MPRA
Munich Personal RePEc Archive

A Model of Competition between Multinationals

Koska, Onur A.

23 November 2014

Online at https://mpra.ub.uni-muenchen.de/68024/
MPRA Paper No. 68024, posted 25 Nov 2015 05:47 UTC

A Model of Competition between Multinationals

November 23, 2014

Abstract

This study models competition between multinationals, sequentially entering the same market, and analyzes how they choose their entry modes between trade, greenfield investment and acquisition, and how competition amongst them affects their choices. I discuss two important factors that lead a multinational whether or not to acquire a local firm: the intensity of *pre-* and *post-acquisition* competition. The former determines both the acquisition price and the profitability of the next best alternative entry mode, whereas the latter determines the extent of business stealing by the rival. The results point to a non-linear relationship between trade and investment liberalization and foreign direct investment.

Keywords: Market Entry; Foreign Direct Investment; Acquisition; Trade

JEL Classification: D21; F23; L13

1 Introduction

It is well documented in the literature that (i) multinationals operate mostly in oligopolistic markets, and (ii) they are significantly responsive to each other's investment decisions; see, for example, Caves (1996). However, most studies either consider a single investor's foreign market entry mode choice, or look at multiple investors in a non-strategic framework. This study contributes to the literature by modeling competition between multinationals entering the same market, and by scrutinizing how they strategically interact and choose their entry modes between trade, greenfield investment and acquisition. I highlight two important factors that lead a multinational whether or not to acquire a local firm: the intensity of *pre-* and *post-acquisition* competition. The former determines both the acquisition price and the profitability of the next best alternative entry mode, whereas the latter determines the extent of business stealing by the rival. Acquisition reduces competition in the product market and enables the rival to steal business from the acquiring firm via trade or horizontal foreign direct investment (FDI).[1] In particular, the results point to a non-linear relationship between trade (or investment) liberalization and FDI, which is consistent with the evidence that economic liberalization in the 1990s did not slow down FDI, while increasing world trade. In studies that assume away competition between multinationals, however, FDI is expected to decrease with a decrease in trade costs, which contradicts the FDI trends in the 1990s.

The empirical motivation of this paper is that there is now a substantial number of multinational firms trying to exploit investment opportunities around the globe. Altomonte and Rungi (2014), for instance, use a unique firm-level dataset that maps more than 270 thousand headquarters controlling more than 1.5 million affiliates in all industries across some 200 countries in 2010. Of the total affiliates, approximately 30% are foreign affiliates, 70% of which are located in the OECD countries. The European Union countries and the USA host 65% of the foreign affiliates worldwide. These numbers point to an unequal distribution of FDI activities among the countries and imply that competition between multinational firms - simultaneously or sequentially - entering the same market is inevitable, especially in countries that are successful in attracting FDI. In such countries, strategic interactions between multinationals become even more pronounced, which warrants a game theoretic approach for the analysis of the optimal entry modes. I consider a sequential foreign market entry game as it seems to be the common approach.[2] In particular, empirical evidence suggests that (i) firms' investment decisions are intrinsically related (Defever *et al.*, 2014), and (ii) there is seemingly sequential entry pattern of the firms that survive in global markets (Albornoz *et al.*, 2012). Also it seems to be natural to model firms' investment decisions as being sequential, especially when irre-

[1]Empirical evidence suggests that horizontal FDI is still dominant. Therefore, throughout the paper, I concentrate only on horizontal FDI, in which the main motivation is to serve consumers in a host country.

[2]I have solved the model also for a simultaneous market entry game, but have not reported the results as they are qualitatively similar to those of the sequential market entry game. Nevertheless, I discuss some important implications of simultaneous entry by multinationals. The results of the simultaneous market entry game are available upon request.

versible investment/export costs are taken into account. Irreversible costs play a similar role as irreversible commitment, and given that FDI projects do not remain secret and require longer lead time as compared to trade, in markets where firms are potentially large, and thus an industry is potentially concentrated, the observation of an investment by a foreign firm will have an effect on the investment decision of other firms.

The traditional models of FDI focus on different market entry costs to explain why firms may prefer FDI over exporting. According to the proximity-concentration trade off, for example, FDI may be more profitable when economies of scale are large at the firm level, and small at the plant level. The reason is that although it is very costly to produce knowledge capital - intangible assets such as reputation, blue prints, brand name - which generates firm-level scale economies, a firm can supply it to foreign production facilities with almost no cost and without decreasing its value or productivity as long as it stays within the firm.[3] By contrast, a firm has to duplicate its production process when undertaking FDI in a foreign country. If this is significantly costly, then the firm may be better off by paying trade costs and exporting. By the same token, the tariff-jumping hypothesis suggests that given sufficiently large market size - so that fixed investment costs per sales are small - a firm may prefer undertaking FDI over exporting just to avoid trade costs. That is, a multinational firm prefers to produce at home and export if locating a subsidiary in a market is not as efficient (Neary, 2009). Similarly, a multinational firm may opt to acquire an existing local firm if entry by establishing its own subsidiary in the market, referred to as greenfield investment, is not as profitable. Görg (2000) finds that a foreign entrant favors acquiring a local firm over undertaking greenfield investment unless additional (fixed) costs associated with greenfield investment are very low relative to costs associated with acquisition (e.g., product and process adaptation costs).

Müller (2007) examines possible impacts of investment costs, technology differences - the difference between firms' marginal costs - market size, market structure and competition

[3]There is sufficient evidence that investors tend to have a preference for FDI (whole ownership) because knowledge capital can be easily dissipated in a shared ownership; see Navaretti and Venables (2004). To keep a tractable model, however, I abstract from such motives for FDI.

intensity on a multinational firm's entry mode choice in a model à la Hotelling where firms compete by prices. According to his finding, a higher cost of greenfield investment makes acquisition more attractive, whereas if the investment cost is too large, acquisition is not profitable and no entry is the optimal choice. The intuition is as follows. First, the relative cost of acquiring a firm decreases when the cost of greenfield investment increases. Second, if the investment cost increases sufficiently, greenfield investment is not profitable, so it is not a credible threat; since there is no alternative entry option except acquisition - Müller (2007) does not allow the multinational firm to export - the multinational firm either acquires a firm or stays out of the market. Consequently, the acquisition price increases and deters the multinational firm from entering the market. Müller (2007) also shows that the multinational firm is better off by undertaking greenfield investment if the technology difference is sufficiently large - if the rival is less efficient - or if the intensity of product market competition is sufficiently high or sufficiently low, whereas, if the intensity of competition is moderate, he finds that acquisition is the optimal entry mode. Eicher and Kang (2005), by allowing for trade, show that the optimal entry mode is a function of fixed costs, trade costs and market size, provided that competition is sufficiently weak or product differentiation is strong. According to their finding, the multinational firm always acquires a local firm in a sufficiently large market when trade is free and transport costs are zero. The reason is that the multinational firm's acquisition profit increases with market size. If trade costs are low, a greenfield investment replaces trade for low fixed costs insofar as low fixed investment costs decrease the multinational firm's profit by less than the efficiency loss due to trade costs. Once fixed costs reach high levels, they show that a multinational firm chooses acquisition in a very large market, trade in a moderately large market and no entry in a small market.

