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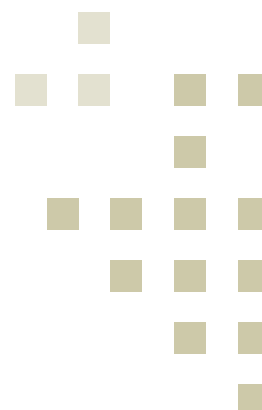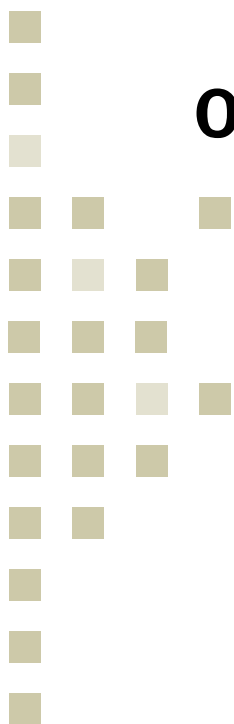
Who Buys Whom in International Oligopolies with FDI and Technology Transfer?

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[Abstract] Under what conditions will a technology leader from a small country acquire a laggard from a large country, and vice versa? We answer this question with a two-firm two-country Cournot model, where firms enter new markets via greenfield FDI or acquisition. The model takes into account both technological and market size asymmetries, and allows for M&A transaction costs, like corporate finance and legal fees. We show that to be the acquirer, a firm from a small country needs not only a strong technological lead but also the ability to exploit it on a global scale, which requires low international technology transfer costs. Moreover, we find that a multilateral greenfield investment liberalization may actually increase the incentives for foreign acquisitions. The effect of such liberalization on the nationality of the acquirer depends largely on the extent of the technology gap.

JEL classifications: L13, F23, O31, O38
Keywords: Multinational firms, FDI, mergers and acquisitions (M&A), Technology transfer

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WHO BUYS WHOM IN INTERNATIONAL OLIGOPOLIES WITH FDI AND TECHNOLOGY TRANSFER?

1. Introduction

The internationalisation of firms has assumed two new features. First, firms increasingly enter foreign markets by acquiring a local producer rather than through greenfield FDI. The pattern is particularly pronounced in industrialized host countries. Acquisitions accounted for 90% of inward FDI in the US[1] in 1998 (UNCTAD (2000)). Most of such investments are directed towards the service sector, not manufacturing, as in the past. In fact, while in the early 1970s services accounted for only one quarter of the world FDI stock, this share had risen to about 60% in 2002 (UNCTAD (2004)). Out of 35.000 M&As registered by Thomson Financial during the period 1995 to 2005, more than half were found in the service sectors. Second, the interaction between the international strategy and the innovative activity of firms has become increasingly tight and complex, due to the key role of multinational companies (MNEs) in the process of generating and transferring technology and knowledge in the global market. Models should therefore capture the technological implications of cross-border acquisitions.

The theoretical literature in economics has not devoted much focus to these important trends. Most of the formal modelling of the internationalization of firms is still devoted to explain the drivers and effects of greenfield FDI in the manufacturing sector (Horstmann and Markusen (1992); Petit and Sanna-Randaccio (2000); Barba Navaretti and Venables (2004); Grünfeld (2006)). Such models cannot help analyzing these recent trends for several reasons. To start with, as opposed to manufactured products, most services are not tradable, thus the traditional way in which these models are framed (the choice between export and FDI) cannot be applied to the internationalization of service. Second, while greenfield FDI is considered, foreign entry via acquisition is not accounted for. As a consequence, what is now the bulk of FDI activity remains unexplored.

Foreign acquisitions are often subject to intense public debate, especially if the takeover is directed towards service sectors, where foreign ownership traditionally has been less pronounced (e.g utilities and local transportation). During the last decades, a large number of technologically advanced firms in smaller industrialized economies have been acquired by firms with larger home markets like the US and UK. Many of these acquired firms were technology leaders and could, under the right conditions, expand internationally on their own through greenfield investment or acquisitions abroad. However there is also a fair amount of examples of advanced service sector firms from small markets expanding in larger foreign markets through acquisitions. For instance, Belgian KBC bank acquired the relatively large UK based financial firm Peel Hunt in 2001, the Austrian based advertising firm Lowe Lintas GGK bought the British advertising firm Broadway Group one year earlier, while Danish Group 4 Falch

acquired French based Euroguard. According to Thomson Financial M&A database, more than 350 acquisitions in the service sectors involved a small country acquirer and a large country target during the last 5 years.

In this paper, we identify the optimal foreign entry mode in a two country, two firm Cournot model with asymmetric firm technology levels and asymmetric market (country) sizes. We are particularly concerned with such asymmetries because the size of a market may affect the decision on how to enter it. And moreover, the relative technological level of a firm also contributes to determine the profitability of entering foreign markets. We specifically ask in which setting a technological leader from a small country finds it optimal to buy a technologically inferior firm from a large country and vice-versa. To answer this question, we develop a model that identifies the acquirer and the target firm. To our knowledge, and somewhat surprisingly, there exists no such model which is applied to issues on international M&As. Moreover, as opposed to the majority of earlier theoretical models on international M&As, we explicitly allow for FDI running both ways between countries. This is a desirable property in the case of industrialised countries, where multinationals often compete in each other's home markets.

In the first stage of the model, firms simultaneously choose between no entry, greenfield FDI or acquisition of the other firm. Notice that the model does not include exports as a strategic option. Thus, it is best suited for studies of foreign entry into service sectors or manufacturing sectors where there are high fixed and low variable export costs. In the second stage, firms set the profit maximizing level of output. If a firm enters the foreign market through greenfield FDI, it has to pay a fixed investment cost and its technology level in the foreign market is reduced due to technology transfer costs. If a firm enters through acquisition, it must offer the other firm a sufficiently high acquisition price in order to obtain an acceptance. If the bid is accepted through a Nash bargaining process, the acquirer becomes a monopolist in both markets. The model is novel in this respect, as it combines a non-cooperative game relating to the greenfield FDI decision, with a cooperative bargaining game where the potential acquisition and the identity of the equilibrium acquirer is established.

If an acquisition takes place, the global monopolist may gain from three effects: a larger monopoly rent, a best practice effect as better technology can be utilized in both countries, and finally saving fixed plant costs associated with greenfield FDI. The model also captures that additional costs are associated with the acquisition, e.g. due to legal and corporate finance fees.

The paper is organised as follows. In section 2, we briefly survey the relevant literature on this subject and clarify what distinguishes our model from previous studies. Section 3 presents the model. Section 4 analyzes the non-cooperative constrained game with a strategy space that excludes acquisition. Section 5 analyses the acquisition decision in a cooperative game framework, by applying the Nash fixed threat bargaining model. In Section 6, we analyse the equilibrium outcomes in the full model, partly

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[1] The figure refers to M&A however the same source indicates that acquisition dominates the scene, since less than 3% of cross-border acquisitions by number are mergers (UNCTAD (2000) p. 99).

based on analytical results and partly on numerical simulations. Finally, Section 7 presents the main conclusions.

2. Earlier empirical and theoretical contributions

Numerous empirical studies, mainly undertaken in the 1990s, have analyzed the MNEs choice between greenfield FDI and acquisition. The technological characteristics of the foreign investor emerge as an important determinant of the entry mode. The R&D intensity of the investing firm appears to be negatively related to the probability of an acquisition as compared to a greenfield FDI (Andersson and Svensson (1994); Brouthres and Brouthres (2000); Harzing (2002)). This finding is explained as the result of two factors. First, greenfield entry reduces the chance of technology dissemination in the foreign country. Second, it may be more difficult to exploit abroad a superior technology implanting it in an existing organisation than by creating a new one. The results are more mixed with respect to the impact of the relative technological capability of the investor, versus the target firm. Kogut and Chang (1991) analysed Japanese investments in the US at the industry level and found that Japanese acquisitions in the US are insensitive to the difference in R&D expenditure in Japan and the US.[2] On the other hand, Anand and Delios (2002), considering 2175 entries by British, German and Japanese investors in the US, found that the probability of entry via acquisition was positively affected by the difference in R&D expenditure in the host and home country, indicating acquisitions motivated by technology sourcing.

As to the effect of home and host country characteristics, there is substantial agreement that the cultural distance between home and host country decreases the probability of entry via acquisition as it increases the cost of integrating the two company cultures (Kogut and Singh (1988); Barkema and Vermeulen (1998); Harzing (2002)). However there is no concordance on other aspects. For instance, the level of GDP per capita in the host economy is found to be positively and significantly related to the probability of acquisition (Andersson and Svensson (1994)), but has a negative (although not significant) effect in Barkema and Vermeulen (1998). Nor the size of the host country bears any clear impact. Furthermore, mixed evidence is obtained on the influence of other factors such as foreign experience and the degree of product diversification of the investor[3].

The economic mechanisms associated with international acquisitions are clearly not yet fully explained by the empirical literature, thus theoretical work may help to stimulate new directions for empirical research.

Recently, a few theoretical papers have addressed the issue of Greenfield FDI via cross border acquisition, but in these studies the identity of the acquirer is exogenously determined and the interplay between asymmetries in the technology level of firms and the relative size of countries is not accounted

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[2] Similar results obtained by Anand and Kogut (1997)
[3] As to the effect of foreign experience on the probability of foreing entry via acquisition or greenfield, Andersson and Svensson (1994) found a positive effetc; Barkema and Vermeulen (1998) and Brouthers and Brouthers (2000), found a negative effect and in Hennart and Park (1993) and Kogut and Singh (1988) this variable was not significant.

for. Moreover in most of these studies the acquisition has no effect on the profitability of the foreign investor in the home country, and technology flows only from the foreign firm to the local ones, thus excluding the possibility of technology sourcing FDI. Interesting insights may nevertheless be drawn from this literature.[4]

These analyses predominantly assume only one way FDI. Mattoo, Olarreaga and Saggi (2004) present a North-South model which highlights how the foreign firm's choice between greenfield FDI or acquisition and the local government's ranking of the two modes are affected by the cost of technology transfer within the MNE. Focusing on developed countries, Bjorvatn (2004) studies the effect of economic integration on the profitability of international merger with two countries and three firms. Two producers are located in a foreign country and are "active" as they decide how to expand abroad via export, greenfield investment or acquisition, the third one in the national market is set to be the potential acquisition target. The model shows that economic integration may stimulate international mergers by lowering the reservation price of the target firm and by reducing the *business stealing* effect[5], since the outside firm (the "active" non merging firm) is more likely to choose export instead of greenfield FDI. The impact that greenfield FDI barriers may have on the likelihood of an acquisition is analyzed also by Norbäck and (2002). They consider the case in which a state-owned firm is privatized and sold in an auction in which a local privately owned firm and a foreign MNE compete as buyers. The foreign firm may enter the market via export, greenfield FDI or acquiring the privatized firm. The paper suggests that high greenfield costs and high trade costs do not necessarily induce foreign acquisitions in privatization, since the domestic firm can more easily prevent the foreign firm from becoming a strong local competitor. Hence the willingness to pay of the domestic firm for the state assets is high.[6] The importance of entry threats by greenfield FDI and/or export is also highlighted be Eicher and Kang (2005). Their three stage entry model based on Bertrand's conjectures shows that very large markets are likely to attract acquisitions due to large monopoly benefits, when entry threats by greenfield FDI and/or export can be used.

Only a few studies consider two-way FDI, and the studies are framed in a symmetric context, where the identity of the acquirer is undetermined. Horn and Persson (2001) analyze how the incentive to form either domestic or international mergers is influenced by trade costs. They consider the choice whether to export abroad or to acquire a foreign firm in a symmetric model with four firms. Greenfield

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[4] Recently, models based on new trade theory and firm heterogeneity have advanced further to explain the choice between export, Greenfield FDI and acquisition in foreign markets. See Nocke and Yeaple (2005) for more on this.
[5] This effect is due to firms not participating to the merger expanding their production and therefore stealing business from merging partners.
[6] See also Görg (2000). He analyses whether a technologically advantaged firm, which has decided to undertake an FDI in a foreign market, will enter via greenfield investment or acquisition, and in the latter case whether to acquire the local low technology or the high technology firm. The analysis shows that under most conditions the take-over of the existing indigenous high technology firm is the preferred market entry mode.

