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Cross-investments by multinationals: a new perspective

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Cross-investments by multinationals: A new perspective

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Abstract

Research Summary: Cross-flows of foreign direct investment (FDI) occur when firms invest in each other's home countries, affecting the terms of competition in each market. They are explained by internalization theory but have never been comprehensively investigated. This article models cross-investment in a duopoly with differentiated products. The firms decide whether to enter each market and whether to serve it through trade or local production. The model combines firm-, country-, and industry-level factors. It places cross-investment in the wider context of cross-sourcing, including cross-trading and asymmetric sourcing. It reveals different forms of cross-investment rather than being limited to cross-multidomestic. Overall, cross-investment is favored by highly differentiated products, low comparative advantage, large markets, high trade costs, and low costs of FDI.

Managerial Summary: Cross-investment, where firms conduct FDI into each other's home countries, is an important phenomenon but has received little recent attention in international business literature. This article seeks, through mathematical modeling, to establish a better understanding of it in the wider context of cross-sourcing. This helps to show how the strategy of the individual firm fits with those of the other firms in an international industry and how different

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possible industry structures and performance levels result. It includes choices over the locations from which markets are served being a potential source of first-mover advantage. For instance, committing to producing in a country could reduce the cost of serving its market, potentially altering the equilibrium outcome in favor of the first mover.

KEYWORDS

economies of scale, foreign investment, multinational enterprise, oligopoly, product differentiation

1 | INTRODUCTION

A multinational enterprise (MNE) may face competition from host country firms not only in the host market but also in its home market. This can involve cross-flows of foreign direct investment (FDI) within the same industry. A cross-flow exists when a firm headquartered in country 1 invests in country 2 at the same time that a firm headquartered in country 2 invests in country 1. The dominant theory of the MNE is internalization theory, which was incorporated into Dunning's eclectic paradigm. While there is work on cross-investment in international business literature, it has focused mainly on the roles of firm-specific advantages, economies of the firm (such as economies of scope), and oligopolistic defense (Casson, 1987; Clegg, 2013; Dunning, 1988; Dunning & Norman, 1985; Kogut, 1983). Multimarket competition literature (Ma, 1998) has also given a reasoning for cross-investment based on oligopolistic defense. According to Karnani and Wernerfelt (1985), firms may have footholds in each other's home markets to enhance the credibility of making a strong response if one is attacked in its home market by another (see also Casson, 1987). However, this does not explain why the extent of cross-investment in an industry would then be deepened and so is clearly only a partial theory of cross-investment.

Much work on international business, more generally, has focused on the level of the individual firm possessing given advantages (i.e., what are termed "ownership advantages" or "firm specific advantages"). This article advocates taking an industry view as well but has a different focus to work on oligopolistic defense. Rivalry between multinationals is now commonplace, and so there is a need for more international business research at the industry level. As is discussed below, it has been recognized in international business literature that existing work on cross-investment is insufficiently developed to properly address competition between firms. For instance, modeling of different configurations of an industry in an explicitly international context is missing from Norman's model, used by Norman and Dunning (1984: 532) to reason about cross-investment, which is simply a spatial model of a market. Such modeling is also relevant to multimarket competition literature. For example, would a quantitative finding of a relationship between multimarket competition and higher profitability be proof of the effects of mutual forbearance or could it reflect the conditions that can lead to multimarket competition, such as product differentiation, and the resulting industrial structures, including where production is located? As some multimarket competition literature has recognized, the task of controlling for other factors is a formidable one (Bernheim & Whinston, 1990: 22).

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A better understanding of such conditions is therefore needed. This article helps to address that need within an international business context. It does so with a model involving a single-shot game to focus on factors determining international industrial configurations absent of repeated game strategies such as mutual forbearance. In doing so it helps to address the lack of models of configurations of international industries in the international business literature on cross-investment. Cross-investment relating to large firms is conspicuous: for instance, between the United States and the United Kingdom in oil (ExxonMobil, BP) and detergents (Unilever, Proctor & Gamble); between the United States and France in hotels (Marriot and Accor); and between the United States and South Korea in motor vehicles (General Motors, Hyundai). These firms are often described as "market-seeking" and are said to operate in high-technology or brand-intensive industries (Dunning & Lundan, 2008). However, other types of MNE are also involved in cross-investment, as explained below.

Cross-investment has been well-documented at the industry level for the past 40 years (Dunning & McQueen, 1981; Sekiguchi, 1979). Greenaway, Lloyd, and Milner (1998), for example, found that by the mid-1990s international production in many industries was already larger than intra-industry international trade. The importance of cross-investment has been corroborated by studies of Chinese cross-investment (an early example is Xu, 2000) and cross-investment within regional trading blocs (Balasubramanyam et al., 2002). More recently, Driffield and Love (2005) found that intra-industry FDI accounted for over 90% of the UK inward and outward FDI flows.

Aggregated data on cross-investment are available from UN World Investment Reports. It remains significant today, as illustrated by the statistics presented in Table 1. Data at a finer level can be obtained using company reports and databases, such as the Dun & Bradstreet WorldBase (Alfaro & Charlton, 2009).

TABLE 1 Foreign direct investment (FDI) flows between the United States and Europe, 2020.

	FDI flow (billion US dollars)	
Industry	**From Europe to the United States**	**From the United States to Europe**
Chemicals	414	200
Machinery	74	45
Transportation equipment	68	28
Metals	36	33
Computers and electrical equipment	83	48
Information	131	236
Wholesale trade	173	84
Finance (excluding banks and insurance)	185	383
Other	131	165
Total	1295	1222

Source: US Bureau of Economic Analysis, bea.gov/news/2021/direct-investment-by-country-and-industry-2020; Statista, statista.com/statistics, 546939/eu-fdi-in-us-by-industry; both accessed 05/18/2022. The figures in the two columns are not directly comparable because the definitions of industries used are slightly different; the figures are approximations only.

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An improved understanding of cross-investment can allow the data to be interpreted more fully and better inform strategic decision-making by firms (Licai & Blandford, 2019). In the model presented here, there are just two firms, and the success of each firm's strategy depends on its rival's strategy. If the firms compete in a market, then each one's output is determined in reaction to its rival's output. The resulting outputs and prices are determined as a Cournot equilibrium, in which neither firm has an incentive to change its output level given the output of the other. Each firm must choose a strategy in terms of the markets entered and the associated production locations. The profitability of each option is conditional on the other firm's strategy. The equilibrium pair of strategies is the one that maximizes the profits of both firms, under the assumption that one firm acts as the first mover, allowing it to invest first. The industry equilibrium combination of firm strategies can be determined for any given set of parameter values.

In contrast to the existing literature, the model goes beyond firm-level factors, to focus on the industry, but with a different focus to oligopolistic defense. It shows how different international industry structures involving cross-investment can result where the firms have differentiated products. It shows how there are various structures beyond just cross-multidomestic, with cross-investment sometimes being stimulated at least partly by comparative advantage and economies of scale. Further, it places cross-investment in the wider context of cross-sourcing, including not only cross (i.e., intra-industry) trade but also asymmetric sourcing. The model also contrasts with those based on monopolistic competition because it involves an oligopoly so that it addresses strategic interdependence between firms with different characteristics. It further adds to the existing literature on cross-investment by incorporating the possibility of first-mover advantage related to choices of production locations. In the model, committing to a particular location can reduce the unit cost of serving a market. This can then adversely affect the location decisions of the second mover, improving the profitability of the first mover. In some cases, the effect on the second mover could be enough to keep it out of the international industry altogether. The model also shows that higher profitability can result from factors that also help to bring about multimarket competition, such as product differentiation, so that care needs to be taken when attributing higher profitability to mutual forbearance.

2 | LITERATURE

2.1 | Integration of internalization theory and theories of product differentiation and trade

Internalization theory and neoclassical economics have much more in common than is often realized. They both address costs of trade, comparative advantage, and economies of scale. But they differ significantly where proprietary knowledge and market power are concerned (Casson, 2018).

Internalization theory affords the more realistic approach (Buckley & Casson, 2019). It is also more flexible because it makes fewer restrictive assumptions than neoclassical theory. It recognizes that different firms exploit different technologies, which can explain why different varieties of the same product exist. In the COVID crisis, for example, the two leading vaccines, produced by Astra-Zeneca and Pfizer, used very different technologies, with different production and transport costs, and yet were close substitutes in demand. By contrast, neoclassical theory normally assumes that different varieties of products have identical production and transport costs.

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Internalization theory also recognizes the importance of barriers to entry. Neoclassical theories of product differentiation rely heavily on Chamberlin's (1933) notion of monopolistic competition, in which entry and exit are free and the optimal scale of production is low, so that firms make only normal profits. Monopolistic competition is important in theories of intra-industry trade, which can be altered to model intra-industry FDI (Caves, 1986), but removes strategic issues by assuming that all firms, including new entrants, face the same conditions. Internalization theory, by contrast, argues that firms face sunk costs, especially in R&D; a successful innovator can therefore operate behind an entry barrier so long as they can protect their intellectual property rights. Monopoly profits are therefore the norm in internalization theory.

Internalization theory also operates at a more disaggregated level than neoclassical theory. In neoclassical theory, the individual firm is normally a "representative firm," reflecting an assumption that all firms are identical. By contrast, in internalization theory, all firms are different because they all exploit different technologies and/or produce different varieties of products.