While there is a well-established literature looking at a single multinational's foreign market entry, few studies model competition between multinationals. Javorcik and Saggi (2010) analyze two firms' preferred entry modes when firms have different production costs. They assume a single local firm and allow the two multinational firms to choose between greenfield investment and a joint venture with the local firm. Their finding suggests that technologically advanced firms are more likely to prefer greenfield investment to joint ventures. In their study, the local firm plays a quasi-passive role such that it is not able to produce without venturing with a multinational firm, although it reduces its partner's marginal production cost and shares rents in a joint venture. Another study that allows for competition between multinationals is Norbäck and Persson (2008) who analyze multinationals' choice between greenfield investment and acquisition. They argue that there may be fierce bidding competition over acquiring a local firm's assets if entry by acquisition provides a large market share. Consequently, the acquisition price substantially increases and the acquirer's ex-post profit may be less than the greenfield profit. In their study, however, market entry by exporting is assumed away.

Mergers and acquisitions have been the driving force of international integration and have increased substantially, especially in the post-*deregulation* era of the 1990s (e.g., see Andrade *et al.*, 2001).[4] Bjorvatn (2004) provides an explanation to the increase in M&As also by modeling competition between multinationals. He shows that economic integration that reduces trade costs (or investment costs) may reduce the business-stealing effect, and/or may reduce the cost of acquiring a firm by increasing the competitive pressure on the firm, and hence by decreasing the firm's reservation price. Bjorvatn (2004), however, focuses only on the profitability of M&As, and overlooks the strategic interactions that may lead to different entry mode choices of multinationals even when M&As are profitable. The main goal of this study is thus to develop a better understanding how strategic interactions lead firms to choose their foreign market entry modes and how their choices relate to trade costs and investment costs. Unlike Bjorvatn (2004), this study is able to show that economic integration does not necessarily lead to more FDI. Investment liberalizations are warranted along with trade liberalizations (as was the case in the post-*deregulation* era of the 1990s) in order to explain the increase in FDI (greenfield investment and acquisitions) as compared to trade. If fixed investment

[4] As reported by Dunning and Lundan (2008: 20) and UNCTAD (2006: 16), in the period 1999-2001 and since 2005, more than six thousand cross-border mergers and acquisitions were undertaken annually, and over a hundred deals annually had a value exceeding US$ 1 billion. Between 1995 and 1997, the share of M&As in World FDI was about 60%, and between 1998 and 2001, their share increased to 75% (Navaretti and Venables, 2004).

costs are reduced sufficiently, both multinationals prefer FDI, and for some levels of fixed investment costs, firm acquisition by a multinational can trigger greenfield investment by another multinational firm. This result is consistent with the observation that higher mergers and acquisitions were typically followed by higher greenfield investment especially in developed countries in the 1990s (see Calderón *et al.* 2004).

The remainder of this study is structured as follows. A simple model of foreign market entry by a single multinational firm is introduced and solved for the optimal entry modes in Section 2. The model is extended to two multinationals and is solved for the optimal entry modes in Section 3. Section 4 discusses possible extensions of the model. Finally, Section 5 concludes. For convenience, I have relegated the proofs and technical details to the Appendix.

2 Foreign market entry by a single multinational

In this section, I introduce a canonical model to illustrate the results discussed above. Consider a market which is served by one local firm, labeled 1. The local firm has paid a fixed cost which allowed market entry in the past. It was a sunk cost. So the fixed cost cannot be recovered by market exit. Let c denote the local firm's marginal cost of production, where $c \in [0, 1]$. Consumers in this market have quasi-linear preferences which give rise to the inverse demand function, $p = a - Q$, where p denotes the equilibrium price and Q is the aggregate supply. If entry to this market is not allowed, the local firm will maintain its monopoly power and produce at the output level of $(a - c)/2$ and earn the monopoly profit of $(a - c)^2/4$.[5] Suppose that entry is allowed and a foreign investor/multinational firm (MNF) - namely, MNF_1 - is willing to enter this market. I normalize MNF_1's production cost to zero. Hence, the foreign firm is technologically

[5]Firm 1 maximizes its profit, $(a - q_1 - c)\, q_1$, where q_1 is firm 1's output. The FOC, $a - 2q_1 - c = 0$, immediately specifies firm 1's monopoly output in equilibrium such that $q_1 = (a - c)/2$. By substituting this optimal monopoly output into firm 1's profit function, firm 1's equilibrium monopoly profit can be computed as $(a - c)^2/4$.

superior.[6] The foreign firm can choose its entry mode from three different options: *acquisition*, *greenfield investment* or *trade*.[7] I will model the acquisition similar to Salant *et al.* (1983): the investor pays an acquisition price, denoted by Ω, to the local firm and the local firm vanishes.[8] There is no efficiency loss when the investor acquires the local firm: MNF_1 employs its more efficient technology (as in Barros, 1998).

If the foreign firm produces at home and ships the goods to this market, it will have to pay additional costs (e.g., transport costs and tariffs), which I refer to as the *per-unit trade cost*, and denote by t: the foreign firm's marginal cost will increase to t. The foreign firm can save the per-unit trade cost by undertaking greenfield investment. However, this investment requires a fixed cost of setting up a subsidiary in the market. Let f denote the *fixed cost* of undertaking greenfield investment. If the fixed investment cost is small such that $f < 4t(a + c - t)/9$, the foreign firm will opt for greenfield investment as the fixed greenfield cost reduces MNF_1's profit by less than the efficiency loss due to trade.[9] If, however, the fixed greenfield cost is large such that $f > 4t(a + c - t)/9$, MNF_1 prefers trade to greenfield investment so long as trade yields positive profits. If the per-unit trade cost is sufficiently high such that $t > (a + c)/2$ - if MNF_1's trade profit is negative - then MNF_1 prefers to stay out of this market unless the fixed greenfield cost allows for a positive greenfield profit (i.e., $f < (a + c)^2/9$); see Appendix A.1.1 for details. Figure 1 illustrates these results for the fixed greenfield cost f and the per-unit trade cost $t \in [0, 1]$, given market size $a = 1$ and the local firm's marginal cost $c = 0$. Clearly, reducing the

---

[6]This normalization is merely a simplification of the common observation in most countries where multinationals are actively operating: local firms possess a less efficient production technology compared to multinationals; see Müller (2007) and Navaretti and Venables (2004).

[7]If none of the entry modes yields non-negative profits in equilibrium, MNF_1 will prefer to stay out of the market.

[8]Also I will assume that there is no additional cost of acquiring a local firm. The acquisition price constitutes the sole cost of acquiring the local firm. Note that this is in fact an assumption which normalizes fixed costs of acquiring a firm (i.e., product and process adaptation costs etc.) to zero. So, fixed greenfield costs should be interpreted relative to fixed acquisition costs. The results of the model would not have changed if I had explicitly introduced additional costs of acquisition (i.e., fixed acquisition costs) in the model.

[9]I shall assume that the market is large enough to accommodate two firms (i.e., $a < 2c$), so that there is no crowding out. MNF_1 prefers greenfield investment to trade if its greenfield profit, $(a + c)^2/9 - f$, is more than its trade profit, $(a + c - 2t)^2/9$, which is the case when $f < 4t(a + c - t)/9$, provided that both entry modes yield positive profits in equilibrium. See Appendix A.1.1 for details. The extension to the n-MNF case is straightforward. See Appendix A.1.2 for details.