FDI is not allowed for, thus making the model less relevant for most service sectors. They find that high trade barriers induce domestic rather than international mergers contrary to the tariff jumping argument.[7]

Several important questions thus remain unanswered: how to determine endogenously the identity of the acquirer; what are the roles of technological and country size asymmetries and what is the effect of greenfield FDI liberalisation and ICT improvements on the equilibrium mode of entry.

3. The model

The model consists of two countries (I and II) and two firms, (1 and 2), that produce a homogeneous service or good in country I and II respectively. Countries may vary in size and firms may differ as to cost reducing exogenous technology as in Fosfuri and Motta (1999).[8] Firms determine the mode of foreign entry, choosing among three possible strategies: no expansion abroad (*N*), greenfield FDI (*G*) or full acquisition[9] of the foreign firm (*Ai*), *i*=1,2 where *i* represents the acquirer.

We assume that the total technology pool is divided between the two firms in proportion σ for firm 1 and $(1-\sigma)$ for firm 2 with $\sigma \in [0,1]$. Unit variable costs in the <u>home market</u> for firm 1 and 2, respectively under the strategies *N* and *G*, are simply:

$$c_{1,I} = c_0 - \sigma \tag{1}$$

$$c_{2,II} = c_0 - (1-\sigma) \tag{2}$$

where the parameter $c_0 \geq 1$ guarantees non-negative costs. We assume that there is no involuntary dissemination of knowledge (no external spillovers) when the two firms are under separate ownership.[10] The unit variable costs of production <u>abroad</u> under G are given by:

$$c_{1,II} = c_0 - \tau\sigma \tag{3}$$

$$c_{2,I} = c_0 - \tau(1-\sigma) \tag{4}$$

showing that cross border internal know how transfer from parent to subsidiary is costly. The costs of internal knowledge transfer are inversely related to the parameter $\tau \in [0,1]$. It follows that if $\tau < 1$, the subsidiary is always less efficient than its parent. If a firm chooses *G*, it also faces a fixed set up cost *F* in the foreign market.

If firm 1 makes the acquisition, unit variable production cost in country I and II respectively are:

$$c_{1,I} = c_0 - \left\lfloor \max \ \{\sigma, \tau(1-\sigma)\} \right\rfloor \tag{5}$$

$$c_{1,II} = c_0 - \left\lfloor \max \ \{\tau\sigma, (1-\sigma)\} \right\rfloor \tag{6}$$

while if firm 2 makes the acquisition we have:

$$c_{2,II} = c_0 - \left\lfloor \max \ \{(1-\sigma), \tau\sigma\} \right\rfloor \tag{7}$$

$$c_{2,I} = c_0 - \left\lfloor \max \ \{\sigma, \tau(1-\sigma)\} \right\rfloor \tag{8}$$

Equations (5)-(8) rest on the assumption of a *best practise effect* (the term in the square brackets). That is to say, we assume that the new company adopts in each market what is the most efficient technology between that available in-house and that available in the target company. However, if foreign technology is implemented in a firm, there will be a loss due to technology transfer costs. An acquisition also requires additional acquisition transaction costs which will be discussed in section 5.1.

We assume linear (inverse) demand functions:

$$p_I(q_{1,I} + q_{2,I}) = as - Q_I \tag{9}$$

$$p_{II}(q_{1,II} + q_{2,II}) = a(1-s) - Q_{II} \tag{10}$$

where $Q_J = q_{1,J} + q_{2,J}$ for J=I,II. The parameter a represents the joint size of the two markets while the parameter $s \in (0,1)$ indicates the share of a accounted for by country I, and (1-s) the share by country II.

The profits of the two firms differ depending on the strategy combinations (λ_1, λ_2) with $\lambda_i \in \Lambda_i = \{N, G, Ai\}$. Six equilibrium strategies may arise: (NN) where each firm produce and sell only in the home market; (GN) $((NG))$ where firm 1 (2) conducts a greenfield FDI while the rival operates only in the domestic market; (GG) where we have a MNE duopoly; $(A1,0)$ where firm 1 acquires firm 2, and finally $(0, A2)$ where firm 2 acquires firm 1. The profit functions are reported in Appendix I.

We identify the optimal foreign entry mode by solving a two stage game. In the first stage, firms decide upon the mode of entry. This is done in two steps. We first find the non-cooperative solution to a constrained game with strategy space $\widetilde{\Lambda}_i = \{N, G\}$ ignoring acquisition as a strategy. We call this the *status quo game*. The solution to this game defines the threat point (alternative profits if no agreement) in the cooperative acquisition game, where we identify whether there will be an acquisition and who buys whom. The cooperative game is solved using the Nash fixed-threat bargaining equilibrium concept. In the second stage, firms set their profit maximizing level of output. As usual, the game is solved by backwards induction.

4. The status quo game

We first describe the non-cooperative status quo game with the constrained strategy space $\widetilde{\Lambda}_i = \{N, G\}$. Firm specific equilibrium profit functions for the four possible strategy combinations are reported in

Appendix II. By comparing equilibrium profits under alternative strategy combinations, we can identify the condition for a dominant strategy:

$$\frac{\left[(1-s)a - c_0 + 2\tau\sigma - (1-\sigma)\right]^2}{9} > F \tag{11}$$

$$\frac{\left[sa - c_0 + 2\tau(1-\sigma) - \sigma\right]^2}{9} > F \tag{12}$$

If (11) is satisfied, G is the dominant strategy for firm 1. Otherwise, N will be the dominant strategy.[11] Similarly, if (12) holds, G will be the dominant strategy for firm 2.[12] The probability that (11) (alternatively(12)) holds is decreasing (increasing) in s (the relative size of market I):

$$\frac{\partial LHS(11)}{\partial s} = -a\frac{2\left[(1-s)a - c_0 + 2\tau\sigma - (1-\sigma)\right]}{9} < 0 \tag{13}$$

$$\frac{\partial LHS(12)}{\partial s} = a\frac{2\left[sa - c_0 + 2\tau(1-\sigma) - \sigma\right]}{9} > 0 \tag{14}$$

This finding reminds us that a large host market (ceteris paribus) is an important attractor for inward greenfield FDI since it implies higher variable profits, to compensate for the additional fixed plant costs (F). Similarly, a larger total market (a) gives stronger incentives for greenfield FDI.

The probability that (11) (alternatively(12)) holds is increasing (decreasing) in σ (the relative technology level of firm 1):

$$\frac{\partial LHS(11)}{\partial \sigma} = (2\tau + 1)\frac{2\left[(1-s)a - c_0 + 2\tau\sigma - (1-\sigma)\right]}{9} > 0 \tag{15}$$

$$\frac{\partial LHS(12)}{\partial \sigma} = -(2\tau + 1)\frac{2\left[sa - c_0 + 2\tau(1-\sigma) - \sigma\right]}{9} < 0 \tag{16}$$

So the technologically leading firm is more likely to expand abroad than the weaker competitor. Its variable cost advantage implies that by producing abroad it will enjoy –ceteris paribus- higher variable profits than its competitor. The advantage of the leading firm is greater the lower the cost of cross border technology transfer (the higher τ) since low internal technology transfer costs imply that the leading firm will benefit more in the foreign market from its technological leadership.

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[11] If (11) holds, we have that: $\hat{\pi}_1^{GG} > \hat{\pi}_1^{NG}$ and $\hat{\pi}_1^{GN} > \hat{\pi}_1^{NN}$

[12] If (12) holds, we have that: $\hat{\pi}_2^{NG} > \hat{\pi}_2^{NN}$ and $\hat{\pi}_2^{GG} > \hat{\pi}_2^{GN}$

The Nash equilibrium strategy configuration in the status quo game ($\widetilde{\Lambda}^*$) clearly depends on the value of the parameters. Fig 1a and 1b illustrates how $\widetilde{\Lambda}^*$ depends on the value of s and σ, where the fixed investment cost (F) is set to 1.5 and 0.5 in Fig 1a and 1b respectively.[13]
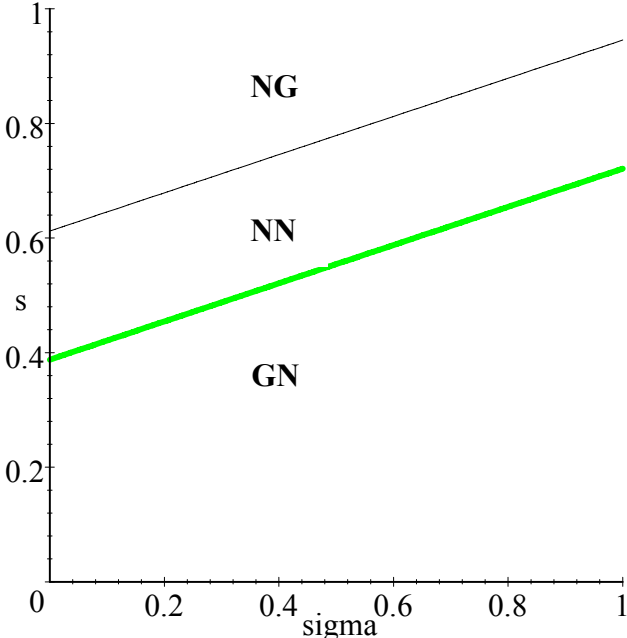
Figure 1a: Regions defining equilibrium outcomes in the (s, σ) plane with F=1.5
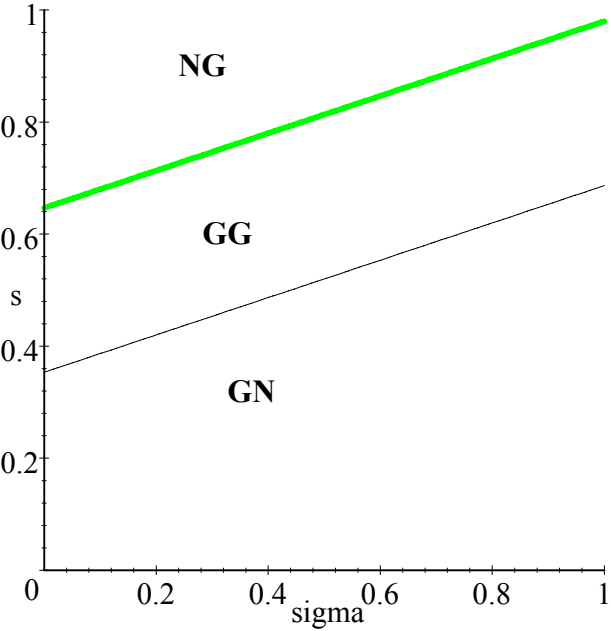
Figure 1b: Regions defining equilibrium outcomes in the (s, σ) plane with F=0.5

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[13] In these figures, a=3, τ=0.5 and $c_0 = 1$.

