Multinationals, Technology Networks and International Takeovers

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Abstract

We formulate a knowledge-based model of direct investment through mergers and acquisitions. M&As are realized to create comparative advantages by exploiting international synergies and appropriating local technology spillovers requiring geographical proximity, but can also represent a strategic response to the presence of a multinational rival. The takeover fee paid tends to increase with the strength of local spillovers which can thus work against multinationalization. Seller's bargaining power increases the takeover fee, but does not influence the

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investment decision. We characterize losers and winners from multi-nationalization, and show that foreign investment stimulates research but could result in a synergy trap reducing multinationals' profits.
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1   Introduction

This paper develops a model of foreign investment through international mergers and acquisitions (M&As) in the same or related industries.[1] The model gives rise to multinationals that manufacture and conduct research in more that one country to maximize international cost-reducing synergies and facilitate learning foreign technologies. The view of international M&As as a channel for exploiting and capturing technologies, complements foreign investment theories based on physical capital investments, and the approach to takeovers as a market for managers acting under imperfect information (Jensen and Ruback [1983]).

The model is consistent with key foreign investment facts. First, inward and outward direct investments occur mostly among industrialized countries. In 1995 these countries accounted for 73 and 92 percent of the stock of inward and outward foreign direct investment, respectively (United Nations [1996]). Second, mergers and acquisitions dominate, for some industries overwhelmingly, foreign investment in developed countries (see Table 1). Third, research-based manufacturers frequently conduct research in facilities spread at strategic locations, especially in the U.S., the U.K., France and Germany (Dunning [1988], Florida [1995]). Fourth, multinationals generate intra-firm synergies (such as technology transfers within a group) and benefit from inter-firm spillovers (such as agglomeration externalities) channelled through the global network of their production and R&D. [2]

Most previous work follows Findlay's seminal paper [1978] and focus on a developed-developing country linkage (Munagurria [1994], Ethier and

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[1]During 1970-87, seventy-five percent of cross-border takeovers in the U.S. involved buyers and sellers in the same or related industries (Harris and Ravenscraft [1991]).

[2]Intra-firm flows are examined in Mansfield and Romeo [1980], Dunning [1988] and Papanastassiou and Pearce [1994]. Spillovers to host countries are discussed by Blomström and Kokko [1996], Graham [1995], and Borensztein, De Gregorio and Jong-Wha Lee [1994]. Spillovers from host countries are documented in Granstrand and Sjolander [1995], Head, Ries and Swenson [1995], Florida [1995], and Neven and Siotis [1996]. Home country spillovers are discussed in Blomström and Kokko [1996] and Zander [1994].

Markusen [1996], Rodríguez-Clare [1996]). Helpman [1984] models multinationalization as a channel to exploit firm-specific assets and Ethier [1986] as a way to internalize complex contractual arrangements. Theoretical work on multinational's technology role in industrialized countries, is scant. Markusen and Venables [1995] obtain that multinationals exist when transport costs, tariffs and incomes are high, and firm-scale economies are important relative to plant-scale economies. Wang and Blomström [1992] model technology transfers to host countries, and Dinopoulos and Kreinin [1996] examine the growth effects of foreign-owned research labs.

We model international M&As as simultaneous games that combine noncooperative and cooperative decisions among four duopoly firms. Firmlevel economies due to international synergistic effects encourage M&As because they provide a cost advantage over firms that only benefit from local spillovers. In equilibrium, there is a minimum strength of international synergies that justifies M&As. This suggests that weak potential synergies (and high technology adaptation costs) hinder foreign investment in developing countries. With intermediate international synergies' strength, a single multinational competes with local firms (partial multinationalization), while two multinationals (globalization) dominate with strong enough synergies (e.g., industrial countries).

Stronger local spillovers tend to augment local firms' profits more than multinationals' profits, working against M&As by increasing the cost of acquiring foreign firms. These results suggest that strong local spillovers and Japanese targets' large opportunity costs (as well as high technology adaptation costs), can contribute to explain the low level of foreign investment in Japan.

A separation theorem is developed showing that buyers and sellers' bargaining power affects the cost of acquiring a firm abroad, and thus M&As' benefits, but not the decision to invest abroad. Under partial multinationalization, firms engaging in M&As win, while firms remaining local lose. When all rivals are multinationals, who wins and who loses depends on firms' relative bargaining power, but paradoxically, all firms could lose (synergy trap). We show that strong enough synergies lead to high-output strategies which result in an equilibrium synergy trap that hurts firms while favoring consumers. Foreign investment is realized as a reaction to rivals' M&A strategy (a firm would be worse off if it remained local competing with a rival that is part of a multinational). Synergy traps are consistent with ample evidence on unprofitable M&As (Sirower [1996]). Eun, Kolodny and Scheraga [1996]

report net wealth gains from international acquisitions of U.S. targets during 1979-90, but no gains for Britain (the most frequent acquirer).

Section 2 introduces the foreign investment model, Section 3 solves the output-research strategic problem, and Section 4 examines the M&As bargaining game. Section 5 endogenizes the pattern of multinationalization - global, partial, or none at all. Section 6 presents the results, and Section 7 offers conclusions.

2 Foreign Investment and Technology Network Model

This section describes the multinationals' stage game, and the international technology network. Later sections endogenize the formation of multinational groups and the equilibrium structure of spillovers and synergies. Due to the model's symmetry, the identities of selling and buying firms, and thus of multinationals, are undetermined, and there is no distinction between mergers and acquisitions.

We examine a two-country duopoly partial equilibrium model. Both markets have the same demand functions: $P = D^{-1}(Q) = a\text{-}bQ$, $P^* = D^{-1}(Q^*) = a\text{-}bQ^*$, $a > 0$, $b > 0$, where P, P^*, Q and Q^* are product prices and aggregate quantities (the star denotes the foreign market). Trade is local and there are no exports so that there are no interdependencies on the demand side. Physical capital investments are not explicitly treated. We rather focus on cost interdependence through technology synergies and spillovers as the key interaction between countries. Firms' costs differ according to the technology network to which they belong, which depends on whether or not they form part of a multinational group.