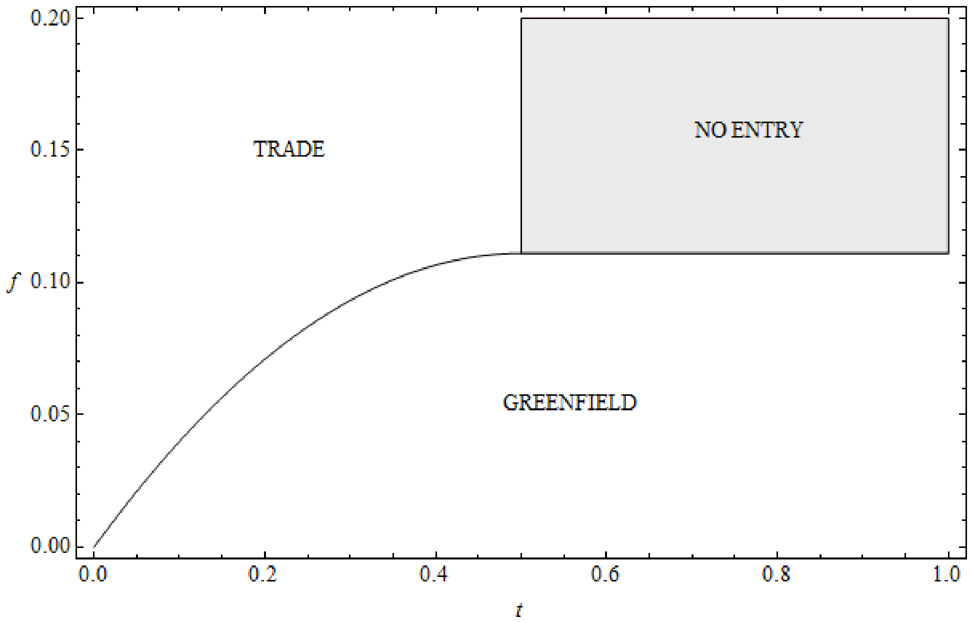

Figure 1 Trade vs Greenfield Investment (Duopoly).

per-unit trade cost encourages MNF_1 to export so long as the fixed greenfield cost is not sufficiently low such that it permits greenfield investment as a solution.[10]

The acquisition of the local firm, giving the multinational monopoly power, earns the multinational larger profits: the acquisition profit, $a^2/4 - \Omega$, is more than both the trade profit, $(a-2t+c)^2/9$, and the greenfield profit, $\left[(a+c)^2/9\right] - f$.[11] Moreover, if the local firm is sufficiently less efficient than the multinational, then merging to monopoly is always more profitable, even when the local firm has complete bargaining power.[12]

[10]For a similar discussion of a single multinational's optimal market entry mode, see Neary (2009).

[11]The acquisition price, Ω, is determined by the multinational's take-it-or-leave-it offer to the local firm. The multinational offers the local firm the outside profit - the local firm's profit if it rejects the offer - so as to make the local firm indifferent between accepting and rejecting the offer. $\Omega = (a-2c)^2/9$ if $f < 4t(a+c-t)/9$, or $\Omega = (a-2c+t)^2/9$ if $f > 4t(a+c-t)/9$. If $t > (a+c)/2$ and $f > (a+c)^2/9$, the local firm will not accept any offer less than its monopoly profit $(a-c)^2/4$.

[12]The IO literature on mergers and acquisitions shows that a merger is profitable if it includes at least 80 per cent of the total number of firms in the market (e.g., merging to monopoly) so that there is no substantial business stealing by the firms that do not participate in the merger. In particular, firms may benefit from a merger, provided sufficient efficiency gains are generated as in Perry and Porter (1985). If, however, there is linear demand and no efficiency gains, firms may not benefit from a merger if they compete in a market of strategic substitutes in the sense of Bulow, Geanakoplos and Klemperer (1985); see, for example, Stigler (1950), Salant *et al.* (1983), and Farrell and Shapiro (1990). This *merger paradox* may be avoided when there is no cost reductions, but convex demand as in Hennessy (2000), or when products are differentiated as in Lommerud and Sorgard (1997), and when firms compete in a market of strategic complements as in Deneckere and Davidson (1985).

3 Optimal entry modes under competition

Suppose now that there is another foreign firm, intending to enter the market following MNF_1's entry.[13] The presence of another firm willing to enter the same market will influence MNF_1's optimal entry mode. Therefore, I will modify the above model and will assume two multinational firms - namely, MNF_1 and MNF_2 - sequentially entering the same market. For simplicity, I will assume that MNF_1 and MNF_2 are ex ante symmetric in their marginal cost of production: they both possess a similar production technology, and produce the homogeneous good with the same marginal cost, which is normalized to zero.[14] When all three firms are active in the market, the aggregate supply, Q, comprises the MNFs' outputs q_{m1} and q_{m2}, and the local firm's output q_1.

The interaction between firms takes place such that MNF_1 decides on its entry mode first. MNF_2 takes this decision as given, and, subsequent to MNF_1's decision, decides on its entry mode. Particularly, MNF_1 makes an acquisition offer to the local firm in the first stage of the game. It is a take-it-or-leave-it offer. If the local firm accepts MNF_1's acquisition offer, MNF_1 acquires the local firm. MNF_2 observes the acquisition and, subsequently, chooses its entry mode between trade and greenfield investment. Then, both multinational firms compete against each other in the Cournot duopoly game. If MNF_1 does not acquire the local firm in the first stage, both multinational firms sequentially choose their entry modes between trade and greenfield investment. Consequently, there will be three firms competing à la Cournot (i.e., the market will consist of two multinational firms and one incumbent firm), provided that all firms choose to produce in equilibrium. Multinationals do not enter the market if neither entry mode yields a non-negative profit. The game is solved backwards for the subgame perfect Nash equilibria.

[13] I can also consider some domestic entrepreneurs observing profitable investment opportunities in this market. However, I will implicitly assume, for simplicity, that multinationals hold intellectual property (e.g., technology ownership through patents) which is necessary to create a new firm in this market; see Mukherjee and Sengupta (2001) for discussions.

[14] Given the fact that most FDI originates from developed countries, and that the majority of FDI goes to developed countries as well, the multinationals are expected to have access to and to possess a similar production technology, especially when producing homogenous goods; see Navaretti and Venables (2004) for discussions.

3.1 Trade versus greenfield investment

Let $\pi_{m1}^{t(t)}$ and $\pi_{m2}^{t(t)}$ denote MNF_1's and MNF_2's profit, respectively, in the case that both multinationals opt for trade. $\pi_{m1}^{t(t)}$ and $\pi_{m2}^{t(t)}$ are given by equation (1) (see Appendix A.1.3 for details):

$$\pi_{m1}^{t(t)} = \pi_{m2}^{t(t)} = \left(\frac{a+c-2t}{4}\right)^2. \tag{1}$$

The superscript t refers to trade, and the superscript in brackets represents the rival firm's entry mode. As is clear from equation (1), the per-unit trade cost t represents the efficiency loss due to trade. The higher the per-unit trade cost - the larger the efficiency loss - the lower is the multinationals' trade profit and the less is the competitive pressure on the local firm.

