 - 3c}{3}. \tag{4}$$

Therefore, when trade cost τ is smaller than $(1-3c)/3$, we have pattern (i). When the trade cost is high and τ becomes equal to $(1-3c)/3$, exporting is no longer profitable for inefficient firms. The economy turns into pattern (ii), which holds true if $r_{ijd}>0$ for both firms and $r_{1jx}>0$ are satisfied but the economy is not in pattern (i) (i.e., $\tau \geq (1-3c)/3$). Again, $r_{ijd}>0$ holds true for all positive values of τ. Furthermore, export is profitable for firm 1 as long as $\tau < (1+c)/3$, that is,

$$r_{1jx}>0 \Leftrightarrow \tau < \frac{1+c}{3}, \tag{5}$$

which implies that pattern (ii) emerges when $(1-3c)/3 \leq \tau < (1+c)/3$. When τ is larger than $(1+c)/3$, no firms export, and the economy is in pattern (iv) (in autarky).

Next, we consider the case in which the cost difference is large $(1/3 < c < 1/2)$. In this case, pattern (i) is never possible because no positive τ satisfies (2), and, hence, it is convenient to start from pattern (ii). When $1/3 < c < 1/2$, $r_{1jd} > 0$ holds true for all positive values of τ, whereas we can see that

$$r_{2jd}>0 \Leftrightarrow \tau > 3c-1,$$
$$r_{1jx}>0 \Leftrightarrow \tau < \frac{1+c}{3}. \tag{6}$$

Hence, pattern (ii) happens when $3c-1 < \tau < (1+c)/3$. When τ is larger than $(1+c)/3$, no firms export, and the economy is in pattern (iv) (in autarky). Finally, when $0 < \tau \leq 3c-1$, inefficient firms stop producing goods, and only efficient firms are active. Moreover, efficient firms supply goods in both countries as long as $\tau < 1/2$, which, combined with the fact that $1/3 < c < 1/2$ leads to $3c-1 < 1/2$, implies that pattern (iii) holds true when $0 < \tau \leq 3c-1$.

The following proposition summarizes the above arguments.

Proposition 1 *Assume that the cost difference is small* $(0 < c \leq 1/3)$. *Then, when the trade cost* τ *is smaller than* $(1-3c)/3$, *all firms supply goods in both countries (pattern (i)). When* $(1-3c)/3 \leq \tau < (1+c)/3$, *all firms supply goods in a domestic market, but only efficient firms export (pattern (ii)). When* $\tau > (1+c)/3$, *all firms supply goods in a domestic market, but no firms export (pattern (iv)). Next, let us assume that the cost difference is large* $(1/3 < c < 1/2)$. *Then, when* $0 < \tau \leq 3c-1$, *only efficient firms are active, and they supply goods in both countries (pattern (iii)). Pattern (ii) happens when* $3c-1 < \tau < (1+c)/3$, *and pattern (iv) holds true when* $\tau > (1+c)/3$.

Put differently, although reductions in trade costs induce firms to engage in trade, their effects are quite different among heterogeneous firms. Efficient firms are most likely to enjoy the benefits from reductions in the trade cost. In fact, they first start exporting, and for a certain range of trade cost, only they export. When the cost difference is not large, sufficiently low trade cost enables inefficient firms to export. However, when the cost difference is sufficiently large, low trade cost may make inefficient firms quit production. These trade patterns are fully consistent with the results obtained in Melitz [24] and Melitz and Ottaviano [25], which introduced firm heterogeneity into trade models of monopolistic competition and showed that self-selection of exporting firms is observed according to the cost difference among firms, as seen in Proposition 1. Therefore, the results here indicate that it is fairly common to have this self-selection of exporting firms in a trade model of imperfect competition with heterogeneous firms.

3. Analysis of mergers: A pairwise merger

(1) Types of a pairwise merger

In this section, we analyze the incentive and outcome of a pairwise merger, and in the next section, we examine the possibility of merger waves. Before we provide the complete results of a pairwise merger in this model, we mention four types of pairwise mergers: **Type** (**I**): a cross-border merger of efficient firms (i.e., a merger of firms 1 and 1 located in countries H and F), **Type** (**II**): a cross-border merger of efficient and inefficient firms (i.e., a merger of firm 1 located in country H and firm 2 located in country F), **Type** (**III**): a domestic merger of efficient and inefficient firms (i.e., a merger of firms 1 and 2 located in country H), and **Type** (**IV**): a cross-border merger of inefficient firms (i.e., a merger of firms 2 and 2 located in countries H and F).

Here, we assume the perfect spillover of technology, and once heterogeneous firms merge, the merged firm can produce goods at a low cost. This assumption is especially relevant when we consider cross-border mergers with trade cost. Perfect spillover implies that a cross-border merger between efficient and inefficient firms makes it possible for a merged firm to produce goods at low costs in both countries. Without this assumption, there is a trade-off for a merged firm. A firm must choose between producing goods at low cost while bearing transport costs to the other country and producing goods in both countries at low cost in one country and at high cost in the other. In the latter case, it bears no trade cost.

After deriving trade and supply patterns as in the previous section, we can obtain the profits of (merged and non-merged) firms under each type of a merger. Appendix B provides these profits explicitly.

(2) Profitability (incentive) and desirability (welfare) of a pairwise merger

a) Profitability

In this paper, for analytical simplicity, we assume that each merger consists of two firms, and we use simple gains from the merger as a criterion of merger incentive. Therefore, when we consider a pairwise merger, we compare the profit of a merged firm (the *ex post* profit) to the *ex ante* joint profit of firms involved in the merger described in Section 2.2.[9] If the former is larger than the latter, we consider that this merger is profitable and these two firms have the incentive to merge. More formally, a merger between firm i in country j and firm h in country k is profitable if

$$\pi_M - \pi_{ij} - \pi_{hk} > 0, \tag{7}$$

where π_M is the profit of a merged firm, and π_{ij} and π_{hk} represent the pre-merger profit of firm i in country j and that of firm h in country k, respectively.

Appendix C yields the conditions under which we observe a particular combination of *ex ante* and *ex post* trade and supply patterns under each type of a merger. In each case, we have to check whether the merged firm's *ex post* profit is larger than the *ex ante* joint profits of firms involved in the merger. Since those calculations are simple but highly tedious, we summarize them in four figures (Figures 1-a, 1-b, 1-c, and 1-d).

The shaded areas of the left-hand side figures represent the combinations of c and τ under which a merger is profitable.

b) Desirability from the viewpoint of global welfare

The shaded areas of the right-hand side figures describe the combinations of c and τ under which a merger is desirable from the viewpoint of global welfare. The bottom figures show the

