

# Cross-Border Strategic Alliances and Foreign Market Entry

by

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## Abstract

This paper develops a model to study firms' incentives to form cross-border strategic alliances and their choice of foreign market entry modes (i.e., export or FDI). We find that cross-border strategic alliances promote FDI. Lower distribution costs and greater alliance synergies raise the relative attractiveness of FDI over export. There exist FDI-inducing alliance incentives. In equilibrium, alliances are formed if the firms' products are sufficiently differentiated.

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*Key Words:* Cross-border strategic alliances, export, FDI, foreign market entry, distribution costs, product differentiation

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## 1. Introduction

In the past two decades we have witnessed the acceleration of globalization. Globalization takes various forms as it penetrates countries. Beyond the traditional forms, namely export and green-field foreign direct investment (FDI), it has become common nowadays for multinationals to use cross-border mergers and acquisitions (M&As) or to form cross-border strategic alliances in order to extend their businesses internationally (OECD, 2001). The value of cross-border M&As grew from USD 153 billion in 1990 to USD 1 trillion in 2000, while the number of new cross-border strategic alliances increased from around 830 in 1989 to 4520 in 1999.<sup>1</sup> The Daimler-Chrysler merger, the Ford-Mazda alliance and the Renault-Nissan alliance are just a few examples of this new trend of globalization occurring in the automobile industry. As pointed out in the OECD Report (2001), cross-border M&As and strategic alliances are two distinctive features of the recent industrial globalization.

Why do firms form cross-border strategic alliances? What economic factors affect their incentives to form such alliances? How does this new form of globalization affect the traditional foreign entry modes? To answer to those questions, we build a two-country, multi-firm and three-stage economic model, in which the firms decide whether or not to form cross-border strategic alliances in the first stage, they make their individual choice of international entry modes in the second stage, and they compete in the market in the final stage.

We model a strategic alliance as a group of rival firms agreeing to cooperate in some aspects but compete in some other aspects. This type of partial cooperation is in fact a common feature among most strategic alliances.<sup>2</sup> Specifically, we assume that within the same alliance, the firms coordinate their production levels to lessen competition, and share their distribution networks to obtain synergies. However, they choose their international entry modes independently.<sup>3</sup> The

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<sup>1</sup>See the OECD Report (2001), which is based on Thomson Financial's database and that of the Japan External Trade Organisation (JETRO).

<sup>2</sup>From Thomson Financial's database, the OECD Report (2001) finds that strategic alliances often involve rival firms and are an instrument for combining co-operation and competition in corporate strategies. Even in M&As, approximately half of them in the United States involve integration in only some plants and divisions of the corporations, rather than the entire corporations (see Maksimovic and Phillips, 2001).

<sup>3</sup>According to Yoshino (1995), strategic alliances have the following three characteristics: (1) a few firms that unite to pursue a set of assented goals remain independent after the formation of the alliance (e.g., the independent export and FDI strategies in our model), (2) the partner firms share the benefits of

Haier-Sampo strategic alliance and the adidas-Reebok acquisition are just two examples that share some of these features.<sup>4</sup> Based on such a model, our analysis yields a number of important and empirically testable results. We find that a firm has a larger incentive to form a cross-border alliance when the products are more differentiated, the synergies derived from the alliance are stronger, and it chooses FDI as its international entry mode. In addition, cross-border alliances are strategically complementary; that is, a group of firms have a larger incentive to form an alliance when other rival firms also form alliances. These findings are supported by observations of the recent waves of cross-border strategic alliances.

With regard to international entry modes, the conventional wisdom is that the choice between export and FDI hinges on the proximity-concentration tradeoff: export involves high variable costs (e.g., trade and transport costs) but low fixed costs (e.g., plant setup costs) while FDI avoids trade costs but incurs high fixed costs.<sup>5</sup> The present paper offers some new findings: cross-border strategic alliances are conducive to FDI in the sense that the first-stage alliance formation induces all firms (both the allied firms and the non-allied firms) to choose FDI under more circumstances than without the alliance formation; the allied firms are more likely to choose FDI than are the non-allied firms; and the alliance's FDI-inducing effect in return raises the firms' incentives to form cross-border strategic alliances. In fact, these predictions are supported by the empirical finding, based on the MERIT-CATI database, that there is a strong positive relationship between the extent to which firms have overseas production (measured by the percentage of foreign employees) and their participation in international alliances (OECD,

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the alliance and the control of the performance of assigned tasks (e.g., the reduction of production levels in our model), and (3) the partner firms contribute on a continuing basis to one or more key strategic areas (e.g., marketing and distribution in our model).

<sup>4</sup>Haier is a leading electronic appliance maker in the Chinese Mainland and Sampo is a leading electronic appliance maker in Taiwan. Before 2002, they had not sold their products in each other's markets. In order to enter the new markets, on February 20, 2002, they signed a strategic alliance agreement to market each other's products in their domestic markets (*People's Daily*, February 25, 2002).

In 2005, adidas (a German company) announced its acquisition of Reebok (one of adidas' rivals from the United States). Mr. Herbert Hainer, the CEO of adidas, expected to cut costs by 125 million euros in the next three years by sharing information technology, synergies in sales and distribution, and cheaper sourcing. However, the new combined company will continue to run separate headquarters and sales forces, and keep most distribution centers apart (*The Economist*, August 6, 2005).

<sup>5</sup>See Markusen (2002) for a summary of the literature and Brainard (1997) for an empirical test of the proximity-concentration hypothesis.

2001). They are also consistent with a phenomenon observed in recent years: the co-movement of FDI and cross-border strategic alliances. This paper also generates another testable result: the firms are more likely to choose FDI over export in industries with lower distribution costs.

This paper contributes to two strands in the international trade and FDI literatures. Although there exists no systematic study on cross-border strategic alliances, our paper is related to the small but growing body of studies on cross-border mergers. We can view cross-border strategic alliances as a non-equity-exchange type of cross-border mergers, at least from analytical point of view.<sup>6</sup> Therefore, our paper is related to the existing studies on cross-border mergers. Most of these studies are concerned with the implications of trade liberalization on the profitability of cross-border mergers,<sup>7</sup> the rationales for the emergence of cross-border mergers,<sup>8</sup> and the various effects of cross-border mergers.<sup>9</sup> However, the present paper has a different focus: it examines both the FDI-inducing incentives to form cross-border strategic alliances and the effects of the alliance formations on the firms' subsequent decisions about their international entry modes.

The second strand of literature is about market entry through export and FDI. Recently, Helpman *et al.* (2004) restudied the export-FDI choice when firms are heterogeneous. We also examine the export-FDI choice, but our approach has two distinguishing features. First, we re-examine the export-FDI choice when the firms are faced with the decision of forming cross-border strategic alliances. This allows us to study the export-FDI choice within a broader decision framework. Second, we emphasize the role of distribution costs, which are a significant part of a firm's total costs.<sup>10</sup> Unlike tariffs and plant setup costs, which affect the proximity-

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<sup>6</sup>Some alliances may also involve minority equity holdings, which is frequently observed in the automobile industry (e.g., the Ford-Mazda or Renault-Nissan alliances) (OECD, 2001). A lot of M&As involve integration/cooperation only in some parts of the merging companies (Maksimovic and Phillips, 2001). Some cross-border M&As are done through exchanges of stocks, which results in no cross-border capital flow. Thus, some cross-border M&As and strategic alliances are similar.

<sup>7</sup>E.g., Long and Vusden (1995).

<sup>8</sup>E.g., Horn and Persson (2001) on trade costs, Lommerud *et al.* (2006) on plant-specific unions in oligopolistic competition, Neary (2004) on international difference in technologies, and Qiu and Zhou (2006) on information sharing.

<sup>9</sup>E.g., Head and Ries (1997), Chen (2004), and Qiu and Zhou (2006) on competition and welfare, and Neary (2004) on trade pattern and income distribution.

<sup>10</sup>Our calculation, which is based on the financial data in Volkswagen's 2004 Annual Report (p. 141), indicates that distribution costs took up 10.42% of the company's total costs in 2004. Similar percentages

concentration tradeoffs in a trivial way, distribution costs are incurred in both export and FDI. Hence, although cross-border strategic alliances reduce distribution costs, their effect on the export-FDI choice is not obvious.

Like our paper, Nocke and Yeaple's (2005) paper also stresses the important role played by the marketing and distribution costs in affecting a firm's foreign market entry mode. In their paper, cross-border M&A is introduced as one of the three entry modes, along with greenfield-FDI and export. In contrast, cross-border strategic alliances in our model are a type of cross-border cooperation that affects the firms' choice between the two entry modes, i.e., export and FDI (greenfield).<sup>11</sup>

In light of the observations that many large firms are engaging in cross-border strategic alliances (OECD, 2001), our model focuses on oligopolistic markets, similar to Horstmann and Markusen's (1992) model but in contrast to Helpman, *et al.*'s (2004) and Nocke and Yeaple's (2005) models, which assume monopolistic competition.<sup>12</sup> As a result, market power and strategic interaction are present in our model, but not in those with monopolistic competition.

The rest of this paper is organized as follows. Section 2 presents the model. Sections 3 and 4 analyze the firms' international entry modes. Section 5 examines the incentives for and the equilibrium of cross-border strategic alliances. Section 6 concludes the paper.

## 2. Model

Consider an industry in two identical countries, A and B. Assume that there are only two firms in each country: firms 1 and 2 in A, and firms 3 and 4 in B. All firms have the same production technology and they produce differentiated products.

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are also obtained for General Electric and Sony.

<sup>11</sup>Strategic alliances per se are not a means of foreign entry. They help their firms to enter foreign markets via exports or FDI. It has been observed that "many auto makers are forming and strengthening alliances with Japanese car makers in order to penetrate fast-growing Asian markets" (OECD, 2001, p. 86).

<sup>12</sup>There are two sets of evidence that support our choice of the industrial organization approach (i.e., focusing on oligopolistic markets and strategic interactions). First, as pointed out by the OECD report (2001), recent studies of multinationals outline that large-scale, cross-border M&As and strategic alliances take place because *large firms* need to adapt to a changing global environment. Thus, cross-border M&As tend to reflect an economic and industrial rationale based principally on size advantages, which have been amplified by recent institutional, technological and organizational changes. Second, governments strengthen their competition policies precisely because they worry about the resulting increased *market power* after M&As and strategic alliances are formed.