Let $\pi_{m1}^{t(g)}$ and $\pi_{m2}^{g(t)}$ denote MNF_1's and MNF_2's profit, respectively, in the case that MNF_1 chooses trade and MNF_2 chooses greenfield investment. The superscript g refers to greenfield investment. Similarly, let $\pi_{m1}^{g(t)}$ and $\pi_{m2}^{t(g)}$ denote MNF_1's and MNF_2's profit, respectively, in the case that MNF_1 chooses greenfield investment and MNF_2 chooses trade. Equations (2) and (3) give the multinational firms' profits, $\left(\pi_{m1}^{t(g)}, \pi_{m2}^{t(g)}\right)$ and $\left(\pi_{m1}^{g(t)}, \pi_{m2}^{g(t)}\right)$, respectively (see Appendix A.1.3 for details):

$$\pi_{m1}^{t(g)} = \pi_{m2}^{t(g)} = \left(\frac{a+c-3t}{4}\right)^2, \tag{2}$$

$$\pi_{m1}^{g(t)} = \pi_{m2}^{g(t)} = \left(\frac{a+c+t}{4}\right)^2 - f. \tag{3}$$

Equations (2) and (3) clearly show that if an MNF chooses trade when the rival MNF undertakes greenfield investment, the exporting firm's profit decreases with the per-unit trade cost (t), whereas the other MNF's profit increases with t. The reason is that both firms have downward-sloping reaction curves as they compete by quantities. Therefore, when one firm reduces its output, the other firm will increase it. In equations (2) and (3), the exporting firm reduces its output due to the efficiency loss - its profit decreases - so the other firm increases its output - its profit increases - insofar as, in this situation, the greenfield investor has a competitive advantage over the exporting firm. The higher is the per-unit trade cost, the larger is the competitive advantage that the greenfield investor has over the exporting firm, so the higher is the greenfield investor's profit.

If both multinational firms undertake greenfield investment, then they have the same competitive position and earn the same profits, which decrease with the fixed greenfield cost. I denote by $\pi_{m1}^{g(g)}$ and $\pi_{m2}^{g(g)}$ MNF$_1$'s and MNF$_2$'s profit, respectively, which are given by equation (4) (see Appendix A.1.3 for details):

$$\pi_{m1}^{g(g)} = \pi_{m2}^{g(g)} = \left(\frac{a+c}{4}\right)^2 - f. \tag{4}$$

In the stage that the multinational firms sequentially choose their entry modes between trade and greenfield investment, MNF$_1$ chooses greenfield investment, irrespective of MNF$_2$'s choice, if (and only if) $\pi_{m1}^{g(t)} > \pi_{m1}^{t(t)}$ and $\pi_{m1}^{g(g)} > \pi_{m1}^{t(g)}$. Subsequent to MNF$_1$'s entry mode choice, MNF$_2$ decides on its entry mode between greenfield investment and trade. MNF$_2$ also chooses greenfield investment, irrespective of MNF$_1$'s choice, if (and only if) $\pi_{m2}^{g(t)} > \pi_{m2}^{t(t)}$ and $\pi_{m2}^{g(g)} > \pi_{m2}^{t(g)}$. This leads to Remark 1.

Remark 1. *Greenfield investment is the dominant strategy for both firms if (and only if)* $f < f_l = 3t(2a + 2c - 3t)/16$.

Proof. See Appendix A.2.1. □

It is straightforward to show that as the cost of serving the market through trade rises, the maximum value of the fixed cost of investment that permits greenfield investment as a solution increases. This is true also when the local firm is less efficient.

Trade can also be both firms' dominant strategy. Both MNF$_1$ and MNF$_2$ opt for trade if (and only if) $\pi_{m2}^{t(t)} \left(= \pi_{m1}^{t(t)}\right) > \pi_{m2}^{g(t)} \left(= \pi_{m1}^{g(t)}\right)$ and $\pi_{m2}^{t(g)} \left(= \pi_{m1}^{t(g)}\right) > \pi_{m2}^{g(g)} \left(= \pi_{m1}^{g(g)}\right)$:

Remark 2. *Trade is the dominant market entry strategy for both firms if (and only if)* $f > f_u = 3t(2a + 2c - t)/16$.

Proof. See Appendix A.2.2. □

Clearly, if the cost of serving the market through trade is zero, it is always (never) a dominant strategy to serve the market through trade (greenfield investment), provided that the fixed greenfield cost is positive. As the cost of serving the market through trade rises, the minimum value of the fixed cost of investment that permits trade as a solution increases. Also the less efficient is the domestic firm - the higher is c - the larger is the minimum value of the fixed cost of investment that permits trade as a dominant strategy.

It is also possible that MNF_2 exports, when MNF_1 undertakes greenfield investment in equilibrium, which is the case if $\pi_{m2}^{g(t)} > \pi_{m2}^{t(t)}$, $\pi_{m2}^{g(g)} < \pi_{m2}^{t(g)}$ and $\pi_{m1}^{g(t)} > \pi_{m1}^{t(g)}$:

Remark 3. *Multinationals may opt for different market entry strategies: MNF_1 opts for greenfield investment and MNF_2 opts to export when $f_l < f < f_u$, where f_l and f_u are given by Remarks 1 and 2, respectively.*

Proof. See Appendix A.2.3. □

I shall note that in Remarks 1, 2 and 3, the per-unit trade cost is given, such that $t < (a + c)/3$, so both multinational firms prefer to enter the market and produce in equilibrium.[15] Furthermore, the market is large enough to accommodate three firms producing in equilibrium (i.e., $a > 3c$). Figure 2 illustrates these results for the fixed greenfield cost f and the per-unit trade cost $t \in [0, 1]$, given market size $a = 1$ and the local firm's marginal cost $c = 0$. In Figure 2, both firms have the following options: greenfield investment, which is represented by the letter G, trade, which is represented by the letter T, or staying out, which is represented by the letter O. *NO ENTRY* refers to both firms staying out of the market. Clearly, prohibitive market entry costs (i.e., $t > 1/2$ and $f > 1/9$) deter both firms from entering the market. If only the per-unit trade cost is prohibitive ($t > 1/2$), but the fixed greenfield cost is reduced such that $1/16 < f < 1/9$, it is optimal for only MNF_1 - because the game is played sequentially - to enter the market; MNF_2 stays out of the market. Consequently, MNF_1 opts for greenfield investment due to prohibitive trade costs. Given that $t > 1/2$, MNF_2 enters the market if (and only if)

[15] Depending on parameter values, further equilibria are possible, in which one multinational firm stays out of the market. For details, see Appendix A.3.

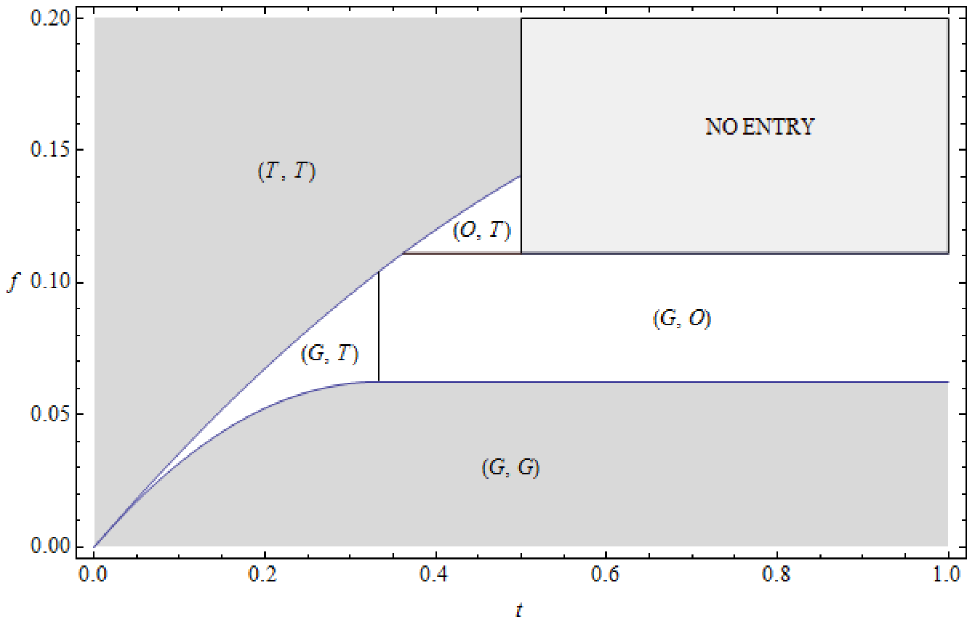

Figure 2 Trade vs Greenfield Investment.