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9 Here, we use "*ex ante*" to represent the no merger case and "*ex post*" to imply there is a merger.
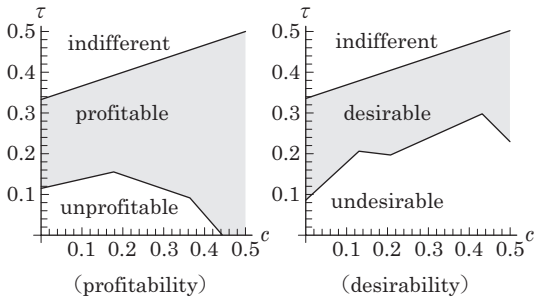
Fig.1-a   Profitability and desirability of a pairwise merger (Type (I): A cross-border merger of efficient firms (firms 1 in H and 1 in F)).
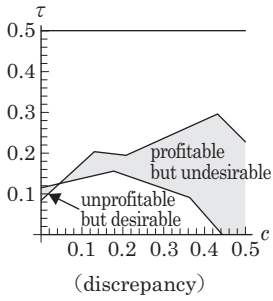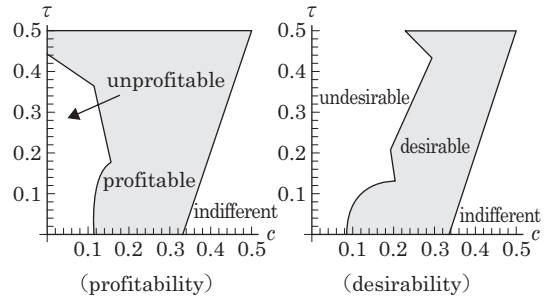
Fig.1-c   Profitability and desirability of a pairwise merger (Type (III): A domestic merger of efficient and inefficient firms (firms 1 and 2 in H)).
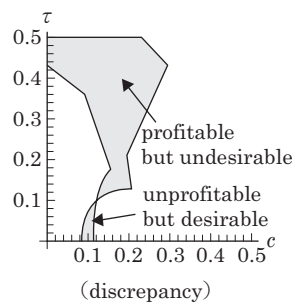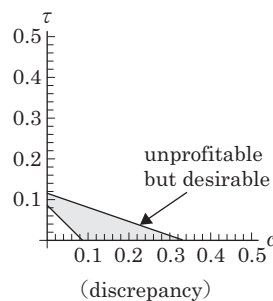
Fig.1-b   Profitability and desirability of a pairwise merger (Type (II): A cross-border merger of efficient and inefficient firms (firms 1 in H and 2 in F)).
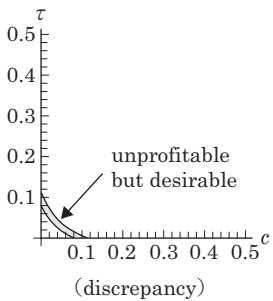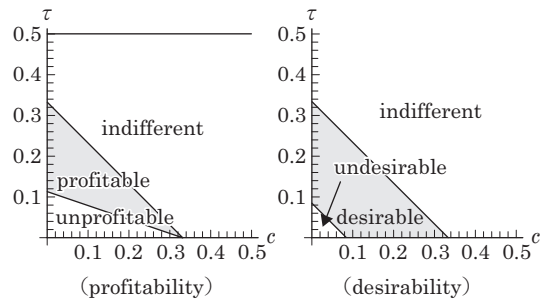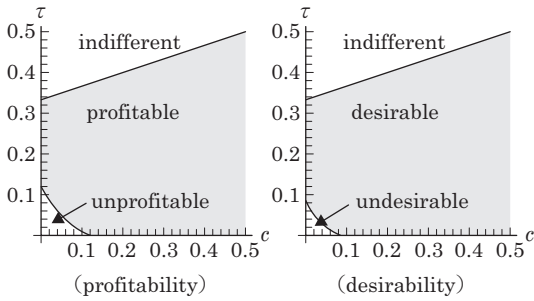
Fig.1-d   Profitability and desirability of a pairwise merger (Type (IV): A cross-border merger of inefficient firms (firms 2 in H and 2 in F)).

areas in which profitability and desirability do not go together. Here, we use the social surplus W as the criterion of welfare:

$$W = \frac{Q_H^2 + Q_F^2}{2} + \text{sum of firms' profits.} \qquad (8)$$

Denoting the pre-merger and post-merger surpluses as W_t and W_m, respectively, a merger is desirable if and only if $W_m - W_t > 0$.

c) General properties

In our model, the following three factors affect merger profitability and desirability: (i) tariff-jumping, (ii) technology spillover, and (iii) degree of competition. (i) is relevant to cross-border mergers, and (ii) can make mergers between heterogeneous firms profitable and desirable. Any type of mergers changes the degree of competition, which affects the profitability and desirability of mergers. In the followings, we examine Figures 1-a to 1-d in order to explore how these three factors affect the profitability and desirability of a merger. Especially, for practical purpose, it would be useful to know when a profitable merger (i.e., a merger that firms have incentive to form) is desirable/undesirable from the welfare point of view.

Before proceeding to each type of a merger, a few comments regarding overall tendencies are in order. First, a merger is neither profitable nor desirable at a lower cost difference and lower trade cost, which is described in the lower-left area of all these figures. Since firms are nearly homogeneous and there is little trade cost, non-profitability is explained by the well-known "Cournot merger paradox."

Non-desirability comes from reductions in the consumer surplus because a merger implies a decrease in the number of firms in the Cournot competition. Second, starting from the lower-left area, increases in the trade cost and in the cost difference make a merger profitable and desirable, these characteristics being the results

of tariff-jumping and technology spillover, respectively. However, these effects work quite differently for different types of mergers. A larger trade cost does not make a domestic merger neither profitable nor desirable for the most part, whereas a merger is likely to become profitable and desirable under larger heterogeneity of firms, except for a merger of Type (I). In this sense, a larger trade cost is in favor of a cross-border merger alone, whereas larger heterogeneity of firms increases both domestic and cross-border mergers. Finally, when the trade cost is very high, the economy is in autarky irrespectively of the merger, and there is no scope for a cross-border merger.

The following proposition summarizes the overall tendencies.

Proposition 2 *When the trade cost is low and the cost difference is small, a merger is neither profitable nor desirable. Increases in trade cost are likely to make a cross-border merger profitable and desirable. Increases in the cost difference may make both cross-border and domestic mergers profitable and desirable.*

d) Properties of each type of a merger

Next, we move to specific cases. We start from Type (I), which is described in Figure 1-a. A merger is profitable but undesirable in the lower-right area of this figure, where the trade cost is low and the cost difference is large. This makes inefficient firms inactive in the absence of a merger. If a cross-border merger of efficient firms occurs, it becomes possible for inefficient firms to earn positive profits and become active. Although it is impossible for a merged firm to become a monopoly, it can still obtain a sufficient market share for a merger to be profitable because it competes with inefficient firms. Put differently, although the tariff-jumping effect is small, a cross-border merger of efficient firms

reduces competition sufficiently for it to be profitable. However, because it makes inefficient firms active, losses in production inefficiency reduce welfare, making a cross-border merger of efficient firms profitable but undesirable. In the upper-left area, no firms export in the absence of a merger, and inefficient firms do not export in the presence of a merger. This implies that a merger does not alter the market structure and is indifferent to firms and to welfare.

The results for Type (II) are described in Figure 1-b. In this case, profitability and desirability almost coincide: profitable mergers are always desirable, and desirable mergers are almost profitable. In the upper-left area, again, no firms export in the absence of a merger, and inefficient firms do not export in the presence of a merger. A merger does not alter the market structure and is indifferent to firms and to the welfare.

Figure 1-c represents the case of Type (III). In the upper-left area, we observe a discrepancy between profitability and desirability. When the cost difference is sufficiently small and firms are quite similar, social gains from a domestic merger via technology spillover are small, and a merger reduces the intensity of competition, leading to undesirability in the left area of this figure. On the other hand, in the upper-left area, the trade cost is high, and a domestic market is more isolated, yielding a higher incentive of a domestic merger. This leads to a discrepancy between profitability and desirability. In the lower-right area, inefficient firms are inactive both in the presence and in the absence of a domestic merger. A domestic merger does not alter the market structure and, hence, is neither profitable nor desirable.

Finally, Figure 1-d deals with Type (IV). In the lower-right area, a cross-border merger of inefficient firms is neither profitable nor desirable because of the small tariff-jumping effect. In contrast, we can observe that although it is not profitable, it is desirable in the lower-center area. The market shares of inefficient firms shrink with a cross-border merger of inefficient firms, leading to unprofitability. However, a merger of inefficient firms enables efficient firms to obtain larger shares, which lowers the price of manufactured goods in both domestic and foreign markets and raises the consumer surplus and the social welfare. In the upper-left area, inefficient firms do not export their products in the absence of a merger. In the right area, inefficient firms are inactive regardless of a merger. In these areas, a merger does not change the market structure and, hence, is neither profitable nor desirable.

The following two propositions summarize the above arguments:

Proposition 3 *A profitable merger between heterogeneous firms is desirable if it is cross-border. If it is domestic, it is desirable only when the cost difference is sufficiently large.*

Proposition 4 *A profitable cross-border merger between efficient firms is desirable if trade cost is sufficiently high. A profitable cross-border merger between inefficient firms is always desirable.*

e) National welfare

Thus far, we examined desirability based on the global welfare. We here discuss briefly the effects on the welfare of each country. Consider mergers of Types (I) and (IV), which are cross-border mergers between firms of the same type. If the profit of a merged firm is distributed equally between countries, each country's welfare changes proportionally to the global welfare, and a merger is desirable for a country whenever it is desirable for the global economy. If H

obtains a larger portion of the profit of a merged firm than F, H is more likely to gain whereas F is more likely to lose.