2.1 Multinationalization and Research-Output Decisions

Figure 1 sketches the sequential game examined. Equilibrium is computed using backward induction, restricting attention to agents playing pure strategies.

In the pre-stage, all duopoly firms are local. Stage 1 concerns the multinationalization decision and the determination of target firms' prices through

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a Nash-bargaining game. Multinationalization decisions are reached at simultaneously taking into account that, in a two-country duopoly setting, at most two firms can multinationalize. The duopoly multinationalization game has three possible outcomes: regionalization (no multinationalization at all), globalization (two multinationals), and partial multinationalization (a single multinational spread over two countries competing with two local firms, one in each country).

Stage 2 determines the R&D expenditures of domestic and foreign duopolists, given the foreign investment decision. In stage 3, firms choose quantities of final output contingent on the volume of research chosen in stage 2.

2.2 International Technology Network and Costs

The structure of technology spillovers and synergies is endogenous in this paper. Figure 2 illustrates three possible equilibrium structures of technology networks.

In Figure 2a, there are no multinationals and firms benefit only from local spillovers. The coefficient $\beta_L^n \in [0, 1]$, represents the strength of technology spillovers from one local firm to another (net of the cost of technology adaptation and implementation). Figure 2b depicts the technology network in a globalized setting with two multinationals that operate as duopolists in both countries. The coefficient $\beta_I^n \in [0, 1]$ represents the strength of intrafirm international technology synergies, net of the cost of intra-firm transfers of technology. Figure 2c illustrates the technology network under partial multinationalization.

If the costs c_L^A or c_I^A of adapting and implementing technology exceed the corresponding spillover or synergy coefficient (β_L or β_I), the net coefficient is zero:

$$\beta_L^n = \max\left\{\beta_L - c_L^A, 0\right\}, \beta_I^n = \max\left\{\beta_I - c_I^A, 0\right\}.$$

Cost functions depend on the equilibrium technology network structure, that is, on whether or not there are multinationals. A multinational's subsidiary has access to a portion of the technology developed by firms within the group, but located outside the local market. These intra-group international synergies supplement own-firm technologies and local spillovers received from local competitors. Empirically, the overall role of international synergies is reflected in that during 1970-87, cross-border M&As were more frequent than local acquisitions in U.S. research-intensive industries (Harris

and Ravenscraft [1991]).

Cost functions with spillovers and synergies for firms 1 and 2 in country 1 are:

$$C_1(q_1, x, x^*) = \left(A - x_1 - \beta_L^n x_2 - \beta_I^n x_1^*\right) q_1 + \gamma\left(x_1\right)^2, \qquad x_1, x_2, x_1^* \geq 0$$

$$C_2(q_2, x, x^*) = \left(A - x_2 - \beta_L^n x_1 - \beta_I^n x_2^*\right) q_2 + \gamma\left(x_2\right)^2, \qquad x_2, x_1, x_2^* \geq 0,$$

where A is a variable cost parameter and γx^2 is the cost of producing own-technology. The terms $(x_1 + \beta_L^n x_2 + \beta_I^n x_1^*)$ and $(x_2 + \beta_L^n x_1 + \beta_I^n x_2^*)$ represent the sum of the unit cost reduction achieved by own research efforts, spillovers from local firms, and international synergies, respectively.[3]

3 The Output-Research Strategies

This section solves the output-research strategic problem, obtaining the profit functions used later to compute the takeover fee and to determine the equilibrium multinationalization structure. Output and R&D spending in different locations are centrally-determined, that is, are formulated at the group level.

3.1 Globalization

Globalization consists of two multinationals operating in two countries. At the third stage of the game, firms choose output quantities (q_1, q_2, q_1^* and q_2^*) that maximize their operating profits for a given level of research spending (x, x^*) = (x_1, x_2, x_1^*, x_2^*). The operating profits $\Pi_1^G = \pi_1^G + \pi_1^{G*}$ of multinational "1," are the sum of the operating profits π_1^G and π_1^{G*} obtained in each market:

$$\pi_1^G\left(q_1, q_2, x, x^*\right) = \left(a - bQ\right) q_1 - \left(A - x_1 - \beta_L^n x_2 - \beta_I^n x_1^*\right) q_1 - \gamma\left(x_1\right)^2$$

$$\pi_1^{G*}\left(q_1^*, q_2^*, x^*, x\right) = \left(a - bQ^*\right) q_1^* - \left(A - x_1^* - \beta_L^n x_2^* - \beta_I^n x_1\right) q_1^* - \gamma\left(x_1^*\right)^2,$$
$$\tag{1}$$

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[3]The network can be extended to include international spillovers and local synergies. Synergy-based foreign investment would occur even if international spillovers were positive, and as large as local spillovers. The attempt to exploit local synergies in the same industry would lead to monopoly in this framework, setting the firm against anti-trust law restrictions, which does not happen when buying or merging with a foreign duopoly firm.

where a is the potential demand, A represents a variable cost parameter, and β_L^n and β_I^n are the net spillover and synergy coefficients.[4]

In the second stage of the game, each firm strategically chooses the volume of research allocated to each market. Solving for x and x^* we find that there exists a unique and symmetric solution for all firms:

$$x_1 = x_2 = x_1^* = x_2^* = \frac{\left(2\left(1 + \beta_I^n\right) - \beta_L^n\right)(a - A)}{9\gamma b - \left(1 + \beta_L^n + \beta_I^n\right)\left(2 - \beta_L^n + 2\beta_I^n\right)}. \tag{2}$$

For $\beta_I^n \in [0, 1]$, $\beta_L^n \in [0, 1]$ and $\gamma b > 1$, multinationals will always invest in technology. In this case, research leads, ceteris paribus, to net advantages against the product market competitor. An increase of the international transfer coefficient β_I^n always leads to increased research. Also, the greater the local externality β_L^n, the smaller the equilibrium research investment. Due to local spillovers, firms benefit from their rival firm group's research without internalizing the costs, but this reduces the incentives to do research. Market size a is positively associated with research spending, while larger operating costs A reduce research.

