The Impact of Multinational Entry on Domestic Market Structure and R&D

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Abstract

By examining the interaction of different modes of multinational entry with the choices of domestic firms regarding changes in market structure and R&D investments this paper provides an alternative view to the more common spillover perspective on the impact of foreign presence in the host country.
The paper shows that a concentrated market structure can result as a consequence of greenfield entry when it induces domestic firms to merge or to leave the market. The paper also reveals that a technological advantage of a multinational firm only favours greenfield investment over acquisitions when the domestic firms are sufficiently competitive. Finally, foreign presence is shown to increase total investment in the local industry at the cost of crowding out domestic R&D.

Keywords: cross-border mergers and acquisitions, greenfield investment, host-country effects, cost-reducing R&D investment
JEL classification: F23, L11, O31

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1 Introduction

The impact of foreign direct investment (FDI) on host country firms and industries has been regarded mainly in the light of technology spillovers. By examining the interaction of different modes of multinational entry with the choices of domestic firms regarding changes in market structure and R&D investments this paper provides an alternative view.

The following observations motivate this analysis: Worldwide foreign direct investment has grown impressively in the past 25 years. At least since the late 1980s FDI has increasingly taken the form of cross-border mergers & acquisitions (M&A) rather than greenfield investment. The World Investment Report (UNCTAD (2000)) computes a ratio of over four-fifths for the value of world cross-border M&As in relation to that of world FDI flows over the 1990s.[1] These developments have been accompanied by rising concentration ratios (UNCTAD (1999)).

At the macro level Globerman and Shapiro (2004) uncover very similar determinants for M&A and FDI flows. At the firm level, in contrast, UNCTAD (2000, p. 145) as well as Kang and Johansson (2000) make out different factors as drivers for mergers & acquisitions and for greenfield entry. Good organisational and managerial skills, high advertising intensity, and the prospect of a speedy market entry are more conducive to M&A. Whereas the most important factor in favour of greenfield investment appears to be technological skill. Besides, distance and trade cost, the cost of research and development (R&D), strategies vis à vis competitors as well as information asymmetries are likely to play a role in a firm's decision between setting up an own plant abroad and acquiring an existing local plant.

When examining the characteristics of multinational enterprises (MNEs), they are in most cases the largest and the most efficient firms in an industry.[2] Moreover, multinational activity is closely associated with research and development (R&D). As a consequence, entry by a foreign MNE constitutes a major change in market structure for the host country industry and the do-

[1] This is to say that if all M&As were financed by FDI, four-fifths of world FDI flows took the form of M&As during that period. It is not possible to get a straightforward and accurate comparison between data series on cross-border M&As and FDI flows and to assess precisely what share of FDI flows in one year is accounted for by cross-border M&As in one country. More specifically: The value of cross-border M&As includes funds raised in local and international financial markets; by definition, FDI data do not. FDI data are reported on a net basis, using the balance-of-payments concept. For instance, while outward FDI from a given country is reduced by the amount of disinvestment undertaken by firms from that country abroad, data on cross-border M&A purchases report only the total value of purchases abroad (i.e. they do not subtract the amounts received from the sales of foreign affiliates). Payments for cross-border M&As are not necessarily made in a single year, but can be phased over several years.

Calculating the value of cross-border M&As as a percentage of FDI flows proceeds on the basis of the assumption that all cross-border M&As are financed by FDI flows. In countries where capital markets are poorly developed, cross-border M&As are more likely to be financed by FDI. (UNCTAD (2000), p. 104)

[2] This has been confirmed in a number of empirical studies. See Barba Navaretti and Venables (2004), ch. 7.3 for an overview.

mestic firms. While greenfield investment is usually regarded more favourably by host country governments as it is said to increase competition by adding new production capacity to the market, M&As may decrease competition or at best may not alter market structure. However, firms acquired by foreign investors may initiate competition with incumbents in the host country with the help of financial resources, advanced management know-how or superior technological skills from parent companies. Furthermore, if inefficient target firms, which otherwise may be forced to exit, are acquired and restructured by foreign investors, M&As may enhance competition in the host country. In the opposite direction, by initially increasing competition, greenfield entry may trigger domestic firms to exit or to merge.

As already mentioned it is empirically a well-established fact that MNEs are usually more productive and efficient than the firms in the markets they enter. The empirical literature has, hence, been busy estimating spillover effects of foreign presence on domestic firms or industries. However, these studies rarely acknowledge that the available data does very often not allow to disentangle spillover effects from pro-competitive effects of multinational presence. The majority of these papers finds a negative impact of foreign presence on domestic firms at least as far as horizontal spillovers are concerned (see Görg and Greenaway (2002) for a survey).[3]

One of the earliest studies of spillovers by Blomström (1986, p. 97) comes to the conclusion that "[t]he most important source of spillover efficiency is found to be in the competitive pressure induced by foreign firms" in Mexico. More recently, Chung, Mitchell and Yeung (2003) obtain a similar result when assessing the impact of Japanese FDI in the US automotive industry. Namely that increased competitive pressure in the auto-sector was the main cause of the overall productivity improvement, - at least during the initial stages of Japanese presence in the 1980s. Baily and Solow (2001) provide a survey of micro-evidence suggesting that international competition via FDI (among others) spurs competitive responses in exposed firms. Sembenelli and Siotis (2002) try to disentangle the pro-competitive and the spillover effects in their study of Spanish firms. They find that especially in non-R&D intensive sectors the entry of MNEs dampens profit margins of local firms in the short run, to give way to efficiency enhancing effects in the longer run. Co (2001) considers the impact of greenfield and non-greenfield FDI in US manufacturing industries separately. She finds the competitive effect of both types of FDI - as estimated by decreased price-cost margins - to predominate above a certain level of concentration.

Higher domestic exit rates after foreign entry are also a sign of a pro-competitive effect of foreign presence. DeBacker and Sleuwaegen (2002) present evidence that import competition as

[3]Exceptions, that is evidence of positive spillovers can sometimes be found in high-tech sectors in developed countries (see Görg and Strobl (2003) for Ireland, and Haskel, Pereira and Slaughter (2002) for the UK). Also, for vertical spillovers the evidence seems more favourable, see e.g. Alfaro and Rodríguez-Clare (2003).

well as FDI discourage entry and stimulate exit of domestic entrepreneurs in a sample of Belgian manufacturing firms.

Studies pinning down the impact of foreign presence on domestic R&D efforts are rare. The only study addressing the issue explicitly is by Veugelers and Vanden Houte (1990). They find that domestic companies operating in a subset of Belgian manufacturing industries have smaller innovative intensities, the higher the presence of multinational firms in the industry.

The theoretical literature, in turn, was able to be more explicit about the channels of spillovers. Surveying the literature Görg and Greenaway (2002) identify imitation, competition, human capital, and exports. As has long been the tradition in the theoretical literature[4], in these studies FDI is treated as a homogenous phenomenon where cross-border mergers & acquisitions and greenfield investment are observationally equivalent. Moreover, the focus there has been mostly on the multinational firm itself rather than on the impact of its presence on the domestic firms and industries in the host economy.

Taking a different perspective, Veugelers and Vanden Houte (1990) build a model where a domestic monopolist is faced with competition from a multinational firm, which is active in two markets. Analysing the two firms' strategic decisions, they show that foreign competition can exert a negative or a positive effect on domestic innovation efforts depending on relative price-cost margins of both firms, the substitutability of products, the demand-cost margin of the MNE in the domestic market, and on differences in R&D effectiveness.

In a two-country-one-firm-each setting Ferret (2003) looks at how the choice of these firms between acquiring a domestic firm and setting up an own plant (greenfield investment) interacts with their decision to invest in technology and also with possible future entry from domestic firms in other industries. In his setting a fixed amount of R&D investment upon entry comes with a certain probability of success. He finds that acquisition FDI arises in medium-sized markets where there is no subsequent entry. Whereas greenfield investment will occur when there is a combination of a large market and low cost of additional plants, because it allows to deter subsequent entry.