The main advantage of neoclassical theory is that it is more formalized and, in some respects more rigorous. The model set out in the following section combines the strengths of these two approaches. It avoids the most restrictive assumptions of neoclassical theory; it includes all the key elements of internalization theory; it synthesizes their insights into the location of production and the pattern of trade (Nielsen et al., 2017); and it matches the rigor of neoclassical theory.

2.2 | Cross-investment

Cross-investment was first systematically theorized by Graham (1978, 1998). He built on the pioneering work of Linder (1961) and Knickerbocker (1973) to model cross-investment as the outcome of a business game. This was on the assumption that it is a reaction to a foreign firm's FDI into the home market of an existing oligopoly, either as a retaliatory move, which might lead the foreign firm to abandon its FDI or due to the wish by the home firms to exploit ownership advantages in the foreign firm's home market following the disruption to their own. A key hypothesis was that post-war FDI from Europe to the United States was induced by investment from the United States into Europe. Since then, the techniques of oligopoly theory and game theory have advanced significantly and it is therefore timely to revive the theoretical study of the subject, which has received less attention in the international business literature than it deserves in recent years.

According to neoclassical economic theory in the 1960s, cross-investment was anomalous. It asserted that international investment flowed in only one direction at once, from low-profit, capital-intensive countries with surplus capital to high-profit, labor-intensive countries that were short of capital (Kemp, 1970; MacDougall, 1960). By switching attention from international differences in rates of profit and resource endowments to the exploitation of proprietary knowledge, the internalization theory of the MNE showed that cross-flows of FDI were a perfectly natural phenomenon (Casson & Norman, 1983; Norman & Dunning, 1984).

This was a great success for internalization theory but it led to complacency. Theoretical development of this topic mostly ceased in about 1985, having focused mainly on the roles of firm-specific advantages, economies of the firm, and oligopolistic defense (Clegg, 2013). It was therefore based partly on firm-level factors rather than on the industry. No systematic synthesis had been achieved. This reflects the traditional dominance of analysis focused on the level of

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the individual firm in international business literature, typified by Dunning's eclectic paradigm, and originally designed to explain (one-way) inter-industry FDI. Indeed, Dunning related gains arising from the common ownership of multiple activities to the concept of ownership advantages (Dunning & Norman, 1985; Dunning, 1988: 11) in seeking to explain intra-industry FDI. Clegg (2013: 116) concluded that theory was not sufficiently developed to explain how cross-investment results from international competition between firms. As will also be shown, cross-investment does not have to be the result of either retaliation or the building credible threats of retaliation. Nor can it be adequately addressed through a firm-level approach, as it is a matter of competition between firms.

To analyze a global phenomenon, such as cross-investment, it is useful to adopt an industry-level view, which applies oligopoly theory to take into account of the inter-dependence between the decisions made by different firms in the same industry. Analyzing behavior at the industry level is more difficult than at the firm level. However, advances in the theory of differentiated oligopoly have now largely overcome these problems (Brander & Spencer, 2015; Singh & Vives, 1984; Vives, 1999). The most direct precursor of the current article is Casson et al. (2016), which provided an industry-level, game-theoretic model of international business. However, due to the other complexities of their model, including product innovation, they used the sharply simplifying assumptions about competition that the products are perfect substitutes and that only one firm can serve each market, with a limited pricing mechanism. The focus of this article, on the other hand, is on cross-investment and related matters such as cross-trade, and so its model includes the possibility that firms may compete in serving each market with differentiated products.

This is part of a wider movement toward seeing the MNE as part of a global system of networked firms (Casson, 2000) rather than focusing on the individual firm. However, the analysis here is of competition between firms in the same industry rather than supply chains. This separates it from work that addresses supply chain issues, such as outsourcing (Buckley, 2018; Buckley & Hashai, 2004, 2020; Casson & Wadeson, 2013). Casson et al. (2016) were also followed by Hashai and Adler (2021), who built on their earlier game theoretic model (Adler & Hashai, 2015), which had demonstrated a tendency toward regionally focused location configurations of value-chain activities based on knowledge-flow costs and the advantages of avoiding competition. The model involves rivalry and strategic interaction, where consumers have a preference for locally supplied support services and production in locations that are perceived to be technologically advanced. By assuming specific parameter values for their model, they were able to show that internalization choices can be significantly affected by competition between MNEs. The more common approach within internalization theory, by contrast, has been to take a firm-centered approach in which profits are maximized through cost minimization. The model below not only involves an equilibrium between firms but also that the equilibrium can be affected by strategic over-investment in choosing production locations. While oligopoly theorists are no strangers to the idea of pre-emptive investments, these can take on a different nature in an international context.

The strategic management literature has also considered oligopolistic industries in analyzing multipoint competition between firms. However, it has done so from what can be modeled as a repeated game theoretic perspective (Dash, 2017) in which an "attack" in one market may generate retaliation in another (similar to some international business literature, as noted above). So, firms in competition across multiple markets may therefore "forbear" from attacking each other to enhance profits in future rounds of the game. By contrast, this article focuses on a one-shot game, so that its starting point is fundamentally different. However, the

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incorporation of insights from the current approach can feed into future work on multipoint competition. For instance, it is important to understand when patterns of behavior and performance associated with forbearance or retaliation might occur in their absence. Otherwise, there is the likelihood of making questionable assumptions about causality. For instance, it might be assumed that mutual forbearance has increased performance when it is really a result of the underlying industry characteristics.

3 | OUTLINE OF THE MODEL

3.1 | Basic assumptions

This section outlines a model of product differentiation that generates cross-flows of FDI. It is designed to satisfy the criteria outlined above. A key feature is that it is a model of an industry and not just an individual firm. Each of the firms in the industry exercises a degree of monopoly power. The number of firms in operation varies according to conditions prevailing in the industry. For simplicity, there are two countries. Firms may undertake FDI or they may not. Cross-investment requires that at least two firms invest in each other's home country. This is just one of many possible outcomes. The model reveals the conditions under which this outcome will occur; it also determines the conditions under which all the other possible outcomes will occur.

The model describes every outcome in detail. It determines which specific firms will enter the industry and which will stay out. It determines which differentiated products are produced, the price of each product in each country, the quantity produced in that country, and the amount imported or exported to or from that country. It determines whether each firm serves each foreign market by exports or FDI and whether it serves its home market by local production or from offshore. It also determines the profitability of each firm.

The details of the model are given in the Appendix A. The model applies to an industry with N potential entrants, but to keep the algebra simple the smallest possible number of firms is used, so that $N = 2$. Because there are just two firms, the only alternatives to monopoly are duopoly and no entry.

Each firm produces just one variety of a consumer product, with or without economies of scale. Costs of production depend on both the technology owned by the firm and the location of production, as in conventional IB theory. There are also trade costs, costs of international technology transfer, and liability of foreignness.

Each firm is headquartered in a different country. Each firm can serve either country's market or both of them. It can serve a market by either local production or trade. It is assumed that contractual arrangements such as licensing, franchising, and subcontracting, are inefficient and so they are omitted from the model; they can readily be included, but they complicate the analysis.

Consumers value both varieties of the good but become progressively satiated with each of them as their consumption increases. Consumer preferences are expressed in terms of a quadratic utility function. Demands for the two varieties are potentially interdependent. They may be either substitutes or complements. In previous literature, substitutability is almost invariably assumed, but the model is perfectly general, and complementarity is possible too. This section follows the literature in assuming substitutability; complementarity is discussed in Section 5.

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3.2 | Solution of the model

The model is solved in two steps. The first determines the industry outcome (prices, outputs, etc.) conditional on which firms decide to enter the industry. This establishes the profits for each firm for each possible industry outcome. In the second step, the game is then solved by backward induction to find the subgame perfect equilibrium. This determines which firms will actually enter each country's market, given the profits that they would make under each possible entry scenario, with each scenario including their production location(s). The most enterprising firm decides its strategy first and it will not want to reverse its decision, having correctly anticipated the reaction of the second mover; the second mover then reacts to this decision. Although this is a strong assumption, it guarantees a determinate result. It implies that the first mover is fully informed about the second mover. Models with imperfect information, on the other hand, are also important in oligopoly literature (Vives, 1999), and so would be a natural stream of future work in applying oligopoly theory to international business. The assumption also means that the model illustrates how first-mover advantages can be of key strategic importance, dependent on the conditions of the case in hand. In some cases, the first mover will overinvest in sunk fixed costs, in choosing production locations, to influence the strategy chosen by the second mover.