The thick line in figures 1a and 1b represents condition (11)[14] with strict equality, whereas the thin line represents condition (12)[15]. In the case where firm 1 has a technology advantage and its foreign market is relatively large (south-east in the diagrams), it will chose G, while firm 2 will chose N. By symmetry, the opposite strategies are chosen in the north-west corner of the diagrams. When F is reduced, these two indifference lines shift upwards and downwards respectively, and when they shift positions, the equilibrium changes from NN in Figure 1a to GG in Figure 1b. Since the two indifference lines are always parallel, no parameter combination allows both GG and NN to be equilibrium within the feasible (s, σ) space. If we reduce knowledge transfer costs (increase τ), the indifference lines become steeper, as illustrated in Figure 2. Hence, an increase in τ contributes to a larger area where $\widetilde{\Lambda}^* = GG$.
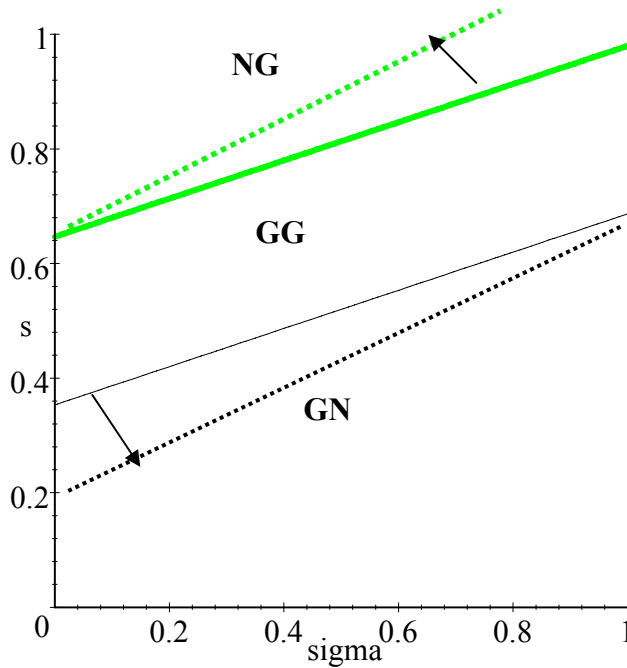
Figure 2: Changes in the regions defining equilibrium outcomes in the (s, σ) plane with an increase in τ

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[14] Eq.(11) can be rearranged as: $s < \dfrac{a - c_0 - 1 - 3\sqrt{F}}{a} + \dfrac{(2\tau + 1)}{a}\sigma$

[15] Eq.(12) can be rearranged as: $s > \dfrac{c_0 - 2\tau + 3\sqrt{F}}{a} + \dfrac{(2\tau + 1)}{a}\sigma$

5. Bargaining for an acquisition

5.1 The equilibrium bid

We first identify the equilibrium offer or bid (B_i) when firm i wants to acquire firm j. The problem can be solve as a cooperative game[16], using the Nash fixed – threat bargaining model (see Friedman 1990; Petit, 1990). The players bargain on how to divide the profits associated with the acquisition. The status quo equilibrium $\widetilde{\Lambda}^*$ provides the payoffs obtained by the players if they fail to make an agreement, called the disagreement outcomes or *status quo profits* (π_i^d, π_j^d).

The profit of the acquirer (firm i) is given by:

$$\Pi_i^{Ai} = V_i^{Ai} - T_i - B_i \tag{17}$$

where V_i^{Ai} represents the gross profits of the global monopolist (see Appendix I). Notice that $V_i^{Ai} = V_j^{Aj} = V^A$ since both firms face exactly the same markets and technology as a global monopolist. Due to the *best practise effect*, unit cost in each market does not depend on which firm makes the acquisition. Consequently, from here on we drop the firm specific notation for V^A. To calculate the net profit of the acquirer, we must subtract T_i which represents transaction costs associated with the deal, as well as the acquisition price B_i paid to j. *Transaction costs* associated with an acquisition (T_i) arise due to legal fees, consulting fees and corporate finance costs, as well as costs related to the integration of the two work forces and to the managerial resources to be devoted to the acquisition. We model the transaction costs as a linear function of the size of the deal, which in turn is a function of the target firm capitalisation. This is equivalent to the target firm status quo profits:

$$T_i = \gamma \pi_j^d \qquad \text{where} \qquad 1 > \gamma > 0 \tag{18}$$

The profits of the target firm are equal to the acquisition price:

$$\Pi_j^{Ai} = B_i \tag{19}$$

The *equilibrium bid* B_i is given by the Nash bargaining solution of the cooperative game described in Appendix III. With constant marginal utility of profits, the bargaining solution provides the standard result that excess profits from the acquisition (i.e. the overall gain from cooperation) is *evenly divided* between the two players. Thus, profits for the target firm becomes

$$B_i = \Pi_j^{Ai} = \pi_j^d + \frac{1}{2}\left\{(V^A - \gamma \pi_j^d) - (\pi_i^d + \pi_j^d)\right\} = \frac{1}{2}\left[V^A + (1 - \gamma)\pi_j^d - \pi_i^d\right] \tag{20}$$

where the term in curly brackets represents the overall gain from cooperation. The acquisition price paid for the target firm reflects what firm j profits could have become if the acquisition did not take place.

As to the acquirer, firm i will earn the following profits:

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[16] This way of dealing with the problem is in line with the empirical finding that the overwhelming number of M&A both domestic and international are friendly rather than hostile takeovers.

$$\Pi_i^{Ai} = \pi_i^d + \frac{1}{2}\left\{(V^A - \gamma\pi_j^d) - (\pi_i^d + \pi_j^d)\right\} = \frac{1}{2}\left[V^A - (1+\gamma)\pi_j^d + \pi_i^d\right] \tag{21}$$

which represents the status quo profit plus the bargaining share of firm i. The profits from acquisition for both firms are increasing in the global monopolist profits, increasing in own status quo profits, but decreasing in the rival's status quo profits.

5.2 Condition for a cross border acquisition to take place

An acquisition equilibrium requires that both firms gain from it as compared to the status quo equilibrium profit, that is $\Pi_i^{Ai} > \pi_i^d$ and $\Pi_j^{Ai} > \pi_j^d$. We find, using (20) and (21), that both these conditions are satisfied iff:

$$V^A > (1+\gamma)\pi_j^d + \pi_i^d \tag{22}$$

If there are excess profits from the acquisition made by firm i, the acquisition will take place since both firms will benefit from it. [17] This leads us to the following proposition:

Proposition 1:

An acquisition will take place if the gross profit from the acquisition (V^A) is larger than the sum of the two firms' status quo profits <u>plus</u> the transaction costs.

5.3 Condition for being the acquirer

We know that firm i would like to be the acquirer if its profit is higher than the profit it receives from being the target, that is if $\Pi_i^{Ai} > \Pi_i^{Aj}$, which implies from (20) and (21) that:

$$\frac{1}{2}\left[V^A - (1+\gamma)\pi_j^d + \pi_i^d\right] > \frac{1}{2}\left[V^A + (1-\gamma)\pi_i^d - \pi_j^d\right] \tag{23}$$

which can be reduced to:

$$\pi_i^d > \pi_j^d \tag{24}$$

The same condition applies to $\Pi_j^{Ai} > \Pi_j^{Aj}$, so we have that Ai is the optimal entry mode ($\Lambda^* = Ai$) iff $\pi_i^d > \pi_j^d$. We can thus state:

Proposition 2:

It is always the firm with the highest status quo profit that becomes the acquirer, regardless of the size of $1 > \gamma > 0$.

To sum up, an acquisition brings the following benefits and costs compared to greenfield entry:

   (i) Market power effect

   (ii) Best practice effect (providing lower unit variable cost.)

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[17] This is the traditional criterion for merger incentive in the IO literature, which however overlooks transaction costs. See e.g. Horn and Persson (2001).

(iii) Savings on fixed costs, if the status quo equilibrium implies greenfield FDI.

However a cross border acquisition does also imply

(iv) additional transaction costs.

The strength of these effects will depend on the extent of market size asymmetries (s), technological asymmetries (σ) and on the status quo equilibrium (as summarized in Table 1).

Table 1
Benefits from an acquisition in different scenarios (a)

	STATUS QUO EQUILIBRIUM ($\widetilde{\Lambda}^{*}$)		
	NN	**NG (GN)** (b)	**GG**
BEST PRACTICE EFFECT			
1. *(s=0.5, σ=0.5)*	0		+
2. *(s>0.5, σ=0.5)*	0	+	++
3. *(s=0.5, σ>0.5)*	++ (c)	+ (d)	++
4. *(s<0.5, σ>0.5)* (e)	++ (c)	+ (d)	++
MARKET POWER EFFECT			
1. *(s=0.5, σ=0.5)*	0		+
2. *(s>0.5, σ=0.5)*	0	+	++
3. *(s=0.5, σ>0.5)*	0	+	++
4. *(s<0.5, σ>0.5* (e)	0	+	++
SAVINGS ON FIXED COSTS			
1. *(s=0.5, σ=0.5)*	0		+
2. *(s>0.5, σ=0.5)*	0	+	++
3. *(s=0.5, σ>0.5)*	0	+	++
4. *(s<0.5, σ>0.5)* (e)	0	+	++

Note: (a) ++ indicates stronger positive effect than +. The strength of the effect is
comparable only within the same row.
(b) NG in case 2; GN in case 3 and 4.
(c) Iff $\tau\sigma > (1-\sigma)$. Otherwise: 0
(d) Iff $\tau\sigma \neq (1-\sigma)$. Otherwise: 0
(e) For (s>0.5, σ>0.5) same results as 4.

6. Equilibrium solution to the full game

We initially present analytical results and then revert to simulations. In Figures 4-7, simulation results are presented for the different combinations of firm characteristics in the (s,σ) space. In the upper half of each matrix, country I is the largest, while it is the smallest in the lower half. We focus our attention to the range $\sigma \in [0.5,1)$ where firm 1 is a technological leader, since this region represents all relevant combinations of technologies and market sizes. In the figures, the left hand matrix illustrates simulation results for the status quo game, while the right hand matrix provides the solution to the full game. In the following discussion, we start out with the simplest case where firms and countries are symmetric, and then add asymmetries as we go along.

6.1 Full symmetry (s=0.5, σ=0.5)

In the case of both market size and technology symmetry, the left hand side of conditions (11) and (12) become identical, thus $\widetilde{\Lambda}^* = (NN)$ and $\widetilde{\Lambda}^* = (GG)$ are the only feasible solutions. It is not possible to identify a potential acquirer since $\pi_i^d = \pi_j^d$. An acquisition generates a monopoly in both countries and since the best practice technology will always be $\sigma = 0.5$ we have that:

$$V^A = 2\pi_i^{NN} \tag{25}$$

If $\widetilde{\Lambda}^* = (NN)$, the profit of the acquirer is given by:

$$\Pi_i^{Ai} = \frac{1}{2}\left[(V^A - (1+\gamma)\pi_j^{NN} + \pi_i^{NN}\right] = (1 - 0.5\gamma)\pi_i^{NN} < \pi_i^{NN} \tag{26}$$

Thus under full symmetry, profits from the acquisition will always be lower than profits from the status-quo *NN* equilibrium. In such scenario foreign entry by acquisition is not feasible as none of the potential benefits from an acquisition (best practise, increased market power, saving on fixed cost) will be at work to compensate for transaction costs (see Table 1). However, this does not have to be the case if $\widetilde{\Lambda}^* = (GG)$, due to technology transfer costs, stronger competition, and *F* (plant fixed cost). If $\widetilde{\Lambda}^* = (GG)$, the condition for a cross border acquisition to take place (Eq. (22)) becomes:

$$\gamma < \frac{2(\pi_i^{NN} - \pi_i^{GG})}{\pi_i^{GG}} \tag{27}$$

implying that an acquisition is feasible in equilibrium under full symmetry since $\pi_i^{NN} > \pi_i^{GG}$ for all parameter values. Note that $\widetilde{\Lambda}^* = (GG)$ may materialize even though both firms get higher profits from *NN*, as we may face a prisoner's dilemma situation. It follows that:

Proposition 3:

With full symmetry, an acquisition will never be the optimal entry mode if $\widetilde{\Lambda}^* = (NN)$. However, if $\widetilde{\Lambda}^* = (GG)$ an acquisition may arise as the solution of the full game.