Consider next a Type (II) merger between an efficient firm in H and an inefficient firm in F. In this case, it is possible that F gains from the merger even if all the additional profit of a merged firm goes to H. Assume that the merger takes the form of buyout of an inefficient firm in F by an efficient firm in H, and all the additional profit from the merger accrues to H. Under this assumption, F loses from the merger in many occasions. However, when both types of firms export, F can gain from the merger. Before the merger, four firms (i.e., efficient and inefficient firms in both countries) are supplying goods in F. The merger reduces this number of firms to three (i.e., an inefficient firm in H, an efficient firm in F, and a merged firm) and alleviate competition in F. This reduces the consumer surplus in F but increases the producer surplus of an efficient firm in F. The latter effect dominates the former effect, and the social surplus in F increases. This mechanism is similar to that shown in Lahiri and Ono[20]. After the merger, there is no export from an inefficient firm in F to H, which reduces the consumer surplus in H and increases the producer surplus in H. Furthermore, the merger increases the producer surplus in H coming from sales in F. When the trade cost is small, the positive effects dominate the negative effect, and H gains from the merger, and the opposite holds true otherwise.

Finally, consider a Type (III) merger between domestic firms. If inefficient firms are inactive, the merger has no impacts. Otherwise, it alleviates competition, reduces the consumer surplus, and increases the producer surplus. The negative effect dominates the positive effect in the country where the merger occurs, and the opposite holds true in the other country. This is because the

domestic merger implies elimination of an inefficient firm in the country, which occupies only a small share in the other country, and hence, the mechanism shown in Lahiri and Ono[20] works in the other country.

f) Likelihood of a merger

It is also worth examining which type of merger is most likely to take place. We do this by comparing gains from a merger ($\pi_M - \pi_{ij} - \pi_{hk}$) of each type. The following figure shows the merger type that yields the highest gain.
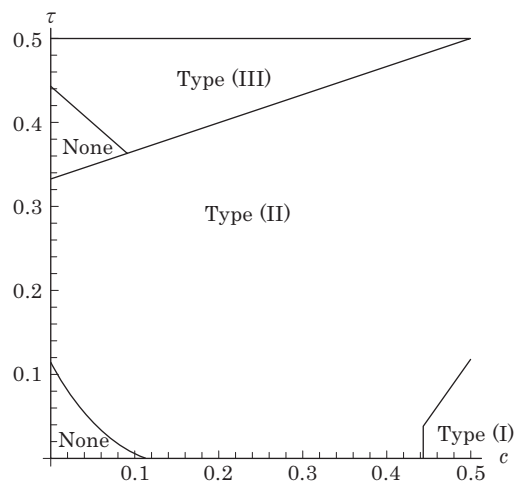

Fig.2 Merger type that leads to the highest gain.

In Figure 2, "None" indicates that no merger yields positive gains. Note, first, that a cross-border merger between inefficient firms (Type (IV)) never leads to the highest gain. When the cost difference is large and the trade cost is low, only a cross-border merger between efficient firms (Type (I)) and one between heterogeneous firms (Type (II)) are profitable. The large cost difference implies that the market share of inefficient firms is low. A Type (II) merger enables the merged firm to obtain much of the market share in both countries, whereas a merged firm of Type (II) merger can become a monopolist domestically but cannot obtain a large share in the foreign country because it must compete with an efficient

— 10 —

foreign firm. In this case, a Type (I) merger yields the highest gain. When the trade cost is very high, only a domestic merger between heterogeneous firms (Type (III)) is profitable. For other cases, a cross-border merger between heterogeneous firms (Type (II)) yields the highest gain because of the tariff-jumping effect and the spillover effect.

4. Extensions

(1) Merger waves

In this section, we explore the conditions under which we observe merger waves, that is, the conditions under which a pairwise merger is followed by another merger.

Before moving to a full analysis of merger waves, we need to examine whether there is an incentive to merge for the remaining two firms given the pairwise merger described in the previous section. In doing so, we ignore the possibility of a merger of one firm and an already merged firm. We now mention four types of second pairwise mergers: (I-2) firms 2 and 2 in countries H and F merge, given that firms 1 and 1 in countries H and F merge; (II-2) firm 2 in country H and firm 1 in country F merge given that firm 1 in country H and firm 2 in country F merge; (III-2) firms 1 and 2 in country F merge given that firms 1 and 2 in country H merge; and (IV-2) firms 1 and 1 in countries H and F merge given that firms 2 and 2 in countries H and F merge. In considering the incentive to merge, we again use the same criterion as that used in the previous section: gains from merger. Appendix D provides the profits of firms under each type of a second pairwise merger.

We now compare the *ex ante* and *ex post* profits of the merged firms. We can use the conditions of the exogenous parameters (c and τ) in Section 3.2. In each case, we have to check whether the merged firm's profit (*ex*

post profit) is larger than the *ex ante* joint profits of the merged firms. In Appendix E, we summarize the profitability of a second pairwise merger in Figure 6.

Combining the results obtained thus far, we can explore the possibility of merger waves by analyzing a sequential merger game *a la* Nilssen and Sørgard [26]. More concretely, we provide a discussion of merger decisions made in sequence by disjointed groups of firms. In our model, there are two possible pairwise mergers that can take place in this industry.[10] We denote the two mergers that can potentially take place as M_1 and M_2. As discussed earlier, there are four types of sequential mergers:

Type (I→I-2): M_1：Firms 1 and 1 in countries H and F, M_2：Firms 2 and 2 in countries H and F.

Type (II→II-2): M_1：Firm 1 in country H and firm 2 in country F, M_2：Firm 1 in country F and firm 2 in country H.

Type (III→III-2): M_1：Firms 1 and 2 in country H, M_2：Firms 1 and 2 in country F.

Type (IV→IV-2): M_1：Firms 2 and 2 in countries H and F, M_2：Firms 1 and 1 in countries H and F.

We now consider the following three-stage game. In this model, the industry is initially in the no-merger situation. There is an opportunity for the firms in M_1 to merge at stage one and for the firms in M_2 to merge at stage two. Hence, M_1 is the first mover. The firms in M_2 observe whether or not M_1 has merged before they make their own merger decision. After merger decisions are made, the firms compete in the market.

In each type of merger, there are four situations that may occur $S \equiv \{s_0, s_1, s_2, s_3\}$.

---

[10] Let us remember that we assumed that each merger consists of two firms and that we ignore a merger of one firm and an already merged firm.

Situation s_0: no merger takes place.

Situation s_1: the firms in M_1 merge, while the firms in M_2 do not.

Situation s_2: the firms in M_2 merge, while the firms in M_1 do not.

Situation s_3: both the firms in M_1 and those in M_2 merge.

Situation s_3 describes the merger waves.

The profit of entity τ in situation s is $\pi_\tau(s)$, and social surplus in situation s is $W(s)$, where $s \in S$ and $\tau \in \{1H, 2H, 1F, 2F, M_1, M_2\}$. We now define four labels, Δ_i^1, Δ_i^2, Δ_i^3, and Δ_i^4 as follows:

$$\Delta_i^1 \equiv \pi_{Mi}(s_i) - \sum\nolimits_{j \in M_i} \pi_j(s_0),\ i \in \{1, 2\},$$

$$\Delta_i^2 \equiv \pi_{Mi}(s_3) - \sum\nolimits_{j \in M_i} \pi_j(s_k),\ i, k \in \{1, 2\}, i \neq k,$$

$$\Delta_i^3 \equiv \pi_{Mi}(s_3) - \sum\nolimits_{j \in M_i} \pi_j(s_0),\ i \in \{1, 2\},$$

$$\Delta_i^4 \equiv \pi_{Mi}(s_i) - \sum\nolimits_{j \in M_i} \pi_j(s_k),\ i \in \{1, 2\}, i \neq k.$$

If Δ_i^1 is positive, the merger of the firms in M_i increases their profits given that M_j does not merge. If Δ_i^2 is positive, the merger of the firms in M_i increases their profits given that M_j merges. If Δ_i^3 is positive, the sequential mergers increase the profits of the firms in M_i. If Δ_i^4 is positive, the firms in M_i prefer their own merger to the rival's merger.

We now denote four regimes according to the signs of M_2's gains from merging, either alone (Δ_2^1) or after M_1 has merged (Δ_2^2):

As mentioned in Nilssen and Sørgard[26] (p.1689, Proposition 1), in regime r, M_1 should merge if and only if $\Delta_1^r > 0$, $r \in \{1, 2, 3, 4\}$. In each regime, we check the sign of Δ_1^r and which situations appear under the exogenous parameters. Since those calculations are simple but highly tedious, we summarize those calculations in four figures (Figures 3-a, 3-b, 3-c, and 3-d).