In the model, each firm faces eight strategic options, which are shown in Figure 1. These concern which markets to serve and how to serve them. For cross-investment to occur, each

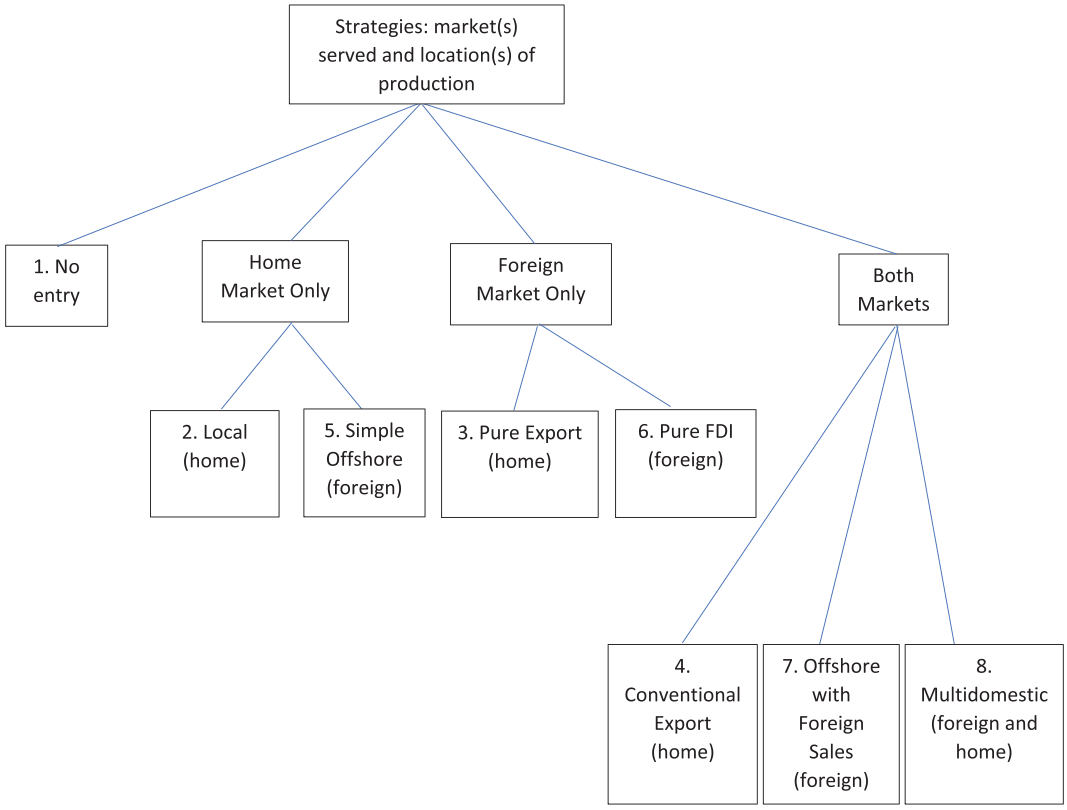

FIGURE 1 Firm strategies.

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firm must invest in the other country. Strategies 5–8 involve FDI (shown as foreign production in Figure 1); three of them involve serving the foreign market and one of them, strategy 5, involves serving the home market only. Of these three, two (strategies 6 and 7) involve producing in the foreign country only, one (strategy 6) involves serving the foreign market only, and one (strategy 8) involves producing in both countries to serve both markets.

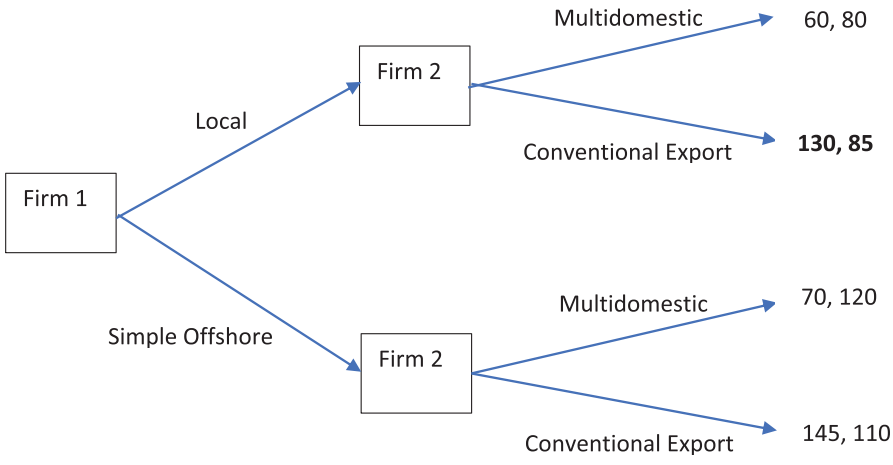
Additionally, as mentioned above, there is the possibility of a firm, particularly the first mover, overinvesting in sunk fixed costs, through its choices of production location(s), to alter the strategy of the other firm. The point is that this can potentially reduce its unit (and therefore marginal) cost of serving one or both markets. This then makes it a stronger competitor for the other firm in the market(s) concerned. The effect on the other firm is stronger if the products are relatively close substitutes, as is shown in the Appendix A.

For instance, take the example shown in Figure 2. The strategies from Figure 1 that are not shown in Figure 2 are assumed to be dominated in this example. Say the first mover, firm 1, is only going to serve its home market, regardless of the strategy of the second mover. Say that the most cost-efficient location for its production is in the foreign country, which has low labor costs.

However, say that it could incur higher sunk fixed costs by instead establishing a production facility in its home country, which involves investing more in automation due to high labor costs. Say that this then gives it an even lower unit cost than if it is produced in the foreign country. It could therefore mean that the second mover would then choose strategy

		Firm 2	
		Multidomestic	Conventional Export
Firm 1	Simple Offshore	**70, 120**	145, 110
	Local	60, 80	130, 85

(a) Simultaneous Game



(b) Sequential Game

FIGURE 2 Simultaneous game equilibrium versus first-mover advantage. (a) Simultaneous game. (b) Sequential game.

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4, Conventional Export, rather than strategy 8, Multidomestic. This will favor the first mover if it increases the second mover's unit cost in competing with the first mover. It will be more likely if the second mover's sunk fixed costs in producing in the first mover's home country are high, and its sales there will not be large enough to make incurring them worthwhile, given the first-mover's strategy. This is as illustrated in comparing Figure 2a with Figure 2b, in which the equilibrium outcomes are shown in bold. The first-mover advantage for firm 1 in the figure is that its equilibrium payoff in the simultaneous game is 70, whereas it is 130 in the sequential game.

TABLE 2 Factors impacting directly on the selection of each strategy.

Ref	Name	Remark	Possible causes
1	No entry	No production and no profit.	• Low demand in both countries • High production costs
2	Local	Purely domestic operation.	• Low foreign demand and high home demand • High trade costs • High costs of FDI
3	Pure export	Home production for export only	• High foreign demand and low home demand • Comparative advantage • Low trade costs • High costs of FDI
4	Conventional export	Domestic production for both home market and export	• Larger home market • Lower home unit cost of production, high fixed costs of production in each country • Low trade costs • High costs of FDI
5	Simple offshore	Offshore production for the home market	• Low foreign demand • Foreign comparative advantage • Low trade costs • Low costs of FDI
6	Pure FDI	Foreign production for the local market only	• High foreign demand and low home demand • Foreign comparative advantage • High trade costs • Low costs of FDI
7	Offshore with foreign sales	Both markets served exclusively by foreign production	• High demand at home and higher abroad • Foreign comparative advantage and large fixed costs of production • Low trade costs • Low costs of FDI
8	Multidomestic investment	Local production in both countries.	• High demand at home and abroad • Low comparative advantage and fixed costs of production • High trade costs • Low costs of FDI

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To give another example, consider a case where the first mover is going to serve both markets, regardless of the decisions of the second mover. Consider the possibility of the first mover choosing strategy 8 (multidomestic), rather than 4 or 7 (conventional export or offshore with foreign sales), in order to make the second mover choose strategy 1 (no entry). Being multidomestic, rather than serving both markets from one country, could reduce the unit cost of serving one of the countries. This could make it not worthwhile for the second mover to serve that country. If the second mover would otherwise have relied on concentrating production in one country, due to high fixed costs, this could potentially cause it not to produce at all.

Note that a case with more countries (and learning by doing) was modeled by Alcácer et al. (2013) for homogeneous products and where each firm can only enter one country in each period. Their model involved avoid, collocate, and stronger-chases the weaker strategies. However, they also assumed that market entry was through FDI, and so their model did not involve the possibility of gaining advantages in serving markets through strategic choices over production locations.

Table 2 identifies the factors that favor each strategy. Low liability of foreignness is the only factor that is common to all four strategies involving FDI. All the other factors favoring FDI vary because of differences in the markets served. For example, for the foreign market to be served locally, trade costs may need to be high to discourage imports from the home country. However, if the domestic market only is to be served, trade costs may need to be low to encourage offshoring of production. If both markets are served from the same location, then economies of scale will tend to be high, whereas if only one market is served, then economies of scale may be low.

Table 3 elucidates the factors identified in Table 2. Each of the factors is decomposed into separate elements, as appropriate.

TABLE 3 Fundamental factors influencing strategic choices.

Factor impacting directly on strategic choice	Fundamental underlying factors
Low demand	Weak preference for the variety or the product as a whole; low population; close substitutability with a cheaper variety produced by the other firm
Low trade costs	Low tariffs; low transport costs
Strong comparative advantage	Differential natural resource endowments; different sets of labor skills; strength of industrial cluster
High costs of FDI: international technology transfer cost	Tacit rather than codified knowledge; cultural and linguistic differences; high international travel costs; lack of local expertise
High costs of FDI: high liability of foreignness	Weak property rights in host country; poor international relations; politically motivated trade rivalry

Note: Because of the simplifying assumption that foreign production is always wholly owned, it is impossible to distinguish between the impact of the costs of international technology transfer and the costs of liability of foreignness; it is only when a licensing option (or other arm's length contractual relationship) is available that it is possible to distinguish them. In this case, high costs of international technology transfer encourage FDI while high liability of foreignness encourages licensing instead. All that can be said is that when there is a simple direct choice between FDI and trade both factors discourage FDI.

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4 | APPLICATIONS OF THE MODEL

This section discusses the contribution of the model. As noted above, it analyses not only cross-investment but the interplay of IB strategies as a whole. In particular, it embeds cross-investment within the wider context of cross-sourcing, which includes trade as well as FDI.

