

Export, FDI and Cross-Border Strategic Alliances

by

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Abstract

This paper develops a model that incorporates firms' decisions on cross-border strategic alliances and international market entry modes (i.e., export or FDI). Market size, product differentiation, distribution costs and alliance synergies are important factors that affect the firms' incentives to form strategic alliances and their choice between exports and FDI. In particular, we find that a larger market size, lower distribution costs and greater alliance synergies raise the relative attractiveness of FDI over export. Cross-border strategic alliances promote FDI. 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 homogenous goods.

JEL Classification No.: F12, F23

Key Words Cross-border strategic alliances, export, FDI,
distribution costs, mergers and acquisitions

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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 1999.¹ 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 from different countries 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, i.e., the firms' choice between export and FDI? This paper is the first to undertake a systematic analysis to provide answers to those questions. To this end, 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 (i.e., between export and FDI) 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 areas but compete in some other areas. This type of partial cooperation is in fact a common feature among most strategic alliances.² Specifically, we assume that within the same alliance, the firms coordinate their production levels to lessen competition, and share their distribution networks

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

²From 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).

to obtain synergies. However, they choose their international entry modes independently.³ The Haier-Sampo strategic alliance and the Adidas-Reebok acquisition are just two examples that share some of these features.⁴ Based on such a model, our analysis yields a number of important and empirically testable results. With regard to the incentives to form strategic alliances, we find that a firm has a larger incentive to form a cross-border alliance with some other firms when the products are more differentiated, the synergies derived from the alliance are stronger, and it chooses FDI, as opposed to export, 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.⁵

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.⁶ 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

³According 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 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).

⁴Haier 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 (through export first), 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).

⁵**Insert some facts.** Eg., communication technology has made coordination in distribution and management more efficient and alliances can obtain larger synergies. Both FDI and cross-border mergers increase faster than do exports. There is a clear wave in cross-border strategic alliances, even within the same industry (e.g., automobile).

⁶See Markusen (2002) for a summary of the literature and Brainard (1997) for an empirical test of the proximity-concentration hypothesis.

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, 2001). The co-movement (surge) of FDI and cross-border strategic alliances, a phenomenon observed in recent years. This paper also generates some other testable results: the firms are more likely to choose FDI over export in industries with larger market sizes and lower distribution costs.

This paper contributes to two strands in the international trade and FDI literatures. The first strand relates to the small but growing body of studies on cross-border mergers. Although our paper concerns cross-border strategic alliances only, we can also view them as a non-equity-exchange type of cross-border mergers, at least from analytical point of view.⁷ Therefore, our paper is related to the existing studies on cross-border mergers. Most of the existing studies on cross-border mergers are concerned with the implications of trade liberalization on the profitability of cross-border mergers,⁸ the rationales for the emergence of cross-border mergers,⁹ and the various effects of cross-border mergers.¹⁰ The present paper examines both the incentives to form international strategic alliances (but under a situation that is different from those in the existing models) and the effects of the alliance formations on the firms' subsequent decisions about their international entry modes. The results obtained in this paper can also be applied to cross-border mergers.

⁷Some 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.

⁸E.g., Long and Vousden (1995).

⁹E.g., Horn and Persson (2001) on trade costs, Lommerud et al. (2005) on plant-specific unions in oligopolistic competition, Neary (2004) on international difference in technologies, and Qiu and Zhou (2006) on information sharing.

¹⁰E.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.

The second strand of literature is that which examines market entry through export and FDI. Recently, Helpman et al. (2004) restudied the export-FDI choice when the firms are heterogeneous and found that the most efficient firms engage in FDI; the less efficient ones choose export; and the least efficient ones do not enter foreign markets. 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, although the proximity-concentration tradeoff still plays an important role in our analysis, we emphasize the role of distribution costs. Distribution costs are a significant part of a firm's total costs.¹¹ Unlike tariffs and plant setup costs, which determine the proximity-concentration tradeoffs, distribution costs are incurred in both export and FDI. With this framework, we show that cross-border strategic alliances reduce distribution costs and hence induce firms to choose FDI. Consequently, our model predicts more FDI than does the traditional export-vs-FDI model.

Our paper is also closely related to the paper by Nocke and Yeaple (2005) because both papers stress the important role played by the marketing and distribution costs in affecting a firm's foreign market entry mode. Nocke and Yeaple (2005) introduce cross-border M&A in their model and consider it as one type of FDI against greenfield-FDI and export. They find that depending on whether the firms differ in their mobile (e.g., production technology) or immobile (e.g., marketing experience) capabilities, cross-border mergers may involve the most or the least efficient firms, and an exporting firm may be more efficient than a greenfield FDI investor. Their finding is different from that of Helpman et al. (2004). In contrast to Nocke and Yeaple (2005), we introduce cross-border strategic alliances in our model and consider it as a type of cross-border cooperation that helps the allied firms to enter their respective foreign markets, via export or FDI (greenfield).¹² We find that the formation of strategic alliances raises the relative

¹¹Our 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 are also obtained for General Electric and Sony.

¹²Strategic 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).

attractiveness of FDI over export for all firms in the industry.

In light of the recent observations that many large firms are engaging in cross-border strategic alliances (OECD, 2001), our model assumes that the firms compete in 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.¹³ 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, with and without cross-border strategic alliances. Section 5 examines the incentives for and the equilibrium of cross-border strategic alliances. Section 6 concludes the paper.

2. Model

We construct a partial equilibrium model in which there is one industry in two identical countries, A and B. Assume that entry to the industry requires a very large fixed cost and so there are only two firms in each country: firms 1 and 2 in country A, and firms 3 and 4 in country B. All firms have the same production technology and they produce differentiated products.

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 may use 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 each country. 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 production costs. For simplicity, we assume that there is a constant marginal cost of production and, without loss of generality, we let this cost be zero.

¹³There 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.

The third 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, advertising costs and transporting costs. 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, additional costs are incurred when the firm's products are sold in the foreign market because the firm is less familiar with the foreign market. 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 greatly simplifies 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 for success in business, and ii) domestic firms have an advantage over foreign firms in marketing activities in their own countries.¹⁴

The final 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.

Now we turn to the demand side. Assume that there is linear demand for the product in each market. Specifically, let x_{ik} (p_{ik}) be the demand (price) in market $k \in \{A, B\}$ for the goods produced by firm $i \in \mathcal{I} \equiv \{1, 2, 3, 4\}$ and let the inverse demand function be

$$p_{ik} = a - x_{ik} - bX_k^{-i}, \quad \text{where } i \in \mathcal{I}, \quad X_k^{-i} \equiv \sum_{j \in \mathcal{I} \setminus i} x_{jk},$$

$a > 0$ and $b \in (0, 1)$. Parameter a represents the market size and parameter b represents the degree of product differentiation. In order to focus on the tradeoff between export and FDI, we assume that the demand is sufficiently strong and the costs are sufficiently small so that both export and FDI are profitable for every firm. The exact conditions for these parameter will be derived later.

¹⁴Recently, 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.

The firms engage in a three-stage game. In the first stage, the firms make their strategic alliance decisions. In the second stage, each firm chooses between export and FDI as its international market entry mode. In the final stage, the firms produce and sell their products to both markets. The firms compete in a Cournot fashion in each market.