From these figures, we have the following proposition.

Proposition 5 *The large cost difference induces both domestic and cross-border merger waves that* consist of mergers between heterogeneous firms. *Cross-border merger waves that consist of mergers between firms of the same type are possible only when both the cost difference and trade cost are moderate.*
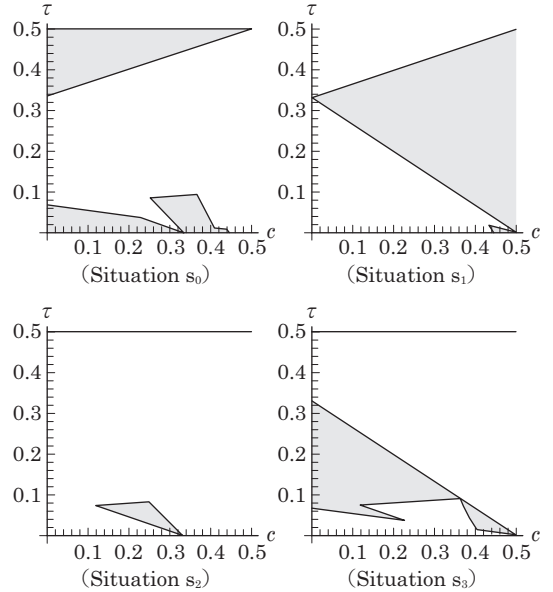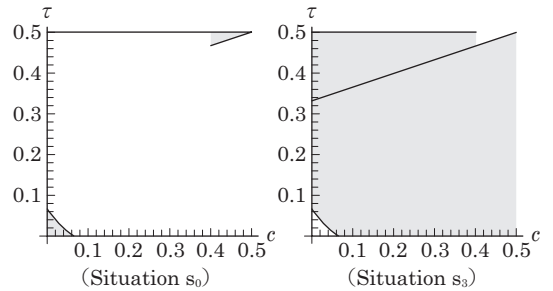

Fig. 3-a   Sequential mergers (Type (I→I-2)).

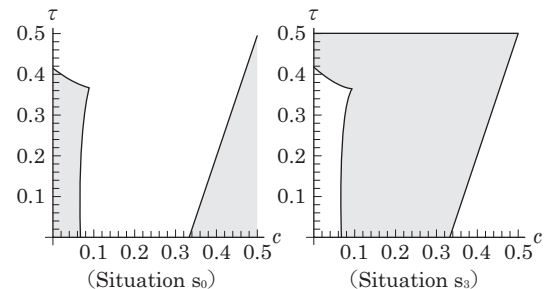Fig. 3-b   Sequential mergers (Type (II→II-2)).

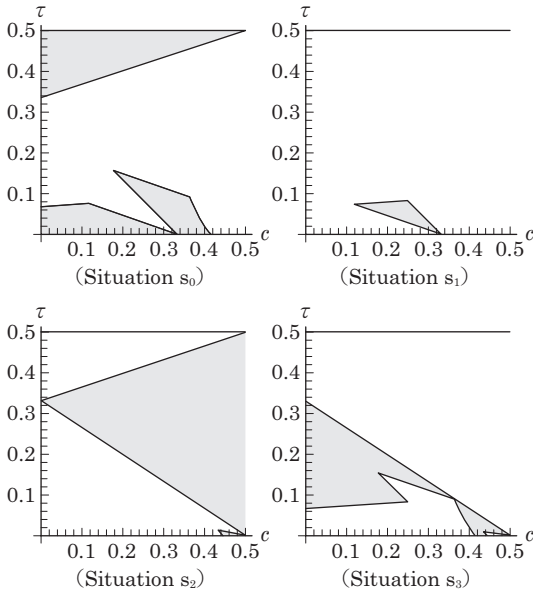Fig. 3-c   Sequential mergers (Type (III→III-2)).

Fig. 3-d　Sequential mergers (Type (IV→IV-2)).

From Figure 3-b and Figure 3-c, it is note-worthy that a merger between heterogeneous firms always leads to merger waves. This result is very similar to that obtained in Salvo [32] (Proposition 1). However, quite a different picture emerges when we focus on mergers between firms of the same type. The first pairwise merger is unlikely to be followed by another merger when both the trade cost and cost difference are sufficiently large (see Figure 3-a and Figure 3-d). This indicates that the possibility of merger waves depends on the type of firms involved in the lead-off merger.

(2) Asymmetric countries

In this section, we explore the profitability and desirability of mergers when countries are asymmetric in the composition of efficient and inefficient firms. Here, we restrict our attention only on a pairwise merger between two firms, as in the case of the myopic merger incentives described in Neary [27]. Moreover, for the sake of expositional simplicity, we assume no trade cost ($\tau = 0$).[11] Consider n firms ($n > 2$) in each

country. Among n firms, $\lambda_j n$ firms are efficient firms (type 1 firms), and $(1-\lambda_j)n$ firms are inefficient firms (type 2 firms), where $0 \leq \lambda_j \leq 1$. Note here that λ_j may differ between countries. Prices in a Cournot equilibrium when all firms engage in trade are given by

$$
\begin{aligned}
P_j &= 1 - Q_j \\
&= 1 - [\,\lambda_j n q_{1jj} + (1-\lambda_j)n q_{2jj} + \lambda_k n q_{1kj} \\
&\quad + (1-\lambda_k)n q_{2kj}\,],
\end{aligned}
$$

and equilibrium outputs are determined by

$$
q_{1jk} = P_k, \qquad q_{2jk} = P_k - c. \tag{9}
$$

The conditions under which inefficient firms produce are given by

$$
\lambda_H + \lambda_F < \Gamma \equiv \frac{1-c}{cn}.
$$

Note here that it can be readily confirmed that efficient firms always produce. Therefore, both types of firms produce if $\lambda_H + \lambda_F < \Gamma$. We assume this inequality to hold true throughout this subsection. As in Section 3, the merger incentive is examined by the profitability (5) of a merger that is defined as the difference between the profit of a firm after a merger and the total profits of two firms before a merger.

The following proposition summarizes the merger in this case:[12]

Proposition 6 *There is no incentive of a merger for two efficient firms or for two inefficient firms. An efficient firm and an inefficient firm have an incentive to merge if and only if $\lambda_H + \lambda_F > \Omega$. Here, Ω is defined as*

$$
\Omega \equiv \frac{4n(n-1)-1-c(12n^2-1)}{cn[4n(n-1)-1]}.
$$

Figure 4 describes the region in which a merger between heterogeneous firms is profitable. In the figure, the horizontal and vertical axes represent λ_H and λ_F, respectively.

First, note that a merger between heterogeneous firms is profitable if there are a sufficiently large number of efficient firms in the economy

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[11] The case of positive trade costs is explored numerically in Matsushima *et al.* [23]

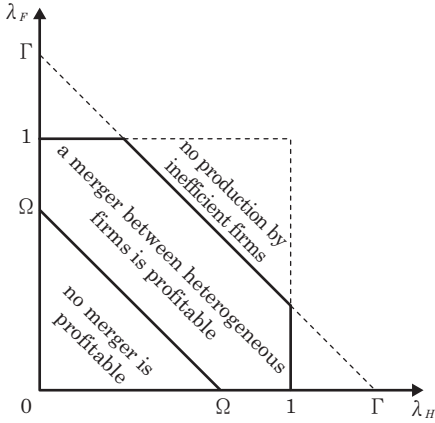[12] See Appendix F for the proof of this proposition.

Fig. 4 Merger incentive under country asymmetry.

as a whole. In this case, a merger implies a reduction in the number of inefficient firms, leading to a trade-off between increases in the price and reductions in the joint output of two merging firms compared to the pre-merger environment. When a large number of efficient firms are in the economy, the second effect becomes ignorable because the output of an inefficient firm in the pre-merger environment is sufficiently small. Second, note that, in the absence of trade cost, a domestic merger has exactly the same impact on the economy as a cross-border merger. Therefore, this case is very similar to that analyzed in Neary [27], in which all firms in one country have low costs and all firms in the other country have high costs. The focus of Neary [27] is on the impacts of the merger on the relationship between the degree of cost heterogeneity between countries and the specialization pattern of countries. In contrast, our focus here is on the relationship among merger, firm heterogeneity, and the degree of asymmetry between countries. Finally, as the cost difference c becomes larger, Ω as well as Γ decreases. Therefore, if $\lambda_H + \lambda_F$ is sufficiently low and a merger between heterogeneous firms is unprofitable, successive increases in c will make the merger profitable. In this sense, larger heterogeneity leads to proliferation of

mergers.