In figure 3, we have depicted the combinations of τ and F, for which $\widetilde{\Lambda}^* = (GG)$ or $\widetilde{\Lambda}^* = (NN)$ in the fully symmetric case.
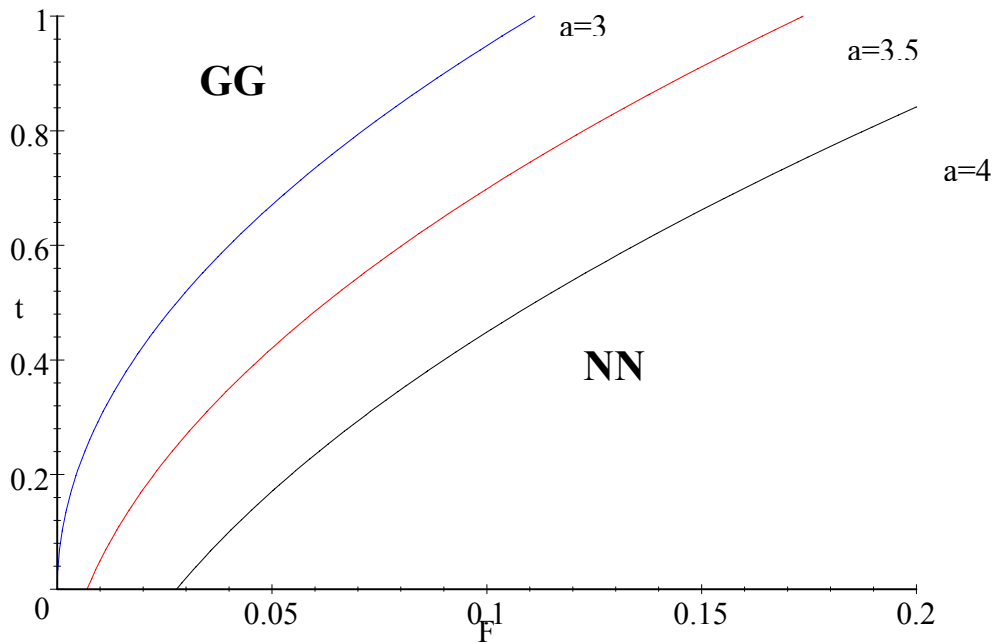
Figure 3: Changes in the regions defining equilibrium outcomes in the (τ, F) plane with an increase in a

Clearly, if τ is large and F is small, *GG* will be preferred to *NN*, and the larger a is, the wider is the range of (τ, F) combinations supporting $\widetilde{\Lambda}^* = (GG)$, since a larger overall market size reduces the share of fixed costs (F) for each unit produced abroad. Thus, the indifference line shifts towards southeast as a increases.

6.2 Market size asymmetry (s>0.5, σ=0.5)

Here, the incentive to invest abroad is greater for firm 2 which is based in the small country ($LHS\ Eq.(11) < LHS\ Eq.(12)$). Thus we may have $\widetilde{\Lambda}^* = (NN)$ or $\widetilde{\Lambda}^* = (GG)$, or $\widetilde{\Lambda}^* = (NG)$. But $\widetilde{\Lambda}^* = (GN)$ can be ruled out, as the smaller size of country II discourages firm 1 from entering it. If the parameters values are such that $\widetilde{\Lambda}^* = (NN)$, Firm 2 from the small country has the lowest profit as

$\sigma > 0.5$. This will also be the case if $\widetilde{\Lambda}^* = (GG)$ when $\tau < 1$, since firm 2 will have a cost disadvantage in the large market due to the cost of internal technology transfer.[18] Simulation results show that if $\widetilde{\Lambda}^* = (NG)$ firm 1 will generally have the highest profit (see Figures 4a-5a, the upper part of the first column identified with a thick frame).[19]

Figure 4a: The status quo game

Positive values: $\pi_1 > \pi_2$
Equilibrium strategies: NG NN GN GG

s \ σ	0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9
0.9	1.39	1.62	1.84	2.07	2.29	2.52	4.62	4.73	4.84
0.85	1.35	1.57	1.78	2.00	3.90	4.00	4.10	4.20	4.31
0.8	1.28	1.49	3.20	3.30	3.40	3.50	3.60	3.70	3.80
0.75	2.50	2.60	2.70	2.80	2.90	3.00	3.10	3.20	3.30
0.7	2.00	2.10	2.20	2.30	2.40	2.50	2.60	2.70	2.80
0.65	1.50	1.60	1.70	1.80	1.90	2.00	2.10	2.20	2.30
0.6	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80
0.55	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30
0.5	-0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
0.45	-0.50	-0.40	-0.30	-0.20	-0.10	-0.00	0.10	0.20	0.30
0.4	-1.00	-0.90	-0.80	-0.70	-0.60	-0.50	-0.40	0.56	0.74
0.35	-1.50	-1.40	-1.30	-1.20	-1.10	0.05	0.23	0.42	0.60
0.3	-2.00	-1.90	-1.80	-0.47	-0.27	-0.08	0.11	0.31	0.50
0.25	-2.50	-0.98	-0.78	-0.58	-0.38	-0.17	0.03	0.23	0.43
0.2	-1.28	-1.07	-0.86	-0.66	-0.45	-0.24	-0.03	0.18	0.39
0.15	-1.35	-1.14	-0.92	-0.70	-0.49	-0.27	-0.05	0.16	0.38
0.1	-1.39	-1.17	-0.95	-0.72	-0.50	-0.27	-0.05	0.18	0.41

Figure 4b: The full game

Positive values: Acquisition equilibrium
Equilibrium strategies: A1 A2 NO

s \ σ	0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9
0.9	1.46	1.55	1.64	1.71	1.78	1.85	0.00	0.00	0.00
0.85	1.44	1.52	1.60	1.68	0.01	0.02	0.02	0.03	0.04
0.8	1.40	1.48	0.00	0.02	0.03	0.05	0.07	0.08	0.10
0.75	-0.03	-0.02	-0.01	0.02	0.05	0.08	0.10	0.13	0.16
0.7	-0.05	-0.05	-0.03	0.01	0.05	0.09	0.13	0.17	0.21
0.65	-0.08	-0.07	-0.05	0.00	0.05	0.11	0.16	0.21	0.26
0.6	-0.11	-0.11	-0.08	-0.02	0.05	0.11	0.18	0.24	0.30
0.55	-0.15	-0.14	-0.12	-0.04	0.04	0.11	0.19	0.26	0.34
0.5	-0.20	-0.19	-0.16	-0.07	0.02	0.11	0.19	0.28	0.37
0.45	-0.15	-0.16	-0.15	-0.07	0.01	0.09	0.19	0.29	0.39
0.4	-0.11	-0.12	-0.10	-0.01	0.08	0.18	0.27	1.27	1.29
0.35	-0.08	-0.08	-0.06	0.04	0.15	1.23	1.28	1.31	1.34
0.3	-0.05	-0.06	-0.03	1.23	1.26	1.28	1.31	1.35	1.39
0.25	-0.03	1.29	1.23	1.27	1.30	1.33	1.35	1.40	1.44
0.2	1.40	1.32	1.26	1.30	1.34	1.37	1.39	1.44	1.49
0.15	1.44	1.34	1.28	1.33	1.37	1.41	1.43	1.49	1.54
0.1	1.46	1.36	1.30	1.35	1.40	1.44	1.47	1.53	1.59

Parameter values: *a=5*   *F=1*   *τ=0.7*   *γ=0.2*

Figure 5a: The status quo game

Positive values: $\pi_1 > \pi_2$
Equilibrium strategies: NG NN GN GG

s \ σ	0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9
0.9	0.88	1.37	1.86	2.35	2.84	3.33	3.82	4.33	4.84
0.85	0.64	1.12	1.59	2.21	2.71	3.22	3.72	4.22	4.72
0.8	0.60	1.10	1.61	2.11	2.61	3.12	3.62	4.12	4.62
0.75	0.50	1.00	1.51	2.01	2.51	3.02	3.52	4.02	4.52
0.7	0.40	0.90	1.41	1.91	2.41	2.92	3.42	3.92	4.42
0.65	0.30	0.80	1.31	1.81	2.31	2.82	3.32	3.82	4.32
0.6	0.20	0.70	1.21	1.71	2.21	2.72	3.22	3.72	4.22
0.55	0.10	0.60	1.11	1.61	2.11	2.62	3.12	3.62	4.12
0.5	0.00	0.50	1.01	1.51	2.01	2.52	3.02	3.52	4.02
0.45	-0.10	0.40	0.91	1.41	1.91	2.42	2.92	3.42	3.92
0.4	-0.20	0.30	0.81	1.31	1.81	2.32	2.82	3.32	3.82
0.35	-0.30	0.20	0.71	1.21	1.71	2.22	2.72	3.22	3.72
0.3	-0.40	0.10	0.61	1.11	1.61	2.12	2.62	3.12	3.62
0.25	-0.50	0.00	0.51	1.01	1.51	2.02	2.52	3.32	3.77
0.2	-0.60	-0.10	0.41	1.10	1.56	2.02	2.48	2.94	3.40
0.15	-0.64	-0.17	0.31	0.78	1.26	1.74	2.21	2.69	3.17
0.1	-0.88	-0.39	0.10	0.59	1.09	1.58	2.07	2.56	3.06

Figure 5b: The full game

Positive values: Acquisition equilibrium
Equilibrium strategies: A1 A2 NO

s \ σ	0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9
0.9	-0.22	0.02	0.27	0.52	0.76	1.00	1.22	1.43	1.61
0.85	-0.23	0.01	0.25	0.65	0.87	1.08	1.27	1.45	1.61
0.8	0.01	0.22	0.43	0.66	0.89	1.09	1.29	1.46	1.63
0.75	0.06	0.24	0.43	0.67	0.89	1.10	1.29	1.47	1.63
0.7	0.09	0.25	0.43	0.67	0.89	1.10	1.29	1.47	1.63
0.65	0.11	0.25	0.41	0.65	0.87	1.08	1.28	1.45	1.61
0.6	0.12	0.24	0.39	0.62	0.85	1.06	1.25	1.43	1.59
0.55	0.12	0.22	0.35	0.59	0.81	1.02	1.21	1.39	1.55
0.5	0.11	0.19	0.30	0.54	0.76	0.97	1.16	1.34	1.50
0.45	0.12	0.14	0.24	0.48	0.70	0.91	1.10	1.28	1.44
0.4	0.12	0.09	0.17	0.41	0.63	0.84	1.03	1.21	1.37
0.35	0.11	0.02	0.09	0.32	0.55	0.76	0.95	1.13	1.29
0.3	0.09	-0.05	-0.01	0.23	0.46	0.66	0.86	1.04	1.20
0.25	0.06	-0.14	-0.11	0.13	0.35	0.56	0.75	0.59	0.76
0.2	0.01	-0.21	-0.23	-0.23	-0.01	0.20	0.40	0.60	0.78
0.15	-0.23	-0.47	-0.54	-0.30	-0.06	0.16	0.38	0.59	0.79
0.1	-0.22	-0.48	-0.62	-0.37	-0.12	0.12	0.36	0.58	0.80

Parameter values: *a=10*   *F=0.1*   *τ=0.7*   *γ=0.35*

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[18] Note that the market size asymmetry influences the relative profitability of the two producers in GG only when internal technology transfer is costly. With s>0.5 and $\sigma=0.5$, with $\tau=1$ $\pi_1^{GG} = \pi_2^{GG}$

Turning to the solution of the full game, as in the completely symmetric case, if $\widetilde{\Lambda}^* = (NN)$ no acquisition may take place because there will be no best practice, market power, or fixed cost saving effects[20]. If $\widetilde{\Lambda}^* = (GG)$, an acquisition may take place, but only $\Lambda^* = (A1)$ is feasible since we know from above that $\pi_1^{GG} > \pi_2^{GG}$. The results are confirmed by simulations in table 4-5. It follows that:

Proposition 4:

Market asymmetry alone (i.e. when $\sigma = 0.5$) is not sufficient to stimulate a cross border acquisition when the threat is represented by two national monopolies. If the status quo equilibrium is GG, an acquisition may take place and the acquirer will be the firm from the large country.