3. International Entry without Strategic Alliances

In this section, we derive the second- and third-stage equilibria, assuming that there is no strategic alliance formed in the first stage. We introduce a decision parameter, $\lambda_i \in \{0, 1\}$, with $\lambda_i = 0$ representing firm i choosing FDI and $\lambda_i = 1$ representing firm i choosing export. Let $\lambda = \{\lambda_1, \lambda_2, \lambda_3, \lambda_4\}$ and let $c_{ik}(\lambda_i)$ denote firm i 's marginal cost for selling its product to market k when its international entry mode is λ_i , and $c_k^{-i}(\lambda) \equiv \sum_{j \in \mathcal{I} \setminus i} c_{jk}(\lambda_j)$. 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 shall first analyze the third-stage equilibrium. Note that $\pi_{ik} \equiv (p_{ik} - c_{ik}(\lambda_i))x_{ik}$ is firm i 's flow profit (i.e., excluding all the fixed costs) from market k , when its international entry mode is λ_i . Given λ , the third-stage equilibrium is a function of λ . But, for convenience and without causing any confusion, sometimes we express firm i 's equilibrium results as a function of λ_i only and sometimes we even drop this strategy variable. With this in mind, we derive the following Nash equilibrium for all $k \in \{A, B\}$ and $i \in \mathcal{I}$,

$$\begin{aligned} x_{ik} &= \frac{1}{\Phi} [(2-b)a + bc_k^{-i} - 2(1+b)c_{ik}], \\ p_{ik} &= \frac{1}{\Phi} [(2-b)a + bc_k^{-i} + (2+2b-3b^2)c_{ik}], \\ \pi_{ik} &= (x_{ik})^2, \quad \text{where } \Phi \equiv 4 + 4b - 3b^2. \end{aligned}$$

Let $\Pi_i(\lambda_i)$ denote firm i 's total profit. Then,

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

Firm 1 is in the most disadvantageous position in the foreign market when it chooses export and firm 2 chooses FDI. Suppose that $x_{1B} > 0$, which is equivalent to

$$(A1) \quad a > \frac{4d + 2(1+b)t}{2-b}.$$

Then, it is clear that due to symmetry, (A1) assures that all firms have positive sales in every market with export or FDI.

Now, we go backward to analyze the second stage of the game. Let us focus on firm 1's decision. Given λ_2 , λ_3 and λ_4 , firm 1 chooses λ_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

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

A few remarks are in order. First, firm 1's profit difference between FDI and export is affected by market B only. This is because the two markets are segmented. FDI is a more attractive mode the larger the market, and this is due to the high fixed costs and low marginal costs associated with FDI. Second, with FDI, the firm avoids the (marginal) export costs and hence it sells more to market B under FDI than under export. As a result, the (marginal) distribution costs, d , have 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, firm 1's profit difference and hence its international entry mode depends on λ_2 . Moreover, $\Delta\pi(d; 1) > \Delta\pi(d; 0)$; that is, firm 1's profit difference is larger when firm 2 chooses export than when it chooses FDI. Because additional marginal costs are associated with export, firm 2 becomes less aggressive in market B with export than with FDI, and, in response, firm 1 becomes more aggressive in this market and produces more for this market. With larger sales in market B, firm 1 will see the increased relative attractiveness of FDI over export, again due to the additional marginal costs associated with export.

Fourth, the international 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 competitor's international entry mode.

Due to symmetry, the same result also holds for all other firms. Thus, we have 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 mode of the foreign firms. A larger market and lower (marginal) distribution costs raise the relative attractiveness of FDI over export.*

Now, we examine the strategic interaction between firms 1 and 2's international entry modes. Denote $s^0 = \Delta\pi(0;0)$ and $s^1 = \Delta\pi(0;1)$. We depict in Figure 1 two straight lines, in the d - s space, which divide firm 1's international entry mode into three regions. The lower dividing line (LDL in short) is obtained from $\Delta\Pi_1 = 0$ at $\lambda_2 = 0$, and the upper dividing line (UDL in short) is obtained from $\Delta\Pi_1 = 0$ at $\lambda_2 = 1$. These two dividing lines are parallel. In region I (the area below LDL), $\Delta\Pi_1 > 0$ for all λ_2 , which means that firm 1's dominant strategy is FDI. This is because the FDI plant setup costs are very small. In region II (the area above UDL), $\Delta\Pi_1 < 0$ for all λ_2 , which means that firm 1's dominant strategy is export. This is because the FDI plant setup costs are very large. In region III (the area between the two dividing lines), $\Delta\Pi_1 > 0$ if $\lambda_2 = 1$, but $\Delta\Pi_1 < 0$ if $\lambda_2 = 0$. Hence, firm 1's optimal response to firm 2's international entry mode is $\lambda_1 = 0$ when $\lambda_2 = 1$, but $\lambda_1 = 1$ when $\lambda_2 = 0$. That is the medium setup cost case and thus firm 2's international 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 international entry decision has exactly the same regions as firm 1's entry decision has, as shown by Figure 1. Thus, the equilibrium international entry modes are

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

Also, due to symmetry, firms 3 and 4 have exactly the same equilibrium international entry modes as described above.

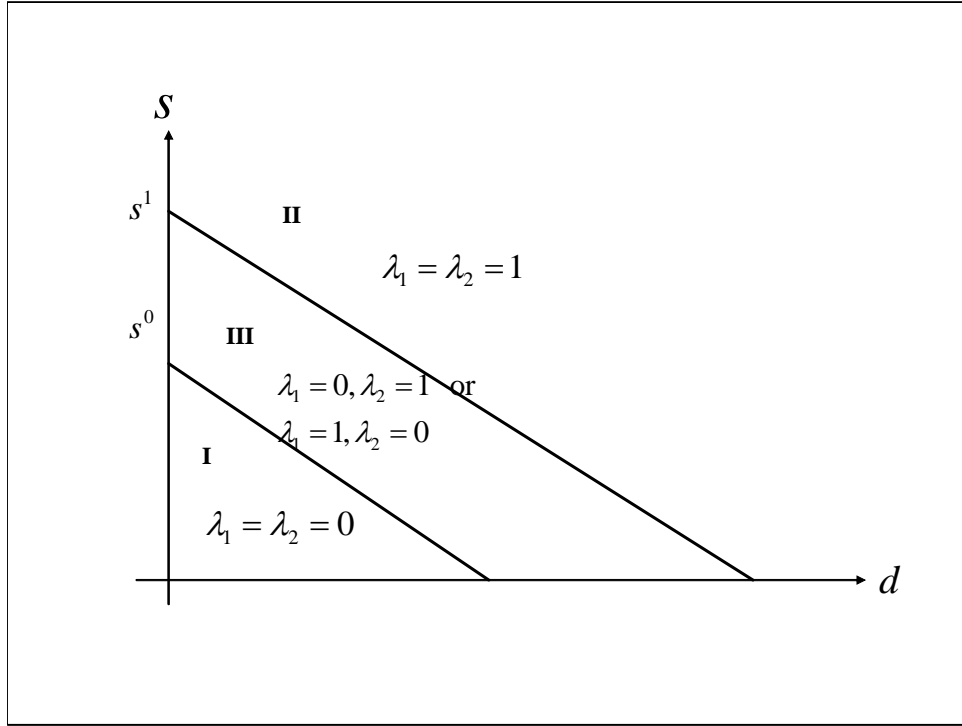


Figure 1: International Entry Mode Equilibrium

It is worth pointing out that the presence of strategic dependence of a firm's choice between FDI and export on its domestic rival's choices 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 reexamine 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 and restrictions. First, we assume that each country's anti-trust policy disallows its two domestic firms to form a strategic alliance.¹⁵ As a result, each strategic alliance must be a cross-border alliance between two firms. Second, after a cross-border strategic alliance has been formed, each allied firm still produces its own variety of the product.