There are various types of costs. First are the plant setup costs. A firm may set up just one plant in its domestic country and uses it to serve both the domestic and foreign markets. In this case, the firm's international entry mode is export. Alternatively, the firm may set up two plants, one in each country, to serve the local market. In this case, the firm's international entry mode is FDI. Let  $S$  denote the fixed cost of setting up each plant.

The second type of cost is distribution costs. We use the term distribution costs to represent all costs incurred after production, including, e.g., the costs of building a sales force, advertisement and transportation. Assume that if a firm sells  $x$  units of its product to its domestic market, its distribution costs in that market are equal to  $(D + dx)$ , where  $D$  is the fixed part of the distribution costs (including, e.g., advertising costs) and  $dx$  is the variable part (including, e.g., wages paid to the salespersons and transport costs). However, these costs are higher when the firm's product is sold in the foreign market which the firm is less familiar with. Accordingly, we assume that a firm's distribution costs in the foreign market are  $(1 + \gamma)(D + dx)$ , where  $\gamma > 0$ . As shown by Qiu (2005), there is no loss of generality to set  $\gamma = 1$ , which simplifies many mathematical expressions in the analysis. Our emphasis on distribution costs and the above specifications about distribution costs are supported by some recent empirical studies (e.g., Maurin et al., 2002), which find that i) nowadays non-production activities, e.g., marketing, are important in business, and ii) domestic firms have an advantage over foreign firms in marketing activities in their own countries.<sup>13</sup>

The third type of cost is export costs. Let  $t$  denote the costs of shipping each unit of the product from the domestic market to the foreign market, including trans-border transport costs and tariffs. Finally, in order to emphasize the role of distribution costs, we assume that the marginal cost of production is zero.

Now we turn to the demand side. Assume that there is linear demand for the products in each market. Specifically, let  $x_{ik}$  be the demand and  $p_{ik}$  the price in market  $k \in \{A, B\}$  for the

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<sup>13</sup>Recently, some researchers also included distribution costs in their analysis of strategic alliances (Chen, 2003) and FDI (Nocke and Yeaple, 2005). Nocke and Yeaple's model (2005) also includes the feature of asymmetric marketing costs in domestic and foreign markets.

goods produced by firm  $i \in \mathcal{I} \equiv \{1, 2, 3, 4\}$  and let the inverse demand function be

$$p_{ik} = 1 - x_{ik} - bX_k^{-i}, \quad \text{where } i \in \mathcal{I}, \quad X_k^{-i} \equiv \sum_{j \in \mathcal{I} \setminus i} x_{jk}, \quad b \in (0, 1).$$

Parameter  $b$  represents the degree of product differentiation.

The firms engage in a three-stage game. In the first stage, they make strategic alliance decisions. In the second stage, each firm chooses between export and FDI. In the final stage, they produce and sell their products to both markets. They compete in a Cournot fashion in each market. To ensure that each firm always has a positive sales in its foreign market, the trade costs and distribution costs must be sufficiently low such that the following condition is satisfied:<sup>14</sup>

$$(A1) \quad 2(2 + 2b - b^2)t + (10 + 3b - 2b^2)d < (1 - b)(2 - b).$$

We assume that (A1) holds throughout the paper.

### 3. International Entry without Strategic Alliances

In this section, we derive the second- and third-stage equilibria, supposing that there is no strategic alliance formed in the first stage. We introduce an international entry mode variable,  $\lambda_i \in \{0, 1\}$ , with  $\lambda_i = 0$  representing firm  $i$  choosing FDI and  $\lambda_i = 1$  representing firm  $i$  choosing export. Let  $c_{ik}(\lambda_i)$  denote firm  $i$ 's marginal cost for selling its product to market  $k$  when its entry mode is  $\lambda_i$ . Then, for  $i \in \{1, 2\}$  and  $j \in \{3, 4\}$ ,  $c_{iA}(\lambda_i) = c_{jB}(\lambda_j) = d$ ,  $c_{iB}(1) = c_{jA}(1) = 2d + t$ , and  $c_{iB}(0) = c_{jA}(0) = 2d$ . We often suppress the entry mode variable in some expressions later for convenience. Denote  $c_k^{-i} \equiv \sum_{j \in \mathcal{I} \setminus i} c_{jk}$ .

We shall first analyze the third-stage equilibrium. Note that  $\pi_{ik} = (p_{ik} - c_{ik}(\lambda_i))x_{ik}$  is firm  $i$ 's flow profit (i.e., excluding all the fixed costs) from market  $k$ , when its entry mode is  $\lambda_i$ . It is easy to derive the following Nash equilibrium for all  $k \in \{A, B\}$  and  $i \in \mathcal{I}$ ,

$$x_{ik} = \frac{1}{\Phi} [2 - b + bc_k^{-i} - 2(1 + b)c_{ik}] \quad \text{and} \quad \pi_{ik} = (x_{ik})^2,$$

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<sup>14</sup>In each scenario, we need to check the strongest condition: any firm's output sold in the foreign market by export is positive when its domestic competitor adopts FDI. The above condition is imposed to ensure that all those conditions are satisfied.

where  $\Phi \equiv 4 + 4b - 3b^2$ . Let  $\Pi_i(\lambda_i)$  denote firm  $i$ 's total profit. Then,

$$\Pi_i(\lambda_i) = \pi_{iA} + \pi_{iB} - S - 3D - (1 - \lambda_i)S.$$

Now, we go backward to analyze the second stage of the game. Let us focus on firm 1's decision. Given  $\lambda_2$ ,  $\lambda_3$  and  $\lambda_4$ , firm 1 chooses  $\lambda_1$  to maximize its total profit. Denote  $\Delta\Pi_1 \equiv \Pi_1(0) - \Pi_1(1)$ . Firm 1 chooses FDI if  $\Delta\Pi_1 > 0$ , and it chooses export if  $\Delta\Pi_1 \leq 0$ . Using the equilibrium results of the third stage, we obtain  $\Delta\Pi_1 = \Delta\pi(d; \lambda_2) - S$ , where

$$\Delta\pi(d; \lambda_2) = \pi_{1B}(0) - \pi_{1B}(1) = \frac{4(1+b)t}{\Phi^2} [2 - b - 4d - (1+b)t + bt\lambda_2]. \quad (1)$$

This result immediately implies the following lemma.

**Lemma 1.** *In the absence of strategic alliances, a firm's international entry mode depends on its domestic competitor's international entry mode, but not on the entry modes of the foreign firms. Lower (marginal) distribution costs raise the relative attractiveness of FDI over export.*

A few remarks on (1) and Lemma 1 are in order. First, firm 1's profit difference between FDI and export is affected by market B only, because the two markets are segmented. Second, with FDI, the firm avoids the trade costs and hence it sells more to market B under FDI than under export. As a result, the (marginal) distribution cost,  $d$ , has a larger negative impact on the firm's FDI profits than on its export profits. This explains why  $\Delta\pi(d; \lambda_2)$  decreases in  $d$ .

Third,  $\Delta\pi(d; 1) > \Delta\pi(d; 0)$ ; that is, firm 1's profit difference is larger when firm 2 chooses export than when it chooses FDI. Because of the trade costs, when firm 2 chooses export, it becomes less aggressive in market B, and, in response, firm 1 produces more for this market. Then, with larger sales in market B, firm 1 will see the increased attractiveness of FDI over export.

Fourth, the entry modes of firms 3 and 4 affect these firms' competitiveness in market A, but not in market B. Hence, firm 1's profits derived from market B are not affected by its foreign competitors' entry modes.

Now, we examine the strategic interaction between firms 1 and 2's entry modes. Denote  $S^0 = \Delta\pi(0; 0)$  and  $S^1 = \Delta\pi(0; 1)$ . Note, from (A1), that for given  $b$  and  $t$ , we have an upper

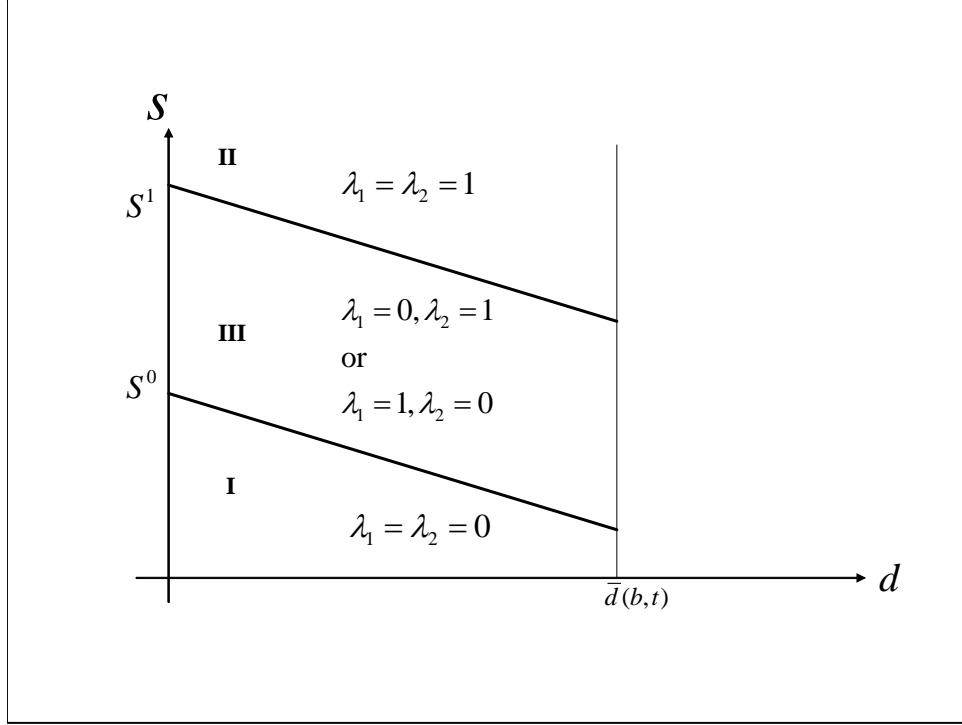


Figure 1: International Entry Mode Equilibrium

bound for  $d$ :  $d < \bar{d}(b,t)$ . We depict in Figure 1 two straight lines, in the  $d$ - $S$  space, which divide firm 1's entry mode into three regions. The lower dividing line (LDL) is obtained from  $\Delta\Pi_1 = 0$  at  $\lambda_2 = 0$ , and the upper dividing line (UDL) is obtained from  $\Delta\Pi_1 = 0$  at  $\lambda_2 = 1$ . These two dividing lines are parallel. In region I,  $\Delta\Pi_1 > 0$  for all  $\lambda_2$ , and so firm 1's dominant strategy is FDI. This is because the plant setup costs are very small. In region II,  $\Delta\Pi_1 < 0$  for all  $\lambda_2$ , and so firm 1's dominant strategy is export. This is because the plant setup costs are very large. In region III,  $\Delta\Pi_1 > 0$  if  $\lambda_2 = 1$ , but  $\Delta\Pi_1 < 0$  if  $\lambda_2 = 0$ . Hence, firm 1's optimal response to firm 2's entry mode is  $\lambda_1 = 0$  when  $\lambda_2 = 1$ , but  $\lambda_1 = 1$  when  $\lambda_2 = 0$ . That is the medium plant setup cost case and thus firm 2's entry mode has a relatively larger impact on firm 1's foreign market profitability. If firm 2 chooses FDI (export), it becomes more (less) aggressive in market B, and, as a result, firm 1's optimal response is to choose a less (more) aggressive mode, i.e., export (FDI).