the fixed greenfield cost is sufficiently low (i.e., 1/16 or less).[16]

Once the per-unit trade cost is reduced such that $t < 1/2$, if the fixed greenfield cost is sufficiently high ($f > f_u$), trade will be the optimal entry mode for both firms inasmuch as it will be the only entry mode yielding positive profits (see equations (1) , (2), (3) and Appendix A.1.1). Given the fixed greenfield cost such that $1/9 < f < f_u$, if the per-unit trade cost is in the high range, such that $t \in [11/30, 1/2]$, MNF_1 stays out of the market but MNF_2 opts for trade. The reason is as follows: if MNF_1 chooses trade, it will be optimal for MNF_2 to undertake greenfield investment, which will intensify competition in the market and will affect MNF_1's profit negatively; since the per-unit trade cost is relatively high, MNF_1's market entry via trade - which leads MNF_2 to undertake greenfield investment - will yield negative profits, so it is dominated by the strategy of staying out. Similarly, if MNF_1 undertakes greenfield investment, it will be optimal for MNF_2 to stay out of the market. However, given sufficiently high fixed investment costs ($1/9 < f < f_u$), greenfield entry will not yield non-negative profits unless the rival

[16]More generally, let n denote the total number of firms having already entered this market by undertaking greenfield investment. Therefore, there are in total $(n+1)$ firms in the market (i.e., one incumbent firm and n foreign firms, where $n = 1, ..., N$). In this situation, the $(N+1)^{th}$ firm's greenfield entry yields positive profits if (and only if) $f < (a+c)^2 / (n+3)^2$. Otherwise, it yields non-positive profits.

multinational firm enters the market by exporting. Consequently, MNF_1 will opt to stay out which will lead MNF_2 to enter the market by exporting so as to make positive profits. Lastly, if all firms can make positive profits irrespective of their entry modes - if the per-unit trade cost is sufficiently small such that $t < 1/3$ - both MNFs' optimal entry modes will be determined by Remarks (1)-(3).

3.2 Acquisition

In this section, I incorporate the acquisition decision of MNF_1 into the analysis. If MNF_1 acquires the local firm in the first stage, the market structure will be characterized by Cournot duopoly. Let $\pi_{m2}^{t(a)}$ and $\pi_{m2}^{g(a)}$ denote MNF_2's profit when it responds to MNF_1's acquisition decision by exporting and by undertaking greenfield investment, respectively. Equations (5) and (6) give $\pi_{m2}^{t(a)}$ and $\pi_{m2}^{g(a)}$, respectively (see Appendix A.1.4 for details):

$$\pi_{m2}^{t(a)} = \left(\frac{a-2t}{3}\right)^2, \tag{5}$$

$$\pi_{m2}^{g(a)} = \left(\frac{a}{3}\right)^2 - f. \tag{6}$$

The superscript a refers to acquisition. Greenfield entry is MNF_2's best response if (and only if) $\pi_{m2}^{g(a)} > \pi_{m2}^{t(a)}$. This leads to Remark 4.

Remark 4. *If MNF_1 acquires the local firm, then MNF_2 undertakes greenfield investment if (and only if) $f < \widetilde{f} = 4t(a-t)/9$. Otherwise, it exports.*

Proof. See Appendix A.2.4. □

Remark 4 assumes that both trade and greenfield investment yield positive profits, so MNF_2 decides on the entry mode which yields the highest profit. However, if the per-unit trade cost is prohibitive ($t > a/2$), MNF_2 will enter the market only if $f < a^2/9$, such that it can earn non-negative profits by undertaking greenfield investment; see equations (5) and (6). If $t > a/2$ and $f > a^2/9$, then MNF_2 will stay out of the market.

To acquire the local firm, MNF_1 offers an acquisition price to the local firm. Let $\pi_{m1}^{a(g)}$ and $\pi_{m1}^{a(t)}$ denote MNF_1's profit when it acquires the local firm and when the rival multinational firm undertakes greenfield investment or exports, respectively. $\pi_{m1}^{a(g)}$ and $\pi_{m1}^{a(t)}$ are given by equations (7) and (8), respectively (see Appendix A.1.4 for details):

$$\pi_{m1}^{a(g)} = \left(\frac{a}{3}\right)^2 - \Omega, \tag{7}$$

$$\pi_{m1}^{a(t)} = \left(\frac{a+t}{3}\right)^2 - \Omega. \tag{8}$$

Clearly, acquisition is profitable if (and only if) the acquisition price (Ω) is less than MNF_1's operating profit. In equilibrium, MNF_1 offers an acquisition price that makes the local firm indifferent between acceptance and rejection: the acquisition price will be equal to the local firm's profit in the case that no acquisition takes place. Note that the local firm's profit given rejection is determined by the two multinational firms' optimal entry modes when no acquisition takes place. Let all firms produce in equilibrium, and $\pi_1^{g/g}$, $\pi_1^{g/t}$, and $\pi_1^{t/t}$ denote the local firm's profits when no acquisition takes place: $\pi_1^{g/g}$ when both multinational firms undertake greenfield investment; $\pi_1^{g/t}$ when one multinational firm undertakes greenfield investment and the other multinational firm exports; and $\pi_1^{t/t}$ when both multinational firms export, in equilibrium. $\pi_1^{g/g}$, $\pi_1^{g/t}$, and $\pi_1^{t/t}$ are given by equations (9) , (10) and (11) , respectively (see Appendix A.1.3 for details):

$$\pi_1^{g/g} = \left(\frac{a-3c}{4}\right)^2, \tag{9}$$

$$\pi_1^{g/t} = \left(\frac{a-3c+t}{4}\right)^2, \tag{10}$$

$$\pi_1^{t/t} = \left(\frac{a-3c+2t}{4}\right)^2. \tag{11}$$

MNF_1 acquires the local firm if the net acquisition profit, given by equation (7) or (8), is larger than the profit it can earn by opting for the next best alternative entry mode (either trade or greenfield investment). There are two main factors that determine the net acquisition profit: the intensity of *pre-acquisition competition* and the intensity of *post-acquisition competition.*

The intensity of pre-acquisition competition is the ensuing level of competition when no acquisition takes place and the multinationals choose between trade and greenfield investment. It is important as it determines the acquisition price. If, for instance, the fixed investment cost (f) is sufficiently low, such that $f < f_l$, there will be fierce competition in the market - provided that no acquisition takes place - as both multinational firms will undertake greenfield investment in equilibrium. Under such a high level of competitive pressure, the local firm's profitability - rejection profit - will be low, and so will the acquisition price; see equation (9). Similarly, if the fixed greenfield cost is sufficiently high, such that $f > f_u$, the level of competitive pressure will be low - provided that no acquisition takes place - as both multinational firms will export in equilibrium. The higher the per-unit trade cost - the larger the multinational firms' efficiency loss - the lower the level of competitive pressure on the local firm and the higher the local firm's profitability. In this situation, the acquisition price will be higher; see equation (11). The intensity of pre-acquisition competition determines not only the acquisition price, but also the profitability of the next best alternative entry mode. An increase in the profitability of the next best alternative entry mode will decrease the incentives to acquire the local firm.