¹⁵In fact, this is not only a practical policy restraint, but it is also rational for the firms. 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, as shown by Salant et al. (1983) for mergers.

Hence, strategic alliances do not reduce product variety or the number of independent firms. It is common to model M&As in a differentiated product industry (e.g., Qiu and Zhou, 2006),¹⁶ but this is in contrast to models of industries with homogenous products.

Third, 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 improve FDI but not export. In contrast, both FDI and export benefit from the reduction in distribution costs due to marketing-motivated cross-border strategic alliances and so the effects of these types of strategic alliances on the firms' export-FDI choices are not obvious. Finally, while the two firms in a strategic alliance coordinate their output levels to internalize competition (as in Salant et al., 1983, and most papers on mergers), they choose their individual international entry modes independently.¹⁷

4.1. The Symmetrical Case: When All Firms Form Strategic Alliances

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). We first derive the equilibrium about international entry and market competition and then examine how this equilibrium differs from that in the absence of any strategic alliance as derived in Section 3. We use “ \wedge ” to denote the variables for the case with two strategic alliances.

■ *The final stage equilibrium.* Given λ , the firms' marginal costs in each market are determined. Each firm's marginal cost in its domestic market remains the same as in the case with

¹⁶One 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.

¹⁷This is justified by the observations that, as mentioned in the introductory section, the ally firms cooperate in some areas but compete in some others.

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 profit (i.e., the sum of the two allied firms' profits from both markets, A and B). Since the markets are segmented and marginal costs are constant, 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 choose the similar profit maximization. As a result, the Nash equilibrium in each market can be calculated as, for $k \in \{A, B\}$,

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

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

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

The equilibrium profits are

$$\hat{\pi}_{ik} = (\hat{p}_{ik} - \hat{c}_{ik})\hat{x}_{ik}, \quad \text{for all } i \in \mathcal{I}.$$

Similar to (A1), to ensure that each firm has positive sales in all markets, we assume that¹⁸

$$(A2) \quad a > \frac{[2 - 2b + (2 + b)\delta]d + (2 + 2b - b^2)t}{2(1 - b)}.$$

A firm's international entry mode affects its sales and profits from the foreign market. Let us first examine and compare a firm's sales in its foreign market when there is no strategic alliance to that when there are two strategic alliances. 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 non-alliance case is

$$x_{1B}(0) = \frac{1}{\Phi} [(2-b)a - 4d + \lambda_2 b t],$$

and those in the two-alliance case are

$$\hat{x}_{1B}(0) = \frac{1}{\hat{\Phi}} \{2(1-b)a - [2 - 2b + (2 + b)\delta]d + \lambda_2 b(1-b)t\}.$$

¹⁸The condition is obtained from $\hat{x}_{1B} > 0$ when firm 1 chooses export and firm 2 chooses FDI.

A direct comparison yields that $x_{1B}(0) > \hat{x}_{1B}(0)$ if and only if

$$H_0(a - d) - H_1d + H_2\delta d + H_3\lambda_2t > 0, \quad (2)$$

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 a , t , and δ affect firm 1's sales in market B. First, *the market size effect*: as a increases, condition (2) is more likely to hold and so is the inequality $x_{1B}(0) > \hat{x}_{1B}(0)$. 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 effect 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 effect raises $\hat{x}_{1B}(0)$. However, the former effect always dominates the latter and so $x_{1B}(0) > \hat{x}_{1B}(0)$. The new insight here is that this output difference is larger with a larger market.

Second, *the tariff effect*: as t increases and if $\lambda_2 = 1$, inequality (2) is more likely to hold and so is the inequality $x_{1B}(0) > \hat{x}_{1B}(0)$. The tariff does not affect firm 1's output in market B directly because the firm chooses FDI. However, if its domestic competitor chooses export, firm 1 will face less competition in market B as t rises. Therefore, to firm 1, an increase in t is similar to an increase in the market size, which makes the inequality $x_{1B}(0) > \hat{x}_{1B}(0)$ more likely to hold.

Lastly, *the synergy effect*: as δ decreases, condition (2) is less likely to hold nor is the inequality $x_{1B}(0) > \hat{x}_{1B}(0)$. Due to the cost synergies, the 1+3 alliance makes firm 1 more efficient (compared to itself in the non-alliance case) 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 the inequality $x_{1B}(0) > \hat{x}_{1B}(0)$.

Note, when firm 1 chooses export, its sales in market B in the non-alliance are

$$x_{1B}(1) = \frac{1}{\Phi} \{(2 - b)a - 4d - [2(1 + b) - \lambda_2b]\}t,$$

and those in the two-alliance case are

$$\hat{x}_{1B}(1) = \frac{1}{\hat{\Phi}} \{2(1-b)a - [2 - 2b + (2+b)\delta]d - [2 + 2b - b^2 - \lambda_2 b(1-b)]t\}.$$

We have $x_{1B}(1) > \hat{x}_{1B}(1)$ if and only if

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

Compared with (2), the above inequality has an extra term that is associated with t . This extra effect is straightforward. With export, firm 1 becomes less efficient in market B and so the 1+3 alliance will further reduce firm 1's output there. This makes the inequality $x_{1B}(1) > \hat{x}_{1B}(1)$ more likely to hold.

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

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

Given λ_2 , λ_3 and λ_4 , firm 1 chooses its λ_1 to maximize the above profits. Define $\Delta\hat{\Pi}_1 \equiv \hat{\Pi}_1(0) - \hat{\Pi}_1(1)$. Firm 1 chooses FDI if $\Delta\hat{\Pi}_1 > 0$ and it chooses export if $\Delta\hat{\Pi}_1 \leq 0$. Direct comparison yields

$$\Delta\hat{\Pi}_1 = \Delta\hat{\pi}(d; \lambda_2) - s,$$

where

$$\Delta\hat{\pi}(d; \lambda_2) \equiv \hat{\pi}_{1B}(0) - \hat{\pi}_{1B}(1) = \frac{t(1-b)}{\hat{\Phi}^2} [2e_1a - (2+4b+b^2)(2+2b-b^2)t + be_1t\lambda_2 - e_2d],$$

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

Note that market A does not affect firm 1's profit difference between FDI and export. Moreover, $\Delta\hat{\pi}(d; \lambda_2)$ 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 δ is small. The reason is that stronger alliance synergies (a smaller δ) 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 than through export.

Due to symmetry, other firms have similar comparisons. Lemma 2 below can be easily established.