Due to symmetry, firm 2's optimal entry decision has exactly the same regions as firm 1's.

Thus, the equilibrium international entry modes are

$$\begin{cases} \lambda_1 = \lambda_2 = 0, & \text{in region I,} \\ \lambda_1 = \lambda_2 = 1, & \text{in region II,} \\ \lambda_1 = 0 \text{ and } \lambda_2 = 1, \text{ or } \lambda_1 = 1 \text{ and } \lambda_2 = 0, & \text{in region III.} \end{cases}$$

Firms 3 and 4 have the same equilibrium entry modes as described above, with  $\lambda_1$  being replaced by  $\lambda_3$  and  $\lambda_2$  by  $\lambda_4$ .

It is worth pointing out that the presence of strategic dependence of a firm's entry mode on its domestic rival's comes from oligopolistic competition. In contrast, a firm's international entry mode as characterized by Helpman, *et al.* (2004) and Nocke and Yeaple (2005) does not depend on other firms' decisions.

#### 4. International Entry with Cross-Border Strategic Alliances

In this section, we examine the second-stage international entry equilibrium when strategic alliances have been formed in the first stage. We confine our analysis to strategic alliances that have the following characteristics. First, after a cross-border strategic alliance has been formed, each allied firm still produces its own variety of the product. Hence, strategic alliances do not reduce product variety.<sup>15</sup>

Second, a cross-border strategic alliance helps the allied firms to reduce their foreign-market distribution costs from  $2(D + dx)$  to  $(1 + \delta)(D + dx)$  where  $\delta \in [0, 1)$ . The cost savings represent the synergies created by a strategic alliance and such synergies exist with both FDI and export. This assumption is supported by facts. According to the OECD Report (2001), approximately 27% of cross-border strategic alliances (18,939 in number) in the 1990s were for marketing and distribution purposes. Although there are also cross-border strategic alliances that help to reduce plant setup costs through joint production, the effects of such strategic alliances on the choice between FDI and export are straightforward: they promote FDI over export because such cost savings help FDI but not export. In contrast, marketing-motivated cross-border strategic alliances generate cost savings for both FDI and export. Thus, the effects of this type of strategic alliances on the firms' export-FDI choice are not obvious.

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<sup>15</sup>One such example in the real world is Ford's M&As. After the M&As, the target firms' car models, e.g., SAAB, Volvo and Jaguar, were still produced. This is a common approach in M&As models with differentiated products.

Third, the firms in a strategic alliance coordinate their output levels to internalize competition, but they choose their individual international entry modes independently.<sup>16</sup>

Note that because there is no synergy created from a strategic alliance formed by the firms from the same country, it is not profitable for two domestic firms to form a strategic alliance, which is a well known result from Salant, *et al.* (1983) for mergers. Thus, in our model each strategic alliance must be a cross-border alliance. Assume that anti-trust policies disallow all four firms to form one grand alliance.

#### 4.1. The Symmetrical Case

Suppose that there are two strategic alliances, one between firms 1 and 3 (called the 1+3 alliance) and the other between firms 2 and 4 (called the 2+4 alliance). Use “ $\wedge$ ” to denote variables for this case. We first derive the international entry equilibrium and then examine how it differs from that in the absence of any strategic alliance.

■ *The final stage equilibrium.* Each firm’s marginal cost in its domestic market remains the same as in the case with no alliance, i.e.,  $\hat{c}_{ik} = c_{ik}$ , but its marginal cost in the foreign market is  $\hat{c}_{ik}(\lambda_i) = (1 + \delta)d + \lambda_i t$ . In the third stage of the game, each pair of allied firms chooses output to maximize their joint profits. Since the markets are segmented, the allied firms maximize their joint profits from each market. Specifically, firms 1 and 3 choose  $\hat{x}_{1k}$  and  $\hat{x}_{3k}$  jointly to maximize  $\hat{\pi}_{1k} + \hat{\pi}_{3k}$ , taking  $\hat{x}_{2k}$  and  $\hat{x}_{4k}$  as given. Firms 2 and 4 have the similar profit maximization. As a result, the Nash equilibrium in each market can be calculated as, for  $k \in \{A, B\}$ ,

$$\begin{aligned}\hat{x}_{ik} &= \frac{1}{\hat{\Phi}} [2(1-b) - (2+2b-b^2)\hat{c}_{ik} + b(2+b)\hat{c}_{jk} + b(1-b)(\hat{c}_{2k} + \hat{c}_{4k})] \quad \text{for } \{i, j\} = \{1, 3\}, \\ \hat{x}_{ik} &= \frac{1}{\hat{\Phi}} [2(1-b) - (2+2b-b^2)\hat{c}_{ik} + b(2+b)\hat{c}_{jk} + b(1-b)(\hat{c}_{1k} + \hat{c}_{3k})] \quad \text{for } \{i, j\} = \{2, 4\},\end{aligned}$$

where  $\hat{\Phi} \equiv 4(1-b)(1+2b)$ . As a result, the equilibrium prices are

$$\begin{aligned}\hat{p}_{ik} &= \frac{(1-b)}{\hat{\Phi}} [2(1+b) - (2+4b-b^2)\hat{c}_{ik} - b^2\hat{c}_{jk} + b(1+b)(\hat{c}_{2k} + \hat{c}_{4k})] \quad \text{for } \{i, j\} = \{1, 3\}, \\ \hat{p}_{ik} &= \frac{(1-b)}{\hat{\Phi}} [2(1+b) - (2+4b-b^2)\hat{c}_{ik} - b^2\hat{c}_{jk} + b(1+b)(\hat{c}_{1k} + \hat{c}_{3k})] \quad \text{for } \{i, j\} = \{2, 4\}.\end{aligned}$$

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<sup>16</sup>This is justified by the observations that, as mentioned in the introductory section, the allied firms cooperate in some areas but compete in some others.

The equilibrium profits are  $\hat{\pi}_{ik} = (\hat{p}_{ik} - \hat{c}_{ik})\hat{x}_{ik}$ , for all  $i \in \mathcal{I}$ .

A firm's entry mode affects its sales and profits from the foreign market. Let us first compare a firm's sales in its foreign market in the no-alliance case to the two-alliance case. Without loss of generality, we focus on firm 1's sales in market B. Note that when firm 1 chooses FDI, its sales in market B in the no-alliance case are  $x_{1B}(0) = [2 - b - 4d + \lambda_2 bt] / \Phi$ , and those in the two-alliance case are  $\hat{x}_{1B}(0) = \{2(1-b) - [2(1-b) + (2+b)\delta]d + \lambda_2 b(1-b)t\} / \hat{\Phi}$ . Then,  $x_{1B}(0) > \hat{x}_{1B}(0)$  if and only if

$$H_0(1-d) - H_1d + H_2\delta d + H_3\lambda_2 t > 0, \quad (2)$$

where  $H_0 \equiv 2b(1-b)(2-b)$ ,  $H_1 \equiv 4(1-b)(1+2b)(2+b)$ ,  $H_2 \equiv (4-b^2)(2+3b)$ , and  $H_3 \equiv b(1-b)(4+3b)$ , all positive. In order to understand condition (2), let us discuss how changes in  $t$  and  $\delta$  affect firm 1's sales in market B. First, *the trade-cost effect*: as  $t$  increases and if  $\lambda_2 = 1$ , inequality (2) is more likely to hold. It is well known from the merger literature that under Cournot competition and when  $d = t = 0$  and  $\delta = 1$ , the 1+3 alliance reduces its allies' output in order to reduce competition. This lowers  $\hat{x}_{1B}(0)$ . On the other hand, the 2+4 alliance reduces its allies' output, which in turn induces firm 1 to raise its output, due to strategic substitutes. This raises  $\hat{x}_{1B}(0)$ . However, the former effect always dominates the latter and so  $x_{1B}(0) > \hat{x}_{1B}(0)$ . When firm 2 chooses export and  $t$  rises, the latter effect is further reduced. Thus, inequality  $x_{1B}(0) > \hat{x}_{1B}(0)$  is reinforced.

Second, *the synergy effect*: as  $\delta$  decreases, condition (2) is less likely to hold. Due to cost synergies, the 1+3 alliance makes firm 1 more efficient and firm 1 thus raises its output in market B. Although firm 2 also becomes more efficient in market B, the strategic effect, which discourages firm 1's output expansion, is secondary. Thus,  $\hat{x}_{1B}(0)$  increases as the alliance synergies become stronger. This is an important force that could reverse inequality  $x_{1B}(0) > \hat{x}_{1B}(0)$ .

Note, when firm 1 chooses export, its sales in market B in the no-alliance are  $x_{1B}(1) = \{2 - b - 4d - [2(1+b) - \lambda_2 b]t\} / \Phi$ , and those in the two-alliance case are  $\hat{x}_{1B}(1) = \{2(1-b) - [2(1-b) + (2+b)\delta]d - [2 + 2b - b^2 - \lambda_2 b(1-b)]t\} / \hat{\Phi}$ . Hence,  $x_{1B}(1) > \hat{x}_{1B}(1)$  if and only if

$$H_0(1-d) - H_1d + H_2\delta d + H_3\lambda_2 t + 3b^2(2 + 2b + b^2)t > 0. \quad (3)$$

Compared with (2), the above inequality has an extra term that is associated with  $t$ . When firm 1 chooses export, a rise in  $t$  reduces its sales in  $B$  with and without the 1+3 alliance. However,  $\hat{x}_{1B}(1)$  decreases more because when facing a weaker firm 1, firms 2 and 4 increase their output more in response to the 1+3 alliance.