The model presented here, in turn, focuses on the reaction a multinational firm's choice between greenfield investment and brownfield investment (i.e. mergers & acquisitions) will evoke among the domestic firms, namely exit or a domestic merger. Moreover, it looks at the impact of this interplay on the R&D investments of the firms under consideration. R&D investments are modelled as reductions in marginal cost and are therefore continuous.

[4] See Markusen (1995) for a survey.

With this setup it is possible to show that a concentrated market structure may result even in the case of greenfield entry when domestic firms merge or leave the market as a consequence. Thereby, providing an explanation for the increase in concentration ratios together with the surge in FDI. Moreover, the paper reveals that a technological advantage of the multinational firm only favours greenfield investment over an acquisition when the domestic firms are sufficiently competitive. Finally, the paper demonstrates that foreign presence will increase total R&D investments in the industry but crowd out domestic R&D compared to a situation with domestic firms only.

The remainder of the paper is structured as follows: section 2 presents the components of the model. In section 3 the benchmark equilibrium without foreign entry is computed. Section 4 analyses the game with foreign entry. Section 5 characterises the different market structures including their R&D levels. Finally, section 6 concludes.

2 The model setup

As the focus here is on the impact of the mode of foreign entry on domestic investment and changes in domestic market structure, all action will take place in one country. We look at one particular industry in this country. There are two domestic firms in this industry, $H1$ and $H2$. They have different levels of marginal cost c_{H1} and c_{H2}. $H1$ is more efficient than $H2$: $c_{H1} \leq c_{H2}$. The potential multinational entrant M is assumed to be more efficient than the domestic firms, its marginal cost are given by c_M, where $c_M \leq c_{H1} \leq c_{H2}$.[5]

All firms in the market can make investments to reduce marginal cost by an amount x_i.[6] Accordingly the kind of investment considered is process R&D.[7] Investment is associated with a cost of γx_i^2 for all firms, where γ measures the degree of convexity of the cost function. Convexity of investment cost is ensured by $\gamma > 1$.

Firms are producing a homogenous good. Hence, demand is the same for all firms with the indirect demand function given by $p = a - Q$, where a represents the size of the market and

[5] Görg (2000) has a similar setup. He assigns different levels of fixed cost components (marketing cost, process and product adaptation cost) to the two domestic firms. In addition greenfield entry bears a fixed setup cost while entry by acquisition is associated with a (fixed) takeover premium that depends on the technology level of the domestic firms. He does not allow for reactions by domestic firms or R&D investments.

[6] This was first done by Brander and Spencer (1983) and Spencer and Brander (1983). Escrihuela-Villar (2004) generalises their results to the case with n homogenous firms. He shows that more efficient firms spend more on R&D which also implies a more concentrated market structure. Neary (2002) also comprises this result in a more general setup.

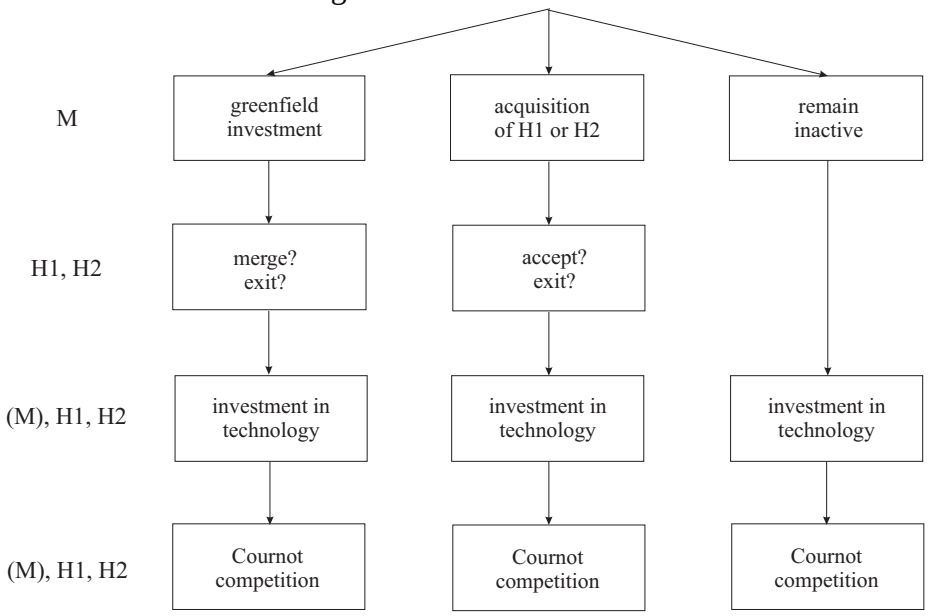
[7] Investments that increase demand could be modelled in a similar way. See for example Veugelers and Vanden Houte (1990).

$Q = \sum_{i=1}^{n} q_i$ is the sum over all firms' sales. For firms to produce positive levels of output, we need $a > c_{H2} \geq c_{H1} \geq c_M > 0$. The multinational's and the domestic firms' profits are then given by, respectively

$$\Pi_i (q_i, x_i) = (p - (c_i - x_i)) q_i - \gamma x_i^2, \text{ where } i = M,\ H1,\ H2 \tag{1}$$

The structure of the game is outlined in figure 1. In the first stage the multinational firm

Figure 1: Game structure



decides whether and if so how to enter the domestic market. It can do so by acquiring one of the domestic firms or by setting up its own plant (i.e. greenfield investment).[8] If the MNE decides to enter via an acquisition, it will make a take-it-or-leave-it offer to one of the domestic firms. The amount offered will depend on the alternative choices of the firms involved in the takeover. Mergers and acquisitions are modelled here as was first done by Salant, Switzer and Reynolds (1983), that is the target firm is compensated for being taken over and then vanishes.[9] Greenfield investment by the MNE is associated with a fixed cost of setting up production facilities f.

[8]This choice of alternatives for a firm to serve a market abroad is not exhaustive, especially exports are omitted for simplicity. Bjorvatn (2001) compares M&A, greenfield investment and exports in a setting with symmetric firms. In one case two foreign firms consider entry in a market with one local incumbent, in the other case one foreign entrant interacts with two domestic incumbents. Buckley and Casson (1998) provide a more comprehensive analysis of entry choices in a monopolistic domestic market distinguishing between production and distribution.

[9]Note, however, that the assumption of different marginal cost does not imply the Salant, Switzer and Reynolds (1983) result that mergers will only be profitable if they involve at least 80% of the firms in an industry.

In the second stage the domestic firms can react to the MNE's decision. In the case of greenfield investment, entry by the MNE may induce exit or a merger among the domestic firms. In the case of entry via acquisition, the domestic firms can accept or reject the take-it-or-leave-it offer. At the same time also an acquisition may force the non-acquired firm out of the market.

In the third stage of the game all active old and new entities of firms decide how much to invest in a cost reducing technology before engaging in Cournot competition in the last stage of the game. The game consists of these last two stages for the domestic firms only if the multinational decides not to enter the market.

To understand the structure of the game and in particular the possibility of mergers and acquisitions note that we assume a competition authority in the background that follows a simple rule: namely to prohibit mergers or acquisitions that lead to monopoly. A final assumption is that whenever two firms form a new entity, they will be able to use the technology of the more efficient firm without additional cost, i.e. technology transfer is costless.