4.1 | Cross-sourcing

Table 4 identifies three types of cross-sourcing. One is cross-investment and the others are cross-trading, where exports replace FDI, and asymmetric sourcing, where exports flow in one direction and FDI in the other. There are two varieties of asymmetric sourcing, depending on which variety of product is supplied to the foreign market by exports and which by FDI. Note that, while cross-trading of the same variety by a given firm is never efficient in the model, cross-trading by different firms producing different varieties of the same product may well be efficient.

4.2 | Cross-investment

Cross-investment is examined in detail in Table 5. It is a more complex phenomenon than often supposed. By definition, cross-investment is a consequence of the interaction between the strategies of two different firms. Each firm has a choice of eight strategies, as indicated in Table 2, and no fewer than four of these strategies can support cross-investment. With four strategies for each firm, there are $4 \times 4 = 16$ possible strategy combinations that can generate cross-investment. Four of the combinations are purely symmetric, that is, each firm pursues an identical strategy; the remaining 12 strategy combinations comprise six pairs, where in each pair the roles of firms 1 and 2 are interchanged. There are therefore $6 + 4 = 10$ cases involving cross-investment listed in Table 5 and discussed below. Section 4 of the Appendix A provides some formal analysis of the strategic choices involved.

Most previous literature on cross-investment has focused on just one of these cases, namely cross-multidomestic investment, which appears at the head of the table. Under this case, both firms produce in both countries. Yet the table shows that more than half the cases of cross-investment involve locational specialization, where each firm produces in just a single country. This indicates that it is not only product differentiation that can stimulate cross-investment but also comparative advantage and economies of scale.

On closer examination, though, it becomes clear why cross-multidomestic investment may represent the most prominent case.

TABLE 4 Varieties of cross-sourcing by different firms.

	Firm 2	
Firm 1	**FDI**	**Exports**
FDI	Cross-investment	Asymmetric sourcing
Exports	Asymmetric sourcing	Cross-trading

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TABLE 5 Strategic combinations that generate cross-investment.

		Strategy		Markets served		Locations of production	
Ref.	Type	Firm 1	Firm 2	Firm 1	Firm 2	Firm 1	Firm 2
1	Cross-multidomestic	8	8	Both	Both	Both	Both
2	Multidomestic + offshore with foreign sales	8	7	Both	Both	Both	1
3	Multidomestic + pure FDI	8	6	Both	1	Both	1
4	Multidomestic + simple offshore	8	5	Both	2	Both	1
5	Cross-offshore with foreign sales	7	7	Both	Both	2	1
6	Offshore with foreign sales + pure FDI	7	6	Both	1	2	1
7	Offshore with foreign sales + simple offshore	7	5	Both	2	2	1
8	Pure FDI + pure FDI	6	6	2	1	2	1
9	Pure FDI + simple offshore	6	5	2	2	2	1
10	Cross-simple offshore	5	5	1	2	2	1

Note: The first-named strategy in the second column is pursued by firm 1 and the second-named strategy by firm 2. The strategy numbers are as shown in Figure 1. The markets served and locations of production refer to countries 1 and 2, where country 1 is the home country for firm 1 and country 2 is the home country for firm 2.

Case 1. *Cross-multidomestic*. This case may be illustrated by two varieties of automobile, for example, a Hyundai and a General Motors. In this case, each variety is assembled in each local market to supply that market. Each firm has its own proprietary technology. Product differentiation is strong enough to allow both firms to be profitable in both markets in competition with each other. Demand is high enough for each variety such that further economies of scale are low, beyond the level of sales in each country, and/or costs of international trade are high. Comparative advantage and costs of FDI, including international technology transfer costs and liability of foreignness, are low. As a result, each firm incurs the costs of local production in each country while avoiding costs of international trade.

Case 2. *Multidomestic plus offshore with foreign sales*. Here the multidomestic firm gains the benefits of local production with each market, avoiding the costs of international trade. The other firm gains the advantages of local production for its host country market but imports into its home-country market. By focusing production in one country, it gains larger economies of scale resulting from its fixed costs. It could be that it chooses to produce in the host country, rather than its home country, because it has larger sales there, so helping to save on trade costs. It could also be that costs in the host country favor its production technology. The multidomestic firm, on the other hand, could have larger sales in both countries, so reducing the influence of its fixed costs. Costs of FDI are low.

Case 3. *Multidomestic plus pure FDI*. This represents another case involving a multidomestic strategy for one firm but in which there are no home sales at all for the

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other firm's product. It could be that production costs do not favor the other firm's product in its home country, or the market for its product there is too small to cover the fixed costs of a local production plant, and costs of international trade are too high for non-local production. It therefore produces only in the host country for its market alone.

Case 4. *Multidomestic plus simple offshore*. This could involve the two firms facing quite different relative costs in the two countries. For instance, one firm has a labor-intensive production technology, being partly handmade, leading it to produce abroad in the lower wage country, despite having no sales there, with its product being at the luxury end of the market for which there is demand only in the higher-wage country. The other firm gains the advantages of the colocation of production with the markets in both countries, avoiding costs of international trade. Again, this is more likely where its sales in both countries are large enough to achieve significant economies of scale in each plant and where product differentiation significantly reduces the intensity of competition in the one country where the firms compete.

Case 5. *Cross-offshore with foreign sales*. This case could arise where both firms have larger sales in their foreign market than their domestic market or where they have significantly different production technologies that favor foreign production for both firms. Foreign ownership is facilitated by low costs of FDI (low technology transfer costs and low liability of foreignness). High fixed costs, resulting in economies of scale, give an incentive for each firm to concentrate production in one location. Strong product differentiation and low trade costs help to bring about competition in both markets. The case can be illustrated by the service sector. For instance, say that there are two hotel chains, who cater for foreign holidays. Firm 1, headquartered in country 1, recruits holiday makers from country 1 to visit its hotels in country 2, and firm 2 does the opposite. The overseas hotels also serve local residents. Each firm therefore serves customers in its own country through offshore FDI.

Case 6. *Offshore with foreign sales plus pure FDI*. The offshorer is sacrificing the advantages of local production for its home market, incurring trade costs, but gaining them for its foreign market. The other firm finds it unprofitable to serve its home market in competition with the offshorer but produces locally in serving its foreign market, avoiding trade costs. This case could arise where one firm locates its production abroad, perhaps because the market there is larger, but finds it too expensive to export back to its home country. The fact that the other firm does export back to its home country could reflect asymmetric trade costs. The concentration of production by the offshorer suggests that it gains significant economies of scale due to high fixed costs or that foreign production costs are lower.

Case 7. *Offshore with foreign sales plus simple offshore*. This is illustrated by a special case of 5 in which only one of the hotel chains serves local residents, for instance, where the other's product is instead more fully tailored to customers from its home country.

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Case 8. *Pure FDI + Pure FDI*. There may be high costs of exporting, while both firms might face little demand in their home countries.

Case 9. *Pure FDI plus simple offshore*. This is similar to Case 6, except that the offshorer is not selling abroad and so locates production there based on lower production costs. It would therefore seem a relatively unlikely case where the two firms have significantly different production technologies, which lead each to locate production in the other's country, despite both serving the same single market.

Case 10. *Cross-simple offshore*. This is a special case of 5 in which neither foreign-owned plant serves its local market. Suppose that both firms use different technologies to produce similar products. Consumers only buy the product produced by their locally headquartered firm. Each technology requires a different basic resource. Each country used to possess the specific resource it requires, but it has been depleted, and additional resource must now be obtained from the other country. Each firm therefore invests in the other country in order to secure this resource. This case requires low trade costs, low costs of international technology transfer, and low liability of foreignness.

Each firm's competitive position depends on which of the above cases is the outcome. For instance, will the other firm be denied presence in a market? Will one firm lose the advantages of local production in a country, and will the other be able to capitalize on that? The outcome can in turn depend on which firm is the first mover.

4.3 | Cross-trade

It is instructive to consider the other forms of cross-sourcing to those noted in Table 5. Table 6 examines cross-trade, in which cross-flows of FDI are replaced by exports. There are two main forms of cross-trade, and both are symmetric: in the first case, the two countries export to each other and may or may not serve their own domestic market too, while in the second case, the two home countries offshore production, and the offshore plant may or may not serve the foreign market too. So, for instance, cross-trade will be important where there is strong product differentiation, but trade is a less costly means for the firms to serve foreign markets than FDI.

4.4 | Asymmetric sourcing

Table 7 identifies six strategy combinations that generate asymmetric sourcing, in which exports flow in one direction and FDI in the other. All six combinations have one thing in common: complete locational specialization. Both firms produce in the same country. The home-country firm exports and the foreign-country firm undertakes FDI. The home-country firm may also supply domestic customers, and the offshore plant may serve customers in the host economy too. Asymmetric sourcing can be important where a country has a strong comparative advantage, which can be profitably exploited by both firms. Also, both firms may have larger sales in the country of production, there may be stronger trade barriers in exporting to that country, and neither firm may have large enough sales in each market to justify having separate plants.

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TABLE 6 Strategic combinations that generate cross-trade.

		Strategy		Markets served		Locations of production	
Ref.	Type	Firm 1	Firm 2	Firm 1	Firm 2	Firm 1	Firm 2
1	Pure export + pure export	3	3	2	1	1	2
2	Pure export + conventional export	3	4	2	Both	1	2
3	Conventional export + conventional export	4	4	Both	Both	1	2
4	Simple offshore + simple offshore	5	5	1	2	2	1
5	Simple offshore + offshore with foreign sales	5	7	1	Both	2	1
6	Offshore with foreign sales + offshore with foreign sales	7	7	Both	Both	2	1

Note: The first-named strategy in the second column is pursued by firm 1 and the second-named strategy by firm 2. There are four additional configurations that generate trade in the same direction by both firms. This may be described as "dual trade" but it is not cross-trade. They all involve asymmetric sourcing, in which exporting from country 1 is combined with offshoring from country 2; they correspond to cases 1, 3, 4, and 6 in Table 7.