The intensity of post-acquisition competition determines the extent of business stealing by the rival multinational. Post-acquisition competition is the ensuing level of competition in the market subsequent to acquisition and the rival multinational's entry mode choice between trade and greenfield investment. The acquisition of the local firm reduces competition in the market, which enables the rival multinational to increase its production and to steal business from the acquiring firm. If, for instance, the fixed investment cost is given such that MNF_2 undertakes greenfield investment subsequent to MNF_1 acquiring the local firm (i.e., $f < \widetilde{f}$), then MNF_2 can steal much more business from MNF_1, as it avoids the efficiency loss (the per-unit trade costs); see equations (7) and (8). Table 1 summarizes these different factors affecting the overall gain from acquisition.

As in the previous sections, I will use the same parameter space as in Bjorvatn (2004)

Table 1 The Overall gain from acquisition (Δ)

Market entry costs $(f\&t)$	:			Δ		
$f < \widetilde{f}$ and $f < f_l < f_u$	:	$\left[\frac{a^2}{9} - \frac{(a-3c)^2}{16}\right]$	$-$	$\left[\frac{(a+c)^2}{16} - f\right]$	$=$	$f - \left[\frac{(a-15c)(a-3c)}{72}\right]$
$f > \widetilde{f}$ and $f < f_l < f_u$	:	$\left[\frac{(a+t)^2}{9} - \frac{(a-3c)^2}{16}\right]$	$-$	$\left[\frac{(a+c)^2}{16} - f\right]$	$=$	$f - \left[\frac{(a-15c)(a-3c)+8t(2a+t)}{72}\right]$
$f < \widetilde{f}$ and $f_l < f < f_u$	:	$\left[\frac{a^2}{9} - \frac{(a-3c+t)^2}{16}\right]$	$-$	$\left[\frac{(a+c+t)^2}{16} - f\right]$	$=$	$f - \left[\frac{(a-15c)(a-3c)+9t(2a-2c+t)}{72}\right]$
$f > \widetilde{f}$ and $f_l < f < f_u$	:	$\left[\frac{(a+t)^2}{9} - \frac{(a-3c+t)^2}{16}\right]$	$-$	$\left[\frac{(a+c+t)^2}{16} - f\right]$	$=$	$f - \left[\frac{(a-15c+t)(a-3c+t)}{72}\right]$
$f < \widetilde{f}$ and $f_l < f_u < f$	:	$\left[\frac{a^2}{9} - \frac{(a-3c+2t)^2}{16}\right]$	$-$	$\left[\frac{(a+c-2t)^2}{16}\right]$	$=$	$-\left[\frac{(a-15c)(a-3c)-36t(2c-t)}{72}\right]$
$f > \widetilde{f}$ and $f_l < f_u < f$	:	$\left[\frac{(a+t)^2}{9} - \frac{(a-3c+2t)^2}{16}\right]$	$-$	$\left[\frac{(a+c-2t)^2}{16}\right]$	$=$	$-\left[\frac{(a-15c)(a-3c)-4t(4a+18c-7t)}{72}\right]$
		The profitability of acquisition (net of the acquisition price)		The profitability of the alternative entry mode		The net gain/loss from acquisition

to illustrate the results. Given this particular parameter space, it can be computed easily from Table 1 that, in the first case, where $f < \widetilde{f}$ and $f < f_l < f_u$, the overall gain from acquisition (Δ) is negative if the fixed greenfield cost is sufficiently low (i.e., $f < 1/72$); therefore, MNF_1 does not acquire the local firm, but undertakes greenfield investment, followed by MNF_2 undertaking greenfield investment in equilibrium (see Remark 1). However, Δ is positive if $f > 1/72$, which leads MNF_1 to acquire the local firm, and MNF_2 to undertake greenfield investment (see Remark 4). The intuition is as follows. First, MNF_2 undertakes greenfield investment, irrespective of MNF_1's entry mode choice, so both multinational firms will eventually have the same competitive position. Second, the business-stealing effect is large, because the acquiring firm has to compete against a greenfield investor. Third, if the fixed investment cost is sufficiently low such that $f < 1/72$, the next best alternative entry mode (greenfield investment) is sufficiently profitable. Although the acquisition price will be low - as there will be fierce competition between one local firm and two greenfield investors when no acquisition takes place - the profitability of greenfield investment and the extent of business stealing sweep away all the benefits of acquiring the local firm and competing against one less firm.

In the third case,[17] where $f < \widetilde{f}$ and $f_l < f < f_u$, Δ is negative, so MNF_1 undertakes greenfield investment and MNF_2 exports in equilibrium (see Remark 3),[18] whereas in the fourth case, where $f > \widetilde{f}$ and $f_l < f < f_u$, Δ is positive, so MNF_1 acquires the local firm, and MNF_2 exports in equilibrium (see Remark 4).[19] The only distinction between the third and the fourth case is the rival multinational's behavior. In the third case, MNF_2 exports if MNF_1 undertakes greenfield investment, but it undertakes greenfield investment if MNF_1 acquires the local firm, as acquisition reduces competition in the market. Therefore, MNF_1 will lose its competitive advantage over MNF_2 if it acquires the local

[17] I shall note that, given $a = 1$ and $c = 0$, the case $\widetilde{f} < f < f_l$ is not possible as $\widetilde{f} = 4t(1-t)/9 > f_l = 3t(2-3t)/16$ for any t. Consequently, this case is disregarded for the current parameter space.

[18] In this case, it is straightforward to show that $f_u < \widetilde{f}$ for $t \leq 10/37$, and that $f_u > \widetilde{f}$ for $t > 10/37$. In either situation, the *overall* gain is negative because f_u is the upper limit of the fixed greenfield cost if $t \leq 10/37$, where $f < f_u < (1 + 9t(2 + t))/72$, or $\widetilde{f}$ is the upper limit of the fixed greenfield cost if $t > 10/37$, where $f < \widetilde{f} < (1 + 9t(2 + t))/72$.

[19] In this case, the per-unit trade cost $t > 10/37$ as $\widetilde{f} < f < f_u$ (i.e., $\widetilde{f} < f_u \iff t > 10/37$). It is straightforward to show that the lower limit of the fixed greenfield cost $\widetilde{f} > (1 + t)^2/72$ for $t > 10/37$.

firm, which will increase business stealing. However, in the fourth case, MNF_2 exports, irrespective of MNF_1's entry mode choice, so MNF_1 retains its competitive advantage even if it acquires the local firm.[20] From this discussion and Figure 3, I can conclude that

Proposition 1. *Unless fixed investment costs are reduced sufficiently, reductions in trade costs are expected to increase both trade and FDI (greenfield investment or acquisition).*

If the fixed greenfield cost is such that $f < \widetilde{f}$ and $f_l < f_u < f$, then acquisition does not take place as Δ is negative (see the fifth case in Table 1). In this case, both the business-stealing effect and the acquisition price are large. Consequently, both firms export in equilibrium (see Remark 2). If, however, $f > \widetilde{f}$ and $f_l < f_u < f$, which is the last case in Table 1, Δ is negative for sufficiently low levels of the per-unit trade cost ($t < 1/14$) - both the business-stealing effect and the profitability of the next best alternative entry mode (exporting) are sufficiently high - so both multinationals export in equilibrium, whereas Δ is positive for $t > 1/14$, which leads MNF_1 to acquire the local firm and MNF_2 to export in equilibrium. These results are illustrated in Figure 3, where *T, G, A* and *O* represent trade, greenfield investment, acquisition, and staying out, respectively. *NO ENTRY* means that both multinationals stay out of the market. Prohibitive market entry costs (i.e., $t > 1/2$ and $f > 1/9$) deter both multinational firms from entering the market. In such a situation, MNF_1 can still acquire the local firm and enter the market. The local firm, however, does not accept any offer below its monopoly profit - neither firm will enter if it rejects the acquisition offer - which is in fact the multinational's monopoly profit, given that all firms produce with zero marginal cost. Consequently, acquisition yields zero profit which is exactly what a multinational firm can get by staying out of the market. Nonetheless, a multinational firm may still want to acquire the local firm and make zero profit in such a situation.[21]

[20] In models without competition and/or without strategic interactions between multinationals, these cases are not present as in Bjorvatn (2004). In a simultaneous-move game, there are even cases that no Nash equilibrium does exist, or that there exist multiple Nash equilibria. The results are available upon request.