3 Benchmark equilibrium without foreign entry

The situation without foreign entry is considered as the initial market structure and as the benchmark. That is, we are looking at the solution to a two-stage game with two domestic firms, where the firms decide to invest in technology in the first stage and engage in Cournot competition in the second stage. Solving by backward induction equilibrium profits of the two firms can be obtained as:

$$\begin{aligned} \Pi_{H1} &= \gamma\left(9\gamma-4\right)\left(\tfrac{3\gamma(a-2c_{H1}+c_{H2})-2(a-c_{H1})}{(9\gamma-2)(3\gamma-2)}\right)^2 \\ \Pi_{H2} &= \gamma\left(9\gamma-4\right)\left(\tfrac{3\gamma(a+c_{H1}-2c_{H2})-2(a-c_{H2})}{(9\gamma-2)(3\gamma-2)}\right)^2. \end{aligned} \tag{2}$$

In equilibrium, both, investment and sales have the standard properties. They are increasing in market size a, decreasing in own initial marginal cost c_i, increasing in the marginal cost of the competitor(s) c_{-i}, decreasing in the technology parameter γ, and decreasing in the number of active firms in the market. For $H2$ to produce positive quantities in equilibrium, the following condition needs to be satisfied:

$$c_{H2}^{Dexit} \leq \frac{3\gamma\left(a+c_{H1}\right)-2a}{2\left(3\gamma-1\right)}. \tag{3}$$

Above this threshold, $H2$ will exit the market. This condition also implies that both firms have positive levels of investment in equilibrium. These are given by

$$\begin{aligned} x_{H1} &= 2\tfrac{3\gamma(a-2c_{H1}+c_{H2})-2(a-c_{H1})}{(9\gamma-2)(3\gamma-2)} \\ &\text{and} \\ x_{H2} &= 2\tfrac{3\gamma(a+c_{H1}-2c_{H2})-2(a-c_{H2})}{(9\gamma-2)(3\gamma-2)}. \end{aligned} \tag{4}$$

Total investment equals

$$x_{tot}^{H1,H2} = 2\frac{(2a-c_{H1}-c_{H2})}{(9\gamma-2)}. \tag{5}$$

4 The game with foreign entry

Now the full game can be addressed. Solving by backward induction, the profits of all firms in the last stage of the game can be obtained as given in table 1. When the foreign firm acquires home firm $H1$ for the takeover price v_1, there are two possible market structure outcomes. One in which the new joint entity of $M\&H1$ shares the market with the less efficient home firm $H2$. The other possibility is that the acquisition of $H1$ by the MNE induces $H2$ to exit. We assume that the competition authorities cannot fully observe the firms' cost parameters and, thus, will only block mergers or acquisitions that lead to monopoly directly (i.e. when there are initially only two firms in the market), but not when a monopoly arises due to the exit of the less efficient firm after a takeover.

When, instead, the MNE decides to acquire $H2$ for the takeover price v_2, the market is made up of the new entity $M\&H2$ and $H1$. Exit of $H1$ due to the takeover is a theoretical possibility but will not occur under given assumptions.

If the MNE engages in greenfield investment and establishes its own plant in the domestic market, there are three possible market structure outcomes, two of them are observationally equivalent. One possibility is that all three firms are active. The other two possibilities are that the two domestic firms merge or that the less efficient domestic firm is driven out of the market. The latter two alternatives cannot be distinguished in the sense that there will be two firms with identical marginal cost in the market.[10]

We will now analyse each of the multinational's alternatives separately, in order to then determine the equilibrium outcomes depending on parameter values. Consider first the case of multinational entry by acquisition.

[10]This is due to the way M&A are modelled here, results are likely to be different if the target firm would constitute an asset.

Table 1: Net Profits

	Acquisition of $H1$	
	$[M\&H1,\ H2]$	$[M\&H1,\ \emptyset]$
M	$\gamma\left(9\gamma-4\right)\left(\frac{3\gamma(a-2c_M+c_{H2})-2(a-c_M)}{(9\gamma-2)(3\gamma-2)}\right)^2-v_1$	$\gamma\frac{(a-c_M)^2}{4\gamma-1}-v_1$
$H1$	v_1	v_1
$H2$	$\gamma\left(9\gamma-4\right)\left(\frac{3\gamma(a+c_M-2c_{H2})-2(a-c_{H2})}{(9\gamma-2)(3\gamma-2)}\right)^2$	0

	Acquisition of $H2$
	$[M\&H2,\ H1]$
M	$\gamma\left(9\gamma-4\right)\left(\frac{3\gamma(a-2c_M+c_{H1})-2(a-c_M)}{(9\gamma-2)(3\gamma-2)}\right)^2-v_2$
$H1$	$\gamma\left(9\gamma-4\right)\left(\frac{3\gamma(a+c_M-2c_{H1})-2(a-c_{H1})}{(9\gamma-2)(3\gamma-2)}\right)^2$
$H2$	v_2

	Greenfield investment
	$[M,\ H1,\ H2]$
M	$\gamma\left(16\gamma-9\right)\left(\frac{4\gamma(a-3c_M+c_{H1}+c_{H2})-3(a-c_M)}{(16\gamma-3)(4\gamma-3)}\right)^2-f$
$H1$	$\gamma\left(16\gamma-9\right)\left(\frac{4\gamma(a+c_M-3c_{H1}+c_{H2})-3(a-c_{H1})}{(16\gamma-3)(4\gamma-3)}\right)^2$
$H2$	$\gamma\left(16\gamma-9\right)\left(\frac{4\gamma(a+c_M+c_{H1}-3c_{H2})-3(a-c_{H2})}{(16\gamma-3)(4\gamma-3)}\right)^2$
	$[M,\ H1\&H2]$ or $[M,\ H1,\ \emptyset]$
M	$\gamma\left(9\gamma-4\right)\left(\frac{3\gamma(a-2c_M+c_{H1})-2(a-c_M)}{(9\gamma-2)(3\gamma-2)}\right)^2-f$
$H1$	$\gamma\left(9\gamma-4\right)\left(\frac{3\gamma(a+c_M-2c_{H1})-2(a-c_{H1})}{(9\gamma-2)(3\gamma-2)}\right)^2$
$H2$	v_3 or 0

4.1 Acquisition decision

If the MNE decides to enter the domestic market by acquisition, its choice among the domestic firms will depend on the cost of the target firm and on the profits under the resulting market structure.

4.1.1 Acquisition of the more efficient domestic firm $H1$

When the more efficient domestic firm $H1$ gets a take-it-or-leave-it-offer from the MNE, it will accept the offer for any quote v_1 that gives it at least the profits it would earn if the MNE had decided to take over the other domestic firm $H2$, that is

$$v_1 \geq \gamma\left(9\gamma-4\right)\left(\frac{3\gamma\left(a+c_M-2c_{H1}\right)-2\left(a-c_{H1}\right)}{\left(9\gamma-2\right)\left(3\gamma-2\right)}\right)^2 . \tag{6}$$

If $H1$ accepts, this leaves the MNE with net profits of $\Pi_M^{M\&H1,H2} - v_1$. An acquisition of $H1$ is profitable for the MNE for

$$c_{H2} \geq c_{H1} \geq c_M \ . \tag{7}$$

Proof: see Appendix A.1.1.

When the MNE decides to buy $H1$, the condition for the less efficient domestic firm $H2$ to leave the market becomes more stringent:

$$c_{H2}^{A\_exit} > \frac{3\gamma\left(a+c_M\right)-2a}{2\left(3\gamma-1\right)} \tag{8}$$

as compared to the situation without foreign presence (eq. (3)). Thus, above this threshold the newly merged entity of $M\&H1$ will earn monopoly profits after compensating $H1$ for the takeover. These are always positive as $a > c_M$ by assumption.

For this range of parameter values the MNE could obtain $H2$ for free ($v_2 = 0$). It will, however, be more profitable for the MNE to buy $H1$ when it is optimal for $H2$ not to supply the market as this earns the new entity of $M\&H1$ monopoly profits. (Proof: see Appendix A.1.2.)

4.1.2 Acquisition of the less efficient domestic firm $H2$

If, instead, the MNE makes $H2$ a take-it-or-leave-it-offer, it will accept for any price that is at least as large as the profits it would earn if the MNE took over $H1$, that is

$$v_2 = max\left[0;\ \gamma\left(9\gamma-4\right)\left(\frac{3\gamma\left(a+c_M-2c_{H2}\right)-2\left(a-c_{H2}\right)}{\left(9\gamma-2\right)\left(3\gamma-2\right)}\right)^2\right]. \tag{9}$$

As long as $H2$ is not forced out of the market by multinational entry, the net profits of the MNE are given by $\Pi_M^{M\&H2,H1}-v_2$, where $v_2=\gamma\left(9\gamma-4\right)\left(\frac{3\gamma(a+c_M-2c_{H2})-2(a-c_{H2})}{(9\gamma-2)(3\gamma-2)}\right)^2$. These are positive for

$$c_{H2}\geq c_{H1}\geq c_M \text{ and } c_{H2}\leq \frac{3\gamma\left(2a-c_M+c_{H1}\right)-2\left(2a-c_M\right)}{2\left(3\gamma-1\right)}. \tag{10}$$

Proof: see Appendix A.1.3.