TABLE 7 Strategic combinations that generate asymmetric sourcing.

		Strategy		Markets served		Locations of production	
Ref.	Type	Firm 1	Firm 2	Firm 1	Firm 2	Firm 1	Firm 2
1	Pure export + simple offshore	3	5	2	2	1	1
2	Pure export + pure FDI	3	6	2	1	1	1
3	Pure export + offshore with foreign sales	3	7	2	Both	1	1
4	Conventional export + simple offshore	4	5	2	2	1	1
5	Conventional export + pure FDI	4	6	Both	1	1	1
6	Conventional export + offshore with foreign sales	4	7	Both	Both	1	1

Note: The first-named strategy in the second column is pursued by firm 1 and the second-named strategy by firm 2.

4.5 | Conclusions on cross-sourcing

The key question is "What conditions are likely to generate each particular type of cross-sourcing?" The answers are summarized in Table 8. The important message from this table is that no single factor dominates others in explaining cross-flows within an industry. The second conclusion is that different factors do not impact additively; it is the existence of a critical set of factors that are important. Some of these factors influence product demand, some the costs of trade, some the costs of FDI, and some the specialization of production location. Each strategy combination reflects a distinctive combination of these factors.

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TABLE 8 Factors favoring different types of cross-sourcing by different firms.

Type of investment	Favorable factors
Cross-investment	• Low intensity of competition: highly differentiated products • Little need to concentrate production of either variety in a single location: ○ A large enough market for each variety in each country to cover fixed costs; low comparative advantage • International Trade is expensive • Low additional costs of FDI: ○ Low costs of technology transfer; low liability of foreignness
Cross-trading	• Low intensity of competition: highly differentiated products • Large advantages to the concentration of production: ○ High fixed costs for each plant; high comparative advantage • A different production location is more attractive for each variety: ○ Each has a larger market in a different country which also has comparative advantage for the variety • International Trade is cheap • High additional costs of FDI: ○ High costs of technology transfer; high liability of foreignness
Asymmetric sourcing	• Low intensity of competition: highly differentiated products • Otherwise, a combination of the above factors that favor cross-investment, but now only for the firm undertaking FDI, and the factors favoring cross-trading, but only for the exporting firm: ○ And where costs of trade and FDI can be asymmetric between the two countries
One-way FDI only	• The host country has a large market and comparative advantage for the variety concerned • International Trade is expensive • Additional costs of FDI to the host country, for the variety concerned, are low: ○ Low costs of technology transfer and low liability of foreignness ○ The costs are higher in the other direction (for the other variant)
One-way trade only	• Major comparative advantage of the exporting country for the variety concerned; low costs of exporting to the country concerned • High additional costs of FDI: ○ High costs of technology transfer and high liability of foreignness
No trade or FDI	Little gain from Trade or FDI as: ○ The varieties are close substitutes ○ There is low comparative advantage International trade is expensive High additional costs of FDI: ○ High costs of technology transfer for both varieties and high liability of foreignness in both countries

4.6 | Monopoly, duopoly, and profits

Where a country is supplied with only a single variety, the supplier has a local monopoly. This applies whether the product is produced locally or imported. Monopoly is a major source of market power, and therefore profits, but duopolists (and oligopolists, more generally) possess some degree of market power as well, particularly with significant product differentiation. Market power is normally expressed in terms of the price–cost margin, that is, the percentage

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markup on unit costs when setting the product price. The price–cost margin does not translate directly into profit, however. Profit from a market = Price–cost margin multiplied by the volume of sales. Thus, when demand is small but intense (e.g., for a niche product) profit may be low even though the mark-up is high.

Factors encouraging monopoly and oligopoly in a national market are summarized in Table 9. A locally headquartered firm normally emerges as a monopolist when trade barriers restrict import competition, and high costs of technology transfer and high liability of foreignness deter inward FDI. However, a foreign-headquartered firm could become a monopolist when the host country has a strong comparative advantage, the foreign firm possesses a strong technological advantage, and both the cost of inward technology transfer and the liability of foreignness are low. First-mover advantage can be important too; the outcome may depend crucially on whether the home firm or the foreign firm makes the first move.

Duopoly in a market requires that the foreign firm has ready access to it, whether by trade or FDI. Duopoly is most likely to emerge when demand for both varieties is intense, the market is large, products are strongly differentiated, and production costs (both unit costs and fixed costs) are low. If trade barriers are low and economies of scale are high, then the foreign entrant may export from a plant in its home country; on the other hand, if the costs of technology transfer and the liability of foreignness are low, then the foreign firm can enter by FDI instead. If there are scale economies, then the foreign firm may export back to its domestic market, while if economies of scale are small, its plant may supply the local market alone.

A market is unlikely to be served at all when demand for neither variety is intense, and the cost of supply is high. A domestic supplier will be deterred by high local production costs, while

TABLE 9 Relationship between market structure (number of firms supplying the market) and market power (price–cost percentage markup) for a given variety of products in a given country.

Market structure	Market power	
	High	**Low**
Duopoly	*For both duopolists*: Intense demand in large market. Own-price-insensitive demand. High differentiation and low costs of production. *For a single duopolist*: Higher production costs for the alternative variety raise the prices of both products and thereby increase market power	*For both duopolists*: Reasonable intensity of demand. Own-price-sensitive demand. Low differentiation encourages "competitive" pricing. Fairly low costs of production (gross of trade costs). *For a single duopolist*: Lower production costs for the alternative variety reduce the prices of both products and thereby reduce market power
Monopoly	Reasonable intensity of demand. Own-price-insensitive demand. Low differentiation encourages monopoly, but the degree of differentiation does not influence monopoly profit.	Reasonable intensity of demand. Own-price-sensitive demand. Low differentiation encourages monopoly rather than duopoly but the degree of differentiation does not influence monopoly profit
No supply	Low intensity of demand in small market. Own-price-sensitive demand. High costs of both local and foreign production (gross of trade costs)	

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an importer will be deterred by high trade costs and a foreign investor by high costs of technology transfer and liability of foreignness. Economies of scale have an ambivalent effect, depending on trade costs and the size of the foreign market.

5 | COMPLEMENTARY PRODUCTS

As noted above, the model applies to differentiated products in general, whether they are substitutes or complements for one another. Almost all the published theory has focused on substitution between consumer goods. Many consumer goods are complementary (e.g., bread and butter) but they are usually classified into different industries. Producer goods, however, are often classified according to the industry in which they are used rather than by the technology used to produce them. Thus complementary producer goods may well be classified to the same industry.

Many producer goods are strictly complementary, so there is no margin of substitution between them whatsoever. A motor car, for example, comprises four wheels, one engine, and so on. Although three-wheel cars exist, this is mainly by design rather than just a response to the high price of wheels. In the design of buildings or major infrastructure projects, however, there are regular opportunities to substitute between different types of construction machinery and different types of materials (Grubel & Lloyd, 1975).

To apply the model to producer goods, it is appropriate to change the context of the discussion. Suppose therefore that in each country, there is a construction sector that requires two different varieties of materials with a limited margin of substitution between them. The focus is on the markets for the two varieties of materials, each of which is made by a different firm headquartered in a different country. The utility function used in the model (see Section 5 and Appendix A) is now interpreted as either the profit function of the construction firm that purchases the materials or the utility function of its customer (e.g., a government undertaking a major infrastructure project).

Although the context is different, the model remains exactly the same, and Tables 2–9 still apply. Two forces govern the location of production of the materials. If they are bulky, transport costs may be high, and this favors local production. On the other hand, the materials may have to be sourced from excavations or mines abroad. The technologies involved in processing the materials may be very different; economies of scale may or may not apply. A wide range of plausible scenarios therefore exists, as before.

Complementarity between the products moderates the intensity of rivalry. A reduction in the price of one material will permit an increase in the price of the other and vice versa; the initial reduction will stimulate demand for construction so much that the price of the other material will increase. However, substitutability still matters; the greater the substitutability, the smaller will be the induced increase in price.

6 | CONCLUSIONS

The agenda of early internalization theory was to extend the reach of conventional economic models of trade by incorporating not only capital flows but the exploitation of proprietary knowledge through the MNE (Buckley & Casson, 1976; Rugman, 1981). Subsequent research in IB has mostly focused on the strategy and organization of the individual firm, while economics

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has focused more on the global economy and the industry environment in which firms compete.

International business literature on cross-investment, more specifically, has mainly focused on firm-specific advantages, economies of the firm, and oligopolistic defense. This article, by contrast, has focused on product differentiation as a driver of cross-investment in a duopoly model. In doing so, it takes a different approach to trade models based on monopolistic competition in that it incorporates firm-specific factors and strategic interdependence. It also involves firms choosing where to locate production for each market served, involving FDI for foreign production. The modeling of strategies involving choices over both production locations and markets served has allowed the identification of a set of different forms of cross-investment, as against assuming that it is cross-multidomestic. It has also allowed cross-investment to be placed in a wider context of possible cross-sourcing outcomes, including various strategic combinations resulting in cross-trade and asymmetric sourcing. The model also involves the possibility of strategic overinvestment in deciding on production locations, which can allow a first mover to reduce its unit costs in serving one or more markets, meaning that the second mover then makes its decisions over its strategy in a worsened competitive position, which can be to the benefit of the first mover.