This result helps us to consider merger possibility under different scenarios. For example, if both countries are developing countries and both λ_H and λ_F are low, mergers are less likely to take place. If one of the two countries, for example, country H, is a developed country and λ_H is close to one, a merger is profitable even if λ_F is low.

The assumption of no trade cost enables us to go one step further, and we can examine when the mergers described above are desirable from the welfare viewpoint, even with asymmetric countries. Again, the criterion of welfare is the social surplus W that is given by (6). Denoting the pre-merger and post-merger surpluses as W_t and W_m, respectively, it is readily confirmed that

$$W_m - W_t = \frac{c^2[3 + 8n(1+n)]}{4(1+2n)^2}$$
$$\times (\lambda_H + \lambda_F - \Gamma)(\lambda_H + \lambda_F - \Phi),$$

where Φ is defined as

$$\Phi \equiv \frac{c[4n(8n^2 + 4n - 1) - 3] - 16n^3 + 8n + 3}{cn[8n(1+n) + 3]}.$$

From this, we have the following proposition:

Proposition 7 *A merger between an efficient firm and an inefficient firm is desirable if and only if* $\lambda_H + \lambda_F < \Phi$.

Once we compare Φ with Γ and with Ω, we observe three possible cases, which are described in Figures 5-a, 5-b, and 5-c.[13]
Figure 5-a represents the case of small cost difference, c. In this case, Φ is small, and the desirability of a merger requires that there be only few efficient firms in the economy. This is because a small cost difference implies small gains from improving efficiency by a merger, which dominates the loss from decreasing the

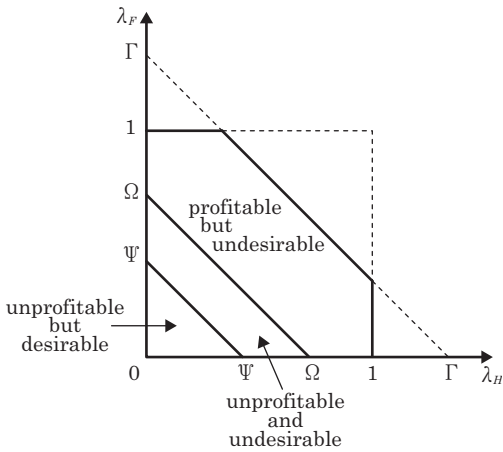---

[13] See Appendix G for details.

Fig. 5-a   Profitability and desirability: The case of a small cost difference
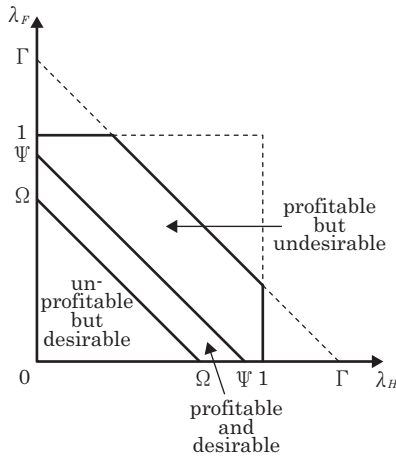(i.e., $c \leq n[4n(n-1)-1]/(8n^3-2n^2+1)$).

Fig. 5-b   Profitability and desirability: The case of a moderate cost difference
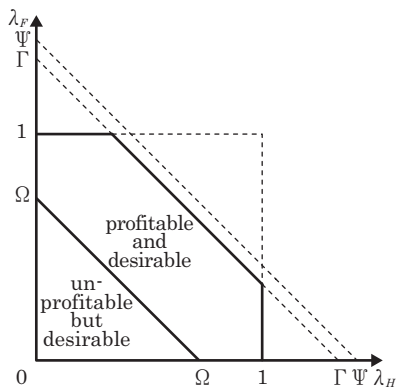(i.e., $n[4n(n-1)-1]/(8n^3-2n^2+1)<c\leq 2n/(1+4n)$).

Fig. 5-c   Profitability and desirability: The case of a large cost difference
(i.e., $c>2n/(1+4n)$).

number of firms only when efficient firms are scarce. As a result, profitable mergers are not desirable, whereas desirable mergers are not profitable. As the cost difference gets larger, the effect of improving efficiency becomes larger, and the region in which a merger is desirable also becomes larger, leading to Figure 5-b. Now some profitable mergers are desirable. When the cost difference is sufficiently large, as seen in Figure 5-c, all profitable mergers become desirable.

5.   Concluding remarks

We investigated the role of firm heterogeneity in considering M&As in the international economy. We showed that larger firm heterogeneity leads to the proliferation of both domestic and cross-border mergers and that whether or not the first pairwise merger leads to merger waves depends on the types of firms involved in it. Furthermore, we uncovered the conditions under which one can find a discrepancy between profitability and desirability for a merger, and showed, for example, that a profitable merger between heterogeneous firms is desirable if it is cross-border, and If it is domestic, it is desirable only when the cost difference is sufficiently large. Although we do not intend to claim that our arguments took everything regarding M&As into consideration, it would be safe to say that our analysis shed some light on the important features of M&As. Especially, given the important literature on firm heterogeneity in the field of international trade, our results should play an important role as a bridge between this M&A literature and trade literature.

It is of value to report some possible extensions. First, we assumed there are only two types of firms, which may limit the scope of the analysis and should be extended to have more types of firms. As shown in Barros [3], we

may be able to examine which combination is most likely among mergers between heterogeneous firms in the context of cross-border mergers. Second, we first fixed the merger pair, and then checked the profitability of that merger. It would be interesting to endogenize the choice of a merger partner. Finally, multidimensional competition among heterogeneous firms is worth analyzing. Especially, R&D investment that precedes the quantity competition has been shown to play an important role in determining merger profitability (see Davidson and Ferrett [10], among others). Given the importance of R&D activities in the current economy, extensions in this direction would be promising.

Appendix A. Derivations of trade and supply patterns

This appendix describes the formal derivations of trade and supply patterns. First, note that any firm obtains positive profits from domestic sales whenever profits from exports are positive. Furthermore, note that efficient firms obtain positive profits from domestic sales (from exports) whenever inefficient firms obtain positive profits from domestic sales (from exports). Finally, note that assumption $c < 1/2$ ensures that all firms earn positive profits under autarky. Then, the following cases are possible. **Pattern** (**i**):

All firms supply goods in both countries. **Pattern** (**ii**): All firms supply goods in a domestic market, but only efficient firms export. **Pattern** (**iii**): Only efficient firms are active, and the supply goods in both countries. **Pattern** (**iv**): All firms supply goods in a domestic market, but no firms export (autarky).

Pattern (i) is fully described in the main text, and we obtain

$$r_{1jd} > 0, \ \forall \, \tau > 0,$$
$$r_{1jx} > 0 \Leftrightarrow \tau < \frac{1+2c}{3},$$
$$r_{2jd} > 0 \Leftrightarrow \tau > \frac{3c-1}{2},$$
$$r_{2jx} > 0 \Leftrightarrow \tau < \frac{1-3c}{3}. \tag{A1}$$

In pattern (ii), firms' profits in country j are given as

$$\pi_{1j} = P_j q_{1jj} + (P_k - \tau) q_{1jk},$$
$$\pi_{2j} = (P_j - c) q_{2jj},$$

and the total supply Q in country j is given by $Q_j = q_{1jj} + q_{2jj} + q_{1kj}$. Hence, the supply functions become

$$q_{1jj} = \frac{1+c+\tau}{4}, \qquad q_{1jk} = \frac{1+c-3\tau}{4},$$
$$q_{2jj} = \frac{1+c+\tau}{4}.$$

Substituting the above equations into (1), we obtain

$$r_{1jd} > 0, \ \forall \, \tau > 0,$$
$$r_{1jx} > 0 \Leftrightarrow \tau < \frac{1+c}{3},$$
$$r_{2jd} > 0 \Leftrightarrow \tau > 3c - 1. \tag{A2}$$