Solving the model recursively, we get:

$$q_1 = q_2 = q_1^* = q_2^* = \frac{3\gamma(a - A)}{9\gamma b - \left(1 + \beta_L^n + \beta_I^n\right)\left(2 - \beta_L^n + 2\beta_I^n\right)}. \tag{3}$$

Stronger international synergies (a higher β_I^n), are cost-reducing and lead to higher output and thus lower prices. Stronger local spillovers always lower research, but the quantity effect is ambiguous. For $\frac{\left(1 + \beta_I^n\right)}{2} < \beta_L^n \leq 1$, stronger local spillovers lead to reduced research, *larger* final output production costs, and lower production. For $\beta_L^n < \frac{\left(1 + \beta_I^n\right)}{2}$, stronger local spillovers imply lower R&D spending, *lower* final output production costs and greater production.[5]

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[4]The non-negative cost conditions $A \geq x_1 + \beta_L^n x_2 + \beta_I^n x_1^*$ and $A \geq x_1^* + \beta_L^n x_2^* + \beta_I^n x_1$ are satisfied by imposing $A \in \left[\overline{A}, a\right)$ with $\overline{A} = \frac{a\left(1 + \beta_L^n + \beta_I^n\right)\left(2 - \beta_L^n + 2\beta_I^n\right)}{9\gamma b}$.

[5]The intuition of the latter inequality relates to the following. In this model, there are two opposite effects from stronger local spillovers $\left(\frac{\partial\left(\beta_L^n x\right)}{\partial \beta_L^n} = x + \beta_L^n \frac{\partial x}{\partial \beta_L^n}\right)$: a direct cost-reduction effect (x) and an indirect cost-increasing effect (equilibrium research spending declines). The direct cost-reduction effect of stronger spillovers is greater with the larger research x associated with a lower β_L^n and a higher β_I^n (stronger synergies imply greater research). Consequently, final output costs can go down, even if research is reduced, when research is high because either β_L^n is small or β_I^n is large enough to compensate for a large β_L^n.

Total operating profits Π^G of a multinational under globalization are given by:

$$\Pi^G = \frac{2\gamma\left(9\gamma b - [\beta_L^n - 2(\beta_I^n + 1)]^2\right)(a - A)^2}{[9\gamma b - (1 + \beta_L^n + \beta_I^n)(2 - \beta_L^n + 2\beta_I^n)]^2}. \tag{4}$$

Profits depend positively on market size a and negatively on the variable cost parameter A. There is a complex relation between profits, synergies and spillovers. For instance, when local spillovers are strong (say, β_L^n close to 1) profits increase with stronger synergies (a higher β_I^n). However, when local spillovers are weak enough, profits *decline* with a higher β_I^n. Firms mimicking behavior leads to excessive technology spending subject to increasing costs, explaining why profits can go down when synergies increase.

3.2 Regionalization

Under regionalization (see D'Aspremont and Jacquemin [1988]), all firms are local and do not benefit from international synergies. The output and research functions can be obtained by making $\beta_I^n = 0$ in the corresponding equations under globalization. Profits π^R of firms 1 and 2 in country 1 are half the multinationals' globalization profits Π^G (see expression (4) when $\beta_I^n = 0$):

$$\pi_1^R = \pi_2^R = \frac{\gamma\left[9\gamma b - (2 - \beta_L^n)^2\right](a - A)^2}{[9\gamma b - (1 + \beta_L^n)(2 - \beta_L^n)]^2}. \tag{5}$$

Profits π^R increase with β_L^n except when β_L^n is large enough. (for $\gamma = b = 2$ profits increase for $\beta_L^n < 0.99$).

3.3 Partial Multinationalization

The profit functions Π^P and $\pi^P = \pi^{P*}$ of the multinational and the two local firms are (for positive levels of R&D):

$$\Pi^P = \frac{2\gamma\left[3\gamma b - (2 - \beta_L^n)(1 - \beta_L^n)\right]^2\left[9\gamma b - (2 - \beta_L^n + 2\beta_I^n)\right](a - A)^2}{(\theta[\beta_L^n, \beta_I^n])^2}, \tag{6}$$

$$\pi^P = \pi^{P*} \tag{7}$$

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$$= \frac{\gamma \left[9\gamma b - (2 - \beta_L^n)^2\right] \left[-3\gamma b - (1 + \beta_L^n + \beta_I^n)(2 - \beta_L^n + 2\beta_I^n)\right]^2 (a - A)^2}{\left(\theta\left[\beta_L^n, \beta_I^n\right]\right)^2},$$

where $\theta\left[\beta_I^n, \beta_L^n\right]$ is defined by:

$$\theta\left[\beta_L^n, \beta_I^n\right] \equiv 27\gamma^2 b^2 - 6\gamma b \left[2(\beta_I^n)^2 + 2\beta_I^n(2 - \beta_L^n) + (2 - \beta_L^n)^2\right]$$
$$+ (2 - \beta_L^n)\left(1 - (\beta_L^n)^2 + \beta_I^n\right)(2\beta_I^n - \beta_L^n + 2),$$

and $\theta\left[\beta_I^n, \beta_L^n\right] > 0$ when $\beta_I^n < \widetilde{\beta}_I^n\left[\beta_L^n\right]$ ($\widetilde{\beta}_I^n\left[\beta_L^n\right]$ is the positive root β_I^n of $\theta\left[\beta_I^n, \beta_L^n\right] = 0$).