[21] If the local firm is less efficient than the foreign firm ($c > 0$), then MNF_1's monopoly profit will be larger than the local firm's monopoly profit (i.e., $a^2/4 > (a-c)^2/4$). Therefore, the foreign firm can make positive profits by acquiring the local firm, even when neither greenfield entry, nor trade is profitable.

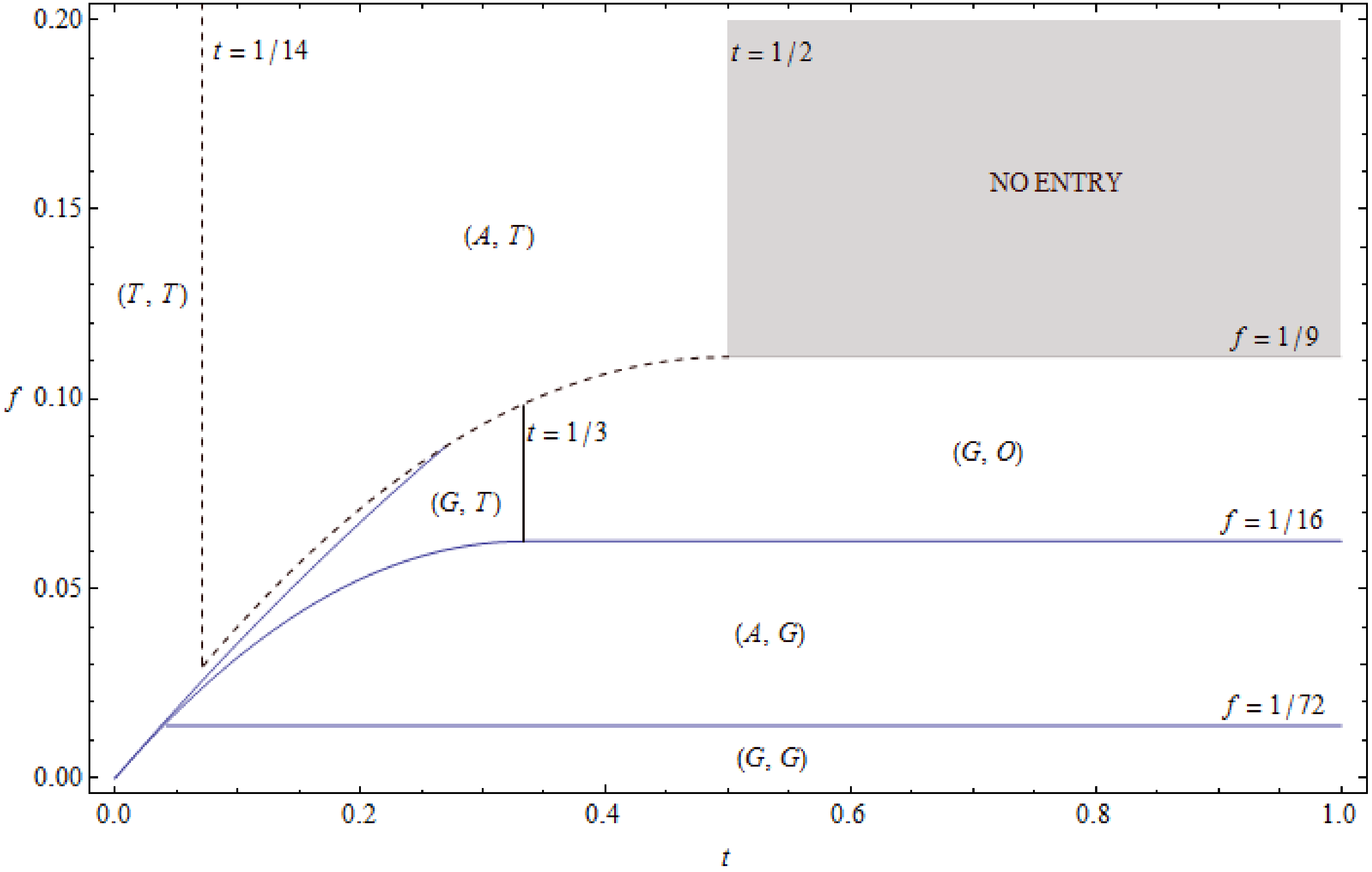

Figure 3 Equilibrium entry modes.

Suppose that $t > 1/2$ and $f > 1/9$. Reducing the per-unit trade cost will lead MNF_1 to acquire the local firm. If the per-unit trade cost is sufficiently high ($t > 1/2$), but the fixed greenfield cost is reduced ($1/16 < f < 1/9$), then MNF_1 undertakes greenfield investment in equilibrium, deterring the rival from entering the market. Reducing trade costs in such a situation will lead the other multinational to start exporting, while MNF_1 will remain greenfield investor for some levels of trade costs, or will be an exporter if trade costs are sufficiently low. Reducing trade costs further will lead MNF_1 to acquire the local firm so as to decrease competition in the market. If, however, trade costs are substantially low, then both firms will export. This immediately leads to

Proposition 2. *There is a non-linear relationship between trade and foreign investment liberalization and FDI.*

In models without competition and without strategic interactions between multinationals, trade costs (fixed investment costs) encourage (discourage) horizontal FDI.

If the fixed investment cost is reduced further to $1/72 < f < 1/16$, MNF_1 acquires the local firm and MNF_2 undertakes greenfield investment; or if it is reduced to $f < 1/72$, then both multinationals undertake greenfield investment. This leads to

Proposition 3. *If fixed investment costs are reduced sufficiently, both multinational firms prefer FDI, and for some low levels of fixed investment costs, firm acquisition by one multinational, by decreasing competition in the product market, can even trigger greenfield investment by the other multinational firm.*

Although there seems to be a non-linear relationship between trade and investment liberalization and FDI such that economic integration does not necessarily increase the tendency towards FDI, it is clear from Figure 3 that reductions in fixed investment costs in addition to trade liberalization may explain the increase in both greenfield investment and acquisitions as compared to trade.