Similarly, pattern (iii) yields

$$\pi_{1j} = P_j q_{1jj} + (P_k - \tau) q_{1jk},$$
$$q_{1jj} = \frac{1+\tau}{3}, \qquad q_{1jk} = \frac{1-2\tau}{3},$$
$$r_{1jd} > 0, \ \forall \, \tau > 0, \qquad r_{1jx} > 0 \Leftrightarrow \tau < \frac{1}{2}. \tag{A3}$$

Finally, in pattern (iv), we have

$$\pi_{1j} = P_j q_{1jj}, \qquad \pi_{2j} = (P_j - c) q_{2jj},$$
$$r_{1jd} > 0 \quad \text{and} \quad r_{2jd} > 0, \ \forall \, \tau > 0. \tag{A4}$$

From (A1), we know that pattern (i) is possi-

ble for some positive trade cost τ only when $0 < c \leq 1/3$. Hence, we consider the case of $0 < c \leq 1/3$ and that of $1/3 < c < 1/2$ separately. We start from the case of $0 < c \leq 1/3$. In this case, both firms earn positive profits from exports as well as domestic sales for τ smaller than $(1-3c)/3$, and, thus, pattern (i) appears. Furthermore, note that only pattern (i) happens when $0 < \tau < (1-3c)/3$ because each firm supplies goods whenever the price exceeds the cost of supply (see (1)). Put differently, when $0 < \tau < (1-3c)/3$, even inefficient firms can earn from exports, and other patterns (e.g., pattern (ii)) cannot be in equilibrium. If τ becomes larger than $(1-3c)/3$, (A2) implies that inefficient firms cannot earn from exports and the economy is now in pattern (ii). Pattern (ii) holds true as long as $(1-3c)/3 \leq \tau < (1+c)/3$ (see (A2)). For $\tau = (1+c)/3$, exports are not profitable even for efficient firms, and the economy is in autarky (pattern (iv)) when $\tau > (1+c)/3$.

When there is a large cost difference ($1/3 < c < 1/2$), it is convenient to start from pattern (ii), which is, from (A2), now possible when $0 < 3c-1 < \tau < (1+c)/3$. For $\tau = 3c-1$, even domestic sales are not profitable for inefficient firms which then stop producing goods; thus, pattern (iii) emerges. Because $3c-1 < 1/2$, (A2) implies that pattern (iii) holds true when $0 < \tau \leq 3c-1$. Meanwhile, when $\tau = (1+c)/3$, exports are not profitable even for efficient firms, and the economy is in autarky (pattern (iv)) when $\tau > (1+c)/3$.

Appendix B. Profits of firms under each type of a merger

Type (I): By symmetry, we only have to consider country H. There are potentially three firms: a merged efficient domestic firm, an inefficient domestic firm, and an inefficient foreign firm. Depending on the values of τ

and c, two patterns appear in the presence of a merger: (a) the merged firm and the inefficient domestic firm supply and (b) all firms supply. In the following, π_{Mj} and π_{ijk} represent the profits of a merged firm from sales in country j and of firm i located in country j from sales in country k, respectively.

Pattern (a) ($\tau \geq (1-2c)/3$): The profits of firms from sales in country H are

$$\pi_{MH} = \frac{(1+c)^2}{9}, \qquad \pi_{2HH} = \frac{(1-2c)^2}{9}.$$

Pattern (b) ($\tau < (1-2c)/3$): The profits of the firms are

$$\pi_{MH} = \frac{(1+2c+\tau)^2}{16}, \qquad \pi_{2HH} = \frac{(1-2c+\tau)^2}{16},$$

$$\pi_{2FH} = \frac{(1-2c-3\tau)^2}{16}.$$

Type (II): The market structure in country H is equivalent to the basic one except for the absence of the inefficient foreign firm. From Proposition l, we have the following result.

Pattern (a) ($\tau \geq (1+c)/3$): The profits of the firms are

$$\pi_{MH} = \frac{(1+c)^2}{9}, \qquad \pi_{2HH} = \frac{(1-2c)^2}{9}.$$

Pattern (b) ($c < 1/3$ and $\tau < (1+c)/3$): The profits of the firms are

$$\pi_{MH} = \frac{(1+c+\tau)^2}{16}, \qquad \pi_{2HH} = \frac{(1-3c+\tau)^2}{16},$$

$$\pi_{1FH} = \frac{(1+c-3\tau)^2}{16}.$$

Pattern (c) ($c \geq 1/3$ and $(3c-1) \leq \tau < (1+c)/3$): The profits of the firms are

$$\pi_{MH} = \frac{(1+c+\tau)^2}{16}, \qquad \pi_{2HH} = \frac{(1-3c+\tau)^2}{16},$$

$$\pi_{1FH} = \frac{(1+c-3\tau)^2}{16}.$$

Pattern (d) ($c \geq 1/3$ and $\tau < (3c-1)$): The profits of the firms are

$$\pi_{MH} = \frac{(1+\tau)^2}{9}, \qquad \pi_{1FH} = \frac{(1-2\tau)^2}{9}.$$

In country F, the former inefficient foreign

firm becomes efficient because of the spillover via integration. There are potentially three firms: a merged (efficient) firm, an efficient foreign firm, and an inefficient domestic firm. Depending on the values of τ and c, two patterns appear in equilibrium: (a') the merged firm and the efficient foreign firm supply and (b') all firms supply.

Pattern (a') $(\tau \geq (1-3c)/3)$: The profits of the firms are

$$\pi_{MF} = \frac{1}{9}, \qquad \pi_{1FF} = \frac{1}{9}.$$

Pattern (b') $(\tau < (1-3c)/3)$: The profits of the firms are

$$\pi_{MF} = \frac{(1+c+\tau)^2}{16}, \qquad \pi_{1FF} = \frac{(1+c+\tau)^2}{16},$$

$$\pi_{2HF} = \frac{(1-3(c+\tau))^2}{16}.$$

Type (III): In this case, there are potentially three firms: a merged firm, an efficient foreign firm, and an inefficient foreign firm. In country H, depending on the values of τ and c, two patterns appear in the presence of a merger: (a) the merged firm and the efficient foreign firm supply and (b) all firm supply.

Pattern (a) $((1-3c)/2 \leq \tau < 1/2)$: The profits of the firms are

$$\pi_{MH} = \frac{(1+\tau)^2}{9}, \qquad \pi_{1FH} = \frac{(1-2\tau)^2}{9}.$$

Pattern (b) $(\tau < (1-3c)/2$ (if $c \geq 1/3$, this does not appear)): The profits of the firms are

$$\pi_{MH} = \frac{(1+c+2\tau)^2}{16}, \qquad \pi_{1FH} = \frac{(1+c-2\tau)^2}{16},$$

$$\pi_{2FH} = \frac{(1-3c-2\tau)^2}{16}.$$

The market structure in country F is equivalent to the basic one except for the export of the inefficient domestic firm. From Proposition 1, we have the following result.

Pattern (a') $(\tau \geq (1+c)/3)$: The profits of the firms are

$$\pi_{1FF} = \frac{(1+c)^2}{9}, \qquad \pi_{2FF} = \frac{(1-2c)^2}{9}.$$

Pattern (b') $(c < 1/3$ and $\tau < (1+c)/3)$: The profits of the firms are

$$\pi_{MF} = \frac{(1+c-3\tau)^2}{16}, \qquad \pi_{1FF} = \frac{(1+c+\tau)^2}{16},$$

$$\pi_{2FF} = \frac{(1-3c+\tau)^2}{16}.$$

Pattern (c') $(c \geq 1/3$ and $(3c-1) \leq \tau < (1+c)/3)$: The profits of the firms are

$$\pi_{MF} = \frac{(1+c-3\tau)^2}{16}, \qquad \pi_{1FF} = \frac{(1+c+\tau)^2}{16},$$

$$\pi_{2FF} = \frac{(1-3c+\tau)^2}{16}.$$

Pattern (d') $(c \geq 1/3$ and $\tau < (3c-1))$: The profits of the firms are

$$\pi_{MF} = \frac{(1-2\tau)^2}{9}, \qquad \pi_{1FF} = \frac{(1+\tau)^2}{9}.$$

Type (IV): By symmetry, we only have to consider country H. There are potentially three firm: a merged inefficient domestic firm, an efficient domestic firm, and an efficient foreign firm. The market structure in country H is equivalent to the basic one except for the absence of the inefficient foreign firm. From Proposition 1, we have the following result.