Lemma 2. *In the presence of two strategic alliances in the first stage, 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. A larger market, lower (marginal) distribution costs and stronger alliance synergies raise the relative attractiveness of FDI over export.*

We now turn to deriving the equilibrium international 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 international entry strategy space into three regions. In the lower region (below LDL, with small s and d), called region I^m , $\Delta\hat{\Pi}_1 > 0$ for all λ_2 . Hence, firm 1's dominant strategy is FDI. In the upper region (above UDL, with large s and d), called region II^m , $\Delta\hat{\Pi}_1 < 0$ for all λ_2 . Thus, firm 1's dominant strategy is export. In the middle region (between LDL and UDL, with medium levels of s and d), called region III^m , $\Delta\hat{\Pi}_1 > 0$ if $\hat{\lambda}_2 = 1$, but $\Delta\hat{\Pi}_1 < 0$ if $\hat{\lambda}_2 = 0$. Therefore, when $\hat{\lambda}_2$ changes, firm 1's best response is $\hat{\lambda}_1 = 0$ when $\hat{\lambda}_2 = 1$, but $\hat{\lambda}_1 = 1$ when $\hat{\lambda}_2 = 0$.

Due to symmetry, firm 2's optimal international entry mode has exactly the same regions as those for firm 1. Therefore, the equilibrium international entry modes are

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

Because of symmetry, firms 3 and 4 have exactly the same equilibrium outcomes as those given above for firms 1 and 2.

After deriving the second- and third-stage equilibria, we are ready to compare the firms' choices between export and FDI in the two-alliance to the firms' choices in the non-alliance case.

By comparing s^0 and \hat{s}^0 , we obtain that $s^0 \leq \hat{s}^0$ if and only if

$$\frac{a}{t} \geq \frac{\hat{A}(b)}{\hat{T}(b)}, \quad (4)$$

where $\hat{A}(b) \equiv 64 + 240b + 320b^2 + 112b^3 - 152b^4 - 16b^5 + 110b^6 + 3b^7 - 9b^8$ and $\hat{T}(b) \equiv 4b^2(2 - b)(16 + 36b + 11b^2 + 3b^3 + 9b^4)$. The right hand side of (4) is a decreasing function of b . It is

equal to 15.496 at $b = 0.2$, equal to 3.285 at $b = 0.5$, and equal to 2.25 at $b = 1$. Note that we are not interested in the case where b is very close to zero because in such a case the firms are not in the same competing industry. Hence (4) holds for sufficiently large a and small t . 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 non-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 non-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 non-alliance case. This result in fact holds for all levels of d because, as we show below, firm 1's dividing lines are not steeper in the two-alliance case than in the non-alliance case.

In order to see the above comparison when d is not equal to zero, we compare the slopes of the dividing lines and find that the slope of firm 1's dividing lines in the alliance case is not steeper than that in the non-alliance case if and only if

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

where $\hat{\Gamma}(b) \equiv 64 + 288b + 256b^2 - 272b^3 - 356b^4 - 118b^5 - 30b^6 + 18b^7$. Note that 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 δ .

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 $LDL_{\hat{1}}$ but above UDL_1 , and hence firm 1 adopts FDI in the two-alliance case, but it adopts export in the non-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 non-alliance case, and we state this result in Proposition 1.

Proposition 1. *Suppose that the market is large such that (4) is satisfied. In addition, the*

alliance synergies are sufficiently strong and the products are not very homogeneous such that (5) is satisfied. Then, the 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 non-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 non-alliance case. 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 non-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.

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. Moreover, these conditions are reasonable (in terms of the market size) and of our interest (in terms of product differentiation and alliance synergies).

4.2. The Asymmetrical Case: When Some Firms Form Strategic Alliances but Others Do Not

Without loss of generality, we suppose that in the first stage, firms 1 and 3 form the 1+3 strategic alliance but firms 2 and 4 do not. We use “ \sim ” to denote the asymmetric alliance case. Then, the non-allied firms' marginal costs remain the same as in Section 3, given by c_{2k} and c_{4k} ,

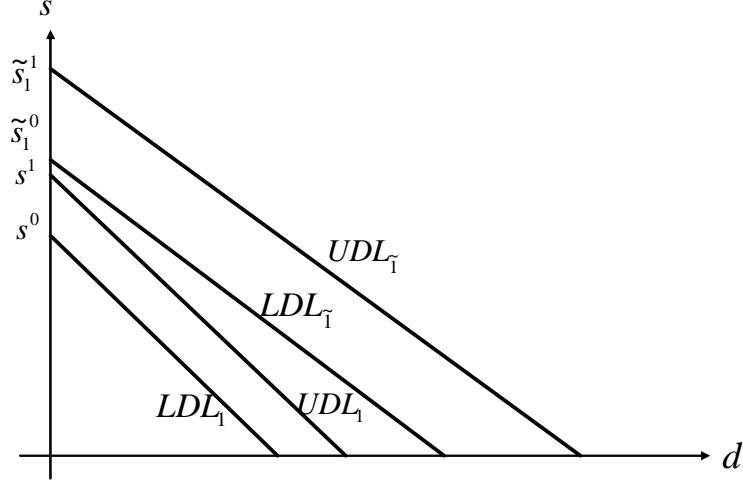


Figure 2: Entry Modes Comparison

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 any international entry mode 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}_{2i} and \tilde{x}_{4i} 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

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

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

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

As a result, the equilibrium prices of the allied firms' products are

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

and those for the non-allied firms' products are

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

The equilibrium (market) profits of the allied firms are

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

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

Similar to (A1), we impose assumptions (A3) and (A4) below to ensure that all firms have positive output in all markets,¹⁹

$$(A3) \quad a > \frac{[2(1-b)^2 + (2-b)(1+b)\delta]d + (2-b)(1+b)t}{(1-b)(2-b)},$$

$$(A4) \quad a > \frac{[2(4+b-b^2) - b(2-b)\delta]d + 2(2+2b-b^2)t}{2(2-b)}.$$

■ *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 λ_2 , λ_3 and λ_4 , firm 1 chooses λ_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 $\Delta\tilde{\Pi}_1 > 0$ and export if $\Delta\tilde{\Pi}_1 \leq 0$. Direct comparison yields

$$\Delta\tilde{\Pi}_1 = \Delta\tilde{\pi}_1(d; \lambda_2) - s,$$

where

$$\Delta\tilde{\pi}_1(d; \lambda_2) \equiv \tilde{\pi}_{1B}(0) - \tilde{\pi}_{1B}(1) = \frac{t}{(1-b)\tilde{\Phi}^2} [(2-b)e_3a - (4+8b+b^2-3b^3-e_3b\lambda_2)t - 2e_4d],$$

where $e_3 \equiv (4+4b-3b^2-b^3) > 0$ and $e_4 \equiv 1-be_3 + (4+8b+b^2-3b^3)\delta > 0$. Note that market A does not affect firm 1's profit difference between FDI and export. Moreover, $\Delta\tilde{\pi}_1(d; \lambda_2)$ has the same features as $\Delta\pi(d; \lambda_2)$. Due to symmetry, firm 3 faces the same comparison.

¹⁹(A3) is derived from $\tilde{x}_{1B} > 0$, when firm 1 chooses export but firm 2 chooses FDI. (A4) is derived from $\tilde{x}_{2B} > 0$, when firm 2 chooses export but firm 1 chooses FDI.