6.3 Technological asymmetry (s=0.5, σ>0.5)

It is now necessary to take into consideration the best practice effect under acquisition. Firm 1, which is the technology leader, has a larger incentive to invest abroad due to lower variable costs. The feasible status quo equilibria are thus NN, GG and GN, while NG can be ruled out since $LHS\ Eq.(11) > LHS\ Eq.(12)$. Here, the acquisition gross profit can be defined as the sum of the national monopoly profits plus the gains through adoption of the best practice (k).

$$V^A = \hat{\pi}_1^{NN} + \hat{\pi}_2^{NN} + k \qquad \text{where} \tag{28}$$

$$k = \begin{cases} 0 & iff \quad \tau\sigma < (1-\sigma) \\ \frac{1}{4}\left\{2\left[(1-s)a - c_0\right]\left[\tau\sigma - (1-\sigma)\right] + (\tau\sigma)^2 - (1-\sigma)^2\right\} > 0 & iff \quad \tau\sigma > (1-\sigma) \end{cases} \tag{29}$$

Thus due to the best practice effect, technology asymmetry alone (i.e. with $s = 0.5$) provides incentives for an acquisition, also when the alternative to an acquisition is represented by two national monopolies. Notice that in the previous section, we found that market size asymmetry alone is not sufficient to trigger an acquisition when $\widetilde{\Lambda}^* = (NN)$, but technology asymmetry is. An acquisition equilibrium will arise if the best practice effect fully compensates for the acquisition transaction costs, which requires from Eq. (22) that $k > \gamma\hat{\pi}_2^{NN}$. Notice that the probability of an acquisition is increasing in the technological asymmetry, since $\dfrac{\partial k}{\partial \sigma} > 0$ (consult the central row with a thick frame in Figures 4b for illustrations).[21]

We can thus state:

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[19] In a few cases (that is if the difference between the size of the two markets is rather small and τ is high), we may have $\hat{\pi}_2^{ng} > \hat{\pi}_1^{ng}$. The likelihood that $\pi_2^{NG} - \pi_1^{NG} > 0$ is increasing in τ and decreasing in s (see Appendix IV).

[20] Due to σ=0.5 $V^A = \pi_1^{NN} + \pi_2^{NN}$ and Eqs (28) and (29) are valid also in this scenario.

[21] Figure 5 shows that an acquisition may take place also when $\widetilde{S}^* = (GG)$ or $\widetilde{S}^* = (GN)$.

Proposition 5: *In the case of technological asymmetry and market size symmetry, an acquisition can take place also when $\widetilde{\Lambda}^* = (NN)$.*

As to the identity of the acquirer, we can state the following[22] (proof in Appendix V):

Proposition 6:

In the case of technological asymmetry and market size symmetry, the acquirer will always be the technology leader.

6.4 Technology and market size asymmetry I: ($s < 0.5, \sigma > 0.5$ - leader from the small country)

We now allow for both market size and technology asymmetries. Since there are no explicit solutions to the equilibrium strategy configurations, we relate our discussion to numerical simulations. When $s<0.5$ and $\sigma>0.5$, we restrict ourselves to the lower half of the simulation tables. Since firm 1 now is the technological leader based in the small country, its incentive to choose greenfield FDI is larger than for firm 2 ($LHS\ Eq.(11) > LHS\ Eq.(12)$), both due to the large foreign market size and the technological advantage. It follows that the possible status quo equilibrium are NN, GG, or GN, while NG can be ruled out.

Figure 6a: Equilibrium strategies when *F*=2.5

The status quo game

Positive values: $\pi_1 > \pi_2$

Equilibrium strategies: | NG | NN | GN | GG |

	0.9	4.00	4.10	4.20	4.31	4.41	4.52	4.62	4.73	4.84
	0.85	3.50	3.60	3.70	3.80	3.90	4.00	4.10	4.20	4.31
	0.8	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80
	0.75	2.50	2.60	2.70	2.80	2.90	3.00	3.10	3.20	3.30
	0.7	2.00	2.10	2.20	2.30	2.40	2.50	2.60	2.70	2.80
	0.65	1.50	1.60	1.70	1.80	1.90	2.00	2.10	2.20	2.30
	0.6	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80
	0.55	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30
s	0.5	-0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
	0.45	-0.50	-0.40	-0.30	-0.20	-0.10	-0.00	0.10	0.20	0.30
	0.4	-1.00	-0.90	-0.80	-0.70	-0.60	-0.50	-0.40	-0.30	-0.20
	0.35	-1.50	-1.40	-1.30	-1.20	-1.10	-1.00	-0.90	-0.80	-0.70
	0.3	-2.00	-1.90	-1.80	-1.70	-1.60	-1.50	-1.40	-1.30	-1.20
	0.25	-2.50	-2.40	-2.30	-2.20	-2.10	-2.00	-1.90	-1.80	-1.70
	0.2	-3.00	-2.90	-2.80	-2.70	-2.60	-2.50	-2.40	-2.30	-2.20
	0.15	-3.50	-3.40	-3.30	-3.20	-3.10	-3.00	-2.90	-2.80	-2.70
	0.1	-4.00	-3.90	-3.80	-3.70	-3.60	-3.50	-3.40	-3.30	-3.20
		0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9

σ

The full game

Positive values: Acquisition equilibrium

Equilibrium strategies: | A1 | A2 | NO |

	0.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.85	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04
	0.8	-0.01	-0.01	0.00	0.02	0.03	0.05	0.07	0.08	0.10
	0.75	-0.03	-0.02	-0.01	0.02	0.05	0.08	0.10	0.13	0.16
	0.7	-0.05	-0.05	-0.03	0.01	0.05	0.09	0.13	0.17	0.21
	0.65	-0.08	-0.07	-0.05	0.00	0.05	0.11	0.16	0.21	0.26
	0.6	-0.11	-0.11	-0.08	-0.02	0.05	0.11	0.18	0.24	0.30
	0.55	-0.15	-0.14	-0.12	-0.04	0.04	0.11	0.19	0.26	0.34
s	0.5	-0.20	-0.19	-0.16	-0.07	0.02	0.11	0.19	0.28	0.37
	0.45	-0.15	-0.16	-0.15	-0.07	0.01	0.09	0.19	0.29	0.39
	0.4	-0.11	-0.12	-0.10	-0.01	0.08	0.18	0.27	0.36	0.45
	0.35	-0.08	-0.08	-0.06	0.04	0.15	0.25	0.35	0.46	0.56
	0.3	-0.05	-0.06	-0.03	0.09	0.20	0.32	0.43	0.55	0.66
	0.25	-0.03	-0.03	0.00	0.13	0.25	0.38	0.51	0.63	0.76
	0.2	-0.01	-0.02	0.02	0.16	0.30	0.44	0.58	0.71	0.85
	0.15	0.00	0.00	0.03	0.18	0.34	0.49	0.64	0.79	0.94
	0.1	0.00	0.00	0.04	0.20	0.37	0.53	0.69	0.86	1.02
		0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9

σ

Parameter values: *a=5*   *F=2.5*   *τ=0.7*   *γ=0.2*

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[22] This finding is also illustrated by the results in Figures 4-6.

Figure 6b: Equilibrium strategies when *F*=1

s \ σ	0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9
0.9	1.39	1.62	1.84	2.07	2.29	2.52	4.62	4.73	4.84
0.85	1.35	1.57	1.78	2.00	3.90	4.00	4.10	4.20	4.31
0.8	1.28	1.49	3.20	3.30	3.40	3.50	3.60	3.70	3.80
0.75	2.50	2.60	2.70	2.80	2.90	3.00	3.10	3.20	3.30
0.7	2.00	2.10	2.20	2.30	2.40	2.50	2.60	2.70	2.80
0.65	1.50	1.60	1.70	1.80	1.90	2.00	2.10	2.20	2.30
0.6	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80
0.55	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30
0.5	-0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
0.45	-0.50	-0.40	-0.30	-0.20	-0.10	-0.00	0.10	0.20	0.30
0.4	-1.00	-0.90	-0.80	-0.70	-0.60	-0.50	-0.40	0.56	0.74
0.35	-1.50	-1.40	-1.30	-1.20	-1.10	0.05	0.23	0.42	0.60
0.3	-2.00	-1.90	-1.80	-0.47	-0.27	-0.08	0.11	0.31	0.50
0.25	-2.50	-0.98	-0.78	-0.58	-0.38	-0.17	0.03	0.23	0.43
0.2	-1.28	-1.07	-0.86	-0.66	-0.45	-0.24	-0.03	0.18	0.39
0.15	-1.35	-1.14	-0.92	-0.70	-0.49	-0.27	-0.05	0.16	0.38
0.1	-1.39	-1.17	-0.95	-0.72	-0.50	-0.27	-0.05	0.18	0.41

s \ σ	0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9
0.9	1.46	1.55	1.64	1.71	1.78	1.85	0.00	0.00	0.00
0.85	1.44	1.52	1.60	1.68	0.01	0.02	0.02	0.03	0.04
0.8	1.40	1.48	0.00	0.02	0.03	0.05	0.07	0.08	0.10
0.75	-0.03	-0.02	-0.01	0.02	0.05	0.08	0.10	0.13	0.16
0.7	-0.05	-0.05	-0.03	0.01	0.05	0.09	0.13	0.17	0.21
0.65	-0.08	-0.07	-0.05	0.00	0.05	0.11	0.16	0.21	0.26
0.6	-0.11	-0.11	-0.08	-0.02	0.05	0.11	0.18	0.24	0.30
0.55	-0.15	-0.14	-0.12	-0.04	0.04	0.11	0.19	0.26	0.34
0.5	-0.20	-0.19	-0.16	-0.07	0.02	0.11	0.19	0.28	0.37
0.45	-0.15	-0.16	-0.15	-0.07	0.01	0.09	0.19	0.29	0.39
0.4	-0.11	-0.12	-0.10	-0.01	0.08	0.18	0.27	1.27	1.29
0.35	-0.08	-0.08	-0.06	0.04	0.15	1.23	1.28	1.31	1.34
0.3	-0.05	-0.06	-0.03	1.23	1.26	1.28	1.31	1.35	1.39
0.25	-0.03	1.29	1.23	1.27	1.30	1.33	1.35	1.40	1.44
0.2	1.40	1.32	1.26	1.30	1.34	1.37	1.39	1.44	1.49
0.15	1.44	1.34	1.28	1.33	1.37	1.41	1.43	1.49	1.54
0.1	1.46	1.36	1.30	1.35	1.40	1.44	1.47	1.53	1.59