Note that an acquisition of $H2$ by the MNE will never induce the more efficient domestic firm $H1$ to leave the market. (Proof: see Appendix A.1.4.)

4.1.3 Acquisition of $H1$ versus acquisition of $H2$

Comparing the payoffs for the MNE under both scenarios $\Pi_M^{M\&H1,H2}-v_1$ and $\Pi_M^{M\&H2,H1}-v_2$ gives the threshold for which the MNE will prefer to acquire $H1$ rather than $H2$:

$$\begin{array}{lll} \text{For} & c_{H2}^{A\_H2vsH1}\leq \frac{9\gamma^2(2a+8c_M-5c_{H1})-24\gamma(a+c_M-c_{H1})+4a(2a-c_{H1})}{45\gamma^2-24\gamma+4} & \text{acquisition of } H2, \\ \text{and for} & c_{H2}^{A\_H2vsH1}> \frac{9\gamma^2(2a+8c_M-5c_{H1})-24\gamma(a+c_M-c_{H1})+4a(2a-c_{H1})}{45\gamma^2-24\gamma+4} & \text{acquisition of } H1. \end{array} \tag{11}$$

This result states that for small values of c_{H2} the MNE will acquire the less efficient domestic firm $H2$. When $H2$ is not so efficient relative to $H1$ (large values of c_{H2}) the MNE will acquire the more efficient domestic firm $H1$. The intuition for this result can be obtained by looking at the after-takeover profits and acquisition prices. In the case of an acquisition of $H1$, the profits for the MNE after the takeover depend positively on c_{H2} while the price of $H1$ (v_1) is independent of c_{H2}. In the case of an acquisition of $H2$, in contrast, the after-takeover profits for the MNE do not depend on c_{H2}, the takeover price v_2 is, however, decreasing in c_{H2}.

The MNE's net profits from a takeover of either the more efficient domestic firm $H1$ or the less efficient domestic firm $H2$ are, therefore, increasing in c_{H2} over the relevant range of parameter values. A look at second-order derivatives reveals that the net profits from acquiring $H1$ are increasing in c_{H2} at an increasing rate, while the net profits of acquiring $H2$ are increasing

in c_{H2} at a decreasing rate (see derivatives in Appendix A.1.5). This implies that as c_{H2} increases - that is $H2$ becomes less efficient - it will eventually become more profitable for the MNE to buy $H1$ if this is not the case at the outset already.

It can be shown that a takeover of $H2$ will always be profitable up to the threshold above which it is more profitable to acquire $H1$ (eq. (11)). This is shown in Appendix A.1.3. Note from (7) that we need not worry about the profitability of a takeover of $H1$ as this is profitable over the whole range of parameter values.

Comparing the profitability of an acquisition of $H1$ to the acquisition of $H2$ and solving for c_{H1} instead of $c_{\overline{H2}}^{A\_H2vsH1}$, one can show that $H1$ will always be in the market when the MNE decides to buy $H2$ (see Appendix A.1.4 for details).

4.2 Greenfield decision

With greenfield entry by the MNE the number of firms in the market increases and so the condition for the less efficient domestic firm to stay in the market is more stringent than in the acquisition case:

$$c_{\overline{H2}}^{G\_exit} > \frac{4\gamma\left(a + c_M + c_{H1}\right) - 3a}{3\left(4\gamma - 1\right)}. \tag{12}$$

However, in this case a merger among the domestic firms might become possible.[11] While the competition authority would have blocked a merger to monopoly in a situation with the two domestic firms only, entry by the MNE may now induce the authorities to look at such a merger more favourably. A merger among the domestic firms $H1$ and $H2$ will be profitable if their joint profits after the merger are larger than the sum of their individual profits in the absence of a merger: $\Pi_{H1\&H2}^{M,H1\&H2} \geq \Pi_{H1}^{M,H1,H2} + \Pi_{H2}^{M,H1,H2}$. The implied threshold for a domestic merger to be profitable $c_{\overline{H2}}^{D\_merger}$ is given in Appendix A.2 as it is very long and does not provide any intuition.

4.3 Greenfield versus Acquisition

In the first stage of the game the MNE decides between greenfield investment and acquisition of one of the domestic firms. The thresholds computed above determine which of the greenfield and acquisition alternatives need to be compared on the basis of net profits (see table 1). As the ranking of some of the above thresholds depends on parameter values, so will the choice between

[11] We assume that the MNE will stick with its initial entry decision. That is it will not want to engage in M&A with the domestic firms after having established its own plant.

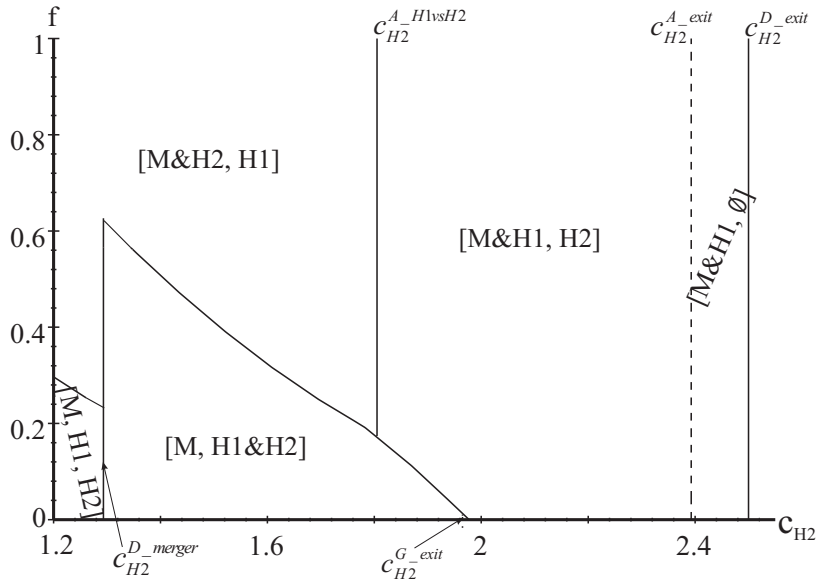
greenfield entry and entry by acquisition. Therefore the next section presents graphical illustrations of the equilibrium structure associated with three different sets of parameter combinations.

5 Equilibrium

5.1 Market Structure

Figure 2 gives a representation of the equilibrium market structure in $f,\ c_{H2}-$ space when the technology parameter γ is large ($\gamma = 5$). This means that investments in R&D are costly and therefore not so high. In fact, the equilibrium structure depicted is qualitatively very similar to the case where the costs of R&D investment are prohibitive (i.e. $\gamma = \infty$).

Figure 2: Equilibrium market structure with a large technology parameter



parameters: $a = 4,\ \gamma = 5,\ c_M = 1,\ c_{H1} = 1.2$

The domestic firm $H2$ is by assumption less efficient than $H1$ ($c_{H2} \geq c_{H1}$), therefore, attention can be constrained to values of c_{H2} larger than $c_{H1} = 1.2$. From above the condition for $H2$ to be in the market when there are only domestic firms, i.e. the upper bound for the field of action here is given by $c_{H2}^{D\_exit} = 2.5$.