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 $\Delta\tilde{\Pi}_2 > 0$ and export if $\Delta\tilde{\Pi}_2 \leq 0$. Direct comparison yields

$$\Delta\tilde{\Pi}_2 = \Delta\tilde{\pi}_2(d; \lambda_1) - s,$$

where

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

where $e_5 \equiv 2(4 + b - b^2) - b(2 - b)\delta$. Note that $\Delta\tilde{\pi}_2(d; \lambda_1)$ is a linear and decreasing function of d . The same comparison applies to firm 4.

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. A larger market and 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 attractiveness for the non-allied firms.*

Now we turn to examining the interdependence of firms 1 and 2's international entry strategies. 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 $\tilde{s}_2^1 = \Delta\tilde{\pi}_2(0; 1)$. Corresponding to these points, we could depict firms 1 and 2's international entry strategies, respectively, in a figure similar to Figure 1, but, to save space, we omit them. There are two dividing lines (corresponding to \tilde{s}_1^0 and \tilde{s}_1^1) that partition firm 1's international 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 international entry strategy space into three regions. These regions correspond to those in Figure 1. If we draw the dividing lines of firms 1 and 2 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 international entry mode in the 1+3 alliance case to that in the non-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

$$\frac{a}{t} \geq \frac{A(b)}{T(b)}, \quad (6)$$

where $A(b) \equiv (1+b)(32+64b+28b^2+12b^3-11b^4)$ and $T(b) \equiv (2-b)(32+48b-4b^2+20b^3+13b^4-9b^5)$. The right-hand side of (6) is an increasing function of b and it is no greater than 2.5. Hence, the above inequality holds for reasonably large a and small t . We can see (from the proof of Proposition 2 in the Appendix) that inequality (6) also implies $s^1 \leq \tilde{s}_1^1$. 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 non-alliance case.

By comparison, we know that the slope of firm 1's dividing lines in the 1+3 alliance case is not steeper than its dividing lines in the non-alliance case if and only if

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

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 δ , condition (7) holds.

Second, we compare the international 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

$$\frac{a}{t} \geq \frac{\tilde{A}(b)}{\tilde{T}(b)}, \quad (8)$$

where $\tilde{A}(b) \equiv (8+8b-7b^2+b^3)$ and $\tilde{T}(b) \equiv b(2-b)(4+b-b^2)$. The right-hand side of (8) is a decreasing function of b and it is equal to 11.24 at $b=0.1$, 6.23 at $b=0.2$, 3.26 at $b=0.5$, and 2.5 at $b=1$. Hence, so long as b is not too small, the above inequality holds for reasonably large a and 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.

The above two comparisons also apply to firms 3 and 4. As in Figure 2, we can conclude (see the proof of Proposition 2 in the Appendix) 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 considering firm 2's equilibrium international entry mode in the 1+3 alliance case and that in the non-alliance case, we compare \tilde{s}_2^0 and s^0 and obtain that $s^0 < \tilde{s}_2^0$ if and only if $A_2(b)a + T_2(b)t > 0$, where $A_2(b) \equiv (2-b)[2\Phi^2(2+2b-b^2) - (1+b)(2-b)^2\tilde{\Phi}^2] = 2b^2(2-b)(16+16b-24b^2-4b^3+9b^4-2b^5) > 0$ 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 non-alliance case because $\delta \leq 2(2-b)(8+40b+38b^2-28b^3-23b^4+9b^5)/(2+2b-b^2)$, the right-hand side of which is greater than 16 for all $b > 0$.

The above comparisons also apply to firm 4. As proved in the Appendix for Proposition 2, the non-allied firms adopt FDI more in the 1+3 alliance case than in the non-alliance case.

We summarize the above analysis in Proposition 2 below.

Proposition 2. *Suppose the market is large, the alliance synergies are sufficiently strong, and the products are sufficiently differentiated such that (6)-(8) 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

These remarks made after Proposition 1 also apply to Proposition 2. In addition, none of these results requires all conditions to hold. In particular, (6) and (7) are sufficient conditions for firms 1 and 3 to adopt FDI more; the result that firms 2 and 4 adopt FDI more in the 1+3 alliance case requires none of these conditions to hold; and if (8) is satisfied and the products are not very homogeneous, then the allied firms adopt FDI under more circumstances than do

the non-allied firms.

5. Cross-Border Strategic Alliances

In this section, we derive the first-stage equilibrium. To make sure that the firms can enter the foreign markets in all cases, we assume that the market size satisfies (A1)-(A4), which are summarized in one condition:²⁰

$$(A5) \quad a > a_{\min} \equiv \frac{(10 + 3b - 2b^2)d + 2(2 + 2b - b^2)t}{(1 - b)(2 - b)}.$$

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

5.1. Strategic Alliance Incentives

As is well-known in concentration-proximity tradeoff studies, the level of plant setup costs is very crucial in determining when a firm will choose export or FDI. Accordingly, 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 strategic alliance incentives when firms 2 and 4 remain independent. Because s is small, all firms choose FDI regardless of the first-stage strategic alliance 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 π_{1k} (from Section 3) and $\tilde{\pi}_{1k}$ (from Section 4), our comparison yields the following result

$$\tilde{\Pi}_1(0) - \Pi_1(0) = \frac{b^2}{(1 - b)\Phi^2\tilde{\Phi}^2} [m_0(a - 3d)a - m_1d^2] + (1 - \delta) \left[\frac{m_2d}{(1 - b)\tilde{\Phi}^2} + D \right], \quad (9)$$

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 $m_2 = 2(1 - b^2)(2 + b)[(2 - b)a - 2(1 - b)d] + (4 + 8b + b^2 - 5b^3)(1 - \delta)d > 0$. Note that the profit difference is decomposed into two parts. The first part is the effect of a change in market competition due to the alliance. As shown in the proof of Lemma 4, this part

²⁰In fact, the market size should be much larger so that the market profits can cover the plant setup costs.

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.²¹ The second part of the right-hand side of (9) 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., δ becomes smaller).

To summarize, we note that firms 1 and 3 have incentives to form an alliance when both b and δ are small. However, they have no such incentives when both b and δ are large.

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

$$\hat{\Pi}_1(0) - \Pi_1^{2+4}(0) = \frac{b^2(1-b)}{(2-b)^2\hat{\Phi}^2\tilde{\Phi}^2}(\hat{m}_0a^2 + \hat{m}_1ad - \hat{m}_2d^2) + (1-\delta) \left[\frac{\hat{m}_3(1-b)d}{\hat{\Phi}^2\tilde{\Phi}^2} + D \right], \quad (10)$$

where Π_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 δ . The expressions of these functions are given in the proof of Lemma 4. Note that the profit difference can also be decomposed to two parts, the competition effect and synergy effect, just like in (9). 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.

The above analysis about firm 1's incentives to form a strategic alliance is also applicable to the other firms. Hence, we establish Lemma 4 below.

Lemma 4. *Suppose that $a \geq a_{\min}$ and 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 δ are sufficiently large.*

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 in the first stage. Then, by calculating and comparing firm 1's total profits with and without the 1+3 alliance, we could have an expression similar to (9), which allows us to discuss the 1+3 strategic alliance's

²¹This result is consistent with the recent finding by Qiu and Zhou (2006) on mergers.