For $b = \gamma = 2$, profits Π^P decline with the strength β_L^n of local spillovers when either spillovers β_L^n or synergies β_I^n are large enough. On the contrary, the profits $\pi^P = \pi^{P*}$ of local firms competing with a multinational are greater the stronger the local spillovers (a larger β_L^n). Stronger spillovers can hinder foreign investment by increasing (1) Π^P (for large β_L^n), (2) the cost of acquiring a firm abroad (which we show increases with π^{P*}), and, (3) the raider's alternative benefits π^P.

4   Bargaining and the Takeover Fee

Establishing foreign operations requires potential buyers and sellers to reach an agreement on the takeover fee to be paid by the buyer (or side payments distributed in mergers). Players are arbitrarily classified as buyers or sellers, with the understanding that, due to symmetry, the game is undetermined as regards players' identities and we cannot distinguish between acquisitions or mergers.

4.1   The Bargaining Problem

Multinationalization entails pairing a seller (target, T_K) and a buyer (raider, R_K) in a coalition K. Potential partners utilize a Nash-bargaining rule to allocate the additional value created by multinationalization.

The equilibrium takeover fee $\overline{F}_K$ represents the price at which the bidder and the seller reach an agreement to buy and sell the target firm, respectively, and hence to form a multinational. Coalition K equilibrium takeover fee $\overline{F}_K \in \Re$ is given by the fee that maximizes the geometrically weighted average

of the surpluses received by the target (labelled S^{T_K}) and the raider (labelled S^{R_K}):

$$\overline{F}_K\left(\cdot\right) \equiv \left\{ \begin{array}{c} \max_F W_K = \left[S^{T_K}\left(\cdot, F\right)\right]^{\alpha}\left[S^{R_K}\left(\cdot, F\right)\right]^{1-\alpha} \\ s.t. S^{T_K}\left(\cdot, F\right) \geq 0, S^{R_K}\left(\cdot, F\right) \geq 0, \end{array} \right\} \qquad (8)$$

where $\alpha \in [0, 1]$ represents seller's bargaining power.

Figure 3a describes the bargaining game. The target firm's equilibrium price, $\overline{F}_K(\alpha, \beta_I^n, \beta_L^n, a, b, A, \gamma, C^M) \in \{\overline{F}_K^G(\alpha, \beta_I^n, \beta_L^n, a, b, A, \gamma, C^M),$ $\overline{F}_K^P(\alpha, \beta_I^n, \beta_L^n, a, b, A, \gamma, C^M)\}$ depends on whether or not the rivals reach an agreement to form a multinational. The surpluses in equation (8) depend on the conjectures agents formulate about the outcome of the other simultaneous game. The size of the pie (i.e., profits from multinationalization) is a function of the structure of multinationalization and will affect the takeover fee paid. Furthermore, the threat or disagreement point t_K is endogenously determined. To obtain the threat point, firms maximize their rents from deviating (i.e., from not accepting their counterparts' offer), subject to the conjectures they have upon other firms' choices.

The target's surplus, S^{T_K}, is the takeover fee F_K received the minus opportunity cost of selling. If it is conjectured that the other bargaining agents do not reach an agreement, the selling firm receives F_K^P, and the opportunity cost of selling is the profit π^R obtainable under regionalization (see equation (5)):

$$S^{T_K}\left(\beta_L^n, a, b, A, \gamma, F_K^P\right) = F_K^P - \pi^R(\beta_L^n, a, b, A, \gamma). \qquad (9)$$

If it is conjectured that there is a multinational in the market, the price of the firm is given by expression F_K^G, and the seller's opportunity cost coincides with the profits π^P of a local firm under partial multinationalization, specified in equation (7). The target's surplus is given by:

$$S^{T_K}\left(\beta_I^n, \beta_L^n, a, b, A, \gamma, F_K^G\right) = F_K^G - \pi^P\left(\beta_I^n, \beta_L^n, a, b, A, \gamma\right). \qquad (10)$$

The raider's surplus, S^{R_K}, is defined as the operating profits, minus the sum of the takeover fee, the fixed cost of multinationalization, and the opportunity cost of buying. The operating profits represent the benefits from multinationalization and the takeover fee is the bidding cost of investing abroad. The opportunity cost of buying is defined by the profits that the bidder would obtain from not buying.

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If we conjecture that there is no other multinational, the operating profits are given by the profits Π^P of a multinational under a partial multinationalization regime, reported in equation (6). The opportunity cost of the raider is the amount of profits π^R obtainable under regionalization, and the surplus would be:

$$S^{R_K}\left(\beta_I^n, \beta_L^n, a, b, A, \gamma, F_K^P\right) \tag{11}$$

$$= \Pi^P(\beta_I^n, \beta_L^n, a, b, A, \gamma) - F_K^P - C^M - \pi^R(\beta_L^n, a, b, A, \gamma).$$

If the presence of another multinational is conjectured, a potential investor's operating profits would be the globalization profits Π^G given by expression (4). The opportunity cost of buying would be the local firm's profits π^P under partial multinationalization, reported in equation (7), and the surplus:

$$S^{R_K}\left(\beta_I^n, \beta_L^n, a, b, A, \gamma, F_K^G\right) \tag{12}$$

$$= \Pi^G(\beta_I^n, \beta_L^n, a, b, A, \gamma) - F_K^G - C^M - \pi^P(\beta_I^n, \beta_L^n, a, b, A, \gamma).$$

The equilibrium takeover fee $\overline{F}_K \in \{\overline{F}_K^G, \overline{F}_K^P\}$, is defined by the following first order necessary and sufficient conditions (with $\alpha \in (0, 1)$),

1-. The ratio of seller's surplus to buyer's surplus is equal to the ratio of seller's bargaining power to buyer's bargaining power,

$$\frac{\alpha}{1-\alpha} = \frac{S^{T_K}\left(\cdot, \overline{F}_K\right)}{S^{R_K}\left(\cdot, \overline{F}_K\right)}, or, \tag{13}$$

$$\alpha = \frac{S^{T_K}\left(\cdot, \overline{F}_K\right)}{S^{T_K}\left(\cdot, \overline{F}_K\right) + S^{R_K}\left(\cdot, \overline{F}_K\right)}, (1-\alpha) = \frac{S^{R_K}\left(\cdot, \overline{F}_K\right)}{S^{T_K}\left(\cdot, \overline{F}_K\right) + S^{R_K}\left(\cdot, \overline{F}_K\right)}. \tag{14}$$

The sellers' bargaining power is equal to the sellers' share in the total surplus ($S^{R_K} + S^{T_K} = \Pi^G$ - $2\pi^P$ - C^M with globalization and $S^{R_K} + S^{T_K} = \Pi^P$ - $2\pi^R$ - C^M with partial multinationalization).