Greenfield investment can be observed in the south-west corner of the figure, while acquisitions dominate the north-east. In the small trapezoid area next to the origin the multinational engages in greenfield investment and the domestic firms both remain in the market independently. This area is characterised by low fixed setup cost for the MNE and rather similar marginal cost of

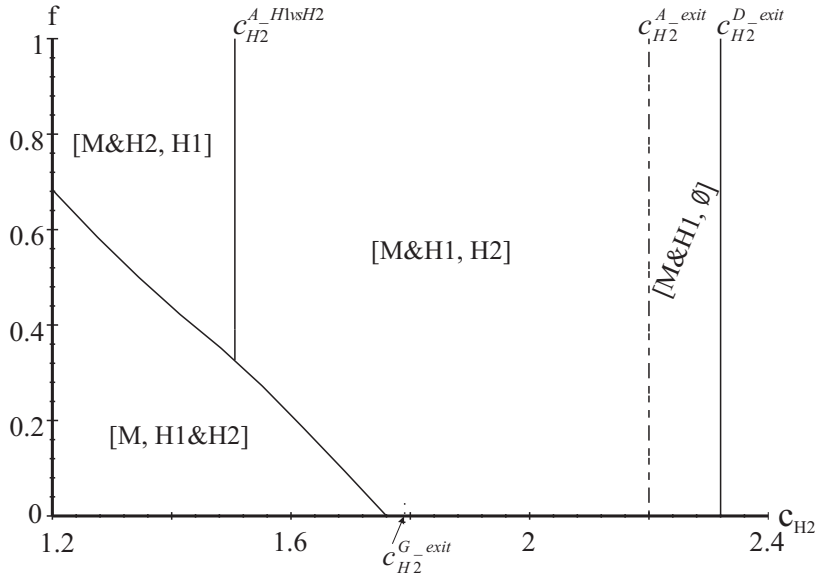
all three firms. In the adjacent triangular shape area on the left, there is also greenfield investment by the MNE but the domestic firms prefer to merge whenever the less efficient domestic firm $H2$ does not leave the market (as is the case in the very right hand corner of this area).

Above most of the greenfield area, that is for higher fixed cost and for small to intermediate values of c_{H2}, the MNE shares the market with $H1$ by acquiring $H2$. Seeing that profits under greenfield investment have to be shared among three firms as long as the domestic firms do not merge the greenfield area reaches into the acquisition area up to much higher levels of fixed cost when there are only two firms in the market.

We observe the MNE acquiring $H2$ provided that its technology level is not too different from that of the more efficient domestic firm $H1$. This is because the net profits of an acquisition of $H2$ are initially higher than those of an acquisition of $H1$. Above a certain level of c_{H2} (namely $c_{H2}^{A\_H2vsH1}$) this is reversed as the operating profits for the MNE in the case of an acquisition of $H1$ increase with c_{H2} while the takeover price stays the same.

When the MNE acquires $H1$, the less efficient domestic firm will decide not to serve the market when c_{H2} is rather high (i.e. when $H2$ is very inefficient relative to $H1$). Above $c_{H2}^{A\_exit}$ the acquisition of $H1$ by the MNE, therefore, results in a monopoly. Note that both exit thresholds are lower than in the case without foreign presence.

Figure 3: Equilibrium structure with a small technology parameter



parameters: $a = 4,\ \gamma = 2,\ c_M = 1,\ c_{H1} = 1.2$

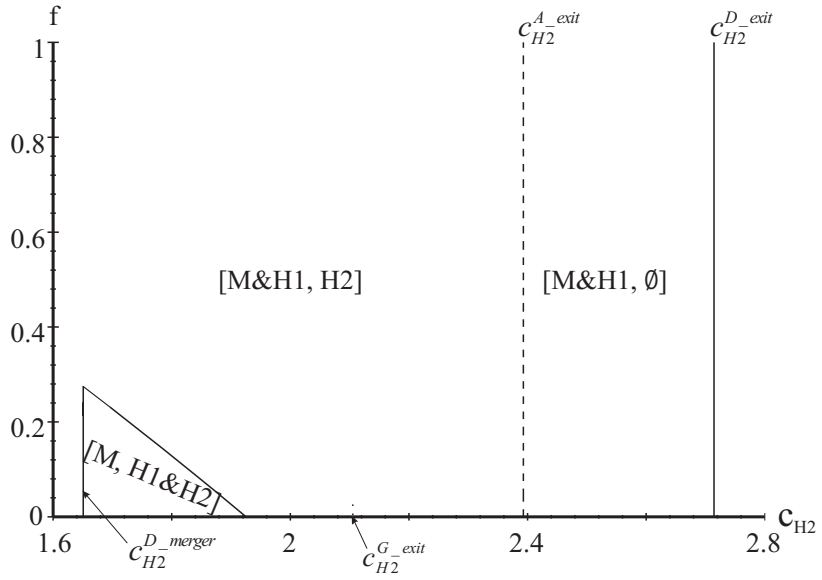
Consider now a case depicted in figure 3 where the technology parameter γ is low ($\gamma = 2$), that is the cost of R&D investment does not increase so fast. Hence, firms' R&D investment

levels will be higher. Here the area where all three firms are active when the MNE engages in greenfield investment and marginal costs of the three firms are not too different does not feature at all. In the south-west corner there is greenfield investment by the MNE with the domestic firms merging (the threshold $c_{H2}^{D\_merger}$ is lower than the smallest possible value of $c_{H2} = c_{H1}$).

Above the greenfield region the area where the MNE acquires $H2$ does not extend as far east as in figure 2. The net profits of acquiring the stronger competitor $H1$ and sharing the market with a relatively inefficient domestic firm $H2$ here exceed those of buying the cheaper domestic firm $H2$ at a lower value of $c_{H2}^{A\_H2vsH1}$. In this figure the area where the MNE acquires $H1$ is proportionally the largest.

Returning to the larger technology parameter ($\gamma = 5$) from figure 2, but assuming that the MNE has now a much more efficient technology than the domestic firms to start with, we obtain figure 4. Thus, firms are very asymmetric and the multinational will be able to improve its technology by much more than the domestic firms by investing in R&D.

Figure 4: Equilibrium structure when the MNE and the domestic firms are very different in initial marginal cost



parameters: $a = 4$, $\gamma = 5$, $c_M = 1$, $c_{H1} = 1.6$

The threshold between a takeover of $H1$ and $H2$ is lower than the smallest possible value of c_{H2}, hence we will only observe takeovers of the more efficient domestic firm $H1$. Moreover, greenfield investment is only profitable when the domestic firms merge. This is suggestive for an observation by Danzon, Epstein and Nicholson (2004) who find that in the pharmaceutical and biotech industries mergers among small firms are primarily an exit strategy for firms in financial

trouble. For the largest part in this picture the MNE acquires $H1$ and shares the market with a rather inefficient competitor or becomes a monopolist through the acquisition.

Comparing the three figures one can obtain the following results: First, exit levels of the domestic firms are lower with foreign presence than without. This reflects a finding by DeBacker and Sleuwaegen (2000) that the inflow of FDI increases domestic exit rates in a sample of Belgian manufacturing firms.[12]

Second, for greenfield investment to be an interesting choice for the MNE in this setting a technological advantage is not sufficient. It is rather the technological advantage in combination with strong competition by the domestic firms that makes greenfield investment attractive. The reason being that when all three firms have similar levels of marginal cost, their profits are close to those in an equilibrium with symmetric firms, and hence an acquisition of either of the domestic firms becomes very expensive for the MNE.[13]

The third result is regarding the MNE's choice of takeover target. In principle the MNE would always like to acquire the more efficient domestic firm $H1$ in order to eliminate the stronger competitor. However, as longs as the MNE's and the domestic firms' marginal cost are not too different, it will only be able to afford the weaker domestic firm $H2$.[14] Empirically, at least the first observation is in line with Harris and Robinson (2002) who provide evidence for a sample of UK manufacturing plants that foreign acquirers have higher productivity levels (as measured by total factor productivity) and that they buy the most productive domestic plants. A comparison between figures 2 and 3 reveals that the area where $H1$ is acquired by the MNE increases when the available technology is not so expensive and therefore R&D investments are higher. While a comparison between figures 2 and 4 shows that the more efficient the MNE with respect to the domestic firms, the more likely an acquisition of the more efficient firm.

[12] DeBacker and Sleuwaegen (2002) do, unfortunately, not distinguish between greenfield FDI and cross-border M&A.

[13] Applying a differentiated products interpretation to a Hotelling model Eicher and Kang (2004) obtain a different result. They show that high degrees of competition (i.e. little product differentiation) reduce the likelihood that the MNE coexists with the local firm, as entry by the more efficient MNE drives the domestic firm out of the market. Sufficiently weak competition in their framework allows for coexistence and rich strategic entry mode interaction between the local firm and the MNE.

[14] These results have to be compared to recent models of cross-border mergers & acquisitions in a general equilibrium context. In Neary (2002) trade liberalisation may lead to cross-border merger waves with low-cost home (foreign) firms buying up high-cost foreign (home) firms.