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

$$\tilde{\Pi}_1(1) - \Pi_1(1) = \tilde{\Pi}_1(0) - \Pi_1(0) - \frac{\tilde{\Theta}b^2t}{(1-b)\tilde{\Phi}^2\tilde{\Phi}^2}, \quad \text{where } \tilde{\Theta} \equiv n_0a + n_1d - n_2d\delta - n_3t, \quad (11)$$

where $n_0 = 2b(1-b)(2-b)(32 + 104b + 20b^2 - 78b^3 + 45b^4 - 9b^5)$, $n_1 = 4(1-b)(32 + 80b + 16b^2 + 56b^3 + 82b^4 - 119b^5 + 54b^6 - 9b^7)$, $n_2 = 2(2-b)^2(2+3b)^2(4+6b-3b^3+b^4)$, $n_3 = b(128 + 272b - 208b^2 - 248b^3 + 368b^4 - 123b^5 + 11b^6)$, and all are positive. Clearly, $\tilde{\Theta}$ increases (therefore the relative strategic alliance incentives under export as opposed to under FDI decrease) when a increases, d increases, δ 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 in the first stage. From the calculation and comparison, we obtain

$$\hat{\Pi}_1(1) - \Pi_1^{2+4}(1) = \hat{\Pi}_1(0) - \Pi_1^{2+4}(0) - \frac{\hat{\Theta}b^2(1-b)t}{(2-b)^2\hat{\Phi}^2\hat{\Phi}^2}, \quad (12)$$

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 a , d , δ and t .

Lemma 5. *Suppose that $a \geq a_{\min}$ and the plant setup costs are high. The strategic alliance incentives are lower under export than under FDI. Moreover, a larger market, higher distribution costs, greater alliance synergies, and a lower tariff increases the relative strategic alliance incentives under FDI as opposed to under export.*

Proof. In Appendix.

■ *Medium plant setup costs.* When s takes a medium value, a firm's equilibrium international entry mode is affected by the outcome of the first-stage strategic alliances. Suppose that firms 2 and 4 do not form an alliance in the first stage. 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 strategic 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 strategic alliance incentives would have been $\tilde{\Pi}_1(1; \lambda_2 = 1) - \Pi_1(1; \lambda_2 = 1)$. A direct comparison gives $[\tilde{\Pi}_1(0; \lambda_2 = 1) - \Pi_1(1; \lambda_2 = 1)] - [\tilde{\Pi}_1(1; \lambda_2 = 1) - \Pi_1(1; \lambda_2 = 1)] = \tilde{\Pi}_1(0; \lambda_2 = 1) - \tilde{\Pi}_1(1; \lambda_2 = 1) = \Delta\tilde{\pi}_1(d; 1) - s > 0$, which indicates that when a strategic alliance induces the allied firms (but not the non-allied firms) to switch from export to FDI, the switch itself in return raises the allied firms' alliance incentives. Let us call these increased incentives the FDI-inducing alliance incentives.

Suppose that the 1+3 alliance induces all firms to switch from export to FDI. Then, $\Delta\tilde{\Pi}_1 = \Delta\tilde{\pi}_1(d; 0) - s > 0$ and firm 1's strategic alliance incentive are measured by $\tilde{\Pi}_1(0; \lambda_2 = 0) - \Pi_1(1; \lambda_2 = 1)$. Should the 1+3 alliance not induce any switch from export to FDI,²² the strategic alliance incentives would be $\tilde{\Pi}_1(1; \lambda_2 = 1) - \Pi_1(1; \lambda_2 = 1)$. Then, $[\tilde{\Pi}_1(0; \lambda_2 = 0) - \Pi_1(1; \lambda_2 = 1)] - [\tilde{\Pi}_1(1; \lambda_2 = 1) - \Pi_1(1; \lambda_2 = 1)] = \tilde{\Pi}_1(0; \lambda_2 = 0) - \tilde{\Pi}_1(1; \lambda_2 = 1) = \Delta\tilde{\pi}_1(d; 0) - s > 0$. Again, the FDI-inducing alliance incentives are present in this case.

The analysis of firm 1's alliance incentives when firms 2 and 4 have a strategic alliance in the first stage is exactly the same as above, with replacing $\tilde{\Pi}_1$ replaced by $\hat{\Pi}_1$ and noting $\Delta\hat{\pi}_1(d; 1) - s > 0$ if the 1+3 alliance induces the allied firms to switch from export to FDI, and $\Delta\hat{\pi}_1(d; 0) - s > 0$ if the 1+3 alliance induces all firms to switch from export to FDI. Therefore, we obtain the following lemma.

Lemma 6. *Suppose the $a \geq a_{\min}$ and 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 or all firms to switch from export to FDI.*

²²Note from Proposition 2 that there is never the case when the 1+3 alliance induces only the non-ally 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 strategic alliance incentives in the presence of the 2+4 alliance to its alliance incentives 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 establish the following result.

Lemma 7. *Suppose that $a \geq a_{\min}$. Then, $\Delta_{FDI} > 0$ 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 that $a \geq a_{\min}$. Given d and δ , 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 first-stage equilibrium for $b \in [b_0, b_1)$? Given any b within this range, there are three possible results: (i) $\tilde{\Pi}_1(0) - \Pi_1(0) > 0$, (ii) $\hat{\Pi}_1(0) - \Pi_1^{2+4}(0) < 0$, and (iii) $\tilde{\Pi}_1(0) - \Pi_1(0) > 0$ while $\hat{\Pi}_1(0) - \Pi_1^{2+4}(0) > 0$. Following the proof of Proposition 3, it is clear that in the first case, the equilibrium is the same as that for $b \leq b_0$, and in the second case, the equilibrium 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: either there is no strategic alliance, or there are two strategic alliances (1+3 and 2+4).

VI. Concluding Remarks

This paper develops a model that incorporates the firms' decisions on cross-border strategic alliances and international entry modes. Market size, product differentiation, distribution costs and alliance synergies all are important in affecting the firms' incentives to form strategic alliances and their choices between export and FDI. In particular, we find that a larger market, 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 larger markets and 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, and we have shown that a reduction in the distribution costs will raise the relative attractiveness of FDI over export. 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.

Since the firms and countries are symmetric in our model, the complementarity property of strategic alliances rules out any asymmetric equilibrium (with regard to alliances). Firm heterogeneity needs to be introduced in order to obtain an asymmetric equilibrium. For example, we can take the simplest approach that would not require us to redo all the analyses in this paper: assume that the 1+3 alliance creates greater synergies than the 2+4 alliance does. Then, for some values of the parameters, the first-stage equilibrium involves just one alliance, i.e., the 1+3 alliance, and as a result, for some levels of s , firms 1 and 3 choose FDI while firms 2 and 4 choose export in the second stage. It would be interesting to examine how firm heterogeneity in productivity affects the firms' incentives to form cross-border strategic alliances and their choices between export and FDI.

Appendix

Proof of Proposition 1.

Let us first compare firm 1's UDL in the alliance case to that in the non-alliance case. Note $s^1 \leq \hat{s}^1$, if and only if $a/t \geq (64 + 192b + 128b^2 - 32b^3 + 56b^4 + 140b^5 - 8b^6 - 24b^7 + 9b^8)/\hat{T}(b)$. A simple comparison shows that (4) implies that $s^1 \leq \hat{s}^1$.