Parameter values: *a=5* *F=1* *τ=0.7* *γ=0.2*

Figure 6c: Equilibrium strategies when *F*=0.7

s \ σ	0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9
0.9	1.09	1.32	1.54	1.77	1.99	2.22	2.45	2.68	2.91
0.85	1.05	1.27	1.48	1.70	1.91	2.12	2.34	2.55	4.31
0.8	0.98	1.19	1.39	1.60	1.81	2.01	3.60	3.70	3.80
0.75	0.88	1.08	1.27	1.47	2.90	3.00	3.10	3.20	3.30
0.7	0.74	0.93	2.20	2.30	2.40	2.50	2.60	2.70	2.80
0.65	1.50	1.60	1.70	1.80	1.90	2.00	2.10	2.20	2.30
0.6	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80
0.55	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30
0.5	-0.00	0.10	0.20	0.30	0.40	0.50	0.60	1.24	1.40
0.45	-0.50	-0.40	-0.30	-0.20	-0.10	0.69	0.86	1.03	1.20
0.4	-1.00	-0.90	-0.80	0.15	0.33	0.50	0.68	0.86	1.04
0.35	-1.50	-0.39	-0.21	-0.02	0.16	0.35	0.53	0.72	0.90
0.3	-0.74	-0.55	-0.36	-0.17	0.03	0.22	0.41	0.61	0.80
0.25	-0.88	-0.68	-0.48	-0.28	-0.08	0.13	0.33	0.53	0.73
0.2	-0.98	-0.77	-0.56	-0.36	-0.15	0.06	0.27	0.48	0.69
0.15	-1.05	-0.84	-0.62	-0.40	-0.19	0.03	0.25	0.46	0.68
0.1	-1.09	-0.87	-0.65	-0.42	-0.20	0.03	0.25	0.48	0.71

s \ σ	0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9
0.9	1.10	1.19	1.28	1.35	1.42	1.49	1.55	1.60	1.64
0.85	1.08	1.16	1.24	1.32	1.39	1.45	1.51	1.56	0.04
0.8	1.04	1.12	1.20	1.28	1.36	1.43	0.07	0.08	0.10
0.75	1.01	1.08	1.16	1.24	0.05	0.08	0.10	0.13	0.16
0.7	0.97	1.03	-0.03	0.01	0.05	0.09	0.13	0.17	0.21
0.65	-0.08	-0.07	-0.05	0.00	0.05	0.11	0.16	0.21	0.26
0.6	-0.11	-0.11	-0.08	-0.02	0.05	0.11	0.18	0.24	0.30
0.55	-0.15	-0.14	-0.12	-0.04	0.04	0.11	0.19	0.26	0.34
0.5	-0.20	-0.19	-0.16	-0.07	0.02	0.11	0.19	0.89	0.90
0.45	-0.15	-0.16	-0.15	-0.07	0.01	0.87	0.90	0.93	0.94
0.4	-0.11	-0.12	-0.10	0.81	0.86	0.90	0.94	0.97	0.99
0.35	-0.08	0.85	0.80	0.83	0.88	0.93	0.98	1.01	1.04
0.3	0.97	0.89	0.84	0.87	0.90	0.96	1.01	1.05	1.09
0.25	1.01	0.93	0.87	0.91	0.94	0.99	1.05	1.10	1.14
0.2	1.04	0.96	0.90	0.94	0.98	1.02	1.09	1.14	1.19
0.15	1.08	0.98	0.92	0.97	1.01	1.05	1.12	1.19	1.24
0.1	1.10	1.00	0.94	0.99	1.04	1.09	1.16	1.23	1.29

Parameter values: *a=5* *F=0.7* *τ=0.7* *γ=0.2*

We first concentrate on the case where $\widetilde{\Lambda}^{*} = (NN)$, illustrated in Figures 6a-c. An acquisition can be profitable even though $\widetilde{\Lambda}^{*} = (NN)$ since there are acquisition benefits due to the best practise effect.[23] $\Lambda^{*} = (Ai)$ requires that these benefits more than compensate the acquisition transaction costs. Note from Eq. (29) that the best practice benefits increase in the extent of the technological leadership of firm 1, in the transferability of the technology and in the size of the laggard home country (country II). And in fact we see from Figure 6a that if technology asymmetry is small and the difference in country size is moderate, there is no scope for significant best practice benefits, hence an acquisition will not take place. Notice that for any given technology asymmetry, a smaller *s* increases the attractiveness of an acquisition, since larger market asymmetries boosts the best practice effect.

What is the identity of the acquirer? In Appendix VI it is shown that if $\widetilde{\Lambda}^* = (NN)$, we have that $\hat{\pi}_2^{NN} > \hat{\pi}_1^{NN}$ iff:

$$[(1-s)-s] > \sigma - (1-\sigma) \tag{30}$$

that is if the market size asymmetry effect is strong relative to the technological asymmetry effect. We also show that $\hat{\pi}_2^{NN} > \hat{\pi}_1^{NN}$ is satisfied for all $s \leq 0.33$ and $\sigma > 0.5$. In other words, with $\widetilde{\Lambda}^* = (NN)$ and a large market size asymmetry, the laggard from the large country will have higher profits. Thus, if an acquisition takes place, $\Lambda^* = (A2)$, and the technology leader from the small country will be acquired. In Figure 6a, where $\widetilde{\Lambda}^* = (NN)$ for all (s, σ) combinations – it is shown that A2 is the optimal entry mode for a rather broad range of (s, σ) within the $(s < 0.5, \sigma > 0.5)$ scenario. Only a limited set of configurations allow $\Lambda^* = (A1)$. To illustrate this, concentrate on the area in Figure 6a with a small market size asymmetry ($s=0.45$). As we increase σ, we move from $\Lambda^* = (NN)$, to $\Lambda^* = (A2)$ and finally to $\Lambda^* = (A1)$. The first change in equilibrium entry strategy is driven by the stronger best practice effect. But since the technological advantage for firm 1 is relatively small, the market size asymmetry effect dominates. Thus, we have $\hat{\pi}_2^{NN} > \hat{\pi}_1^{NN}$ and $\Lambda^*=(A2)$. This is illustrated with the negative values in the left matrix in Figure 6a. The second shift in equilibrium is driven by the stronger technology asymmetry, generating higher status quo profits for firm 1. This is illustrated by the growing positive values in the left hand matrix in Figure 6a.

Result 1:

If the technological leader is based in the small country and $\widetilde{\Lambda}^* =(NN)$, under rather general conditions, the leader will be acquired by the laggard from the large country.

Moving from Figure 6a through 6b and further to 6c, we simulate the effect of a reduction in *F*, which is equivalent to a multilateral liberalization of greenfield FDI. Such an exercise is much in line with the suggested MAI-treaty reform. One would expect that such a liberalization increases the incentive to choose greenfield FDI, yet our model show that it may just as well raise the incentives to engage in an acquisition, reducing the likelihood of greenfield FDI. When $\widetilde{\Lambda}^* = (GN)$, the profitability of an acquisition is higher as compared to $\widetilde{\Lambda}^* = (NN)$. In addition to the best practice effect, which in the scenario $(s < 0.5, \sigma > 0.5)$ is relevant independently of $\widetilde{\Lambda}^*$, an acquisition now profits from reduced competition and saving on fixed costs (see Table 1). Consequently, if a fall in *F* leads to a strategy shift from $\widetilde{\Lambda}^* = (NN)$ to $\widetilde{\Lambda}^* = (GN)$, we have that an acquisition is the optimal mode of entry for a wider

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[23] Eq. (31) holds also for the $(s < 0.5, \sigma > 0.5)$ case. We are assuming that the condition $\tau\sigma > (1-\sigma)$ holds.

range of parameter values (the white area in the right hand matrixes in Figure 6 progressively shrinks as we move from 6a to 6b and then to 6c). With $\widetilde{\Lambda}^* = (GN)$ the leader from the small country will enjoy monopoly profits in its home market, and if $\tau\sigma > (1-\sigma)$ the leader will also obtain higher operating profits in the host country compared to its rival. On the other hand, firm 1 by becoming a MNE will faces additional fixed costs due to the new plant abroad. Thus, there is no analytical solution that identifies which producer will have the larger profits in general, and thus, who is the potential acquirer.

Simulations results indicate that a fall in F, leading to a strategy shift, has an effect on the identity of the acquirer, which depends on whether the technology leader from the small country is a *strong* or a *weak* leader.[24] Let us look at the strong leader first (large σ). In Figure 6b the technology leader from the small country benefits significantly more from its technological advantage as compared to the situation in Figure 6a. Due to the fall in F, firm 1 is now able to exploit its advantage in the world market via greenfield FDI, and the benefits from investing abroad increase in τ (lower the technology transfer costs). Thus, when $\widetilde{\Lambda}^*$ shifts from NN to GN, we have that $\hat{\pi}_1^d > \hat{\pi}_2^d$ for a larger range of the (s,σ) combinations. And thus the range of situations for which $\Lambda^* = (A1)$ widens, as shown by a comparison of Figure 6a with 6b and 6c. If the leader is weak (σ is close to 0.5), the range of (s,σ) combinations for which we have $\Lambda^* = (A2)$ increases, indicating that the weak leader is more likely to be the target of a cross border acquisition when F falls.

To illustrate this, let us start out with a market asymmetry of *s=0.3*. If *F* is high as in Figure 6a, we have $\Lambda^* = (NN)$ for $0.6 \geq \sigma > 0.5$ and $\Lambda^* = (A2)$ for $\sigma > 0.6$. The technology leader will be taken over by the follower only if its technological advantage generates sufficient best practise benefits to compensate for acquisition transaction costs. If *F* is low as in Figure 6c, we have *Λ*=(A1)* for $\sigma \geq 0.7$, due to the large benefits associated with one way multinational expansion for the strong leader. So the strong leader from the small country will be the acquirer. In the case of the weak leader, the probability of been a target increases, as we have $\Lambda^* = (A2)$ also for values of σ for which in 6a we have $\Lambda^* = (NN)$. In this case the fall in F makes multinational expansion profitable, but the strategy shift does not generate sufficient benefits for firm 1 to become the most profitable of the two firms. At the same time, the threat from firm 1 (the leader) to enter country II via greenfield FDI creates an additional incentive for the laggard to make an acquisition (as it lowers its status quo profits). So for firm 2, being the acquirer creates both best practise benefits and market power benefits. Consequently, if small country governments are concerned about technologically advanced national firms being acquired by firms from larger countries, they should be aware of the effect of reducing F in the case where their technology leaders are weak leaders.

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[24] The threshold value of σ for strong leadership depends on other parameters values.

Result 2:

Multilateral greenfield FDI liberalization (i.e. a reduction in F) increases the likelihood of an acquisition, as compared to the case of segmented markets (i.e. $\widetilde{\Lambda}^* = (NN)$)[25].

Result 3:

If the technological leader is based in the small country, the effect of multilateral greenfield FDI liberalization on the identity of the acquirer depends on the extent of the technological gap. If firm 1 is a weak technology leader (σ close to 0,5), its probability of being acquired by the laggard increases. If it is a strong technology leader, its probability of acquiring the laggard from the large market increases.

If the threat is cross-greenfield FDI ($\widetilde{\Lambda}^* = (GG)$), the gains from an acquisition are further enlarged as saving on fixed costs is doubled and the gains from reduced competition relates to both markets (see Table 1). Hence, only if acquisition costs are large, the firms will decide not to merge (consult the simulations in Figure 5 where $\Lambda^* = (Ai)$ for most parameter combinations even though γ is as large as 0.35). Furthermore, if $\tau\sigma > (1-\sigma)$, the leader from the small country will always be the acquirer ($\Lambda^* = (A1)$), since it will have higher operating profits due to a better technology in both markets, while facing the same fixed costs.

In Figure 7 we simulate a reduction in technology transfer costs (higher τ) which may be due to technological development in ICT or to greater attention devoted by firms to know-how management. The effects are similar to those driven by a fall in *F*. Moving from Figure 7a to 7b, we see that as τ increases, the white area (i.e. the non acquisition area) shrinks. It becomes relatively more profitable for the technology leader to go multinational, and the smaller the transfer costs are, the higher will its profit be relative to the opponent. Furthermore, the effect on the identity of the acquirer is also similar to the effect from a fall in F. If you start out from *s*=0.3 in Figure 7a and cut transfer costs (see 7b), you will move from $\Lambda^* = (NN)$ to $\Lambda^*=(A2)$ if the firm 1 is a weak technology leader, while you move from $\Lambda^* = (A2)$ to $\Lambda^* = (A1)$ if firm 1 is a strong technology leader.

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[25] This result holds also for the other scenarios considered.