Pattern (a) $(\tau \geq (1+c)/3)$: The profits of the firms are

$$\pi_{1HH} = \frac{(1+c)^2}{9}, \qquad \pi_{MH} = \frac{(1-2c)^2}{9}.$$

Pattern (b) $(c < 1/3$ and $\tau < (1+c)/3)$: The profits of the firms are

$$\pi_{1HH} = \frac{(1+c+\tau)^2}{16}, \qquad \pi_{MH} = \frac{(1-3c+\tau)^2}{16},$$

$$\pi_{1FH} = \frac{(1+c-3\tau)^2}{16}.$$

Pattern (c) $(c \geq 1/3$ and $(3c-1) \leq \tau < (1+c)/3)$: The profits of the firms are

$$\pi_{1HH} = \frac{(1+c+\tau)^2}{16}, \qquad \pi_{MH} = \frac{(1-3c+\tau)^2}{16},$$

$$\pi_{1FH} = \frac{(1+c-3\tau)^2}{16}.$$

Parameters c	τ	ex ante Sect.2.2	ex post Sect.3.1 (H, F)
$\forall c \in (0,1/2)$	$\tau \geq (1+c)/3$	(iv)	(a,a')
$c < 1/3$	$(1-3c)/3 \leq \tau < (1+c)/3$	(ii)	(b,a')
	$\tau < (1-3c)/3$	(i)	(b,b')
$1/3 \leq c$	$(3c-1) \leq \tau < (1+c)/3$	(ii)	(c,a')
	$\tau < (3c-1)$	(iii)	(d,a')

Pattern (d) $(c \geq 1/3$ and $\tau < (3c-1))$: The profits of the firms are

$$\pi_{1HH} = \frac{(1+\tau)^2}{9}, \qquad \pi_{1FH} = \frac{(1-2\tau)^2}{9}.$$

Appendix C. Conditions that lead to a particular combination of ex ante and ex post trade and supply patterns.

Type (I): a cross-border merger of efficient firms (firms 1 and 1 in countries H and F merge).

Type (II): a cross-border merger of efficient and inefficient firms (firm 1 in country H and firm 2 in country F merge).

Parameters c	τ	ex ante Sect.2.2	ex post Sect.3.1
$\forall c \in (0,1/2)$	$\tau \geq (1+c)/3$	(iv)	(a)
$c < 1/3$	$(1-2c)/3 \leq \tau < (1+c)/3$	(ii)	(a)
	$(1-3c)/3 \leq \tau < (1-2c)/3$	(ii)	(b)
	$\tau < (1-3c)/3$	(i)	(b)
$1/3 \leq c < 4/11$	$(1-2c)/3 \leq \tau < (1+c)/3$	(ii)	(a)
	$(3c-1) \leq \tau < (1-2c)/3$	(ii)	(b)
	$\tau < (3c-1)$	(iii)	(b)
$4/11 \leq c < 1/2$	$(3c-1) \leq \tau < (1+c)/3$	(ii)	(a)
	$(1-2c)/3 \leq \tau < (3c-1)$	(iii)	(a)
	$\tau < (1-2c)/3$	(iii)	(b)

Type (III): A domestic merger of efficient and inefficient firms (firms 1 and 2 in country H merge).

Parameters c	τ	ex ante Sect.2.2	ex post Sect.3.1 (H, F)
$c < 1/11$	$(1-3c)/2 \leq \tau < 1/2$	(iv)	(b,a')
	$(1+c)/3 \leq \tau < (1-3c)/2$	(iv)	(c,a')
	$(1-3c)/3 \leq \tau < (1+c)/3$	(ii)	(c,b')
	$\tau < (1-3c)/3$	(i)	(c,b')
$1/11 \leq c < 1/3$	$(1+c)/3 \leq \tau < 1/2$	(iv)	(b,a')
	$(1-3c)/2 \leq \tau < (1+c)/3$	(ii)	(b,b')
	$(1-3c)/3 \leq \tau < (1-3c)/2$	(ii)	(c,b')
	$\tau < (1-3c)/3$	(i)	(c,b')
$1/3 \leq c$	$(1+c)/3 \leq \tau < 1/2$	(iv)	(b,a')
	$(3c-1) \leq \tau < (1+c)/3$	(ii)	(b,c')
	$\tau < (3c-1)$	(iii)	(b,d')

Type (IV): A cross-border merger of inefficient firms (firms 2 and 2 in countries H and F merge).

Parameters c	τ	ex ante Sect.2.2	ex post Sect.3.1 (H, F)
$\forall c \in (0,1/2)$	$\tau \geq (1+c)/3$	(iv)	(a)
$c < 1/3$	$(1-3c)/3 \leq \tau < (1+c)/3$	(ii)	(b)
	$\tau < (1-3c)/3$	(i)	(b)
$1/3 \leq c$	$(3c-1) \leq \tau < (1+c)/3$	(ii)	(c)
	$\tau < (3c-1)$	(iii)	(d)

Appendix D. Profits of firms under each type of a second pairwise merger

Type (I-2): By symmetry, we only have to consider country H. There are potentially two firms: the merged efficient domestic firm $M1$ and the merged inefficient domestic firm $M2$. There is only one case: both firms supply.

The profits of the firms are

$$\pi_{M1H} = \frac{(1+c)^2}{9}, \qquad \pi_{M2H} = \frac{(1-2c)^2}{9}.$$

Type (II-2): By symmetry, we only have to consider country H. There are potentially two firms: the merged efficient domestic firms $MH1$ and $MH2$ (one of the firms becomes efficient because of the spillover effects caused by the merger). There is only one case: both firms supply.

The profits of the firms are

$$\pi_{MH\,1H} = \frac{1}{9}, \qquad \pi_{MH\,2H} = \frac{1}{9}.$$

Type (III-2): In each country, there are potentially two firms: the merged efficient domestic firm MH and the merged efficient foreign firm MF. There only is one case: both firms supply. In country H, the profits of the firms are

$$\pi_{MHH} = \frac{(1+\tau)^2}{9}, \qquad \pi_{MFH} = \frac{(1-2\tau)^2}{9}.$$

In country F, the profits of the firms are

$$\pi_{MHH} = \frac{(1-2\tau)^2}{9}, \qquad \pi_{MFH} = \frac{(1+\tau)^2}{9}.$$

Type (IV-2): By symmetry, we only have to consider country H. There are potentially two firms: the merged efficient domestic firm $M1$ and the merged inefficient domestic firm $MH2$. There is only one case: both firms supply.

The profits of the firms are

$$\pi_{M\,1H} = \frac{(1+c)^2}{9}, \qquad \pi_{M\,2H} = \frac{(1-2c)^2}{9}.$$

Appendix E.　Profitability of a second pairwise merger

The following figures summarize the profitability of incentives to merge for the remaining two firms given the pairwise merger described in Section 3.

Appendix F.　Pairwise mergers under asymmetric countries with no trade cost

In this case, it is sufficient to consider the following three cases because we need not to distinguish between the domestic merger and a cross-border merger: (i) efficient firms merge, (ii) efficient and inefficient firms merge, and (iii) inefficient firms merge. Moreover, it is obvious that a merger between firms of the same type is not profitable, i.e., (i) and (iii) are not profitable for $\forall \lambda_j \in [0,1]$ and $\forall n > 2$.
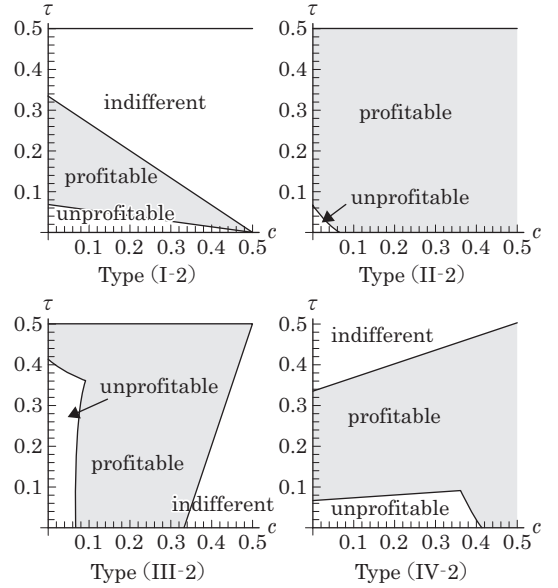

Fig. 6　Profitability of the second paiirwise merger.