■ *The second stage equilibrium.* Given  $\lambda_2$ ,  $\lambda_3$  and  $\lambda_4$ , firm 1 chooses  $\lambda_1$  to maximize its profits

$$\hat{\Pi}_1(\lambda_1) \equiv \hat{\pi}_{1A} + \hat{\pi}_{1B} - S - (2 + \delta)D - (1 - \lambda_1)S.$$

Define  $\Delta\hat{\Pi}_1 \equiv \hat{\Pi}_1(0) - \hat{\Pi}_1(1)$ . Firm 1 chooses FDI if and only if  $\Delta\hat{\Pi}_1 > 0$ . Direct comparison yields  $\Delta\hat{\Pi}_1 = \Delta\hat{\pi}(d; \lambda_2) - S$ , where

$$\Delta\hat{\pi}(d; \lambda_2) = \hat{\pi}_{1B}(0) - \hat{\pi}_{1B}(1) = \frac{t(1-b)}{\hat{\Phi}^2} [2e_1 - (2 + 4b + b^2)(2 + 2b - b^2)t + be_1t\lambda_2 - e_2d],$$

where  $e_1 \equiv 2(2+b)(1+b-b^2)$  and  $e_2 \equiv 2e_1 + 2(1+b)(4+6b-b^2)\delta$ .

$\Delta\hat{\pi}(d; \lambda_2)$  has the same properties as  $\Delta\pi(d; \lambda_2)$ . In particular,  $\Delta\hat{\pi}(d; \lambda_2)$  decreases in  $d$ , but at a slower rate when  $\delta$  is small. The reason is that stronger alliance synergies reduce the allied firms' marginal costs more, which helps firm 1 more when it chooses FDI than when it chooses export because it has more units to sell in market B through FDI. Lemma 2 below can be easily established.

**Lemma 2.** *In the case of two strategic alliances, a firm's international entry mode depends on its domestic competitor's international entry mode, but not on the entry modes of the foreign firms. Lower (marginal) distribution costs and stronger alliance synergies raise the relative attractiveness of FDI over export.*

We now turn to deriving the equilibrium entry mode. Denote  $\hat{S}^0 = \Delta\hat{\pi}(0; 0)$  and  $\hat{S}^1 = \Delta\hat{\pi}(0; 1)$ . We could have depicted firm 1's optimal entry mode in a figure similar to Figure 1, but, to save space, we omit it. We simply replace  $S^i$  with  $\hat{S}^i$  to get the UDL and LDL, which partition firm 1's entry strategy space into three regions: region  $I^m$  (small  $S$ ), region  $II^m$  (large  $S$ ), and region  $III^m$  (medium  $S$ ). The same analysis as before leads to the following equilibrium entry modes

$$\begin{cases} \hat{\lambda}_1 = \hat{\lambda}_2 = 0, & \text{in region I}^m, \\ \hat{\lambda}_1 = \hat{\lambda}_2 = 1, & \text{in region II}^m, \\ \hat{\lambda}_1 = 0 \text{ and } \hat{\lambda}_2 = 1, \text{ or } \hat{\lambda}_1 = 1 \text{ and } \hat{\lambda}_2 = 0, & \text{in region III}^m. \end{cases}$$

Firms 3 and 4 have the same equilibrium outcomes as those given above, with  $\hat{\lambda}_1$  being replaced by  $\hat{\lambda}_3$  and  $\hat{\lambda}_2$  by  $\hat{\lambda}_4$ .

We are ready to compare the firms' entry modes in the two-alliance case to the no-alliance case. By comparing  $S^0$  and  $\hat{S}^0$ , we obtain that  $S^0 \leq \hat{S}^0$  if and only if

$$t \leq \frac{\hat{T}(b)}{\hat{T}_0(b)}, \quad (4)$$

where  $\hat{T}_0(b) \equiv 64 + 240b + 320b^2 + 112b^3 - 152b^4 - 16b^5 + 110b^6 + 3b^7 - 9b^8$  and  $\hat{T}(b) \equiv 4b^2(2-b)(16 + 36b + 11b^2 + 3b^3 + 9b^4)$ . The right hand side of (4) is an increasing function of  $b$ . It is equal to 0.065 at  $b = 0.2$ , equal to 0.304 at  $b = 0.5$ , and equal to 0.444 at  $b = 1$ . Since we are not interested in the case where  $b$  is very close to zero, (4) is not restrictive at all. The inequality  $S^0 \leq \hat{S}^0$  implies that when  $d = 0$  and  $\hat{\lambda}_2 = 0$ , the critical level of the plant setup costs above which firm 1 will not choose FDI is higher in the two-alliance case than in the no-alliance case. In the Appendix (see the proof of Proposition 1), we show that  $S^0 \leq \hat{S}^0$  implies  $S^1 \leq \hat{S}^1$ . Thus, when  $d = 0$  and  $\hat{\lambda}_2 = 1$ , the critical level of the plant setup costs above which firm 1 will not choose FDI is higher in the two-alliance case than in the no-alliance case.

The above two comparisons together show that when  $d = 0$ , firm 1 is more likely to choose FDI in the two-alliance case than in the no-alliance case. This result in fact holds for all levels of  $d$  because firm 1's dividing lines are not steeper in the two-alliance case than in the no-alliance case so long as

$$\delta \leq \frac{\hat{\Gamma}(b)}{(1+b)(4+6b-b^2)\Phi^2}, \quad (5)$$

where  $\hat{\Gamma}(b) \equiv 64 + 288b + 256b^2 - 272b^3 - 356b^4 - 118b^5 - 30b^6 + 18b^7$ . The right-hand side of (5) is decreasing in  $b$ . It is equal to 1 at  $b = 0$ , equal to 0.759 at  $b = 0.5$ , and equal to 0 at  $b = 0.9152$ . Thus, given that  $b$  is not too close to one, (5) holds for sufficiently small  $\delta$ .

When both (4) and (5) are satisfied, we can draw firm 1's dividing lines with and without the strategic alliances on the same diagram, as shown in Figure 2 for one case while the other case is drawn in the Appendix to prove Proposition 1. The relative position of these dividing

lines indicates the relative profitability of FDI over export. For example, point a in Figure 2 is below  $LDL_1^*$  but above  $UDL_1$ , and hence firm 1 adopts FDI in the two-alliance case, but it adopts export in the no-alliance case. The same comparison also applies to firms 3 and 4. Based on these comparisons, we can show that the firms adopt FDI more in the two-alliance case than in the no-alliance case, and we state this result in Proposition 1.

**Proposition 1.** *Suppose that trade costs are sufficiently low such that (4) is satisfied. In addition, suppose that the alliance synergies are sufficiently strong and the products are sufficiently differentiated such that (5) is satisfied. Then, cross-border strategic alliances induce more FDI.*

**Proof.** In the Appendix

The proposition implies that (for any given  $d$ ) when  $S$  is very large, firm 1 does not adopt FDI with or without the strategic alliances; when  $S$  drops to a certain level, it adopts FDI in the alliance case while it does not in the no-alliance case; when  $S$  becomes sufficiently small, firm 1 adopts FDI with and without the strategic alliances. The intuition behind the results for the very large and very small  $S$  cases is clear. When  $S$  takes a medium value, other factors play more important roles in affecting the firms' export-FDI choice. Since a firm produces more under FDI than under export, it benefits more from the distribution cost reduction generated by the alliance if it takes FDI than if it chooses export. This extra benefit does not exist in the no-alliance case.<sup>17</sup>

Note that the conditions stated in Proposition 1 are sufficient conditions and so violating some of these conditions does not imply a failure of the result. All these conditions are quite weak as indicated by the numbers given above.

## 4.2. The Asymmetrical Case

For the asymmetrical case, we suppose that firms 1 and 3 form the 1+3 strategic alliance but firms 2 and 4 do not. We use “ $\sim$ ” to denote variables for this case. Then, the non-allied

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<sup>17</sup>This intuition can be seen from the following output comparison. From conditions (2) and (3), we know that, for some ranges of parameter values, we may have  $x_{1B}(0) < \hat{x}_{1B}(0)$  but  $x_{1B}(1) > \hat{x}_{1B}(1)$ . Suppose that firm 1 chooses export in the no-alliance case. The 1+3 alliance results in firm 1 having lower sales in market B if it still chooses export; however, its sales will be much higher if it switches to FDI because  $\hat{x}_{1B}(0) > x_{1B}(0) > x_{1B}(1)$ . The switch allows it to extract the largest benefit from the distribution cost reduction, due to the alliance synergies.

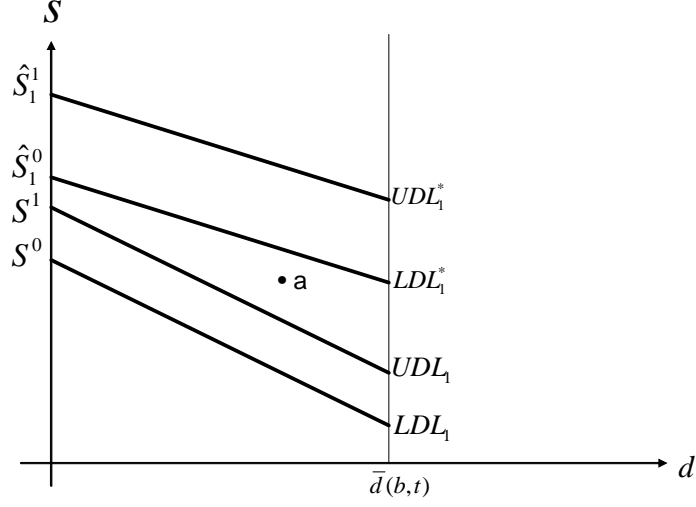


Figure 2: Entry Modes Comparison

firms' marginal costs remain the same as in Section 3, while the allied firms' marginal costs are  $\tilde{c}_{1A} = c_{1A}$ ,  $\tilde{c}_{1B}(\lambda_1) = (1 + \delta)d + \lambda_1 t$ ,  $\tilde{c}_{3B} = c_{3B}$ , and  $\tilde{c}_{3A}(\lambda_3) = (1 + \delta)d + \lambda_3 t$ .