Figure 7a: Equilibrium strategies when $\tau = 0.7$

The status quo game

Positive values: $\pi_1 > \pi_2$

Equilibrium strategies: NG NN GN GG

s									
0,9	1,39	1,62	1,84	2,07	2,29	2,52	4,62	4,73	4,84
0,85	1,35	1,57	1,78	2,00	3,90	4,00	4,10	4,20	4,31
0,8	1,28	1,49	3,20	3,30	3,40	3,50	3,60	3,70	3,80
0,75	2,50	2,60	2,70	2,80	2,90	3,00	3,10	3,20	3,30
0,7	2,00	2,10	2,20	2,30	2,40	2,50	2,60	2,70	2,80
0,65	1,50	1,60	1,70	1,80	1,90	2,00	2,10	2,20	2,30
0,6	1,00	1,10	1,20	1,30	1,40	1,50	1,60	1,70	1,80
0,55	0,50	0,60	0,70	0,80	0,90	1,00	1,10	1,20	1,30
0,5	-0,00	0,10	0,20	0,30	0,40	0,50	0,60	0,70	0,80
0,45	-0,50	-0,40	-0,30	-0,20	-0,10	-0,00	0,10	0,20	0,30
0,4	-1,00	-0,90	-0,80	-0,70	-0,60	-0,50	-0,40	0,56	0,74
0,35	-1,50	-1,40	-1,30	-1,20	-1,10	0,05	0,23	0,42	0,60
0,3	-2,00	-1,90	-1,80	-0,47	-0,27	-0,08	0,11	0,31	0,50
0,25	-2,50	-0,98	-0,78	-0,58	-0,38	-0,17	0,03	0,23	0,43
0,2	-1,28	-1,07	-0,86	-0,66	-0,45	-0,24	-0,03	0,18	0,39
0,15	-1,35	-1,14	-0,92	-0,70	-0,49	-0,27	-0,05	0,16	0,38
0,1	-1,39	-1,17	-0,95	-0,72	-0,50	-0,27	-0,05	0,18	0,41
	0,5	0,55	0,6	0,65	0,7	0,75	0,8	0,85	0,9

σ

The full game

Positive values: Acquisition equilibrium

Equilibrium strategies: A1 A2 NO

s									
0,9	1,46	1,55	1,64	1,71	1,78	1,85	0,00	0,00	0,00
0,85	1,44	1,52	1,60	1,68	0,01	0,02	0,02	0,03	0,04
0,8	1,40	1,48	0,00	0,02	0,03	0,05	0,07	0,08	0,10
0,75	-0,03	-0,02	-0,01	0,02	0,05	0,08	0,10	0,13	0,16
0,7	-0,05	-0,05	-0,03	0,01	0,05	0,09	0,13	0,17	0,21
0,65	-0,08	-0,07	-0,05	0,00	0,05	0,11	0,16	0,21	0,26
0,6	-0,11	-0,11	-0,08	-0,02	0,05	0,11	0,18	0,24	0,30
0,55	-0,15	-0,14	-0,12	-0,04	0,04	0,11	0,19	0,26	0,34
0,5	-0,20	-0,19	-0,16	-0,07	0,02	0,11	0,19	0,28	0,37
0,45	-0,15	-0,16	-0,15	-0,07	0,01	0,09	0,19	0,29	0,39
0,4	-0,11	-0,12	-0,10	-0,01	0,08	0,18	0,27	1,27	1,29
0,35	-0,08	-0,08	-0,06	0,04	0,15	1,23	1,28	1,31	1,34
0,3	-0,05	-0,06	-0,03	1,23	1,26	1,28	1,31	1,35	1,39
0,25	-0,03	1,29	1,23	1,27	1,30	1,33	1,35	1,40	1,44
0,2	1,40	1,32	1,26	1,30	1,34	1,37	1,39	1,44	1,49
0,15	1,44	1,34	1,28	1,33	1,37	1,41	1,43	1,49	1,54
0,1	1,46	1,36	1,30	1,35	1,40	1,44	1,47	1,53	1,59
	0,5	0,55	0,6	0,65	0,7	0,75	0,8	0,85	0,9

σ

Parameter values: $a=5$ $F=1$ $\tau=0.7$ $\gamma=0.2$

Figure 7b: Equilibrium strategies when $\tau = 1$

Positive values: $\pi_1 > \pi_2$

Equilibrium strategies: NG NN GN GG

s									
0,9	1,00	1,27	1,53	1,80	2,07	2,33	2,60	4,73	4,84
0,85	0,98	1,24	1,49	1,75	2,00	4,00	4,10	4,20	4,31
0,8	0,94	1,18	1,43	1,67	3,40	3,50	3,60	3,70	3,80
0,75	0,86	1,09	2,70	2,80	2,90	3,00	3,10	3,20	3,30
0,7	2,00	2,10	2,20	2,30	2,40	2,50	2,60	2,70	2,80
0,65	1,50	1,60	1,70	1,80	1,90	2,00	2,10	2,20	2,30
0,6	1,00	1,10	1,20	1,30	1,40	1,50	1,60	1,70	1,80
0,55	0,50	0,60	0,70	0,80	0,90	1,00	1,10	1,20	1,30
0,5	-0,00	0,10	0,20	0,30	0,40	0,50	0,60	1,31	1,51
0,45	-0,50	-0,40	-0,30	-0,20	-0,10	-0,00	0,95	1,15	1,36
0,4	-1,00	-0,90	-0,80	-0,70	0,39	0,60	0,81	1,02	1,24
0,35	-1,50	-1,40	-0,18	0,04	0,26	0,48	0,70	0,92	1,15
0,3	-2,00	-0,52	-0,30	-0,07	0,16	0,39	0,62	0,86	1,09
0,25	-0,86	-0,62	-0,39	-0,15	0,09	0,33	0,58	0,82	1,06
0,2	-0,94	-0,69	-0,44	-0,19	0,06	0,31	0,56	0,81	1,07
0,15	-0,98	-0,73	-0,47	-0,21	0,05	0,31	0,58	0,84	1,11
0,1	-1,00	-0,73	-0,46	-0,19	0,08	0,35	0,62	0,90	1,17
	0,5	0,55	0,6	0,65	0,7	0,75	0,8	0,85	0,9

σ

Positive values: Acquisition equilibrium

Equilibrium strategies: A1 A2 NO

s									
0,9	1,29	1,41	1,53	1,63	1,73	1,82	1,90	0,03	0,04
0,85	1,28	1,40	1,52	1,63	1,73	0,06	0,08	0,09	0,11
0,8	1,26	1,39	1,51	1,63	0,10	0,12	0,15	0,17	0,20
0,75	1,23	1,37	0,05	0,09	0,13	0,18	0,21	0,25	0,29
0,7	-0,05	0,00	0,06	0,11	0,17	0,22	0,28	0,33	0,38
0,65	-0,08	-0,01	0,06	0,13	0,19	0,26	0,33	0,40	0,46
0,6	-0,11	-0,03	0,05	0,13	0,22	0,30	0,38	0,46	0,54
0,55	-0,15	-0,06	0,04	0,13	0,23	0,33	0,42	0,51	0,61
0,5	-0,20	-0,09	0,02	0,13	0,24	0,35	0,46	1,23	1,22
0,45	-0,15	-0,05	0,05	0,16	0,26	0,36	1,28	1,29	1,29
0,4	-0,11	0,00	0,12	0,24	1,27	1,31	1,33	1,35	1,36
0,35	-0,08	0,05	1,23	1,26	1,31	1,36	1,39	1,41	1,43
0,3	-0,05	1,25	1,28	1,31	1,35	1,40	1,44	1,48	1,50
0,25	1,23	1,28	1,32	1,35	1,39	1,45	1,50	1,54	1,57
0,2	1,26	1,31	1,36	1,40	1,43	1,50	1,56	1,61	1,64
0,15	1,28	1,34	1,39	1,43	1,48	1,55	1,62	1,67	1,72
0,1	1,29	1,36	1,42	1,46	1,52	1,60	1,67	1,74	1,79
	0,5	0,55	0,6	0,65	0,7	0,75	0,8	0,85	0,9

σ

Parameter values: $a=5$ $F=1$ $\tau=1$ $\gamma=0.2$

6.5 Technology and market size asymmetry II: ($s > 0.5, \sigma > 0.5$ *- leader from the large country)*

Firm 1 is the technological leader and is based in the large country. Market size and technological effects run in the opposite direction. All the four status quo outcomes are possible (NN, GG, GN, GG). If $\widetilde{\Lambda}^* = (NN)$, firm 1 will have a larger profits; that is also the case in the GG outcome (see Figures 4 - 7 for illustrations). In the case of one way FDI, if the potential MNE is firm 1 (the GN case) here too firm 1 will have a larger status quo profit[26]. However, if the incentive from a large host market size prevail (the NG case) due to the contrasting effect from technology and market size difference, we cannot have a clear reply on which firm will have the largest status quo size and thus may become the acquirer.

Result 4:

In the case of a technology leader from a large country, under rather general conditions, this firm will be the acquirer in case of a cross border take-over.

7. Conclusions

In the theoretical industrial organisation literature, the study of why firms decide to enter a foreign market through greenfield investment or M&As is in an infant stage. So far, no study has succeeded in identifying what kind of firms chooses to make a cross border acquisition and what kind of firms chooses instead to be acquired by foreign firms. In this paper we apply a simple bargaining model to determine the identity of the acquirer, in a setting where firms differ with respect to technological level and countries vary with respect to market size. We are thus able to analyse whether technology leaders from small countries may find it optimal to acquire technology laggards from large countries, or vice versa.

Our model contains important features that seem to play a pivotal role in the choice between conducting an acquisition or establishing a new subsidiary abroad through greenfield investment. We consider the gains from implementing a best practice technology, and take into account knowledge transfer costs and transaction costs associated with a merger due to legal fees, consulting fees and costs of integrating the two company cultures. Empirical studies show that such acquisition costs can be surprisingly high, leading to low profits from cross border acquisitions.

Our model shows that the acquiring firm is always the one that would have gained the highest profits if an acquisition was not possible. In fact we find that the equilibrium acquisition price reflects the target firm potential for growth. We also find that changes in the market size and technology asymmetries affect the choice between cross border acquisition and other entry modes, both directly and indirectly via strategy shifts, that is by inducing a change in what would be the equilibrium in the no acquisition situation.

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[26] We have $\pi_1^{NN} > \pi_2^{NN}$ which implies $\pi_1^{GN} > \pi_2^{NN}$ if the status quo is GN.

When only one type of asymmetry is considered, we find that if national markets are highly protected and thus the alternative to an acquisition is represented by two national monopolies, market size asymmetry alone does not generate an incentive for a cross border acquisition. However, technological asymmetry alone may create such incentives. Furthermore, if we have technological asymmetry but market size symmetry, when an acquisition takes place the technological leader is always the acquirer.

When both types of asymmetries play a role, we find that if the technology leader comes from a large country, it will – except for some extreme configurations - be the acquirer if there is any cross border take over at all. In the case of a technology leader based in the small country, the results are more complex. With prohibitively high barriers to greenfield FDI (thus with. national monopolies in the non acquisition case), under rather general conditions, if there is an acquisition that is made by the laggard based in the large country. Market size asymmetry tends to prevail on technological asymmetry in such scenario, and a large home market emerges as a key factor for determining who will be the acquirer in an international deal. Only if market size asymmetry is rather small, an acquisition made by the technology leader may emerge as the optimal entry mode within the segmented markets setting.

We also show that greenfield FDI liberalisation increases the likelihood of observing an acquisition as the equilibrium outcome. In other words, if the globalization process leads to e.g. lower fixed investment costs under greenfield, it does not necessarily mean that we will see more greenfield investment, but rather more acquisitions. This prediction seems to fit the developments mentioned in Section 1. As to the identity of the acquirer, we find that the effect of multilateral greenfield FDI liberalization depends on the *extent of the technology gap*. If the small country producer enjoys a strong technological lead and is able to exploit it internationally, FDI liberalization increases the range of parameters for which such firm may become the acquirer. In order to fully benefit from its advantage in the global market, the technology leader should be able not only to become an MNE but also to transfer its technology at low costs across borders. However the same liberalisation in the FDI regime increases the likelihood that a weak technology leader will become a target in a cross border deal. Thus globalization seems to create the preconditions for world leadership in the case of strong technology leaders based in small countries, but at the same time it increases weak leaders' vulnerability to foreign take-over.

The size of the home market – as expected- emerges as a more crucial factor in international M&As when national markets are highly protected, in other words it is more important with segmented markets than in a globalized world. In a liberalized FDI regime instead, a strong technological lead becomes a crucial determinant of who will buy whom, if technologies are transferable.