In Nocke and Yeaple (2004) cross-border M&A involve either the most or the least efficient active firms depending on whether firms differ in their mobile or non-mobile capabilities. In an industry where firms differ in mobile factors the most efficient firms engage in cross-border M&A, less efficient firms engage in greenfield FDI, while the least efficient active firms export. In an industry where firms differ in immobile capabilities the ranking of choices for the most efficient to least efficient firms is greenfield FDI, exports, cross-border M&A.

Finally, we observe that the tendency towards market concentration is stronger the less costly investment in research and development. When the cost function for R&D investments is not too convex (γ small), the firms invest more in R&D. Therefore they have higher expenses and competition is fiercer, implying smaller profit margins. This can be offset by a more concentrated market structure to some extent.

5.2 R&D investment

We now turn to characterise the possible market structure outcomes regarding R&D levels at the firms and at the industry level. Recall from the benchmark analysis in section 3 that total investment with only the two domestic firms in the market is given by $x_{tot}^{H1,H2} = 2\frac{(2a-c_{H1}-c_{H2})}{(9\gamma-2)}$. It is easy to see from table 2 that the presence of a more efficient foreign firm increases the total level of investment targeted at the domestic market for all market structures other than the monopoly case, where the relationship is ambiguous (see Appendix A.3.1 for details).

Table 2: Investment levels

	Acquisition of $H1$		Acquisition of $H2$
	$[M\&H1,\ H2]$	$[M\&H1,\ \emptyset]$	$[M\&H2,\ H1]$
M	$\frac{3\gamma(a-2c_M+c_{H2})-2(a-c_M)}{(9\gamma-2)(3\gamma-2)}$	$\frac{a-c_M}{4\gamma-1}$	$\frac{3\gamma(a-2c_M+c_{H1})-2(a-c_M)}{(9\gamma-2)(3\gamma-2)}$
$H1$	0	0	$\frac{3\gamma(a+c_M-2c_{H1})-2(a-c_{H1})}{(9\gamma-2)(3\gamma-2)}$
$H2$	$\frac{3\gamma(a+c_M-2c_{H2})-2(a-c_{H2})}{(9\gamma-2)(3\gamma-2)}$	0	0
total	$2\frac{2a-c_M-c_{H2}}{9\gamma-2}$	$\frac{a-c_M}{4\gamma-1}$	$2\frac{2a-c_M-c_{H1}}{9\gamma-2}$

	Greenfield investment	
	$[M,\ H1,\ H2]$	$[M,\ H1\&H2]$ or $[M,\ H1,\ \emptyset]$
M	$\frac{4\gamma(a-3c_M+c_{H1}+c_{H2})-3(a-c_M)}{(16\gamma-3)(4\gamma-3)}$	$\frac{3\gamma(a-2c_M+c_{H1})-2(a-c_M)}{(9\gamma-2)(3\gamma-2)}$
$H1$	$\frac{4\gamma(a+c_M-3c_{H1}+c_{H2})-3(a-c_{H1})}{(16\gamma-3)(4\gamma-3)}$	$\frac{3\gamma(a+c_M-2c_{H1})-2(a-c_{H1})}{(9\gamma-2)(3\gamma-2)}$
$H2$	$\frac{4\gamma(a+c_M+c_{H1}-3c_{H2})-3(a-c_{H2})}{(16\gamma-3)(4\gamma-3)}$	0
total	$3\frac{3a-c_M-c_{H1}-c_{H2}}{16\gamma-3}$	$2\frac{2a-c_M-c_{H1}}{9\gamma-2}$

Note, however, that entry of the more efficient multinational firm in most cases eliminates at least one of the domestic firms. As firms' investment levels are decreasing in own marginal cost and increasing in their competitors' marginal cost, a more efficient firm in the market reduces their R&D spending. That is, we have that R&D investment by the MNE crowds out R&D investment by the domestic firm(s) (see Appendix A.3.2 for individual comparisons).

These results are in line with empirical findings by various authors: Lipsey (2002) in a survey of home country effects of FDI concludes that overall productivity is improved by the presence of foreign owned operations. Concerning the innovative efforts of domestic firms Veugelers and Vanden Houte (1990) find them to be reduced by foreign presence in a sample of Belgian manufacturing firms, - especially when products are not so differentiated as is the case here. For small Venezuelan enterprises Aitken and Harrison (1998) show that foreign equity participation is positively correlated with plant productivity, whereas foreign investment negatively affects the productivity of domestically owned firms. Finally, Driffield (2001) in a sample of UK manufacturing firms estimates inward investment to stimulate productivity growth in the domestic sector by around 0.75% per annum. He argues that this is a result of the productivity advantage exhibited by foreign firm and that it cannot be attributed to investment or output spillovers. Moreover, he finds that foreign R&D appears to crowd out domestic R&D with a negligible effect on domestic productivity.

6 Concluding Remarks

This paper analyses the impact of entry and presence of foreign firms on the firms in an industry in the host country along different lines than much of the literature which is concentrated on technology or productivity spillovers. In fact, it centres the attention on the changes in market structure brought about by different forms of foreign entry. It also investigates the implied effects of such changes on competition in R&D investments and in the product market .

Allowing for sufficient symmetries across industries the model provides an intuition for the relative shares of greenfield investment and cross-border mergers & acquisitions in foreign direct investment. Cross-border M&A are favoured over greenfield investments because they are in many cases a cheaper way of entering a foreign market while at the same time allowing to eliminate a competitor.

The paper also offers a rationalisation of a less standard argument for the increase in concentration ratios along with the surge in foreign direct investment world-wide over the last decade or more. That is to say that this may well be due to not only foreign multinationals buying up domestic firms but also to domestic firms merging as a reaction to foreign entry.

Moreover, with the assumed setup it is possible to demonstrate that foreign entry may in fact make it desirable and feasible for domestic incumbents to merge. In turn, anticipating such a reaction a foreign multinational considering to enter the market may prefer to setup its own plant (greenfield investment) to an acquisition of a local firm.

When this sort of strategic interaction is combined with continuous investments in process R&D by all active firms, a technological advantage of the MNE translates into higher R&D investment at the industry level. However, this comes at the cost of crowding out R&D investment by the domestic firm(s). This accords well with empirical findings that do not allow to discriminate between technology spillovers from multinational firms and the impact of foreign presence on competition. To make sure, this is not to say that there is no potential for spillovers. Various authors (e.g. DeBacker and Sleuwaegen (2002), Görg and Strobl (2003), Sembenelli and Siotis (2002)) have emphasised that technology spillovers and efficiency gains through multinationals are likely to be long-run effects. For that reason this issue is left to be addressed in (more) dynamic models.

Furthermore, future research should improve on the present setup by eliminating the bias in favour of cross-border acquisitions which is implied by the assumption of costless technology transfer. (See e.g. Wang and Blomström (1992) and also Glass and Saggi (2002) who provide models of technology transfer along with FDI.) By the same token, modelling M&A as acquisitions of assets rather than as payments to the acquired firm to leave the market would move the model closer to recent developments in the merger literature.

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A Appendix

A.1 Issues regarding acquisitions

A.1.1 Profitability of a takeover of $H1$:

Solving $\Pi_M^{M\&H1,H2} - v_1 \geq 0$ yields

$$c_{H2} \leq \frac{-3\gamma\left(2a - c_M - c_{H1}\right) + 2\left(2a - c_M - c_{H1}\right)}{3\gamma} \text{ and } c_{H2} \geq \frac{3\gamma\left(3c_M - 2c_{H1}\right) + 2\left(c_M - c_{H1}\right)}{3\gamma}.$$

However, both of these potential thresholds are dominated by the assumed structure of marginal cost $c_{H2} \geq c_{H1} \geq c_M$ as

$$\begin{aligned} &c_{H2} \leq \tfrac{-3\gamma\left(2a - c_M - c_{H1}\right) + 2\left(2a - c_M - c_{H1}\right)}{3\gamma} - c_{H1} = -\tfrac{9\gamma - 2}{3\gamma}\left(c_{H1} - c_M\right) \\ &\text{and} \\ &c_{H2} \geq \tfrac{3\gamma\left(3c_M - 2c_{H1}\right) + 2\left(c_M - c_{H1}\right)}{3\gamma} - c_{H1} = -\tfrac{3\gamma - 2}{3\gamma}\left(2a - c_M - c_{H1}\right) \end{aligned}$$

are strictly smaller than zero. Hence, an acquisition of $H1$ by the MNE will be profitable for any $c_{H2} \geq c_{H1} \geq c_M$.