The article therefore gives a significantly enhanced view of cross-investment to that given in existing international business research. It represents an advance on contemporary IB theories that offer a classification of phenomena, either in terms of different forms of advantages, different modes of entry, or different motivations for FDI (Dunning & Lundan, 2008). It demonstrates that IB strategies are many and varied and need to be finely tuned to industry conditions. IB decision-making is a complex process that can only be understood through a full appreciation of the different scenarios involved. Regarding multimarket competition research, the article provides an enhanced view of the complexities involved in relationships between multimarket competition, the degree of competition in each market, and levels of performance in an international context.

The model considers different international configurations of an industry, in terms of which firms serve which markets, whether each one exports or conducts FDI to serve its foreign market, and whether it produces at home or offshores to serve its home market. While it demonstrates that there are different forms of cross-investment, it is shown that overall it is favored by strong product differentiation, low comparative advantage, large markets, high trade costs, low costs of international technology transfer, and low liabilities of foreignness. So, a combination of a set of factors determines the outcome, some concerning product demand, some the costs on international trade, some the costs of FDI, and some the costs of production at different locations. However, note that there is some variation depending on the exact type of cross-investment. For instance, cross-investment can involve FDI at least partly to benefit from comparative advantage, incurring trade costs in the case of offshoring. This seems likely to most often be in only one of the two directions though.

The parameters of the model capture not only inter-firm variations in access to technologies but also inter-country variations in size, sophistication and natural resource endowments, and inter-industry variations in product differentiation and economies of scale. The predictions of the model relate not only to trade and FDI but also to profitability, firm concentration at the country and industry levels, and market power.

The model can help strategic decision makers to consider factors relating to the industry rather than just those at the level of their own firms. The article has explained which factors

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favor each different type of outcome, providing a useful analytical tool for strategic decision makers. They can consider, for instance, how changing underlying circumstances can be expected to reconfigure an international industry, helping them to understand how their own strategic choices fit in the wider industry context. While the model involves a simple case of two firms and two countries, the results are intended to be relevant to more complex situations involving more countries and more firms. Simplifying assumptions are, of course, a necessary part of any model but further work can expand on its contribution.

The model has been applied to the specific phenomenon of cross-investment, but more work is required to test the robustness of its predictions through industry case studies. Testing its propositions opens up many promising new avenues of research. The possibility of extending the model to *N* countries is discussed in the Appendix A. Another natural line of further research would be to incorporate asymmetric information. For instance, a first mover might then engage in limit pricing to make the second mover believe that it has lower costs in serving one or more markets. Uncertainty over the market and institutional environment in a country could also be introduced. While a first mover might gain relative to a second mover by becoming embedded within and adjusted to a country's institutions and with its brand becoming known in the market, as well as through committing to production locations, a second mover could potentially gain from resolving some uncertainty by observing the experience of the first mover.

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MATHEMATICAL APPENDIX A

Specification of the model

There are two firms, indexed $i = 1,2$, and two countries, indexed $j = 1,2$. Firm 1 produces product 1 and is headquartered in country 1, and firm 2 produces product 2 and is headquartered in country 2. The two products are different varieties of the same type of good or service. The firms compete to serve markets in both countries. Each firm carries out R&D in its home country. Its

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proprietary technology provides it with a unique variety of products with a unique cost structure. Both are potential MNEs.

Costs vary according to the firm, i, the market served, j, and the location of production, which may differ from the market served, and is indexed k. Firms incur both plant-specific fixed costs and constant unit costs. Fixed costs, f_{ik}, are sunk at the time of entry, they are financed by loans, and are measured by their recurrent interest charges. If both markets are served from local plants, then the fixed costs $f_{i1} + f_{i2}$ are incurred. These fixed costs result in economies of scale related to the total output of each plant, and therefore provide some incentive for the firm to concentrate production in a single country.

Unit costs, c_{ij}, are measured at the point of delivery, j, and are therefore gross of trade costs, and so on. The unit cost of FDI is the cost of production in the target market *plus* the cost of international knowledge transfer to that country *plus* the cost of doing business there, while the unit cost of exporting is the cost of production in the home market *plus* tariff and transport costs. Unit costs are therefore partly determined by k, the location of production used by the firm to serve the market. They are partly determined by national distances, including geographical, institutional, and cultural distances.

Licensing, franchising, and subcontracting are ignored; they are easy to incorporate into the model, but the model becomes more complicated as a result. Other complications, such as the existence of a competitive fringe of smaller firms, are also ignored.

There are various ways of modeling the demand for differentiated products (Lancaster, 1990). There may be different varieties of customers, each of whom prefers one variety of product, or one type of consumer (a "representative type") who prefers a mixture of varieties; the latter is assumed here. Products may be differentiated "vertically" (e.g., by quality or by "distance" from some ideal type) or "horizontally" (e.g., by style); the latter is assumed here (Helpman, 1981; Hotelling, 1929). Consumers may value all varieties equally, or value some more than others; the latter is assumed here (Chamberlin, 1933).

There are different patterns of demand in each country. These reflect both preferences (e.g., culturally specific tastes) and resource constraints (e.g., income per head). Demands are derived from consumer utility functions. Constant elasticity of substitution functions generates nonlinear demand functions with constant expenditure shares (Dixit & Stiglitz, 1977; Krugman, 1979), while quadratic functions generate linear demand functions with variable expenditure shares (Bernhofen, 2001); the latter are most suitable here.

Consumers in each country choose between three products. One is a standard numeraire (unit price) good for which they have an insatiable demand. The other two are varieties of a novel product and are partial substitutes for each other. The numeraire good is perfectly homogeneous, uniform across countries, freely tradeable, and acts as a unit of account; it is produced by self-employed people who do not work for either of the two firms. There is full employment in both countries.

The representative consumer's utility function utility, u_j, is a linear function of the consumption of the standard product, x_{0j}, and a quadratic function of the consumption of the novel products, x_{1j}, x_{2j}. Consumers experience diminishing marginal utility to consumption of each variety of the novel product:

$$u_j = x_{0j} + a_{1j}x_{1j} + a_{2j}x_{2j} - b_{11j}{x_{1j}}^2 - b_{22j}{x_{2j}}^2 - 2b_{12j}x_{1j}x_{2j} \quad (1)$$

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where a_{1j}, a_{2j}, b_{11j}, b_{22j}, and b_{12j} are non-negative fixed parameters. If $b_{12j} = (b_{11j}b_{22j})^{1/2}$, then the two varieties become perfect substitutes. If $b_{12j} = 0$, then they are independent.

Incomes are sufficiently high that consumption of the novel products never exhausts income, so there is always a margin of substitution between the standard product and the novel products.

The Cournot equilibrium

Cournot equilibrium is the chosen scenario for determining prices and quantities. The Cournot model is chosen in preference to a Bertrand model, in which firms set prices rather than outputs, for the reasons given by Vives (1999), Chapter 5. The Bertrand model requires the firms to commit to supplying all the output demanded at the price they charge, irrespective of their production capacity. Furthermore, as Kreps and Scheinkman (1983) and Madden (1998) have shown, Bertrand competition in which, in a first stage, outputs are decided and production is simultaneous, and in a second stage, there is price competition, leads to Cournot outcome. The Kreps and Scheinkman model also involves common knowledge of outputs, all costs being sunk in the first stage, perfect substitutes. While the final one of these is incompatible with our model, the Kreps and Scheinkman result was extended to cover differentiated products by Martin (1999). While Bertrand is a plausible alternative, the issue of which of the two types of competition to use is also of less importance with product differentiation, as their properties are then more similar (Singh & Vives, 1984: 549). The choice between the two models is, in fact, arguably not of great significance given the aims of this article. While it could be important in further work, it is something to which oligopoly literature has paid significant attention without reaching a conclusive result (Brander & Spencer, 2022: 3–4). This article, by contrast, has a broader focus.

From a business perspective, managers need to accurately predict the reactions of other firms when making decisions over market entry (Argyres et al., 2019; Hansen & Hoenen, 2016). The output decisions predicted by the Cournot model approximate closely to practical outcomes, even though the decision-making process may seem unconventional, and so the model is eminently suitable for analyzing strategic decision-making in international business.

Utility (1.1) is maximized subject to the budget constraint:

$$y_j = x_{0j} + p_{1j}x_{1j} + p_{2j}x_{2j} \tag{2}$$

where p_{1j} and p_{2j} are the prices of the two varieties of the novel product.

Solving the first order conditions for a maximum of utility gives the price equations (or "inverse demand schedules"):

$$p_{1j} = a_{1j} - 2b_{11j}x_{1j} - 2b_{12j}x_{2j} \tag{3.1}$$

$$p_{2j} = a_{2j} - 2b_{12j}x_{1j} - 2b_{22j}x_{2j} \tag{3.2}$$

Firms 1 and 2 maximize the operating surplus made in the market, conditional on the location of production and the mode of market servicing:

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$$s_{1j} = \left(p_{1j} - c_{1j}\right)x_{1j}; s_{2j} = \left(p_{2j} - c_{2j}\right)x_{2j} \tag{4}$$

Note, that the location, k, of production for serving the market, j, is endogenous and can be different for the two firms. Fixed costs are omitted from (4) because they do not affect price and output; furthermore, they can be shared across markets. They are discussed in detail below.