2-. Seller and buyer surplus from multinationalization cannot be negative,

$$S^{T_K}\left(\cdot, \overline{F}_K\right) \geq 0 \text{ and } S^{R_K}\left(\cdot, \overline{F}_K\right) \geq 0. \tag{15}$$

The takeover occurs only if firms expect non-negative surpluses from the deal.

4.2 The Bargaining Solution

We proceed to determine the fees, $\overline{F}_K^G$ and $\overline{F}_K^P$, under the conjectures of globalization and partial multinationalization, respectively. Because of the model's symmetry, $\overline{F}^G = \overline{F}_K^G = \overline{F}_{K'}^G$ (K and K' are the two groups under globalization).

If we conjecture that there is a multinational rival, the seller's opportunity cost of accepting the buyer's offer is given by the partial multinationalization profits π^P reported in equation (7). Substituting the globalization and partial multinationalization profits (4) and (7) into the bargaining condition (13) and simplifying, we get the equilibrium price $\overline{F}^G$ of a target firm under globalization:

$$\overline{F}^G(\cdot) = \alpha\left\{\Pi^G\left(\beta_I^n, \beta_L^n, a, \text{b}, \text{A}, \gamma\right) - C^M\right\} + (1 - 2\alpha)\,\pi^P\left(\beta_I^n, \beta_L^n, a, b, A, \gamma\right)$$

$$= \alpha\left[\Pi^G\left(\beta_I^n, \beta_L^n, a, \text{b}, \text{A}, \gamma\right) - C^M - \pi^P\left(\beta_I^n, \beta_L^n, a, b, A, \gamma\right)\right]$$
$$+ (1 - \alpha)\,\pi^P\left(\beta_I^n, \beta_L^n, a, b, A, \gamma\right), \text{with} \tag{16}$$

$$\begin{aligned}\pi^P(\beta_I^n, \beta_L^n, a, b, A, \gamma) \;\leq\;& \overline{F}^G\left(\beta_I^n, \beta_L^n, a, b, A, \gamma\right)\\ \leq\;& \Pi^G\left(\beta_I^n, \beta_L^n, a, \text{b}, \text{A}, \gamma\right) - C^M - \pi^P(\beta_I^n, \beta_L^n, a, b, A, \gamma).\end{aligned}$$

The equilibrium price of a firm, $\overline{F}^G$, is a linear combination of the maximum gain obtainable under globalization, and the profits obtained by not forming a multinational. The acquisition price depends on firms' bargaining power α and $(1 - \alpha)$, the strength of synergies and spillovers, demand parameters a and b, costs parameters A and γ, and the fixed cost C^M.

The weaker the seller (buyer) bargaining power, the closer the firm's price is to the seller (buyer) opportunity cost. For instance, when sellers have no bargaining power ($\alpha = 0$), then $\overline{F}^G(\cdot) = \pi^P$ which corresponds to

the seller's threshold to accept the bidder's proposal, that is, $\overline{F}^G(\cdot)$ is such that $S^{T_K}\left(\cdot,\overline{\mathrm{F}}^{\mathrm{G}}(\cdot)\right) = 0$. On the other hand, when sellers dominate the negotiation process $(\alpha = 1)$, $S^{R_K}\left(\cdot,\overline{F}^G(\cdot)\right) = 0$, or, $\overline{F}^G(\cdot) = \{\Pi^G\text{-}C^M\}\text{-}\pi^P$, which refers to the maximum price the bidder is able to offer (i.e., the additional profits).

Similarly, it can be shown that the partial multinationalization equilibrium price is (substitute the partial multinationalization and regionalization profits (6) and (5) into the bargaining condition (13)):

$$
\overline{F}^P(\cdot) = \alpha \left\{ \Pi^P\left(\beta_I^n, \beta_L^n, a, \mathrm{b}, \mathrm{A}, \gamma\right) - C^M \right\} + (1 - 2\alpha)\,\pi^R\left(\beta_L^n, a, b, A, \gamma\right)
$$

$$
\begin{aligned}
= \alpha &\left[\Pi^P\left(\beta_I^n, \beta_L^n, a, \mathrm{b}, \mathrm{A}, \gamma\right) - C^M - \pi^R\left(\beta_L^n, \mathrm{a}, \mathrm{b}, \mathrm{A}, \gamma\right) \right] \\
&+ (1 - \alpha)\,\pi^R\left(\beta_L^n, a, b, A, \gamma\right), \text{with}
\end{aligned}
\tag{17}
$$

$$
\begin{aligned}
\pi^R(\beta_L^n, a, b, A, \gamma) \;\leq\; & \overline{F}^P\left(\beta_I^n, \beta_{\mathrm{L}}^{\mathrm{n}}, \mathrm{a}, \mathrm{b}, \mathrm{A}, \gamma\right) \\
\leq\; & \left\{ \Pi^P\left(\beta_I^n, \beta_L^n, a, \mathrm{b}, \mathrm{A}, \gamma\right) - C^M \right\} - \pi^R(\beta_L^n, a, b, A, \gamma).
\end{aligned}
$$

The takeover fee under partial multinationalization is a linear combination of the maximum surplus obtainable under that structure, and the opportunity cost of bidders and sellers (i.e., the profits from remaining a regional business).

5 Multinationalization as Strategic Equilibrium

This section formulates the equilibrium conditions of the multinationalization game. We derive a separation theorem showing that the bargaining power distribution influences the allocation of the surplus among sellers and bidders, but does not affect the multinationalization decision.