■ *The last stage equilibrium.* Given entry modes in the second stage, the allied firms in the third stage choose output  $\tilde{x}_{1k}$  and  $\tilde{x}_{3k}$  jointly to maximize  $\tilde{\pi}_{1k} + \tilde{\pi}_{3k}$ , taking  $\tilde{x}_{2k}$  and  $\tilde{x}_{4k}$  as given. Each of the non-allied firms chooses its output to maximize its own profit. The Nash equilibrium in market  $k \in \{A, B\}$  can be calculated as

$$\tilde{x}_{ik} = \frac{1}{(1-b)\tilde{\Phi}} [(1-b)(2-b) - (1+b)(2-b)\tilde{c}_{ik} + 2b\tilde{c}_{jk} + b(1-b)(c_{2k} + c_{4k})] \quad \text{for } \{i, j\} = \{1, 3\},$$

$$\tilde{x}_{ik} = \frac{1}{(2-b)\tilde{\Phi}} [2(2-b) - 2(2+2b-b^2)c_{ik} + 2bc_{jk} + b(2-b)(\tilde{c}_{1k} + \tilde{c}_{3k})] \quad \text{for } \{i, j\} = \{2, 4\},$$

where  $\tilde{\Phi} \equiv 2(2 + 3b - b^2)$ .

The equilibrium (market) profits of the allied firms are

$$\tilde{\pi}_{ik} = \frac{\tilde{x}_{ik}}{\tilde{\Phi}} [(1+b)(2-b) - (2+3b)\tilde{c}_{ik} - b^2\tilde{c}_{jk} + b(1+b)(c_{2k} + c_{4k})] \quad \text{for } \{i, j\} = \{1, 3\},$$

and those of the non-allied firms are  $\tilde{\pi}_{2k} = \tilde{x}_{2k}^2$  and  $\tilde{\pi}_{4k} = \tilde{x}_{4k}^2$ .

■ *The second stage equilibrium.* Firm 1's total profits are

$$\tilde{\Pi}_1(\lambda_1) \equiv \tilde{\pi}_{1A} + \tilde{\pi}_{1B} - S - (1 + \delta)D - (1 - \lambda_1)S.$$

The corresponding functions for the other firms can be written similarly.

Given  $\lambda_2$ ,  $\lambda_3$  and  $\lambda_4$ , firm 1 chooses  $\lambda_1$  to maximize its total profits. Define  $\Delta\tilde{\Pi}_1 \equiv \tilde{\Pi}_1(0) - \tilde{\Pi}_1(1)$ . Firm 1 chooses FDI if and only if  $\Delta\tilde{\Pi}_1 > 0$ . Direct comparison yields  $\Delta\tilde{\Pi}_1 = \Delta\tilde{\pi}_1(d; \lambda_2) - S$ , where

$$\Delta\tilde{\pi}_1(d; \lambda_2) = \tilde{\pi}_{1B}(0) - \tilde{\pi}_{1B}(1) = \frac{t}{(1-b)\tilde{\Phi}^2} [(2-b)e_3 - (4+8b+b^2-3b^3-e_3b\lambda_2)t - 2e_4d],$$

where  $e_3 \equiv (4+4b-3b^2-b^3) > 0$  and  $e_4 \equiv 1-be_3+(4+8b+b^2-3b^3)\delta > 0$ .

The non-allied firms have different profits from the allied firms. The 1+3 alliance has both positive and negative effects on firm 2's profits. On the one hand, the alliance reduces competition which benefits firm 2. On the other hand, the alliance creates synergies, which reduce the marginal costs of firms 1 and 3 and so this hurts firm 2. Let  $\Delta\tilde{\Pi}_2 \equiv \tilde{\Pi}_2(0) - \tilde{\Pi}_2(1)$ . Firm 2 chooses FDI if and only if  $\Delta\tilde{\Pi}_2 > 0$ . Direct comparison yields  $\Delta\tilde{\Pi}_2 = \Delta\tilde{\pi}_2(d; \lambda_1) - S$ , where

$$\Delta\tilde{\pi}_2(d; \lambda_1) \equiv \tilde{\pi}_{2B}(0) - \tilde{\pi}_{2B}(1) = \frac{4t(2+2b-b^2)}{(2-b)^2\tilde{\Phi}^2} \{2(2-b) - [(2+2b-b^2) - b(2-b)\lambda_1]t - e_5d\},$$

where  $e_5 \equiv 2(4+b-b^2) - b(2-b)\delta$ .

Summarizing the above analysis results in Lemma 3 below, which is different from Lemma 2 in that the alliance synergies have the opposite effects on the allied and non-allied firms.

**Lemma 3.** *In the case of one strategic alliance, a firm's international entry mode depends on its domestic competitor's international entry mode, but not on the entry mode of the foreign firms. Lower (marginal) distribution costs raise the relative attractiveness of FDI for all firms. Stronger alliance synergies raise the relative attractiveness of FDI for the allied firms, but reduce the FDI attractiveness for the non-allied firms.*

The analysis of the alliance's effects on entry modes is similar to the symmetrical case. The following conditions are important for the result. First, the trade costs should not be too large:

$$t \leq \min \left\{ \frac{T(b)}{T_0(b)}, \frac{\tilde{T}(b)}{\tilde{T}_0(b)} \right\} \quad (6)$$

where  $T_0(b) \equiv (1+b)(32+64b+28b^2+12b^3-11b^4)$ ,  $T(b) \equiv (2-b)(32+48b-4b^2+20b^3+13b^4-9b^5)$ ,  $\tilde{T}_0(b) \equiv (8+8b-7b^2+b^3)$ , and  $\tilde{T}(b) \equiv b(2-b)(4+b-b^2)$ . So long as  $b$  is not too close to zero, (6) holds for reasonably small  $t$ .

Second, the synergies should be strong enough:

$$\delta \leq \delta_0(b) \equiv (1-b)(2+b) \frac{(32+144b+176b^2+16b^3-54b^4-15b^5+9b^6)}{\Phi^2(4+8b+b^2-3b^3)}. \quad (7)$$

Note that  $\delta_0(b)$  is decreasing in  $b$ ,  $\delta_0(0) = 1$ ,  $\delta_0(0.5) = 0.843$  and  $\delta_0(1) = 0$ . Hence, for sufficiently small  $b$  and  $\delta$ , condition (7) holds.

Corresponding to Proposition 1, we establish Proposition 2 below.

**Proposition 2.** *Suppose that the trade costs are not too high, the alliance synergies are sufficiently strong, and the products are sufficiently differentiated such that (6)-(7) are satisfied. Then, a cross-border strategic alliance in the first stage leads all firms to adopt FDI under more circumstances than without the alliance. However, the allied firms adopt FDI under even more circumstances than do the non-allied firms.*

**Proof.** In the Appendix.

Those remarks made after Proposition 1 also apply to Proposition 2. Also note that none of these results requires all conditions to hold.

## 5. Cross-Border Strategic Alliances

In this section, we first examine the firms' incentives to form strategic alliances (in Subsection 5.1) and then derive the first-stage equilibrium (in Subsection 5.2).

### 5.1. Strategic Alliance Incentives

We examine the strategic alliance incentives in the case of low, medium and high levels of plant setup costs, respectively. Two firms have incentives to form a strategic alliance if and only if their joint profits with the alliance are higher than the sum of their individual profits without the alliance.

■ *Low setup costs.* Let us first examine the 1+3 alliance incentives when firms 2 and 4 remain independent. Because  $S$  is small, all firms choose FDI regardless of the first-stage outcome. Due

to symmetry, we only need to compare firm 1's total profits from the two markets with the 1+3 alliance to its total profits without the alliance. Based on  $\pi_{1k}$  (from Section 3) and  $\tilde{\pi}_{1k}$  (from Section 4), our comparison yields the following result

$$\tilde{\Pi}_1(0) - \Pi_1(0) = \frac{b^2}{(1-b)\Phi^2\tilde{\Phi}^2} [m_0(1-3d) - m_1d^2] + (1-\delta) \left[ \frac{m_2d}{(1-b)\tilde{\Phi}^2} + D \right], \quad (8)$$

where  $m_0 = 2(1-b)(2-b)^2(4-8b-19b^2+9b^3)$ ,  $m_1 = 128 + 512b + 400b^2 - 176b^3 - 784b^4 - 544b^5 + 985b^6 > 0$ , and  $m_2 = 2(1-b^2)(2+b)[(2-b) - 2(1-b)d] + (4+8b+b^2-5b^3)(1-\delta)d > 0$ . The profit difference is decomposed into two parts. The first part is the effect of a change in market competition due to the alliance. It is shown in the proof of Lemma 4 that this part is positive for small  $b$ , but negative for large  $b$ . That is, in the absence of the alliance synergies (i.e.,  $\delta = 1$ ), firms 1 and 3 have incentives to form an alliance if and only if the products are sufficiently differentiated.<sup>18</sup> The second part is the synergy effect. Because the alliance lowers the allied firms' distribution costs, the alliance incentives are higher when the alliance synergies become stronger (i.e.,  $\delta$  becomes smaller). To summarize, firms 1 and 3 have incentives to form an alliance except when both  $b$  and  $\delta$  are large.

Now we turn to the case when firms 2 and 4 also form a strategic alliance. Based on  $\hat{\pi}_{1k}$  (from Subsection 4.1) and  $\tilde{\pi}_{1k}$  (from Subsection 4.2), we obtain

$$\hat{\Pi}_1(0) - \Pi_1^{2+4}(0) = \frac{b^2(1-b)}{(2-b)^2\hat{\Phi}^2\tilde{\Phi}^2} (\hat{m}_0 + \hat{m}_1d - \hat{m}_2d^2) + (1-\delta) \left[ \frac{\hat{m}_3(1-b)d}{\hat{\Phi}^2\tilde{\Phi}^2} + D \right], \quad (9)$$

where  $\Pi_1^{2+4}$  stands for firm 1's total profits in the 2+4 alliance case,  $\hat{m}_0$ ,  $\hat{m}_1$  and  $\hat{m}_2$  are functions of  $b$ , and  $\hat{m}_3$  is a function of  $b$  and  $\delta$ . The expressions of these functions are given in the proof of Lemma 4. The above profit difference is also decomposed into two parts, the competition effect and synergy effect, just like in (8). We can show (in the Appendix) that the same qualitative results derived in the absence of the 2+4 alliance also hold in the presence of the 2+4 alliance.

Hence, we establish Lemma 4 below.

**Lemma 4.** *Suppose that the plant setup costs are low. The firms have incentives to form strategic alliances when  $b$  is sufficiently small or  $(1-\delta)D$  is sufficiently large; they have no incentives to form strategic alliances when both  $b$  and  $\delta$  are sufficiently large.*

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<sup>18</sup>This result is consistent with the recent finding by Qiu and Zhou (2006) on mergers.