Substituting (3.1) and (3.2) into (4), and maximizing profit with respect to output determines the equilibrium outputs. Remember that the value of each firm's unit cost c_{ij} in supplying market j is partly determined by the location of production it uses to serve market j:

$$x_{1j} = x_{1j}\left(c_{1j}, c_{2j}\right) = \left(1/\left(D_j\right)\right)\left(2b_{22j}\left(a_{1j} - c_{1j}\right) - b_{12j}\left(a_{2j} - c_{2j}\right)\right) \tag{5.1}$$

$$x_{2j} = x_{2j}\left(c_{2j}, c_{1j}\right) = \left(1/\left(D_j\right)\right)\left(-b_{12j}\left(a_{1j} - c_{1j}\right) + 2b_{11j}\left(a_{2j} - c_{2j}\right)\right) \tag{5.2}$$

where $D_j = 8b_{11j}b_{22j} - 2b_{12j}{}^2$.

Back-substitution into (3) gives the equilibrium prices:

$$p_{1j} = p_{1j}\left(c_{1j}, c_{2j}\right) = a_{1j} - \left(1/D_j\right)\left(2b_{11j}b_{22j} - b_{12j}{}^2\right)\left(a_{1j} - c_{1j}\right) + 2b_{11j}b_{12j}\left(a_{2\mathrm{j}} - c_{2j}\right)\right) \tag{6.1}$$

$$p_{2j} = p_{2j}\left(c_{2j}, c_{1j}\right) = a_{2j} - \left(1/D_j\right)\left(2b_{22j}b_{12j}\left(a_{1\mathrm{j}} - c_{1j}\right) + \left(2b_{11j}b_{22j} - b_{12j}{}^2\right)\left(a_{2j} - c_{2j}\right)\right) \tag{6.2}$$

Back-substitution of (5) and (6) into (4) gives the equilibrium surpluses (gross of fixed costs) of the two firms:

$$\begin{aligned} s_{1j} &= s_{1j}\left(c_{1j}, c_{2j}\right) \\ &= \left(1/D_j\right)\left(a_{1j} - c_{1j}\right)\left(2b_{22j}\left(a_{1j} - c_{1j}\right) - b_{12}\left(a_{2\mathrm{j}} - c_{2j}\right)\right) - \left(2/D_j{}^2\right)\left(2b_{11j}b_{22j} - b_{12j}{}^2\right)\left(a_{1j} - c_{1j}\right) \\ &\quad + 2b_{11j}b_{12j}\left(a_{2j} - c_{2j}\right)\left(2b_{22j}\left(a_{1j} - c_{1j}\right) - b_{12}\left(a_{2j} - c_{2j}\right)\right) \end{aligned} \tag{7.1}$$

$$\begin{aligned} s_{2j} = s_{2j}\left(c_{2j}, c_{1j}\right) = \left(1/D_j\right)\left(a_{2j} - c_{2j}\right)\left(-b_{12j}\left(a_{1\mathrm{j}} - c_{1j}\right) + 2b_{11j}\left(a_{2j} - c_{2j}\right)\right) - \left(2/D_j{}^2\right)\left(2b_{22j}b_{12j}\left(a_{1j} - c_{1j}\right)\right) \\ + \left(2b_{11j}b_{22j} - b_{12j}{}^2\right)\left(a_{2j} - c_{2j}\right)\right)\left(-b_{12j}\left(a_{1j} - c_{1j}\right) + 2b_{11j}\left(a_{2j} - c_{2j}\right)\right) \end{aligned} \tag{7.2}$$

A monopoly equilibrium can be derived simply by constraining the output of product 2 to 0. Social welfare can be proxied by consumer utility, which can be calculated by back-substituting equations (5) into equation (1). Competition is more intense, and so the profits of the firms are lower, the less differentiated the products are, unless this results in one of the firms becoming unprofitable under competition in one or both markets, resulting in monopoly in those market(s).

Solution of the entry problem

We assume that the entry decisions of the firms are sequential, and that the first mover can correctly anticipate the response of the second mover, so that after both have moved neither regrets their decision. First-mover advantage plays a major role in the international business strategy literature, and so it is appropriate to include it in a model of cross-investment. In

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entrepreneurship studies, it is widely accepted that entry into a new market is a sequential process in which leaders commit and followers then decide whether or not to do the same (Shane, 2003). Historical studies of formation and growth of firms confirm this hypothesis (Casson & Casson, 2014). Following Knickerbocker's (1973) pioneering study, many IB scholars have also postulated that firms "follow the leader" when entering foreign markets and are slow to reverse what may turn out to be mistaken decisions. For further discussion of entry processes, see Sarafopoulos, 2015; for a discussion of sequential games, see Also-Ferre (2016).

By convention, firm 1 moves first. Once they have moved, the firms will not change their minds, firm 1 having chosen its move knowing what firm 2's response will be. Both firms also know all the relevant parameters and know that the other firm knows them too. They both appreciate that neither can bluff the other.

Each firm serves each national market in the most profitable way. It does not pay to use more than one country to serve each market because each firm's marginal costs at each location are constant, its average costs in each location are either constant or decreasing, and this renders unnecessary, or actively discourages, replication of production. Thus for each market, there are three options: to produce in country 1 only, to produce in country 2 only, or not to produce at all. Since there are two markets, there are $3 \times 3 = 9$ possible market-servicing strategies for each firm, one of which is not to produce at all. One of these strategies is inefficient, however, it involves the firm serving each country by export from the other country and, when compared with multidomestic production, incurs unnecessary transport costs. The efficient options were shown in Figure 1.

With 8 potential strategies for each firm, there are $8 \times 8 = 64$ possible pairwise strategy combinations. Each combination is associated with a unique outcome for the two-country system. Firm 1, the first mover, can calculate how firm 2 will react to each possible strategy and can calculate the profit it will make with this response. It then chooses the most profitable strategy. Firm 2 will respond optimally, given the constraint imposed by firm 1's choice, and firm 1 knows that it has maximized its profit conditional of firm 2's reaction. The outcome is therefore an equilibrium: neither firm has any incentive to change its strategy.

The total profit for each firm is the sum of the profits derived from serving the two markets less the fixed cost. Note that multidomestic investment and cross-trading incur two sets of fixed costs but all the other strategies incur just one.

Firm 1, as first mover, considers each of its strategies in turn. For each potential strategy, it investigates the consequences of entry by firm 2. Firm 2 has the same set of options as firm 1. Each combination of strategic choices by the two firms determines whether there will be rivalry in each market (duopoly), a sole supplier to that market (monopoly), or no supply to that market at all. As a consequence, it determines (from the equations above) how much operating profit each firm will make from each market.

Each firm's profits from the two markets are grossed up and fixed costs are then deducted to determine the overall profit accruing to each firm. Firm 2's responses can then be ranked by its profit, and the highest ranked response can be identified by firm 1 as the response that firm 2 will make. One of these responses, as noted above, is no entry by firm 2 at all.

Firm 1 can then calculate its own profit from its prediction of firm 2's response. This exercise is then repeated for each of firm 1's strategies. Firm 1's strategies are then ranked according to their profits, and most profitable strategy is chosen. Once this strategy is implemented, firm 2 reacts in the predicted way, and the outcome is determined. Prices, outputs, and profits are given by the formulae above.

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Strategies

Define s_{ijkm} and s_{ijkc} as surpluses of revenues over variable costs that firm i will make in market j served with production from location k, with a monopoly and under competition with the other firm respectively. These are as derived above in equation 7. Under competition, s_{ijkc} is a function of the unit cost of the other firm in serving the market in question, which is accurately predicted by the first mover based on its calculation of the second mover's best response to its own strategy. For the second mover, it is based on the first mover's already known strategy. The variables x and p (output and price, respectively) are similarly subscripted below. The chosen strategy is assumed to be whichever maximizes profit, given the strategy of the other firm, which the first mover foresees, and the second mover knows has already been implemented. The profit variable Π is subscripted with a digit identifying the firm's strategy, as shown in Figure 1. The profit under the no entry strategy (strategy 1) is:

$$\Pi_1 = 0 \tag{8}$$

Π also has either an m or c subscript below to indicate whether the firm has a monopoly or is in competition with the other firm in the market served. Where both markets are served, then the subscript letters indicating either monopoly or competition are for the home market and then the foreign market.

Home-plant only strategies

Note that, for the first mover, choosing a home-plant only strategy to serve the home market (i.e., strategy 2 or 4), rather than serving it through offshoring, could potentially deter the second-mover from entering it, if the unit cost of serving it is then lower than when importing from the foreign country. In reducing the sales and profits of firm 2, investments in plant also have the potential to stop the foreign firm from operating at all or force it to serve both markets from a plant in one country, potentially pushing up its unit cost in one country. All home-plant only strategies are encouraged by domestic comparative advantage.

Local

Consider the choices facing firm 1, given that firm 2 faces a symmetrical set of inequalities.

For instance,

$$s_{111m} = (p_{111m} - c_{111})x_{111m} \tag{9}$$

Recall that the three subscript digits for each of the four variables in this equation represent first the firm, then the market, and then the location of production. s_{111m} will be high with strong local demand and a low unit cost of local production. The profit then depends on the strategy of the other firm. The profit of a Local strategy (strategy 2) is Π_2. If the other firm does not serve the market as well, then it is:

$$\Pi_{2m} = s_{111m} - f_{11} \tag{10}$$

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The fixed cost means that there are economies of scale at the plant level. Alternatively, under competition from firm 2, so that s_{111c} is a function of c_{21k} (noting that c_{21k} is in turn determined by firm 2's best response choice of production location, k), the profit is:

$$\Pi_{2c} = s_{111c}(c_{21k}) - f_{11} \tag{11}$$

Choosing local production will sometimes prevent the other firm from entering the home market or create a cost advantage in serving it in competition with the other firm. However, it can be a disadvantage where production is cheaper in the other country, and costs of international trade are low. With firm 1 as the first mover, it considers what firm 2's best response to its strategy will be. This could allow it to determine whether it will face competition or not and the value of c_{21k} if it does. The second mover, on the other hand, takes the first mover's unit cost as given.