5.1 The Multinationalization Game

Figure 3 illustrates the takeover negotiation and the non-cooperative multinationalization game. Equilibrium requires all agents' conjectures to be sustained. The only relevant pairings consist of two-firm multinationals or single

firms (treated as "paired" with a "dummy" player). Agents' strategies are: (1) {agree, agree}, in which case an agreement to buy-sell is reached, and, (2) {agree, disagree}, {disagree, agree}, or {disagree, disagree}, in which case there is no takeover.

Buyers' payoffs in the Nash equilibrium are the net profits obtained (operating profits minus fixed multinationalization costs) and sellers' payoffs are the takeover fees received. Payoffs contingent on all firms' strategies are

$$\left\{ \left(v^{T_K}, v^{R_K} \right), \left(v^{T_{K'}}, v^{R_{K'}} \right) \right\}$$

$$= \begin{cases} \left[\left(F_K^G, \Pi^G\left(\cdot\right) - \mathrm{F}_K^G - \mathrm{C}^M \right), \left(\mathrm{F}_{K'}^G, \Pi^G\left(\cdot\right) - \mathrm{F}_{K'}^G - \mathrm{C}^M \right) \right] \\ \qquad \mathrm{if\,globalization}, \\ \left[\left(F_K^P, \Pi^P\left(\cdot\right) - \mathrm{F}_K^P - \mathrm{C}^M \right), \left(\pi^P\left(\cdot\right), \pi^P\left(\cdot\right) \right) \right] \\ \qquad \mathrm{if\,partial\,multinationalization}, \\ \left[\left(\pi^P\left(\cdot\right), \pi^P\left(\cdot\right) \right), \left(\mathrm{F}_{K'}^P, \Pi^P\left(\cdot\right) - \mathrm{F}_{K'}^P - \mathrm{C}^M \right) \right] \\ \qquad \mathrm{if\,partial\,multinationalization}, \\ \left[\left(\pi^R\left(\cdot\right), \pi^R\left(\cdot\right) \right), \left(\pi^R\left(\cdot\right), \pi^R\left(\cdot\right) \right) \right] \\ \qquad \mathrm{if\,regionalization}, \end{cases}$$
(18)

where the terms $\left(v^{T_K}, v^{R_K} \right)$ and $\left(v^{T_{K'}}, v^{R_{K'}} \right)$ denote the payoffs of the potential sellers and buyers of coalitions K and K'. Expressions Π^G, Π^P, π^P and π^R are given by (4), (6), (7), and (5), respectively.

5.2 Multinationalization Equilibrium Concepts

We say that _Globalization_ arises as an equilibrium of the game if the following two conditions are satisfied simultaneously:

(1) the profits (net of takeover and fixed multinationalization costs) from investing abroad, when a multinational is already established there, have to be no smaller than the profits obtainable by remaining an independent firm

$$\Pi^G\left(\beta_I^n, \beta_L^n, \mathrm{a}, \mathrm{b}, \mathrm{A}, \gamma\right) - \overline{F}^G\left(\alpha, \beta_I^n, \beta_L^n, \mathrm{a}, \mathrm{b}, \mathrm{A}, \gamma\right) - C^M \geq \pi^P\left(\beta_I^n, \beta_L^n, \mathrm{a}, \mathrm{b}, \mathrm{A}, \gamma\right),$$
(19)

(2) the firms that initially were conjectured to be a target, have to find the strategy of selling their firm to be the most profitable,

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$$\overline{F}^G \geq \pi^P\left(\beta_I^n, \beta_L^n, a, b, A, \gamma\right). \tag{20}$$

Equation (20) means that targets' payoffs are greater or equal to the threat point (the operating profits π^P the target firm could obtain as a domestic firm coexisting with an already established multinational).

In a _Partial Multinationalization_ equilibrium (there is only one multinational), the following conditions should be satisfied:

(1') the profits (net of takeover and fixed costs) obtained from investing abroad, when potential rivals are all domestic firms, have to be no smaller than the regionalization profits obtainable by remaining local,

$$\Pi^P\left(\beta_I^n, \beta_L^n, a, b, A, \gamma\right) - \overline{F}^P\left(\alpha, \beta_I^n, \beta_L^n, a, b, A, \gamma\right) - C^M \geq \pi^R\left(\beta_L^n, a, b, A, \gamma\right), \tag{21}$$

and, the other potential raider has to find it optimal not to invest abroad when there is a firm that invests abroad,

$$\pi^P\left(\beta_I^n, \beta_L^n, a, b, A, \gamma\right) \geq \Pi^G\left(\beta_I^n, \beta_L^n, a, b, A, \gamma\right) - \overline{F}^G\left(\alpha, \beta_I^n, \beta_L^n, a, b, A, \gamma\right) - C^M, \tag{22}$$

(2') the firm that is conjectured to be a target, has to find the strategy of selling its firm to be profitable,

$$\overline{F}^P\left(\alpha, \beta_I^n, \beta_L^n, a, b, A, \gamma\right) \geq \pi^R\left(\beta_L^n, a, b, A, \gamma\right). \tag{23}$$

The firm conjectured to remain local has to find that strategy to be optimal:

$$\pi^P\left(\beta_I^n, \beta_L^n, a, b, A, \gamma\right) \geq \overline{F}^G\left(\alpha, \beta_I^n, \beta_L^n, a, b, A, \gamma\right). \tag{24}$$

In a _Regionalization_ equilibrium (absence of multinationals), one of the following conditions should be satisfied:

(1 ")

$$\pi^R\left(\beta_L^n, a, b, A, \gamma\right) \geq \Pi^P\left(\beta_I^n, \beta_L^n, a, b, A, \gamma\right) - \overline{F}^P\left(\alpha, \beta_I^n, \beta_L^n, a, b, A, \gamma\right) - C^M, \tag{25}$$

(2") $\pi^R\left(\beta_L^n, a, b, A, \gamma\right) \geq \overline{F}^P\left(\alpha, \beta_I^n, \beta_L^n, a, b, A, \gamma\right).$

5.3 Multinationalization, Bargaining Power and the Takeover Fee

The following theorem presents the equilibrium conditions, and shows that the allocation of bargaining power affects the distribution of firms' surpluses, but not the foreign investment decision.