**Proof.** In the Appendix.

■ *High plant setup costs.* When  $S$  is large, all firms choose export regardless of the first-stage outcome. Suppose that firms 2 and 4 do not form a strategic alliance. Then, by calculating and comparing firm 1's total profits with and without the 1+3 alliance, we could have an expression similar to (8), which allows us to discuss the 1+3 strategic alliance's incentives. However, we are more interested in a comparison between the strategic alliance incentives under export and those under FDI. To this end, we have

$$\tilde{\Pi}_1(1) - \Pi_1(1) = \tilde{\Pi}_1(0) - \Pi_1(0) - \frac{\tilde{\Theta}b^2t}{(1-b)\tilde{\Phi}^2\tilde{\Phi}^2}, \quad \text{where } \tilde{\Theta} \equiv n_0 + n_1d - n_2d\delta - n_3t, \quad (10)$$

where  $n_0 = 2b(1-b)(2-b)(32 + 104b + 20b^2 - 78b^3 + 45b^4 - 9b^5)$ ,  $n_1 = 4(1-b)(32 + 80b + 16b^2 + 56b^3 + 82b^4 - 119b^5 + 54b^6 - 9b^7)$ ,  $n_2 = 2(2-b)^2(2+3b)^2(4+6b-3b^3+b^4)$ , and  $n_3 = b(128 + 272b - 208b^2 - 248b^3 + 368b^4 - 123b^5 + 11b^6)$ , all positive. Clearly,  $\tilde{\Theta}$  increases (therefore the relative alliance incentives under export as opposed to under FDI decrease) when  $d$  increases,  $\delta$  decreases, and  $t$  decreases. We can also examine how  $b$  affects  $\tilde{\Theta}$  through its effects on  $n_i$ . The results are summarized in Lemma 5.

Suppose that firms 2 and 4 also form a strategic alliance. Then,

$$\hat{\Pi}_1(1) - \Pi_1^{2+4}(1) = \hat{\Pi}_1(0) - \Pi_1^{2+4}(0) - \frac{\hat{\Theta}b^2(1-b)t}{(2-b)^2\hat{\Phi}^2\hat{\Phi}^2}, \quad (11)$$

where, as proved in the Appendix,  $\hat{\Theta}$  is positive for all  $b$  and has the same properties as  $\tilde{\Theta}$  with regard to changes in  $d$ ,  $\delta$  and  $t$ .

**Lemma 5.** *Suppose that the plant setup costs are high. The strategic alliance incentives are lower under export than under FDI. Moreover, higher distribution costs, greater alliance synergies, and lower trade costs increase the relative alliance incentives under FDI as opposed to under export.*

**Proof.** In the Appendix.

■ *Medium plant setup costs.* When  $S$  takes a medium value, a firm's equilibrium entry mode is affected by the first-stage outcome. Suppose that firms 2 and 4 do not form an alliance. Based

on Propositions 1-2, we know that for some medium levels of  $S$ , all firms choose export if there is no strategic alliance in the first stage. However, if firms 1 and 3 form an alliance, then there are two possible results: firms 1 and 3 choose FDI while firms 2 and 4 choose export, or all firms choose FDI. That is, in the former case, the 1+3 alliance induces the allied firms, but not the non-allied firms, to switch from export to FDI, and in the latter case, it induces all firms to switch from export to FDI.

Suppose that the 1+3 alliance induces only the allied firms to switch from export to FDI. Then,  $\Delta\tilde{\Pi}_1 = \Delta\tilde{\pi}_1(d; 1) - S > 0$ . Firm 1's alliance incentives are measured by  $\tilde{\Pi}_1(0; \lambda_2 = 1) - \Pi_1(1; \lambda_2 = 1)$ . If the 1+3 alliance had not induced the allied firms to switch from export to FDI, the alliance incentives would have been  $\tilde{\Pi}_1(1; \lambda_2 = 1) - \Pi_1(1; \lambda_2 = 1)$ . Note,  $\left[\tilde{\Pi}_1(0; \lambda_2 = 1) - \Pi_1(1; \lambda_2 = 1)\right] - \left[\tilde{\Pi}_1(1; \lambda_2 = 1) - \Pi_1(1; \lambda_2 = 1)\right] = \tilde{\Pi}_1(0; \lambda_2 = 1) - \tilde{\Pi}_1(1; \lambda_2 = 1) = \Delta\tilde{\pi}_1(d; 1) - S > 0$ . Hence, when a strategic alliance induces the allied firms to switch from export to FDI, the switch itself in return raises the allied firms' alliance incentives. We call these increased incentives the *FDI-inducing alliance incentives*.

The analysis of firm 1's alliance incentives when firms 2 and 4 have a strategic alliance is exactly the same as above, with  $\tilde{\Pi}_1$  replaced by  $\hat{\Pi}_1$  and  $\Delta\tilde{\pi}_1(d; \lambda_2)$  by  $\Delta\hat{\pi}_1(d; \lambda_2)$ . Therefore, we obtain the following lemma.

**Lemma 6.** *Suppose that the plant setup costs are at some medium level. Then, the firms have FDI-inducing alliance incentives, i.e., their strategic alliance incentives are higher because the alliance induces the allied firms to switch from export to FDI.*

■ *Complementarity in strategic alliance incentives.* Will the 1+3 alliance incentives be higher when the 2+4 alliance is formed than when there is no 2+4 alliance? To answer this question, we compare firm 1's alliance incentives in the presence of the 2+4 alliance to those in the absence of the 2+4 alliance. If  $S$  is very low, we calculate  $\Delta_{FDI} \equiv (\hat{\Pi}_1(0) - \Pi_1^{2+4}(0)) - (\tilde{\Pi}_1(0) - \Pi_1(0))$ . If  $S$  is very high, we calculate  $\Delta_E \equiv (\hat{\Pi}_1(1) - \Pi_1^{2+4}(1)) - (\tilde{\Pi}_1(1) - \Pi_1(1))$ . Based on these comparisons, we can establish the following result.

**Lemma 7.**  $\Delta_{FDI} > 0$  and  $\Delta_E > 0$ . That is, for sufficiently large or sufficiently small setup costs, two firms' strategic alliance incentives are higher when their rivals also engage in a strategic alliance than when their rivals do not engage in a strategic alliance.

**Proof.** In the Appendix.

## 5.2. The Strategic Alliance Equilibrium

Finally, we examine the first-stage equilibrium. Our early analysis has indicated that two firms have incentives to form a strategic alliance when  $b$  is sufficiently small. The complementarity shows that these incentives are stronger if all firms participate in strategic alliances. These two properties jointly shape the alliance formation equilibrium.

**Proposition 3.** *Suppose  $S$  is either sufficiently large or small. Given  $d$  and  $\delta$ , there exist  $0 < b_0 \leq b_1 \leq 1$  such that for  $b \leq b_0$ , the 1+3 and 2+4 strategic alliances are formed, and for  $b > b_1$ , no strategic alliance will be formed.*

**Proof.** In the Appendix.

What is the equilibrium for  $b \in [b_0, b_1)$ ? Given  $\lambda_1$  and any particular  $b^* \in [b_0, b_1)$ , because  $\Delta_{FDI} > 0$  and  $\Delta_E > 0$ , there are three possible results: (i)  $\tilde{\Pi}_1(\lambda_1) - \Pi_1(\lambda_1) > 0$ , (ii)  $\hat{\Pi}_1(\lambda_1) - \Pi_1^{2+4}(\lambda_1) < 0$ , and (iii)  $\tilde{\Pi}_1(\lambda_1) - \Pi_1(\lambda_1) < 0$  while  $\hat{\Pi}_1(\lambda_1) - \Pi_1^{2+4}(\lambda_1) > 0$ . Following the proof of Proposition 3, it is clear that in the first case, the equilibrium for the given  $b^*$  is the same as that for  $b \leq b_0$ , and in the second case, the equilibrium for  $b^*$  is the same as that for  $b > b_1$ . But in the third case, firms 1 and 3's optimal decision is to form a strategic alliance if firms 2 and 4 also form an alliance, but not to form a strategic alliance if firms 2 and 4 do not form a strategic alliance. Firms 2 and 4's optimal decision is the same. Then, it is clear that there are multiple equilibria for the given  $b^*$ : either there is no strategic alliance, or there are two strategic alliances (1+3 and 2+4).

When  $S$  takes some medium levels, alliance incentives complementarity may not exist. To compare firm 1's alliance incentives when the 2+4 alliance exists to those when 2+4 does not exist, the results depend on whether the 2+4 and the 1+3 induce the allied firms and the non-allied firms' entry modes to switch from export to FDI, and also on what the firms' entry modes are

without any alliance. There are many cases to examine. If there is no alliance that induces any entry mode to change, then the case is the same as small  $S$  or large  $S$  case and so the complementarity exists and Proposition 3 also applies. However, using  $(\lambda_1, \lambda_2, \lambda_3, \lambda_4)$  to denote the four firms' entry modes, we can show that  $\Delta = [(\hat{\pi}_{1A}(1, 0, 1, 0) + \hat{\pi}_{1B}(1, 0, 1, 0)) - (\pi_{1A}^{2+4}(1, 0, 1, 0) + \pi_{1B}^{2+4}(1, 0, 1, 0))] - [(\tilde{\pi}_{1A}(0, 1, 0, 1) + \tilde{\pi}_{1B}(0, 1, 0, 1)) - (\pi_{1A}(1, 1, 1, 1) + \pi_{1B}(1, 1, 1, 1))]$  is negative for some  $b, d, \delta$  and  $t$ . That is, there is no alliance complementarity when the 1+3 alliance induces only firms 1 and 3 to switch from export to FDI if firms 2 and 4 do not form an alliance, but the 1+3 alliance does not induce firms 1 and 3 to switch from export to FDI if the 2+4 alliance also exists. Without complementarity, we may have the following asymmetrical equilibrium: firms 1 and 3 form a strategic alliance but 2 and 4 do not, and 1 and 3 take FDI while 2 and 4 choose export.