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 $UDL_{\hat{1}}$, firm 1' choice is export with and without the alliances; in the area between $LDL_{\hat{1}}$ and $UDL_{\hat{1}}$, 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 $LDL_{\hat{1}}$, 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 without the alliances; in the area below LDL_1 , its choice is FDI with and without the alliances. Therefore, firm 1 is more likely to adopt FDI in the alliance case than in the non-alliance case.

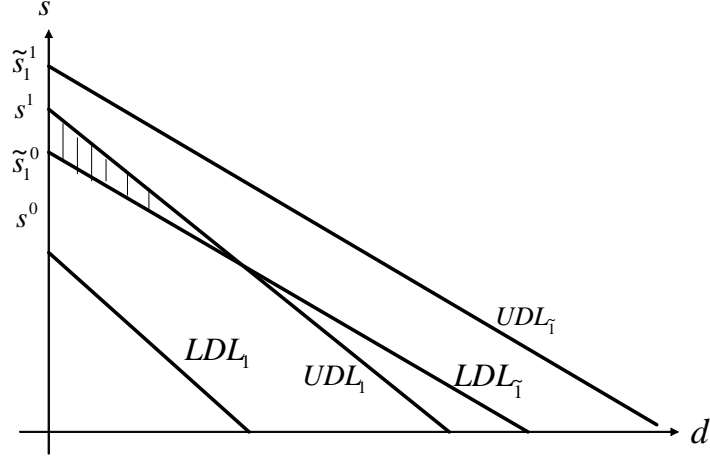


Figure 3: Entry Modes Comparison (2)

In Figure 3, UDL_1 intercepts $LDL_{\hat{1}}$. In the shaded area (below UDL_1 and above $LDL_{\hat{1}}$), 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 international entry mode. In the other areas, the comparisons are exactly the same as those in Figure 2. Hence, the strategic alliances encourage the firms to adopt FDI. Q.E.D.

Proof of Proposition 2.

Let us first compare firm 1's UDL in the 1+3 alliance case to that in the non-alliance case. We have $s^1 \leq \tilde{s}_1^1$ if and only if $a/t \geq (32 + 64b + 44b^2 + 44b^3 - 19b^4 - 24b^5 + 9b^6)/T(b)$. A simple comparison shows that (6) implies that $s^1 \leq \tilde{s}_1^1$.

Then, under conditions (6) and (7), we can draw firm 1'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. Q.E.D.

Proof of Lemma 4.

First, $a - 3d > 0$ by (A5). Second, $m_0 > 0$ for $b < 0.3073$ and $m_0 > 0$ for $b > 0.3073$. Hence, for sufficiently large b , the first term of the right-hand side (RHS) of (9) is negative. If δ is also large, the second term is small and so the RHS of (9) is negative.

However, since (A5) implies $a > 10d/(1-b)(2-b)$ and $a - 3d > 4d/(2-b)$, we have, for $b < 0.3073$, $m_0(a - 3d)a - m_1d^2 > d^2[40m_0/(1-b)(2-b)^2 - m_1] = (192 - 1152b + 784b^2 + 896b^3 + 784b^4 + 544b^5 - 985b^6 + 357b^7 - 36b^8)d^2$, which is positive for $b \leq 0.137$.

Note that the second term of the RHS of (9) is always positive. Hence, due to continuity, there exists $b_m > 0.137$ such that the RHS of (9) 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 (10). Our calculation shows that $\hat{m}_0 = 32(1-b)(2-b)^2(1-b-5b^2+b^3)$, $\hat{m}_1 = 16(1-b)(2-b)^2(24+120b+180b^2-86b^3-21b^4) > 0$, $\hat{m}_2 = 2336+7328b-1264b^2-14528b^3+1710b^4+7942b^5-3063b^6-711b^7 > 0$, and $\hat{m}_3 = 16b^2(1-b)(4+10b+7b^2+4b^3-b^4)a+(1+b)(136+360b-230b^2-660b^3+365b^4+156b^5-31b^6)d+(1+b)^2(8+32b+26b^2-14b^3-5b^4+b^5)\delta d > 0$. First, $\hat{m}_0 > 0$ if and only if $b < 0.367$. Second, when b is large, $\hat{m}_0 < 0$ and $\hat{m}_0a^2 + \hat{m}_1ad = (\hat{m}_0\frac{a}{d} + \hat{m}_1)ad \leq 0$ for sufficiently large a/d . Then, it is clear that $\hat{m}_0a^2 + \hat{m}_1ad - \hat{m}_2d^2 < 0$. Moreover, for sufficiently large δ , the second term of the RHS of (10) is small. This proves that the RHS of (10) is negative for sufficiently large b and δ .

Third, $\hat{m}_1ad - \hat{m}_2d^2 > [10\hat{m}_1/(1-b)(2-b) - \hat{m}_2]d^2 = (5334 + 27232b + 39664b^2 - 41792b^3 + 5330b^4 - 4582b^5 + 3063b^6 + 711b^7)d^2 > 0$. Thus, for sufficiently small b , $\hat{m}_0a^2 + \hat{m}_1ad - \hat{m}_2d^2 > 0$.

Moreover, the second term of the RHS of (10) is positive and if $(1 - \delta)D$ is large, this term is large. Hence, the critical level of b for the RHS of (10) to be positive could be very large. Q.E.D.

Proof of Lemma 5.

First, we focus on the case when firms 2 and 4 do not form an alliance. The effects of changes in a , d , δ and t on $\tilde{\Theta}$ is clear from the definition of $\tilde{\Theta}$. This is the second part of the lemma.

As for the first part of the lemma, note that by (A5) we have $a > (10d + 4t)/(1-b)(2-b)$. 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 $2(320 + 912b - 88b^2 - 508b^3 + 690b^4 - 602b^5 + 282b^6 - 75b^7 + 9b^8)d$, which is positive, and the second term is $(384 + 1104b - 48b^2 - 872b^3 + 728b^4 - 195b^5 + 11b^6)t$, which is also

positive. Hence, $\tilde{\Theta} > 0$ for all b .

Now, we turn to the case when firms 2 and 4 form an alliance in the first stage. Direct calculation and comparison yields $\hat{\Theta} \equiv \hat{n}_0 a + \hat{n}_1 d - \hat{n}_2 d \delta - \hat{n}_3 t$, where $\hat{n}_0 = 16(1-b)(2-b)^2(8+40b+60b^2+22b^3-7b^4-4b^5+b^6)$, $\hat{n}_1 = 32(1-b)(48+216b+256b^2-18b^3-93b^4+25b^5+12b^6-7b^7+b^8)$, $\hat{n}_2 = 16(1+b)(2-b)^2(8+36b+46b^2+12b^3-3b^4-4b^5+b^6)$, $\hat{n}_3 = 512+2304b+2496b^2-1408b^3-2896b^4-208b^5+840b^6-56b^7-56b^8+8b^9$, and all are positive. Thus, the effects of changes in a , d , δ and t on $\hat{\Theta}$ are clear from the definition of $\hat{\Theta}$. This is the second part of the lemma.