Theorem 1 *The globalization and regionalization equilibrium conditions are*

$$\Pi^G \left(\beta_I^n, \beta_L^n, a, \mathrm{b}, \mathrm{A}, \gamma \right) - C^M \geq 2\pi^P \left(\beta_I^n, \beta_L^n, a, b, A, \gamma \right) (\text{Globalization}). \quad (26)$$

$$2\pi^R \left(\beta_L^n, a, b, A, \gamma \right) \geq \Pi^P \left(\beta_I^n, \beta_L^n, a, \mathrm{b}, \mathrm{A}, \gamma \right) - C^M (\text{Regionalization}). \quad (27)$$

Partial globalization occurs in the region in which neither (26) nor (27) hold. The decision to invest abroad does not depend on the bargaining power distribution, independently of what agents' conjectures are, but the sellers' bargaining power α, is positively related to the takeover fee received by the target firm.

bf ProofEquation (26) is obtained by substituting (16) into (19) and (20); equation (27) is obtained by substituting (17) into (25).[6]

The globalization and regionalization conditions (26) and (27) do not depend on $\alpha \in [0, 1]$. These conditions show that the decision to invest abroad is not affected by the distribution of bargaining power between the raider and the target firms, but only by the potential surplus.

To see that the takeover fee is directly related to the seller's bargaining power, differentiate equations (16) and (17) with respect to α:

$$\frac{d\overline{F}^G (\alpha, \cdot)}{d\alpha} = \Pi^G \left(\beta_I^n, \beta_L^n, a, \mathrm{b}, \mathrm{A}, \gamma \right) - C^M - 2\pi^P \left(\beta_I^n, \beta_L^n, a, b, A, \gamma \right) \geq 0$$

$$\frac{d\overline{F}^P (\alpha, \cdot)}{d\alpha} = \Pi^P \left(\beta_I^n, \beta_L^n, a, \mathrm{b}, \mathrm{A}, \gamma \right) - C^M - 2\pi^R \left(\beta_L^n, a, b, A, \gamma \right) \geq 0,$$

where the inequalities follow from equations (26) and (27).**q.e.d**

The previous result represents a separation theorem showing that the decision to multinationalize is independent of the allocation of bargaining

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[6]The partial multinationalization conditions are obtained by substituting the takeover fee $\overline{F}^P$ in expression (17) into the partial multinationalization inequalities (21), (22), (23) and (24). The two inequalities obtained are the reverse of conditions (26) and (27).

power even though bargaining power affects the takeover fee. This property implies that the endogenous takeover costs of foreign investment do not work as a fixed cost barrier to multinationalization. The result hinges on the property that the negotiated cost factor is internalized once potential sellers and buyers resolve to sell-buy a firm. The productive benefits from multinationalization determines whether or not it occurs. In the financial negotiation process, agents determine the distribution of the additional profits to be obtained from investing abroad, depending on each agent's bargaining power.

6   The Structure and Effects of Multinationalization

This section describes the models's solution. We examine the equilibrium structure of multinationalization, its effects on firms, and show that the model can generate an equilibrium "synergy trap."

Figure 4 shows the game's equilibrium multinationalization structure as a function of the synergy and local spillover parameters $\beta_I^n \in [0,1]$ and $\beta_L^n \in [0,1]$.[7] Globalization arises as the equilibrium when the synergy coefficient is large enough (the area above the GG curve), and partial multinationalization dominates for an intermediate range of the synergy parameter (the area between RR and GG). There are no multinationals in the area below curve RR. Except at the boundaries, all the equilibria are unique. The boundary curves look linear because in the range studied, the equations are dominated by the constants and are nearly linear. The equations characterizing areas' boundaries are presented in the appendix.

Globalization arises from strong firm-level economies due to synergistic effects encouraging direct investment by providing a cost advantage over firms that only benefit from local spillovers. A duopolist that does not foreign invest is at a disadvantage because it foregoes international synergies and the benefits from capturing foreign local spillovers and diffusing them within the firm.

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[7]Figure 4 is based on demand parameters $a = 10$ and $b = 2$, variable cost parameter $A = 7$, research cost parameter $\gamma = 2$, and fixed costs $C^M = 0.2$. If the fixed cost of an additional local research facility is $C^M = 0.2$ firms prefer a single facility because the costs of two local research facilities, $\gamma[x^2/2 + x^2/2] + C^M$, exceed γx^2.

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The model produces equilibria in which local firms coexist with a single multinational. In an intermediate range of synergies' strength, a single multinational secures high enough profits to sustain itself, but potential synergies are not strong enough to sustain two multinationals (they would not earn enough profits to compensate for the multinationalization costs and the opportunity cost).

The combination of weak synergies with high technology adaptation costs precludes multinationalization (the regionalization area below the RR curve in Figure 4). If the synergy coefficient is less than the cost of transferring technology, there is no transfer of technology and thus no benefits from establishing a subsidiary abroad (the rectangle below the line $\beta_I = c_I$, in which $\beta_I^n = 0$). Even if $\beta_I^n > 0$, foreign investment will not occur when multinationals' operating profits, net of the costs of acquiring a foreign firm plus fixed costs ($C^M = 0.2$ in Figure 4), are less than the profits obtained by remaining a local firm.