## VI. Concluding Remarks

This paper develops a model that incorporates the firms' decisions on cross-border strategic alliances and international entry modes. We find that lower distribution costs and greater alliance synergies raise the relative attractiveness of FDI over export. Cross-border strategic alliances promote FDI, as opposed to export, in the sense that FDI is chosen by the firms under more circumstances with cross-border strategic alliances than without. The alliance incentives are higher when the alliance formation induces the firms to switch from export to FDI. In equilibrium, alliances are formed if the products are sufficiently differentiated, but there is no alliance if the products are close to being homogenous goods. Some of these findings are supported by preliminary empirical observations (e.g., a strategic alliance is conducive to FDI and vice versa) and some of them help to form empirically testable hypotheses (e.g., strategic alliances are more likely to be present in industries with high degrees of product differentiation and great synergies in product distribution; FDI is preferred to export in industries with lower distribution costs).

In addition to the effects of strategic alliances on the export-FDI choice, this paper also emphasizes the effect of distribution costs on the export-FDI choice. A large number of cross-

border strategic alliances are marketing and distribution alliances that reduce distribution costs for the allied firms. There are also a large number of cross-border production alliances that reduce the allied firms' production costs. A natural question is how, analytically, distribution costs and production costs are different in our model. That is, do production costs have the same qualitative effect on the export-FDI choice as distribution costs do? The answer is no because these two types of cross-border strategic alliances create different synergies in the domestic and foreign markets. Production alliances help each of the allied firms to reduce production costs in both their domestic plants as well as their foreign plants (from FDI). However, cross-border marketing/distribution alliances reduce the allied firms' distribution costs in their foreign markets only. How production alliances affect the firms' export-FDI choice requires a separate scrutiny.

It would be interesting to examine how firm heterogeneity in productivity affects the firms' incentives to form cross-border strategic alliances and their choices on foreign market entry modes.

## Appendix

Note: In some mathematical expressions of the proofs below,  $b$  has a power larger than 3 (in some cases as large as 11). To save space, we only present their approximate expressions by dropping the terms with  $b$  to the power 4 and above. Since  $b < 1$ , the proofs are not affected in any qualitative respect. The exact expressions can be found in the working paper version of this paper (Qiu, 2005).

### *Proof of Proposition 1.*

Note that  $S^1 \leq \hat{S}^1$ , if and only if  $t \leq \hat{T}(b)/(64 + 192b + 128b^2 - 32b^3)$ , which holds under (4).

Under conditions (4) and (5), we draw firm 1's dividing lines with and without the alliances, in Figure 2 for one case and in Figure 3 for the other case. Look at Figure 2 first, from top to bottom: In the area above  $UDL_1^*$ , firm 1' choice is export with and without the alliances; in the area between  $LDL_1^*$  and  $UDL_1^*$ , its choice may be export or FDI with the alliances, but it is surely export without the alliances; in the area between  $UDL_1$  and  $LDL_1^*$ , its choice is FDI with the alliances, but export without the alliances; in the area between  $LDL_1$  and  $UDL_1$ , its choice is FDI with the alliances, but may be export or FDI

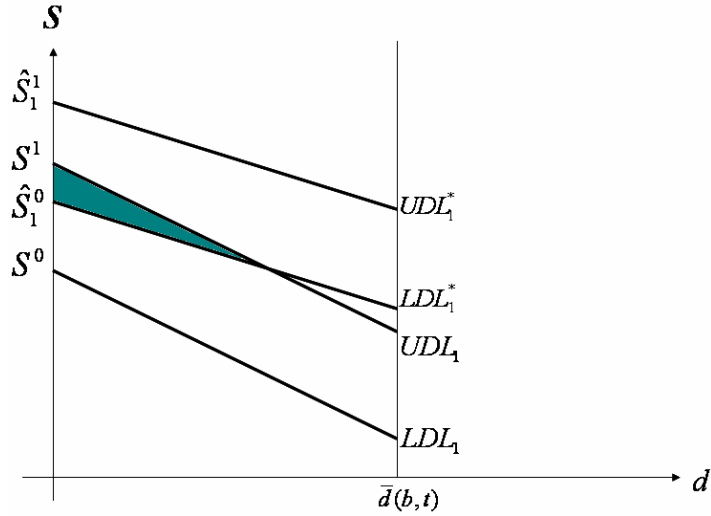


Figure 3: Entry Modes Comparison (2)

without the alliances; in the area below  $LDL_1$ , its choice is FDI with and without the alliances. In summary, firm 1 is more likely to adopt FDI in the alliance case than in the no-alliance case.

In Figure 3,  $UDL_1$  intercepts  $LDL_1^*$ . In the shaded area, firm 1 may choose FDI or export, with and without the alliances, depending only on the entry mode that firm 2 adopts. That is, the strategic alliances per se do not affect firm 1's choice of entry mode. In the other areas, the comparisons are exactly the same as those for Figure 2. Hence, strategic alliances encourage the firms to adopt FDI.

*Proof of Proposition 2.*

Denote  $\tilde{S}_1^0 = \Delta\tilde{\pi}_1(0; 0)$ ,  $\tilde{S}_1^1 = \Delta\tilde{\pi}_1(0; 1)$ ,  $\tilde{S}_2^0 = \Delta\tilde{\pi}_2(0; 0)$  and  $\tilde{S}_2^1 = \Delta\tilde{\pi}_2(0; 1)$ . Similar to Figure 1, there are two dividing lines (corresponding to  $\tilde{S}_1^0$  and  $\tilde{S}_1^1$ ) that partition firm 1's entry strategy space into three regions. There are also two dividing lines (corresponding to  $\tilde{S}_2^0$  and  $\tilde{S}_2^1$ ) that partition firm 2's entry strategy space into three regions. If we draw those dividing lines on the same diagram, as in Figure 2, we are able to derive the second-stage equilibrium, with an analysis analogous to that in Section 4.1.

First, we compare firm 1's equilibrium entry mode in the 1+3 alliance case to that in the no-alliance

case. By comparing  $S^0$  and  $\tilde{S}_1^0$ , we obtain that  $S^0 \leq \tilde{S}_1^0$  if and only if  $t \leq T(b)/T_0(b)$ , which is a decreasing function of  $b$  and it is no less than 0.4. Hence, the condition holds for reasonably small  $t$ . On the other hand, we have  $S^1 \leq \tilde{S}_1^1$  if and only if  $t \leq T(b)/(32 + 64b + 44b^2 + 44b^3)$ . A simple comparison shows that the former condition is stronger than the latter and so  $S^1 \leq \tilde{S}_1^1$ . The above two comparisons together show that when  $d = 0$ , firm 1 is more likely to choose FDI in the 1+3 alliance case than in the no-alliance case.

The slope of firm 1's dividing lines in the 1+3 alliance case is not steeper than its dividing lines in the no-alliance case if and only if (7) holds.

Second, we compare the entry mode of the allied firms to that of the non-allied firms. Direct comparison yields that  $\tilde{S}_2^0 \leq \tilde{S}_1^0$  if and only if  $t \leq \tilde{T}(b)/\tilde{T}_0(b)$ , which is an increasing function of  $b$  and it is equal to 0.089 at  $b = 0.1$ , 0.161 at  $b = 0.2$ , 0.307 at  $b = 0.5$ , and 0.4 at  $b = 1$ . Hence, so long as  $b$  is not too small, the above inequality holds for reasonably small  $t$ . Firm 1's dividing lines are not steeper than firm 2's dividing lines if and only if  $\delta \leq \delta_1(b)$ , where  $\delta_1(b) \equiv (32 + 48b - 54b^2 - 60b^3 + 50b^4 - 6b^5 - b^6)/(2 - b)(16 + 24b - 16b^2 - 24b^3 + 5b^4 + 7b^5 - 2b^6)$ . Note that  $\delta_1(b) > 1$  for all  $b < 0.9644$  and  $\delta_1(b)$  reaches minimum at  $b = 1$  with  $\delta_1(1) = 0.9$ . Therefore, Firm 1's dividing lines are not steeper than firm 2's dividing lines except when the products are very close to being homogeneous and when the synergies are very weak. As for Figure 2, we can conclude that the allied firms adopt FDI under more circumstances than do the non-allied firms.

Finally, we examine whether a strategic alliance encourages the non-allied firms to choose FDI. By comparing  $\tilde{S}_2^0$  and  $S^0$ , we obtain that  $S^0 < \tilde{S}_2^0$  if and only if  $T_3(b) + T_2(b)t > 0$ , where  $T_3(b) \equiv (2 - b)[2\Phi^2(2 + 2b - b^2) - (1 + b)(2 - b)^2\tilde{\Phi}^2] = 2b^2(2 - b)(16 + 16b - 24b^2 - 4b^3 + 9b^4 - 2b^5) > 0$  and  $T_2(b) \equiv (1 + b)^2(2 - b)^2\tilde{\Phi}^2 - (2 + 2b - b^2)^2\Phi^2 = b^3(2 - b)^2(8 + 20b + 8b^2 - 5b^3) > 0$ . Thus,  $S^0 < \tilde{S}_2^0$  holds for all parameter values. By comparing  $\tilde{S}_2^1$  and  $S^1$ , we obtain that  $S^1 < \tilde{S}_2^1$  if and only if  $2(2 + 2b - b^2)\Phi^2 - (1 + b)(2 - b)^2\tilde{\Phi}^2 > 0$ . This condition is reduced to  $2b^2(16 + 16b - 24b^2 - 4b^3 + 9b^4 - 2b^5) > 0$ , which holds for all  $b$ .

Firm 2's dividing lines in the 1+3 alliance case are flatter than its dividing lines in the no-alliance case because  $\delta \leq 16 < 2(2 - b)(8 + 40b + 38b^2 - 28b^3 - 23b^4 + 9b^5)/(2 + 2b - b^2)$ , for all  $b > 0$ .

Then, under conditions (6) and (7), we can draw firm 2's dividing lines with and without the 1+3

alliance. The figure is similar to Figures 2 and 3. The rest of the proof is just the same as that of Proposition 1.

*Proof of Lemma 4.*

First,  $1 - 3d > 0$  by (A1). Second,  $m_0 > 0$  for  $b < 0.3073$  and  $m_0 > 0$  for  $b > 0.3073$ . Hence, for sufficiently large  $b$ , the first term in the RHS of (8) is negative. If  $\delta$  is also large, the second term is small and so the RHS of (8) is negative.

However, since (A1) implies  $10d < (1-b)(2-b)$  and  $1 - 3d > 4d/(2-b)$ , we have, for  $b < 0.3073$ ,  $m_0(a - 3d) - m_1d^2 > d^2[40m_0/(1-b)(2-b)^2 - m_1] = (192 - 1152b + 784b^2 + 896b^3)d^2$ , which is positive for  $b \leq 0.137$ .