A.1.2 Acquiring $H1$ when it is optimal for $H2$ not to supply the market versus incorporating $H2$ for free

$\Pi_M^{M\&H1,\emptyset} - v_1 - \left(\Pi_M^{M\&H2,H1} - 0\right)$ can be written as

$$\begin{aligned} &\Pi_M^{M\&H1,\emptyset} - v_1 - \left(\Pi_M^{M\&H2,H1} - 0\right) \\ &= \tfrac{\left(a - c_M\right)^2}{4\gamma - 1} - \gamma\left(9\gamma - 4\right)\left[\left(\tfrac{3\gamma(a + c_M - 2c_{H1}) - 2(a - c_{H1})}{(9\gamma - 2)(3\gamma - 2)}\right)^2 + \left(\tfrac{3\gamma(a - 2c_M + c_{H1}) - 2(a + c_M)}{(9\gamma - 2)(3\gamma - 2)}\right)^2\right]. \end{aligned} \tag{13}$$

As c_{H1} approaches its lower bound c_M, this expression approaches:

$$\Pi_M^{M\&H1,\emptyset} - v_1 - \left(\Pi_M^{M\&H2,H1} - v_2^{\min}\right) = \frac{\gamma\left(9\gamma^2 + 14\gamma - 4\right)}{\left(9\gamma - 2\right)^2\left(4\gamma - 1\right)}\left(a - c_M\right)^2,$$

which is larger than zero.

The upper bound for this expression is given by the condition for $H2$ to exit in the equilibrium with domestic firms only $c_{H2}^{D\_exit}$. Equation (13) does, however, not depend on c_{H2}. Therefore,

we take a detour by calculating the exit threshold (eq. (3)) in the domestic equilibrium for c_{H1} :

$$c_{H1}^{D\_exit} = \frac{3\gamma\left(2c_{H2}-a\right)\left(a-c_{H2}\right)}{3\gamma}.$$

Plugging this into equation (13) gives

$$\begin{aligned}&\Pi_M^{M\&H1,\emptyset} - v_1 - \left(\Pi_M^{M\&H2,H1} - v_2^{\min}\right)\\ &= \frac{-81\gamma^4\left(9a^2-14ac_M-7c_M^2-32ac_{H2}+16c_{H2}^2\right)+441\gamma^3(3a-c_M-2c_{H2})(a+c_M-2c_{H2})}{9(9\gamma-2)(4\gamma-1)(3\gamma-2)}\\ &+\frac{-24\gamma^2\left(34a^2-6ac_M-3c_M^2-74ac_{H2}+37c_{H2}^2\right)+4(49\gamma-4)(a-c_{H2})^2}{9(9\gamma-2)(4\gamma-1)(3\gamma-2)}\end{aligned}$$

As c_{H2} in this expression approaches its upper limit a, this expression goes to

$$\Pi_M^{M\&H1,\emptyset} - v_1 - \left(\Pi_M^{M\&H2,H1} - v_2^{\min}\right) = \frac{\gamma\left(63\gamma^2-49\gamma+8\right)}{\left(9\gamma-2\right)\left(4\gamma-1\right)\left(3\gamma-2\right)}\left(a-c_M\right)^2,$$

which is also positive under given assumptions. Therefore, it is never profitable for the MNE to incorporate $H2$ for free, when it can become a monopolist by acquiring $H1$.

A.1.3 Profitability of a (costly) takeover of $H2$

Solving $\Pi_M^{M\&H2,H1} - v_2 \geq 0$, where $v_2 = \gamma\left(9\gamma-4\right)\left(\frac{3\gamma(a+c_M-2c_{H2})-2(a-c_{H2})}{(9\gamma-2)(3\gamma-2)}\right)^2$ yields

$$\frac{3\gamma\left(3c_M-2c_{H1}\right)-2c_{H1}}{2\left(3\gamma-1\right)} \leq c_{H2} \leq \frac{3\gamma\left(2a-c_M+c_{H1}\right)-2\left(2a-c_1\right)}{2\left(3\gamma-1\right)}.$$

The lower bound is less stringent than the assumed structure of marginal cost $c_{H2} \geq c_{H1} \geq c_M$:

$$\frac{3\gamma\left(3c_M-2c_{H1}\right)-2c_{H1}}{2\left(3\gamma-1\right)} - c_{H1} = -\frac{9\gamma-2}{2\left(3\gamma-1\right)}\left(c_{H1}-c_M\right) < 0.$$

Therefore, acquiring $H2$ will be profitable for any value of c_{H2} between $c_{H2} \geq c_{H1} \geq c_M$ and $c_{H2} \leq \frac{3\gamma(2a-c_M+c_{H1})-2(2a-c_M)}{2(3\gamma-1)}$.

Note that this upper bound is larger than the threshold for a takeover of $H1$ to be more profitable than a takeover of $H2$ ($c_{H2}^{A\_H1vsH2}$):

$$\begin{aligned}&\frac{3\gamma(2a-c_M+c_{H1})-2(2a-c_M)}{2(3\gamma-1)} - \frac{9\gamma^2(2a+8c_M-5c_{H1})-24\gamma(a+c_M-c_{H1})+4a(2a-c_{H1})}{45\gamma^2-24\gamma+4}\\ &= \frac{9\gamma-2}{2(3\gamma-1)(45\gamma^2-24\gamma+4)}\left[\left(18\gamma^2-12\gamma\right)a-\left(36\gamma^2-36\gamma+4\right)c_M+\left(45\gamma^2-24\gamma+4\right)c_{H1}\right].\end{aligned}$$

The coefficients to a and c_{H2} add up to the coefficient to c_M. Hence, given that we have assumed

$a > c_{H2} \geq c_M$ this term is always larger than zero, and an acquisition of $H2$ is profitable up to the threshold where an acquisition of $H1$ becomes more profitable.

A.1.4 A takeover of $H2$ will never induce $H1$ to leave the market

Comparing the net profits of an acquisition of $H1$ to the net profits of an acquisition of $H2$ and solving for c_{H2} (as given in eq. (11)) yields

$$c_{H1}^{A\_H1\,vs\,A\_H2} = \frac{9\gamma^2\left(2a+8c_M-5c_{H2}\right)-24\gamma\left(a+c_M+c_{H2}\right)-4\left(2a-c_{H2}\right)}{\left(3\gamma-1\right)\left(45\gamma^2-24\gamma+4\right)}.$$

The threshold for $H1$ to exit the market when $H2$ is taken over is $c_{H1}^{A\_exit} > \frac{3\gamma(a+c_M)-2a}{2(3\gamma-1)}$. Comparing the two

$$\begin{aligned} & c_{H1}^{A\_exit} - c_{H1}^{A\_H1vsH2} \\ &= \frac{\left(27\gamma^3+18\gamma^2-36\gamma+8\right)a-\left(279\gamma^3+216\gamma^2+36\gamma\right)c_M+\left(270\gamma^3-234\gamma^2+72\gamma-8\right)c_{H2}}{2(3\gamma-1)(45\gamma^2-24\gamma+4)}. \end{aligned}$$

The coefficients to a and c_{H2} add up to the coefficient to c_M. Hence, given that we have assumed $a > c_{H2} \geq c_M$ this term is always larger than zero. $H1$ will, therefore, always be in the market when the MNE acquires $H2$.