Stronger local spillovers have a discouraging foreign investment effect. This relates to the fact that, by increasing local profits in the status quo, larger local spillovers raise both targets and raiders' opportunity costs [see equations (5) and (7)]. For that reason, the synergy threshold required by raiders for engaging in foreign investment, and by targets for selling, goes up with the strength of local spillovers. This discouraging effect provides a reason why the boundaries of the globalization and partial multinationalization areas are tilted up in Figure 4.[8]

6.1   Winners, Losers and the Synergy Trap

What are the effects of multinationalization on domestic firms? With partial multinationalization, the answer hinges on whether or not a firm participates in the M&A transaction. Firms taking part in a M&A deal always gain, independently of whether they act as target or as raider. The reason is that they would only participate in a M&A if the gains exceed the opportunity costs (i.e., the profits under regionalization). On the other hand, those firms remaining local under partial multinationalization lose if their profits are lower than in the status quo [for instance $\pi^P = 0.4 < \pi^R = 0.5$, when

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[8]With the parameters underlying Figure 4, firms' profits under regionalization go down with β_L^n for $\beta_L^n > 0.99$. However the profits of a single multinational under partial multinationalization also go down when β_L^n is large enough, discouraging foreign investment.

$(\beta_L, \beta_I) = (0, 0.5)$]. It was not possible to prove analytically that firms remaining local always lose, but this occurred in all the simulations performed.

Who wins and who loses in the globalization case? In general, the answer depends on the bargaining power strength of the seller and buyer but, paradoxically, all could lose. The model generates an equilibrium synergy trap with high β_I^n and low β_L^n. In this region, multinational firms' profits are lower than domestic firms' profits in the absence of multinationals. Such result can be seen by comparing expressions (4), (7) and (5). For instance, if $\beta_I^n = 0.9$ and $\beta_L^n = 0$, then $\{\Pi^G\text{-}C^M\} - \pi^P - \pi^R = 0.7\text{-} 0.5\text{-} 0.3 = \text{-}0.1$. The presence of a synergy trap does not mean that firms should abstain from multinationalization, because competing as a local firm against a multinational would entail even lower profits.

Multinational firms invest more in R&D than in the pre-stage when they remain purely local firms. This can be seen by comparing the levels of research undertaken by firms under regionalization and under globalization (contrast (2) with $\beta_L^n = 0$ and $\beta_L^n > 0$). Multinationalization that stimulates R&D and reduces variable costs, however, can result in a price decline that pushes firms into a synergy trap with lower profits.

Finally, market structure would change if alternative opportunities outside the industries considered are good enough to lead firms to exit these markets. For instance, local firms facing a large enough profit reduction when competing with a multinational, would exit the market if they have alternatives that produce greater rewards. Local firms exit would result in a multinational's monopoly and foreign investment could be viewed as a strategy to force the exit of foreign firms.

7   Conclusions

Knowledge-based foreign investment is viewed as a strategic choice to locate abroad in order to create comparative advantages by enhancing global technological capabilities. Technically, we develop a stage game that combines noncooperative aspects with simultaneous bargaining games that have endogenous treat points that depend on the extent of multinationalization.

Foreign investment is stimulated by high potential synergies and low costs of adapting local and foreign technologies. When equilibrium entails competition between a multinational and local firms (partial multinationalization), firms engaging in a M&A deal win, while firms remaining local lose. However,

market concentration does not increase as long as simultaneous multinationalization merely replaces competition between local firms by competition among multinationals (globalization). In fact, globalization can paradoxically result in an equilibrium synergy trap in which direct investment is strategically preferred, but firms strategic interactions reduce output prices and lower post-M&As profits.

Investment and research globalization channelled through multinationalization leads to knowledge integration across countries. By endogenizing the technology structure, the analysis provides a microeconomic basis for models and evidence showing international knowledge interdependencies[9]. The externalities associated with research and technology creation are due to the diffusion of technologies that are created and captured locally, and transferred globally.

8   APPENDIX

Globalization arises in the parameter area above the GG curve (see Figure 4), which is obtained by substituting the operating profits in expressions (4) and (7) into the globalization condition Π^G-$C^M > 2\pi^P$ defined by (26):

$$
\frac{2\gamma \left(9\gamma b - \left(\left[\beta_L^n - 2\left(\beta_I^n + 1\right)\right]^2\right)\right)(a-A)^2}{\left[9\gamma b - \left(1 + \beta_L^n + \beta_I^n\right)\left(2 - \beta_L^n + 2\beta_I^n\right)\right]^2} - C^M
$$
$$
> \frac{\gamma \left[9\gamma b - \left(2 - \beta_L^n\right)^2\right]\left[-3\gamma b - \left(1 + \beta_L^n + \beta_I^n\right)\left(2 - \beta_L^n + 2\beta_I^n\right)\right]^2 (a-A)^2}{\left(\theta\left[\beta_L^n, \beta_I^n\right]\right)^2},
$$

where $\theta\left[\beta_L^n, \beta_I^n\right]$ was defined in (6)-(7) and $\beta_I^n = \beta_L^n = 0$ when $\beta_L \leq c_L^A$ and $\beta_I \leq c_I^A$.

Regionalization arises in the parameter area below the boundary curve RR (Figure 4), obtained by substituting firms' operating profits defined by expressions (6) and (5) into the regionalization condition, $2\pi^R > \Pi^P$-C^M, defined by (27):

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[9]See Coe and Helpman [1995], Coe, Helpman and Hoffmaister [1995], Grossman and Helpman [1992], Rivera-Batiz and Romer [1991], Segerstrom, Anant, and Dinopoulos [1990].

$$\frac{2\gamma \left[3\gamma b - \left(2 - \beta_L^n\right)\left(1 - \beta_L^n\right)\right]^2 \left[9\gamma b - \left(2 - \beta_L^n + 2\beta_I^n\right)\right] (a - A)^2}{\left(\theta \left[\beta_L^n, \beta_I^n\right]\right)^2} - C^M$$
$$< \frac{\gamma \left[9\gamma b - \left(2 - \beta_L^n\right)^2\right] (a - A)^2}{\left[9\gamma b - \left(1 + \beta_L^n\right)\left(2 - \beta_L^n\right)\right]^2}.$$

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