As for the first part of the lemma, using $a > (10d+4t)/(1-b)(2-b)$, 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 $(3584+14592b+11520b^2-10496b^3-6336b^4+3712b^5+144b^6-912b^7+368b^8-48b^9)d$, which is positive, and the second term is $(512+2304b+2624b^2+384b^3+592b^4+144b^5-456b^6-8b^7+56b^8-8b^9)t$, which is also positive. Hence, $\hat{\Theta} > 0$ for all b . Q.E.D.

Proof of Lemma 7.

First, the case of small s . Direct calculation and arrangement yields the following result,

$$\Delta_{FDI} = \frac{32b^2(1-b)^2(2-b)^2}{\Phi^2\hat{\Phi}^2\tilde{\Phi}^2}(q_0a^2+q_1ad-q_2d^2) + \frac{8b^2(1-b)(2-b)^2(2+3b)^2}{\Phi^2\hat{\Phi}^2\tilde{\Phi}^2}(q_3a-q_4d-q_5d\delta)d\delta,$$

where $q_0 = 12+34b+7b^2-27b^3+5b^4-6b^5$, $q_1 = 32+256b+808b^2+1224b^3+772b^4-42b^5-107b^6$, $q_2 = 32+264b+87b^2+1452b^3+1165b^4+325b^5+52b^6$, $q_3 = 2(1-b)(8+40b+58b^2+12b^3-23b^4)$, $q_4 = 4(1-b^2)(8+28b+11b^2-32b^3)$, $q_5 = 16+96b+196b^2+132b^3-39b^4-63b^5$, and all are positive. Since $a > 10d/(1-b)(2-b)$ by (A5), we have $(q_1ad-q_2d^2) > [10q_1-(1-b)(2-b)q_2]d^2/(1-b)(2-b) = (256+2128b+7088b^2+11700b^3+8870b^4+973b^5-1364b^6-169b^7-52b^8)d^2/(1-b)(2-b) > 0$ for all b , and $(q_3a-q_4d-q_5d\delta) > [10q_3/(1-b)-(2-b)(q_4+q_5)]d/(2-b) = (64+432b+952b^2+664b^3-402b^4-213b^5+65b^6)b/(2-b) > 0$ for all b . Thus, $\Delta_{FDI} > 0$.

Second, the case of large s . Based on (11) and (12), 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 $(2-b)^2\hat{\Phi}^2\tilde{\Theta} - (1-b)^2\Phi^2\hat{\Theta} = 8(1-b)^2(2-b)^2(\bar{q}_0a + \bar{q}_1d - \bar{q}_2d\delta - \bar{q}_3t)$, where $\bar{q}_0 \equiv 2(1-b)(2-b)(64+416b+864b^2+416b^3-452b^4-206b^5-30b^6-229b^7+114b^8 -$

$9b^9$), $\bar{q}_1 \equiv 2b(256 + 1632b + 3104b^2 + 640b^3 - 2112b^4 + 1110b^5 + 982b^6 - 1491b^7 + 865b^8 - 195b^9 + 9b^{10})$, $\bar{q}_2 \equiv b^2(2 + 3b)^2(8 + 40b - 10b^2 - 158b^3 - 43b^4 + 89b^5 - 16b^6 + b^7)$, $\bar{q}_3 \equiv 2(384 + 2368b + 4432b^2 + 400b^3 - 6464b^4 - 4332b^5 + 1021b^6 + 669b^7 - 178b^8 - 202b^9 + 120b^{10} - 18b^{11})$, and all are positive. We enlarge Δ_E by dropping the positive terms associated with \bar{q}_2 , \bar{q}_3 and $d\delta$ to have $\Delta_E > \frac{1}{(1-b)(2-b)^2\Phi^2\tilde{\Phi}^2} [4(1-b)(2-b)^2(q_0a^2 + q_1ad - q_2d^2) - \bar{q}_0at - \bar{q}_1dt]$. Rearranging the terms in the bracket and noticing that $a > 10d/(1-b)(2-b)$ shows that the term is larger than $4(2-b)\Psi_0d^2 + \Psi_1dt + \Psi_2at$, where $\Psi_0 = 256 + 2128b + 8666b^2 - 1687b^3 + 9659b^4 + 973b^5 - 1364b^6 - 169b^7 - 52b^8 > 0$, $\Psi_1 = 1024 + 7168b + 18496b^2 - 15232b^3 + 21472b^4 - 9472b^5 - 4972b^6 - 252b^7 + 2982b^8 - 1730b^9 + 390b^{10} - 18b^{11} >$, and $\Psi_2 = 2(2-b)(32 - 80b - 392b^2 + 232b^3 + 908b^4 - 294b^5 - 176b^6 + 199b^7 - 343b^8 + 123b^9 - 9b^{10})$. Thus, $\Delta_E > 0$ for all b . Q.E.D.

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 , δ 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 δ is large, then there exists b , denoted 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 need to prove a result similar to Lemma 4 for the case of large s . Using (9) and (11), we rewrite

$$\tilde{\Pi}_1(1) - \Pi_1(1) = \frac{b^2}{(1-b)\Phi^2\tilde{\Phi}^2}\Omega_0 + \frac{(1-\delta)}{(1-b)\Phi^2\tilde{\Phi}^2}[d\Omega_1 + (1-b)\Phi^2\tilde{\Phi}^2D],$$

where $\Omega_0 = m_0(a - 3d - n_0t)a - m_1d^2 + (n_2 - n_1)dt + n_3t^2$ and $\Omega_1 = \Phi^2m_2 - n_2b^2t$.

First, $a - 3d > 0$ by (A5). Second, $m_0 > 0$ for $b < 0.3073$ and $m_0 > 0$ for $b > 0.3073$. Hence, for sufficiently large b , the first term of the RHS of (9) is negative. If δ is also large, the second term is small and so the RHS of (9) is negative.

Using (A5) and dropping the positive term associated with n_3 , we have $\Omega_0 > \frac{d^2}{1-b}\varpi_1 + \frac{dt}{1-b}\varpi_2$, where $\varpi_1 = 192 - 304b - 3088b^2 - 1644b^3 + 3368b^4 - 780b^5 - 1529b^6 + 1342b^7 - 393b^8 + 36b^9$, which is positive for $b \leq 0.199$, and $\varpi_2 = 448 - 32b - 23760b^2 + 90964b^3 - 57536b^4 - 99540b^5 - 25908b^6 + 150554b^7 + 476712b^8 - 1313262b^9 + 1343480b^{10} - 745440b^{11} + 239760b^{12} - 42480b^{13} + 3240b^{14}$, which is positive for $b \leq 0.589$. Also using (A5), we have $\Omega_1 > 2(1+b)(2+b)\Phi^2[10 - 2(1-b)^2]d + \frac{t}{2-b}\varpi_3$, where the first term is obviously positive and $\varpi_3 = 4(1+b)(2+b)\Phi^2[2 + b(2-b) - (2-b)b^2n_2 = 256 + 1152b + 1280b^2 - 768b^3 - 1392b^4 + 776b^5 + 712b^6 - 756b^7 - 72b^8 + 332b^9 - 138b^{10} + 18b^{11}$, which is an increasing function of b and positive for all b . Hence, there exists a critical level of b , below which $\tilde{\Pi}_1(1) - \Pi_1(1) > 0$.

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