A.1.5 Derivatives of net acquisition profits

$$\begin{aligned}
\frac{\partial}{\partial c_{H2}}\left[\Pi_M^{M\&H1,H2}-v_1\right] &= 6\gamma^2\left(9\gamma-4\right)\frac{\left(3\gamma-2\right)\left(a-c_M\right)+3\gamma\left(c_{H2}-c_M\right)}{\left(9\gamma-2\right)^2\left(3\gamma-2\right)^2} > 0 \\
\frac{\partial^2}{\partial c_{H2}^2}\left[\Pi_M^{M\&H1,H2}-v_1\right] &= 18\gamma^3\frac{9\gamma-4}{\left(9\gamma-2\right)^2\left(3\gamma-2\right)^2} > 0 \\
\frac{\partial}{\partial c_{H2}}\left[\Pi_M^{M\&H2,H1}-v_2\right] &= 4\gamma\left(9\gamma-4\right)\left(3\gamma-1\right)\frac{3\gamma\left(a+c_M-2c_{H2}\right)-2\left(a-c_{H2}\right)}{\left(9\gamma-2\right)^2\left(3\gamma-2\right)^2} \\
&\geq 0 \text{ for } c_{H2} \leq c_{H2}^{A_exit} = \frac{3\gamma\left(a+c_M\right)-2a}{2\left(3\gamma-1\right)} \\
&< 0 \text{ for } c_{H2} > c_{H2}^{A_exit} = \frac{3\gamma\left(a+c_M\right)-2a}{2\left(3\gamma-1\right)} \\
\frac{\partial^2}{\partial c_{H2}^2}\left[\Pi_M^{M\&H2,H1}-v_2\right] &= -8\gamma\left(9\gamma-4\right)\frac{\left(3\gamma-1\right)^2}{\left(9\gamma-2\right)^2\left(3\gamma-2\right)^2} < 0
\end{aligned}$$

A.2 Threshold for a merger among the domestic firms in the case of greenfield investment by the MNE

$$c_{H2}^{D\_merger} = \frac{32\gamma^2(a+c_M+3c_{H1})-12\gamma(3a+c_M+2c_{H1})+9a}{160\gamma^2-72\gamma+9} + \frac{(16\gamma-3)}{(16\gamma-9)(9\gamma-2)(3\gamma-2)(160\gamma^2-72\gamma+9)}\sqrt{\gamma\left(16\gamma-9\right)z},$$

where

$$\begin{aligned} z = {} & 20736\gamma^6\left(a+c_M-2c_{H1}\right)^2 - 144\gamma^5\left(391a+415c_M-806c_{H1}\right)\left(a+c_M-2c_{H1}\right) \\ & +24\gamma^4\left(a\left(2195a+5171c_M-9561c_{H1}\right)+2442c_M^2-10055c_Mc_{H1}+9808c_{H1}^2\right) \\ & -\gamma^3\left(17a\left(839a+3840c_M-5518c_{H1}\right)+26016c_M^2-117312c_Mc_{H1}+105559c_{H1}^2\right) \\ & -\gamma^2\left(a\left(6511a-19330c_M+6308c_{H1}\right)-5921c_M^2-31172c_Mc_{H1}+18740c_{H1}^2\right) \\ & +12\gamma\left(11a\left(34a-29c_M-39c_{H1}\right)-51c_M^2+421c_Mc_{H1}+4c_{H1}^2\right) \\ & -36\left(a-c_{H1}\right)\left(19a-12c_M-7c_{H1}\right) \end{aligned}$$

A.3 Investment levels

A.3.1 Comparing total investment levels under the different market structure outcomes to those in the situation without MNE entry

Acquisition of $H1$ with $H2$ in the market

$$2\frac{2a-c_M-c_{H2}}{9\gamma-2} - 2\frac{2a-c_{H1}-c_{H2}}{9\gamma-2} = c_M - c_{H1} \geq 0.$$

Acquisition of $H1$ without $H2$ in the market (monopoly outcome)

$$\frac{a-c_M}{4\gamma-1} - 2\frac{2a-c_{H1}-c_{H2}}{9\gamma-2} = \frac{\left(-7\gamma+2\right)a+\left(-9\gamma+2\right)c_M+\left(8\gamma-2\right)c_{H1}+\left(8\gamma-2\right)c_{H2}}{\left(4\gamma-1\right)\left(9\gamma-2\right)}.$$

Solving for c_{H2}, we have that total investment in a market with the domestic firms only will be higher than investment when the MNE is a monopolist for $c_{H2} \leq \frac{(-7a-9c_1+8c_2)\gamma+2a+2c_{H1}-2c_{H2}}{4\gamma-1}$.

Acquisition of $H2$ / Greenfield investment with one domestic firm in the market

Investment levels are the same when the MNE acquires $H2$ and when it engages in greenfield investment with only one domestic firm in the market, simply because the active firms have the same marginal cost in both cases.

$$2\frac{2a-c_M-c_{H1}}{9\gamma-2} - 2\frac{2a-c_{H1}-c_{H2}}{9\gamma-2} = c_M - c_{H2} > 0.$$

Greenfield investment with two domestic firms in the market

$$3\frac{3a-c_M-c_{H1}-c_{H2}}{16\gamma-3}-2\frac{2a-c_{H1}-c_{H2}}{9\gamma-2}=\frac{(17\gamma-6)\,a+(-27\gamma+6)\,c_M+5\gamma c_{H1}+5\gamma c_{H2}}{(16\gamma-3)\,(9\gamma-2)}>0.$$

Other than in the monopoly outcome where the result is ambiguous, total investment in the industry is always at least as large with the MNE in the market than in the absence of foreign entry.

A.3.2 Comparing investment levels of the domestic firm(s) without MNE entry to those under the different market structure outcomes

Acquisition of $H1$ with $H2$ in the market

R&D investment of $H2$:

$$2\frac{3\gamma\,(a+c_{H1}-2c_{H2})-2\,(a-c_{H2})}{(9\gamma-2)\,(3\gamma-2)}-\frac{3\gamma\,(a+c_M-2c_{H2})-2\,(a-c_{H2})}{(9\gamma-2)\,(3\gamma-2)}=\frac{c_{H1}-c_M}{(9\gamma-2)\,(3\gamma-2)}>0.$$

Acquisition of $H2$ / Greenfield investment with one domestic firm in the market

R&D investment of $H1$:

$$2\frac{3\gamma\,(a-2c_{H1}+c_{H2})-2\,(a-c_{H1})}{(9\gamma-2)\,(3\gamma-2)}-\frac{3\gamma\,(a+c_M-2c_{H1})-2\,(a-c_{H1})}{(9\gamma-2)\,(3\gamma-2)}=\frac{c_{H2}-c_M}{(9\gamma-2)\,(3\gamma-2)}>0.$$

Greenfield investment with two domestic firms in the market
R&D investment of $H1$:

$$\begin{aligned}&2\tfrac{3\gamma(a-2c_{H1}+c_{H2})-2(a-c_{H1})}{(9\gamma-2)(3\gamma-2)}-\tfrac{4\gamma(a+c_M-3c_{H1}+c_{H2})-3(a-c_{H1})}{(16\gamma-3)(4\gamma-3)}\\&=\gamma\tfrac{\left(60\gamma^2-85\gamma+30\right)a+\left(-324\gamma^2+288\gamma-48\right)c_1+\left(204\gamma^2-131\gamma+12\right)c_2+\left(60\gamma^2-72\gamma+6\right)c_3}{(16\gamma-3)(4\gamma-3)(9\gamma-2)(3\gamma-2)}>0.\end{aligned}$$

R&D investment of $H2$:

$$\begin{aligned}&2\tfrac{3\gamma(a+c_{H1}-2c_{H2})-2(a-c_{H2})}{(9\gamma-2)(3\gamma-2)}-\tfrac{4\gamma(a+c_M+c_{H1}-3c_{H2})-3(a-c_{H2})}{(16\gamma-3)(4\gamma-3)}\\&=\gamma\tfrac{\left(60\gamma^2-85\gamma+30\right)a+\left(-324\gamma^2+288\gamma-48\right)c_1+\left(60\gamma^2-72\gamma+6\right)c_2+\left(204\gamma^2-131\gamma+12\right)c_3}{(16\gamma-3)(4\gamma-3)(9\gamma-2)(3\gamma-2)}>0.\end{aligned}$$

There is no R&D investment by a domestic firm in the **monopoly** case. For the other market outcomes the calculations above show that R&D investment of the domestic firms is always higher when the MNE is not in the market.