Note that the second term in the RHS of (8) is always positive. Hence, by continuity, there exists  $b_m > 0.137$  such that the RHS of (8) is positive for all  $b \leq b_m$ . Moreover, if  $(1 - \delta)D$  is large, the second term is also large, in which case,  $b_m$  will be a large number (close to or equal to 1).

Now turn to (9). Our calculation shows that  $\hat{m}_0 = 32(1-b)(2-b)^2(1-b-5b^2+b^3)$ ,  $\hat{m}_1 = 16(1-b)(2-b)^2(24+120b+180b^2-86b^3) > 0$ ,  $\hat{m}_2 = 2336 + 7328b - 1264b^2 - 14528b^3 > 0$ , and  $\hat{m}_3 = 16b^2(1-b)(4+10b+7b^2+4b^3) + (1+b)(136+360b-230b^2-660b^3)d + (1+b)^2(8+32b+26b^2-14b^3)\delta d > 0$ . First,  $\hat{m}_0 > 0$  if and only if  $b < 0.367$ . Second, when  $b$  is large,  $\hat{m}_0 < 0$  and  $\hat{m}_0 + \hat{m}_1d \leq 0$  for sufficiently small  $d$ . Then, it is clear that  $\hat{m}_0 + \hat{m}_1d - \hat{m}_2d^2 < 0$ . Moreover, for sufficiently large  $\delta$ , the second term of the RHS of (9) is small. This proves that the RHS of (9) is negative for sufficiently large  $b$  and  $\delta$ .

Third,  $\hat{m}_1d - \hat{m}_2d^2 > [10\hat{m}_1/(1-b)(2-b) - \hat{m}_2]d^2 = (5334 + 27232b + 39664b^2 - 41792b^3)d^2 > 0$ . Thus, for sufficiently small  $b$ ,  $\hat{m}_0 + \hat{m}_1d - \hat{m}_2d^2 > 0$ .

Moreover, the second term in the RHS of (9) is positive and so if  $(1 - \delta)D$  is large, the critical level of  $b$  for the RHS of (9) to be positive could be very large.

*Proof of Lemma 5.*

Note that (A1) implies  $(10d + 4t) < (1-b)(2-b)$ . Using this, we have  $\tilde{\Theta} > [10n_0/(1-b)(2-b) + n_1 - n_2]d + [4n_0/(1-b)(2-b) - n_3]t$ . By calculation, the first term is equal to  $2(320 + 912b - 88b^2 - 508b^3)d$ , which is positive, and the second term is  $(384 + 1104b - 48b^2 - 872b^3)t$ , which is also positive. Hence,  $\tilde{\Theta} > 0$  for all  $b$ .

Direct calculation and comparison also yields  $\hat{\Theta} \equiv \hat{n}_0 + \hat{n}_1 d - \hat{n}_2 d \delta - \hat{n}_3 t$ , where  $\hat{n}_0 = 16(1 - b)(2 - b)^2(8 + 40b + 60b^2 + 22b^3)$ ,  $\hat{n}_1 = 32(1 - b)(48 + 216b + 256b^2 - 18b^3)$ ,  $\hat{n}_2 = 16(1 + b)(2 - b)^2(8 + 36b + 46b^2 + 12b^3)$ ,  $\hat{n}_3 = 512 + 2304b + 2496b^2 - 1408b^3$ , and all are positive. Thus, the effects of changes in  $d$ ,  $\delta$  and  $t$  on  $\hat{\Theta}$  are clear from the definition of  $\hat{\Theta}$ .

Using  $(10d + 4t) < (1 - b)(2 - b)$ , we have  $\hat{\Theta} > [10\hat{n}_0/(1 - b)(2 - b) + \hat{n}_1 - \hat{n}_2]d + [4\hat{n}_0/(1 - b)(2 - b) - \hat{n}_3]t$ . By calculation, the first term is equal to  $(3584 + 14592b + 11520b^2 - 10496b^3)d$ , which is positive, and the second term is  $(512 + 2304b + 2624b^2 + 384b^3)t$ , which is also positive. Hence,  $\hat{\Theta} > 0$  for all  $b$ .

*Proof of Lemma 7.*

First, the case of small  $S$ . Direct calculation yields the following result,

$$\Delta_{FDI} = \frac{32b^2(1 - b)^2(2 - b)^2}{\Phi^2\hat{\Phi}^2\tilde{\Phi}^2}(q_0 + q_1d - q_2d^2) + \frac{8b^2(1 - b)(2 - b)^2(2 + 3b)^2}{\Phi^2\hat{\Phi}^2\tilde{\Phi}^2}(q_3 - q_4d - q_5d\delta)d\delta,$$

where  $q_0 = 12 + 34b + 7b^2 - 27b^3$ ,  $q_1 = 32 + 256b + 808b^2 + 1224b^3$ ,  $q_2 = 32 + 264b + 87b^2 + 1452b^3$ ,  $q_3 = 2(1 - b)(8 + 40b + 58b^2 + 12b^3)$ ,  $q_4 = 4(1 - b^2)(8 + 28b + 11b^2 - 32b^3)$ ,  $q_5 = 16 + 96b + 196b^2 + 132b^3$ , and all are positive. Since  $10d < (1 - b)(2 - b)$ , we have  $(q_1d - q_2d^2) > [10q_1 - (1 - b)(2 - b)q_2]d^2/(1 - b)(2 - b) = (256 + 2128b + 7088b^2 + 11700b^3)d^2/(1 - b)(2 - b) > 0$  for all  $b$ , and  $(q_3 - q_4d - q_5d\delta) > [10q_3/(1 - b) - (2 - b)(q_4 + q_5)]d/(2 - b) = (64 + 432b + 952b^2 + 664b^3)b/(2 - b) > 0$  for all  $b$ . Thus,  $\Delta_{FDI} > 0$ .

Second, the case of large  $S$ . Based on (10) and (11), we can easily get

$$\Delta_E = \Delta_{FDI} - \frac{t}{(1 - b)(2 - b)^2\Phi^2\hat{\Phi}^2\tilde{\Phi}^2} \left[ (2 - b)^2\hat{\Phi}^2\tilde{\Theta} - (1 - b)^2\Phi^2\hat{\Theta} \right].$$

Substituting in  $\tilde{\Theta}$  and  $\hat{\Theta}$ , we obtain  $(2 - b)^2\hat{\Phi}^2\tilde{\Theta} - (1 - b)^2\Phi^2\hat{\Theta} = 8(1 - b)^2(2 - b)^2(\bar{q}_0 + \bar{q}_1d - \bar{q}_2d\delta - \bar{q}_3t)$ , where  $\bar{q}_0 \equiv 2(1 - b)(2 - b)(64 + 416b + 864b^2 + 416b^3)$ ,  $\bar{q}_1 \equiv 2b(256 + 1632b + 3104b^2 + 640b^3)$ ,  $\bar{q}_2 \equiv b^2(2 + 3b)^2(8 + 40b - 10b^2 - 158b^3)$ ,  $\bar{q}_3 \equiv 2(384 + 2368b + 4432b^2 + 400b^3)$ , and all are positive. We enlarge  $\Delta_E$  by dropping the positive terms associated with  $\bar{q}_2$ ,  $\bar{q}_3$  and  $d\delta$  to have  $\Delta_E > \frac{t}{(1 - b)(2 - b)^2\Phi^2\hat{\Phi}^2\tilde{\Phi}^2} [4(1 - b)(2 - b)^2(q_0 + q_1d - q_2d^2) - \bar{q}_0t - \bar{q}_1dt]$ . Rearranging the terms in the bracket and noticing that  $10d < (1 - b)(2 - b)$  shows that the term is larger than  $4(2 - b)\Psi_0d^2 + \Psi_1dt + \Psi_2at$ , where  $\Psi_0 = 256 + 2128b + 8666b^2 - 1687b^3 > 0$ ,  $\Psi_1 = 1024 + 7168b + 18496b^2 - 15232b^3 >$ , and  $\Psi_2 = 2(2 - b)(32 - 80b - 392b^2 + 232b^3)$ . Thus,  $\Delta_E > 0$  for all  $b$ .

*Proof of Proposition 3.*

Suppose that  $S$  is sufficiently small such that the firms choose FDI regardless of the first-stage equilibrium. In the proof of Lemma 4, we have shown that for given  $d$ ,  $\delta$  and  $D$ , there exists  $b'_0$  such that  $\tilde{\Pi}_1(0) - \Pi_1(0) > 0$  for all  $b < b'_0$ . (This  $b'_0$  is just the same as  $b_m$  in the proof of Lemma 4). Because  $\Delta_{FDI} > 0$ , we also have  $\hat{\Pi}_1(0) - \Pi_1^{2+4}(0) > 0$  for all  $b < b'_0$ . Therefore, firm 1's dominant strategy is to have a strategic alliance with firm 3. Due to symmetry, all other firms' dominant strategies are to engage in strategic alliances. Hence, in the first stage equilibrium, the 1+3 alliance and the 2+4 alliance are formed.

In the proof of Lemma 4, we have also shown that for given  $d$  and  $D$  and if  $\delta$  is large, then there exists  $b'_1$ , such that  $\hat{\Pi}_1(0) - \Pi_1^{2+4}(0) \leq 0$  for all  $b \geq b'_1$ . Because  $\Delta_{FDI} > 0$ , we must have  $\tilde{\Pi}_1(0) - \Pi_1(0) < 0$ . Therefore, firm 1's dominant strategy is not to have a strategic alliance with firm 3. Due to symmetry, all other firms' dominant strategies are not to have strategic alliances. Hence, there is no strategic alliance in the first stage.

Suppose that  $S$  is sufficiently large such that the firms choose export as their international entry modes regardless of the first stage equilibrium. We can prove a result similar to Lemma 4 for the case of large  $S$ . Specifically, given  $d$ ,  $\delta$  and  $D$ , there exists  $b''_0$  such that  $\tilde{\Pi}_1(1) - \Pi_1(1) > 0$  for all  $b < b''_0$ ; and there exists  $b''_1$ , such that  $\hat{\Pi}_1(1) - \Pi_1^{2+4}(1) \leq 0$  for all  $b \geq b''_1$ . Then, using  $\Delta_E > 0$ , the rest of the proof is the same as for small  $S$  case. Setting  $b_0 = \min\{b'_0, b''_0\}$  and  $b_1 = \max\{b'_1, b''_1\}$ , the proof of the proposition is completed.

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