Pure export

With pure export (strategy 3), exporting alone must cover the fixed costs of the plant in the home country. The profit again depends on whether there is competition from the other firm in the foreign market and, if so, the production location used by the other firm to serve the market:

$$\Pi_{3c} = s_{121c}(c_{22k}) - f_{11} \tag{12}$$

$$\Pi_{3m} = s_{121m} - f_{11} \tag{13}$$

Given that the fixed costs of home production are incurred either way, the unit costs of serving the home market must be greater than the price for pure export to be preferred to conventional export:

$$p_{111m} < c_{111} \text{ or } p_{111c}(c_{21k}) < c_{111} \tag{14}$$

The strategy is therefore more likely if the firm faces competition from a close substitute in the home market from a firm with a cost advantage in serving it or a product that is preferred there to some extent so that there is weak home demand alongside strong foreign demand. This is more likely if fixed costs are low for the other firm, and costs of FDI and trade for the other firm are low.

Conventional export

A local strategy will only be preferred to a conventional export strategy (strategy 4) and if it does not, then pay to export to the foreign country. The condition for this depends on whether firm 2 is selling in country 2. Conventional export will be preferred over local, therefore, if:

$$s_{121m} > 0 \text{ or } s_{121c}(c_{22k}) > 0 \tag{15}$$

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Also, in the case that a local strategy would be loss making, the combination of sales in the two countries must cover the fixed costs of the plant in the home country for conventional export to be profitable, where:

$$\Pi_{4cc=} s_{111c}(c_{21k}) + s_{121c}(c_{22k}) - f_{11} \tag{16}$$

$$\Pi_{4cm} = s_{111c}(c_{21k}) + s_{121m} - f_{11} \tag{17}$$

$$\Pi_{4mm} = s_{111m} + s_{121m} - f_{11} \tag{18}$$

$$\Pi_{4mc} = s_{111m} + s_{121c}(c_{22k}) - f_{11} \tag{19}$$

Strategies involving FDI

Now consider strategies involving FDI. All of these involve a knowledge transfer cost and costs associated with the liability of foreignness. All the following are therefore more likely where those costs are low, though high fixed costs will sometimes be accepted to gain strategic advantage over the other firm or where the scale of production is large.

Simple offshore

This is used to access lower production costs in the foreign country at the expense of incurring trade costs. Profits are:

$$\Pi_{5c} = s_{112c}(c_{21k}) - f_{12} \tag{20}$$

$$\Pi_{5m} = s_{112m} - f_{12} \tag{21}$$

The firm must also not find it profitable to sell locally in the foreign country, despite having a plant there:

$$p_{122m} < c_{122} \text{ or } p_{122c}(c_{22k}) < c_{122} \tag{22}$$

For instance, this could arise where the firm would face competition in the foreign market from the other firm that has a lower unit cost in serving the market and a product that is generally preferred there.

Pure FDI

For this strategy, trade costs must be too high to export back to the home market, while inadequate demand there and high fixed costs prevent also having a plant there.

For this strategy, the profits are:

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$$\Pi_{6c} = s_{122c}(c_{22k}) - f_{12} \tag{23}$$

$$\Pi_{6m} = s_{122m} - f_{12} \tag{24}$$

and for the firm not to export back to its home country:

$$p_{112m} < c_{12} \text{ or } p_{111c}(c_{21k}) < c_{12} \tag{25}$$

Offshore with Foreign Sales

This gains additional economies of scale due to selling in both markets with a single production plant. It can also concentrate production in the largest market for firm 1 and/or the location with lower production costs. The profits are:

$$\Pi_{7cc} = s_{112c}(c_{21k}) + s_{122c}(c_{22k}) - f_{12} \tag{26}$$

$$\Pi_{7cm} = s_{112c}(c_{21k}) + s_{122m} - f_{12} \tag{27}$$

$$\Pi_{7mm} = s_{112m} + s_{122m} - f_{12} \tag{28}$$

$$\Pi_{7mc} = s_{112m} + s_{122c}(c_{22k}) - f_{12} \tag{29}$$

In order not to make it worthwhile having a plant in the home country:

$$s_{111m} - s_{112m} < f_{11} \tag{30}$$

$$s_{111c}(c_{21k}) - s_{112c}(c_{21k}) < f_{11} \tag{31}$$

Otherwise, the strategy would be multidomestic instead.

Multidomestic investment

Here the profits are:

$$\Pi_{8cc} = s_{111c}(c_{21k}) + s_{122c}(c_{22k}) - f_{11} - f_{12} \tag{32}$$

$$\Pi_{8cm} = s_{111c}(c_{21k}) + s_{122m} - f_{11} - f_{12} \tag{33}$$

$$\Pi_{8mm} = s_{111m} + s_{122m} - f_{11} - f_{12} \tag{34}$$

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$$\Pi_{8mc} = s_{111m} + s_{122c}(c_{22k}) - f_{11} - f_{12} \tag{35}$$

This strategy incurs an extra fixed cost to avoid trade costs. It also sacrifices the advantages of concentrating production, whether to gain additional economies of scale or to access lower production costs. So, it is more likely to be the best choice with low fixed costs and/or large sales in each country. In addition, high costs of international trade and weak comparative advantage can also be key. Large markets will be needed if fixed costs are high and there is competition from a close substitute and no major advantage in unit costs.

Strategic interactions and effects on profits

Say that firm 1 is calculating the effect of a strategic choice that will reduce the unit cost of serving a market, which is country 2 for expository purposes, locating a plant there to avoid trade costs or perhaps locating it instead in country 1 if that has the comparative advantage. How large would the effect on profits be in serving the country 2 market? The difference in firm 1's operating profits, from reducing its unit cost in country 2 by Δc_{12} ($\Delta c_{12} < 0$) if it does not affect firm 2's entry into the market or the production location it serves it from is:

$$(\Delta p_{12} - \Delta c_{12})x_{12} + (p_{12} + \Delta p_{12} - c_{12} - \Delta c_{12})\,\Delta x_{12}$$

where

$$\Delta p_{12} = \left(2b_{112}b_{222} - b_{122}{}^2\right)\Delta c_{12}/D_2 \text{ and } \Delta x_{12} = -2b_{222}\Delta c_{12}/D_2. \tag{36}$$

Here Δp_{12} and Δx_{12} are the changes in the firm's equilibrium price and quantity resulting from the fall in unit cost.

The reduction in profits for firm 2 caused by this is:

$$\Delta p_{22}x_{22} + (p_{22} + \Delta p_{22} - c_{22})\,\Delta x_{22}$$

where

$$\Delta p_{22} = 2b_{222}b_{122}\,\Delta c_{12}/D_2 \text{ and } \Delta x_{22} = 2b_{122}\Delta c_{12}/D_2 \tag{37}$$

Firm 2 has a lower price and lower sales in country 2, due to the lower cost competition from firm 1. The effect is stronger where the two firms' products are closer substitutes. If it means that firm 1 gains a monopoly in one or both markets, then it could cause a large rise in its profits.

Additional countries, firms, and products

The model can be scaled up to a general N country model. This is a relatively simple exercise if certain key assumptions are retained. There are N varieties of product, each produced by a different firm and all pairwise substitutable to varying degrees; there is also a numeraire product

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as before. Consumers in each country maximize utility, which is a quadratic function of the quantities of each variety consumed, as before.

Location of production decisions made by different firms are independent of each other; only their decisions about how much to supply are interdependent. A given firm serving a given market can produce in any one of the N countries (including its home country and the local market) or not serve the market at all. No firm ever wishes to serve a market from more than one location (i.e., the cheapest location) because any country can host as much production of as many varieties as required simply by switching resources away from local production of the numeraire product.

Thus, each firm has $N + 1$ potential sourcing strategies for each of its N markets. The firm's decisions for each market are logically separate, although where there are economies of scale they are linked. There are therefore $S = (N + 1)^N$ possible strategic combinations for each firm. These include a few combinations that involve cross-trade within the firm; these are always inefficient, but they are relatively few and will always be eliminated in the strategy decision process.

Each firm is sovereign; firms can influence each other's decisions but they cannot control them. In principle, therefore, there are $T = S^N$ strategic combinations involving all the possible strategies of all the different firms. In the special case $N = 2$, for example, each firm has three potential sourcing strategies for each of its two markets, generating $S = 3^2 = 9$ strategic combinations (one of which involves intra-firm cross-trading and was eliminated from the analysis). This gives a total of $9^2 = 81$ combinations, which has been reduced to $8^2 = 64$ in the tables. For $N = 3$, however, the statistics are very different: there are $4^3 = 64$ strategic combinations per firm and $64^3 = 262{,}144$ combination altogether. Thus, although the model can, in principle, be applied to industries of any size and scope, it is not really viable as a computational model beyond the two-firm case.

However, an increase in the number of products or firms introduces complexities of a different and more challenging kind. The inequalities that govern the outcomes become extremely complicated, and the number of possible outcomes (i.e., which firms produce which products, which markets they serve, and which country they serve each market from) increases dramatically, even in the two-country case.

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