Therefore, it is sufficient to consider only (ii). When an efficient firm in H and an inefficient firm in F merge, the total outputs of H and F are given by

$$Q_H = q_{mH} + (\lambda_H n - 1)q_{1HH} + (1 - \lambda_H)n q_{2HH}$$
$$\qquad + \lambda_F n q_{1FH} + [(1 - \lambda_F)n - 1]q_{2FH},$$
$$Q_F = q_{mF} + (\lambda_H n - 1)q_{1HF} + (1 - \lambda_H)n q_{2HF}$$
$$\qquad + \lambda_F n q_{1FF} + [(1 - \lambda_F)n - 1]q_{2FF}.$$

The first-order conditions for profit maximization become (9) with $\tau = 0$ and

$$q_{mj} = P_j.$$

The merger incentive In is now described by

$$In = \pi_m - \pi_{1H} - \pi_{2F}.$$

In this case, we observe that

$$In > 0 \Leftrightarrow \lambda_H + \lambda_F < \Gamma, \ \lambda_H + \lambda_F > \Omega,$$

where

$$\Omega \equiv \frac{4n(n-1) - 1 - c(12n^2 - 1)}{cn[4n(n-1) - 1]}.$$

Note here that

$$\Gamma - \Omega = \frac{4 + 8n}{4n(n-1) - 1} > 0.$$

Because we assume that $\lambda_H + \lambda_F < \Gamma$, $In > 0$ if and only if $\lambda_H + \lambda_F > \Omega$.

Appendix G. Profitability and desirability of a pairwise merger under asymmetric countries

First, note that, in this subsection, a merger is profitable if and only if $\lambda_H + \lambda_F > \Omega$, and it is desirable if and only if $\lambda_H + \lambda_F < \Phi$ because we consider only the case of $\lambda_H + \lambda_F < \Gamma$. Moreover. we already know that $\Gamma > \Omega$. A simple comparison yields

$$\Phi > \Omega \Leftrightarrow c > \frac{n[4n(n-1)-1]}{8n^3 - 2n^2 + 1},$$

$$\Phi > \Gamma \Leftrightarrow c > \frac{2n}{1+4n}.$$

Therefore, when

$$c \leq n[4n(n-1)-1]/(8n^3 - 2n^2 + 1),$$

we have Figure 5-a. Then, when

$$n[4n(n-1)-1]/(8n^3 - 2n^2 + 1) < c \leq 2n/(1+4n),$$

we observe Figure 5-b. Finally, the case in which $c > 2n/(1+4n)$ leads to Figure 5-c.

References

1) Antras, P., and E. Helpman, Global sorting. *Journal of Political Economy*, 112, 552-580, 2004.

2) Baldwin, R., Heterogeneous firms and trade: Testable and untestable properties of the Melitz model, *NBER Working Paper*, 11471, 2005.

3) Barros, P. P., Endogenous mergers and size asymmetry of merger participants, *Economics Letters*, 60, 113-119, 1998.

4) Bernard, A. B., and J. B. Jensen, Exceptional exporter performance: Cause, effect, or both?, *Journal of International Economics*, 47, 1-25, 1999.

5) Bernard, A. B., and J. B. Jensen, Exporting and productivity in the USA, *Oxford Review of Economic Policy*, 20, 343-357, 2004.

6) Bjorvatn, K., Economic integration and the profitability of cross-border mergers and acquisitions, *European Economic Review*, 48, 1211-1226, 2004.

7) Brander, J. A., lntra-industry trade in identical commodities, *Journal of International Economics*, 11, 1-14, 1981.

8) Brander, J. A., and P. Krugman, A'reciprocal dumping' model of international trade, *Journal of International Economics*, 15, 313-321, 1983.

9) Chaudhuri, A. R., and H. Benchekroun, Welfare effect of mergers and trade liberalization. *TILEC Discussion Paper Series*, 2008-009, 2008.

10) Davidson C. and B. Ferret, Mergers in multidimensional competition, *Economica*, 74, 695-712, 2007.

11) Greenaway, D., and R. Kneller, Firm heterogeneity, exporting, and foreign direct investment, *Economic Journal*, 117, F134-F161, 2007.

12) Farrell, J., and C. Shapiro, Horizontal mergers: An equilibrium analysis. *American Economic Review*, 80, 107-126, 1990.

13) Fumagalli, E., and H. Vasconcelos, Sequential cross-border mergers, forthcoming in *International Journal of Industrial Organization*, doi: 10.1016/j. ijondorg.2008. 06.002, 2008.

14) Helpman, E., Trade, FDI, and the organization of firms, *Journal of Economic Literature*, 44, 589-630, 2006.

15) Helpman, E., M. J. Melitz, and S. R. Yeaple, Export versus FDI with heterogeneous firms, *American Economic Review*, 94, 300-316, 2004.

16) Hijzen, A., H. Görg, and M. Manchin, Cross-border mergers and acquisitions and the role of trade costs, *European Economic Review*, 52, 849-866, 2008.

17) Huck, S., K. A. Konrad, and W. Müller, Merger without cost advantages, *TILEC Discussion Paper Series*, 2005-019, 2005.

18) Horn, H. and L. Persson, The equilibrium ownership of an international oligopoly, *Journal of International Economics*, 53, 307-333, 2001.

19) Ishikawa, J., and Y. Komoriya, Subsidies and countervailing duties with firm heterogeneity, *Asia-Pacific Journal of Accounting and Economics*, 14, 279-291, 2007.

20) Lahiri, S. and Y. Ono, Helping Minor Firms Reduces Welfare, *Economic Journal*, 98, 1199-1202, 1988.

21) Levy, D., and J. Reitzes, Anticompetitive effects of mergers in markets with localized competition, *Journal of Law, Economics, & Organization*, 8, 427-440, 1992.

22) Manasse, P., and A. Turrini, Trade, wages, and "superstars." *Journal of International Economics*, 54, 97-117, 2001.

23) Matsushima, N., Y. Sato, and K. Yamamoto, Trade and mergers in the presence of firm heterogeneity, *Discussion Papers in Economics and Business* 08-35, Osaka University, 2008.

24) Melitz, M. J., The impact of trade on intraindustry reallocations and aggregate industry productivity, *Econometrica*, 71, 1695-1725, 2003.

25) Melitz, M. J., and G. I. P. Ottaviano, Market size, trade, and productivity, *Review of Economic Studies*, 75, 295-316, 2008.

26） Nilssen, T., and L. Sørgard, Sequential horizontal mergers, *European Economic Review*, 42, 1683-1702, 1998.

27） Neary, J. P., Cross-border mergers as instruments of comparative advantage, *Review of Economic Studies*, 74, 1229-1257, 2007.

28） Pepall, L., D. Richards, and G. Norman, *Industrial Organization* (4th ed.), Blackwell Publishing, 2008.

29） Perry, M., and R. Porter, Oligopoly and the incentive for horizontal merger, *American Economic Review*, 75, 219-227, 1985.

30） Qiu, L. D., and W. Zhou, International mergers: Incentives and welfare, *Journal of International Economics*, 68, 38-58, 2006.

31） Salant, S., S. Switzer, and R. Reynolds, Losses from horizontal merger: The effects of an exogenous change in industry structure on Cournot-Nash equilibrium, *Quarterly Journal of Economics*, 98, 185-199, 1983.

32） Salvo, A., Sequential cross-border mergers in models of oligopoly, forthcoming in *Economica*, 2007.

　本稿では、国際的企業合併の誘因とその望ましさに対して企業の異質性が及ぼす影響を分析した。分析の結果、例えば、異質な企業同士が合併の誘因をもつ時、そうした合併が社会的に望ましいかどうかは、それが国際的であるかどうかで異なり、また、同質な企業同士が合併の誘因をもつ時、望ましさは効率的な企業同士の合併であるか、非効率的な企業同士の合併であるかで異なることが明らかになった。更に、ひとつの企業合併が更なる企業合併を呼び起こすかどうかも合併する企業のタイプに依存することが分かった

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投稿論文