Our future research will continue analysing the consequences of imposing both technology and market size asymmetries. One extension will be to incorporate the financial determinants of M&As, capturing different access to the capital market via firm specific parameters**.** Furthermore, we will investigate possible policy implications. Here, it is natural to ask whether governments can find it optimal to block

acquisitions in order to avoid the establishment of monopolies, even though acquisitions may improve production technology through knowledge transfer.

Appendix 1

The profit functions of the two firms in selected market configurations (GN, A1, A2) are:

$$\pi_1^{GN} = (sa - q_{1,I})q_{1,I} - (c_0 - \sigma)q_{1,I} + ((1-s)a - (q_{1,II} + q_{2,II}))q_{1,II} - (c_0 - \tau\sigma)q_{1,II} - F \qquad \text{A.I.1}$$

$$\pi_2^{GN} = ((1-s)a - (q_{1,II} + q_{2,II}))q_{2,II} - (c_0 - (1-\sigma))q_{2,II} \qquad \text{A.I.2}$$

$$\Pi_1^{A1} = (V_1^{A1} - T_1) - B_1 \qquad \text{A.I.3}$$

$$\Pi_2^{A2} = (V_2^{A2} - T_2) - B_2 \qquad \text{A.I.4}$$

where

$$V_1^{A1} = (sa - q_{1,I})q_{1,I} - (c_0 - \left[\max\ \{\sigma, \tau(1-\sigma)\}\right])q_{1,I} + ((1-s)a - q_{1,II})q_{1,II} - (c_0 - \left[\max\ \{\tau\sigma, (1-\sigma)\}\right])q_{1,II} \qquad \text{A.I.5}$$

$$V_2^{A2} = (sa - q_{2,I})q_{2,I} - (c_0 - \left[\max\ \{\sigma, \tau(1-\sigma)\}\right])q_{2,I} + ((1-s)a - q_{2,II})q_{2,II} - (c_0 - \left[\max\ \{\tau\sigma, (1-\sigma)\}\right])q_{2,II} \qquad \text{A.I.6}$$

Appendix II

The equilibrium profits for each market configuration in the non-cooperative game with $\widetilde{\Lambda}^* = \{N, G\}$ obtained by substituting in the profit functions the optimal sales we get by solving the second stage games, are:

$$\hat{\pi}_1^{NN} = \frac{(sa - c_0 + \sigma)^2}{4} \qquad \text{A.II.1}$$

$$\hat{\pi}_2^{NN} = \frac{((1-s)a - c_0 + (1-\sigma))^2}{4} \qquad \text{A.II.2}$$

$$\hat{\pi}_1^{NG} = \frac{(sa - c_0 + 2\sigma - \tau(1-\sigma))^2}{9} \qquad \text{A.II.3}$$

$$\hat{\pi}_2^{NG} = \frac{((1-s)a - c_0 + (1-\sigma))^2}{4} + \frac{(sa - c_0 + 2\tau(1-\sigma) - \sigma)^2}{9} - F \qquad \text{A.II.4}$$

$$\hat{\pi}_1^{GN} = \frac{(sa - c_0 + \sigma)^2}{4} + \frac{((1-s)a - c_0 + 2\tau\sigma - (1-\sigma))^2}{9} - F \qquad \text{A.II.5}$$

$$\hat{\pi}_2^{GN} = \frac{((1-s)a - c_0 + 2(1-\sigma) - \tau\sigma)^2}{9} \qquad \text{A.II.6}$$

$$\hat{\pi}_1^{GG} = \frac{(sa - c_0 + 2\sigma - \tau(1-\sigma))^2}{9} + \frac{((1-s)a - c_0 + 2\tau\sigma - (1-\sigma))^2}{9} - F \qquad \text{A.II.7}$$

$$\hat{\pi}_2^{GG} = \frac{(sa - c_0 + 2\tau(1-\sigma) - \sigma)^2}{9} + \frac{((1-s)a - c_0 + 2(1-\sigma) - \tau\sigma)^2}{9} - F \qquad \text{A.II.8}$$

Appendix III

Let us consider the case in which firm 1 makes an offer. Firms bargain over $(V^A - \gamma\pi_2^d)$. The equilibrium bid is given by the Nash bargaining solution of the cooperative game. This is point N on the negotiation set (segment AD), such that the products of the gains obtained from the agreement (with reference to the threat point d) is maximised (see Petit (1990), p. 231). The Nash solution N can also be interpreted as the point on the AD segment which yields the largest rectangle for d. Note that dD = dA. Since the triangle AdD is equilateral and symmetric, N

has coordinates $(\pi_1^d + \frac{1}{2}dD; \pi_2^d + \frac{1}{2}dD)$ where $dD = \{(V^A - \gamma\pi_2^d) - (\pi_1^d + \pi_2^d)\}$ represents the overall gain from cooperation, that is the excess profits from the acquisition when firm 1 is the acquirer.

Insert figure A1

Appendix IV *(s>0.5, σ=0.5)*

$$\hat{\pi}_2^{NG} - \hat{\pi}_1^{NG} = \frac{((1-s)a - c_0 + 0.5)^2}{4} + \frac{(sa - c_0 + \tau - 0.5)^2}{9} - \frac{(sa - c_0 + 1 - \tau 0.5)^2}{9} - F \qquad \text{A.IV.1}$$

from which:

$$\frac{\partial \hat{\pi}_2^{NG} - \hat{\pi}_1^{NG}}{\partial \tau} = \frac{2(sa - c_0 + \tau - 0.5)}{9} + \frac{(sa - c_0 + 1 - \tau 0.5)}{9} > 0 ,$$

$$\frac{\partial \hat{\pi}_2^{NG} - \hat{\pi}_1^{NG}}{\partial s} = -\frac{2((1-s)a - c_0 + 0.5)}{4} + \frac{2a(sa - c_0 + \tau - 0.5)}{9} - \frac{2a(sa - c_0 + 1 - \tau 0.5)}{9} < 0 \quad \text{since}$$

$$sa - c_0 + \tau - 0.5 < sa - c_0 + 1 - \tau 0.5$$

$$\frac{\partial \hat{\pi}_2^{NG} - \hat{\pi}_1^{NG}}{\partial F} = -1 < 0$$

Appendix V *(s=0.5, σ>0.5)*

If $\widetilde{\Lambda}^* = (NN)$ or $\widetilde{\Lambda}^* = (GG)$, firm 1 (the technology leader) will have higher profits than firm 2 due to lower unit costs. If $\widetilde{\Lambda}^* = (GN)$ equilibrium profits are given by:

$$\hat{\pi}_1^{GN} = \frac{(0.5a - c_0 + \sigma)^2}{4} + \frac{(0.5a - c_0 + 2\tau\sigma - (1-\sigma))^2}{9} - F \qquad \text{A.V.1}$$

$$\hat{\pi}_2^{GN} = \frac{(0.5a - c_0 + 2(1-\sigma) - \tau\sigma)^2}{9} \qquad \text{A.V.2}$$

from which we have $\hat{\pi}_1^{GN} > \hat{\pi}_2^{GN}$ (given that $\hat{\pi}_{1,I}^{GN} > \hat{\pi}_{2,II}^{GN}$ and $\frac{(0.5a - c_0 + 2\tau\sigma - (1-\sigma))^2}{9} - F > 0$ necessary for GN to be the status quo).

Appendix VI *(s<0.5, σ>0.5)*

$$\hat{\pi}_1^{NN} = \frac{(sa - c_0 + \sigma)^2}{4} = \frac{A^2}{4} \qquad \text{A.VI.1}$$

$$\hat{\pi}_2^{NN} = \frac{((1-s)a - c_0 + (1-\sigma))^2}{4} = \frac{B^2}{4} \qquad \text{A.VI.2}$$

Since $A > 0$ and $B > 0$, $B^2 > A^2$ requires $B > A$, from which $\hat{\pi}_2^{NN} > \hat{\pi}_1^{NN}$ iff

$(1-s)a - as > \sigma - (1-\sigma)$

Let us consider $s = 0.33$ (lower bound of the large market size asymmetry) and $\sigma = 0.99$ (upper bound of the technological asymmetry). The model require that $sa - c_0 > 0$ which implies $a > 3.0303$. It follows that $(1-s)a - as > \sigma - (1-\sigma)$ is verified and that $\hat{\pi}_2^{NN} > \hat{\pi}_1^{NN}$ for all admissible parameters in the case of a large market size asymmetry.

References

Anand, J. and A. Delios (2002): Absolute and relative resources as determinants of international acquisitions, *Strategic Management Journal*, 23, 119-34.

Andersson, T. and R. Svensson (1994): "Entry modes for direct investment determined by the composition of firm specific skills" *Scandinavian Journal of Economics*, 96 (4), 551-560

Barba Navaretti G. and A. J. Venables (2004): *Multinational Firms in the World Economy* Princeton University Press, Princeton, NJ.

Barkema, H. G. and F. Vermeulen (1998): International expansion through start-up or acquisition: a learning perspective, *Academy of Management Journal*, 41(1), 7-26.

Bjorvatn, K. (2004): Economic Integration and the profitability of Cross-Border Mergers and Acquisitions, *European Economic Review*, 48 (6), 1211-26.

Brouthres, K. D. and L. E. Brouthres (2000): Acquisition or Greenfield start-up? Institutional, cultural and transaction cost influence, *Strategic Management Journal*, 21, 89-97.

Eicher, T. and J. W. Kang (2005): Trade, Foreign Direct Investment or Acquisition: Optimal Entry Modes for Multinationals, *Journal of Development Economics*, 77 (1), 207-28.

Ferrett, B. (2003): Greenfield Investment versus Acquisition: Positive Analysis, *Research Paper Series*, University of Nottingham.

Friedman, J.W. (1990) *Game Theory with Applications to Economics*, Oxford University Press, Oxford

Fosfuri, A. and M. Motta (1999): Multinationals without advantages, *Scandinavian Journal of Economics* 101 (4), 617-630.

Gorg, H. (2000): Analysing Foreign Market Entry: The Choice between Greenfield Investment and Acquisition, *Journal of Economic Studies*, 27(3) , 165-81.

Grünfeld, L. A. (2006): Multinational Production, Absorptive Capacity and Endogenous R&D Spillovers, *Review of International Economics*, 14 (5), 922-940.

Harzing, A. W. (2002): Acquisitions versus Greenfield investments: International Strategy and Management Entry Modes, *Strategic Management Journal*, 23, 211-227.

Horn, H. and L. Persson (2001): The equilibrium ownership of an international oligopoly, *International Journal of Industrial Organization,* 53, 307-333.

Horstmann, I. J. and J. R. Markusen (1992): Endogenous market structures in international trade, *Journal of International Economics*, 32, 109-129.

Kogut, B. and H. Singh (1988): The effect of national culture on the choice of entry mode, *Journal of International Business Studies*, 19 (3), 411-432.

Kogut, B. and S. J. Chang (1991): Technological capabilities and Japanese foreign direct investment in the United States, *The Review of Economic and Statistics*, 78, 401-413.

Mattoo, A., Olarreaga M. and K. Saggi (2004): Mode of foreign entry, technology transfer, and FDI policy, *Journal of Development Economics*, 75, 95-111.

Nocke, V. and S. Yeaple (2004): An Assignment Theory of Foreign Direct Investment," NBER Working Papers 11003, National Bureau of Economic Research, Massachsetts.

Norbäck P. J. and L. Persson (2002): Investment Liberalisation- Who Benefits from Cross-Border Merger and Acquisitions?, *CEPR Discussion Paper*, No. 3166, CEPR, London.

Petit, M.L. (1990): *Control theory and dynamic games in economic policy analysis,* Cambridge University Press, Cambridge

Petit, M.L. and F. Sanna-Randaccio (2000): Endogenous R&D and foreign direct investment in international oligopolies, *International Journal of Industrial Organization*, 18, 339-367.

UNCTAD (2000): *World Investment Report 2000: Cross-border Mergers and Acquisitions and Development*, United Nations, Geneva

UNCTAD (2004): *World Investment Report 2004: The Shift Towards Services*, United Nations, Geneva