4 Extensions

In this section, I examine possible extensions of the model. In particular, I discuss the implications of allowing MNF_2 to acquire the local firm. There will be slight changes if I use the same model and the same parameter values of c and a, but allow MNF_2 to acquire the local firm when it has not been acquired by MNF_1. First, I can show that if the per-unit trade cost is given such that $t < 1/3$ - so all firms produce in equilibrium - MNF_2 does not want to acquire the local firm if it has not been acquired by MNF_1 in the first stage, and so the results illustrated by Figure 3 for the parameter values $c = 0$, $a = 1$ and $t < 1/3$ will remain the same. If the per-unit trade cost is, however, given such that $t > 1/3$ - so one or both firms may stay out of the market - it may be the case that MNF_2 acquires the local firm when MNF_1 stays out of the market. Second, as I have already discussed, a substantially high per-unit trade cost ($t > 1/2$) and fixed investment cost ($f > 1/9$) deter both multinational firms from entering the market. In such a situation, reducing the per-unit trade cost will lead MNF_1 to acquire the local firm. If the per-unit trade cost is substantially high such that $t > 1/2$, but the fixed greenfield cost is reduced such that $1/16 < f < 1/9$, MNF_1 undertakes greenfield investment in equilibrium; however, MNF_2 may either stay out of the market or acquire the local firm. MNF_1 undertakes greenfield investment in equilibrium as it is the only entry mode yielding positive profits. MNF_2 may want to acquire the local firm, but it has to offer its acquisition (operating) profit to the local firm as MNF_2 will stay out - the local firm will compete against MNF_1 in the duopoly market - if acquisition does not take place. Note that MNF_2's acquisition (operating) profit is equal to the local firm's profit when MNF_2 stays out, provided MNF_1 undertakes greenfield investment and the local firm produces with zero marginal cost. Consequently, acquisition will yield zero profit just like staying out. Finally, if the fixed greenfield cost is sufficiently small such that $f < 1/16$, then the model will generate the same results illustrated by Figure 3.

The discussion above presumes that there is no strategic delaying of the acquisition of the local firm, and that the multinational firms move in a sequence. If the multinational firms make the acquisition decisions simultaneously, then there will be a bidding contest. Such a bidding contest model will produce the well-known Bertrand results due to the complete information structure of the model. By contrast, if I presume that the multinational firms move in a sequence and consider the fact that firms may want to delay strategically the acquisition decision, a different modeling approach will be required. In a different model, one may show that MNF_1 will not acquire the local firm if it knows that MNF_2 will acquire the local firm. In this case, the "dirty job" of creating a duopoly is done by MNF_2, and this will be anticipated by the first mover MNF_1.

5 Concluding remarks

The literature on multinational firms and FDI overlooks the implications of strategic interactions between multinationals on their market entry behavior. Despite the fact that competition amongst multinationals is inevitable, and that they are influenced by each other's direct investment decisions, most studies either consider a single investor's foreign market entry mode choice, or look at multiple investors in a non-strategic framework. This study, therefore, incorporates competition between multinational firms by focusing on two multinational firms, sequentially entering the same market, and distinguishes between multinationals' different market entry modes. It complements Bjorvatn (2004), and analyzes further how multinational firms choose their entry modes between trade, greenfield investment and acquisition, and how competition amongst them affects their optimal entry mode choices.

Appendix A

A.1 Solution to the Cournot competition

A.1.1 One MNF and one local firm

(1) *The MNF exports*: Firms' maximization problems give the following FOCs:

$$q_1(q_{m1}) = \left(\frac{a - q_{m1} - c}{2}\right) \quad \text{and} \quad q_{m1}(q_1) = \left(\frac{a - q_1 - t}{2}\right),$$

leading to the following equilibrium output levels: $q_1^* = (a - 2c + t)/3$ and $q_{m1}^* = (a + c - 2t)/3$. Firms' equilibrium profits are $(a-2c+t)^2/9$ for firm 1, and $(a+c-2t)^2/9$ for the MNF, respectively. The MNF's trade profit is positive if (and only if) the per-unit trade cost is sufficiently low, such that $t < (a + c)/2$.

(2) *The MNF undertakes greenfield investment*: Firms' maximization problems give the following FOCs:

$$q_1(q_{m1}) = \left(\frac{a - q_{m1} - c}{2}\right) \quad \text{and} \quad q_{m1}(q_1) = \left(\frac{a - q_1}{2}\right),$$

leading to the following equilibrium output levels: $q_1^* = (a - 2c)/3$ and $q_{m1}^* = (a + c)/3$. Firms' equilibrium profits are $(a - 2c)^2/9$ for firm 1, and $(a + c)^2/9 - f$ for the MNF, respectively. The MNF's greenfield profit is positive if (and only if) the fixed greenfield cost is less than the MNF's operating profit, such that $f < (a + c)^2/9$. Note that the MNF's greenfield profit, $(a+c)^2/9 - f$, is more than its trade profit, $(a+c-2t)^2/9$ when $f < 4t(a + c - t)/9$ for $t \in [0, (a + c)/2]$ and $f < (a + c)^2/9$. ■

A.1.2 An extension: the case of n multinational firms (no competition)

Let $f_{\max}$ denote the maximum value of the fixed investment cost that permits greenfield investment as a solution. In the 2−firm case, $f_{\max} = 4t(a + c - t)/9$. I can generalize the critical value of the fixed investment cost, $f_{\max}$, to an n-firm case.

Let there be k periods and only one multinational firm entering the market in every single period. In the first period, MNF_1 first enters the market and undertakes greenfield investment so long as $f < 4(a + c - t)/9$. Note that, in the first period, there will be only one local firm and one multinational firm competing against each other.

Suppose that $(k - 2)$ periods have passed and $(n - 2)$ multinational firms have successfully entered the market by undertaking greenfield investment, where $k = n > 2$. In the $(k - 1)^{\text{th}}$ period, MNF_{n-1} chooses its entry mode between greenfield investment and trade, and competes against the other $(n - 1)$ firms (i.e., one local firm and $(n - 2)$ multinational firms). If MNF_{n-1} undertakes greenfield investment, it will make a profit of $\left[(a + c)^2 / (n + 1)^2 - f\right]$, where c and n represent the local firm's marginal cost and the total number of active firms competing by quantities in the $(k-1)^{\text{th}}$ period, respectively. If MNF_{n-1} opts for trade, it will make a profit of $(a-nt+c)^2/(n+1)^2$, where t represents the per-unit trade cost. Consequently, MNF_{n-1} prefers greenfield investment to trade - MNF_{n-1}'s greenfield profit is more than its trade profit - if (and only if) $f < nt\,(2a+2c-nt)/(n+1)^2$.

Moreover, MNF_{n-1}'s trade profit will be negative if $t > (a+c)/n$. In such a situation, MNF_{n-1} will undertake greenfield investment as long as its operating profit under greenfield investment is larger than the fixed greenfield cost such that $f < (a+c)^2/(n+1)^2$. Note that $f_{\max}$ is maximized at $t = (a+c)/n$, and that $f_{\max} = nt\,(2a+2c-nt)/(n+1)^2 = (a+c)^2/(n+1)^2$ for $t = (a+c)/n$. Furthermore, $f_{\max}$ decreases with the number of total firms in the market (i.e., $\partial f_{\max}/\partial n < 0$ for $n > 1$). The larger is the number of firms in the market, the less likely it is that an MNF prefers greenfield investment to trade. Finally, the local firm - the competitively disadvantaged firm - will stay in the market and produce in equilibrium as long as $a > nc$, provided that it competes against $(n-1)$ multinational firms that have entered the market by undertaking greenfield investment. ■

A.1.3 Two MNFs and one local firm: greenfield versus trade

Both firms have to choose their entry modes between greenfield investment and trade. The possibilities are as follows:

(1) *Both MNFs export:* Firms' maximization problems give the following FOCs:

$$\begin{aligned} q_1(q_{m1}, q_{m2}) &= \left(\frac{a-(q_{m1}+q_{m2})-c}{2}\right), \\ q_{m1}(q_1, q_{m2}) &= \left(\frac{a-(q_1+q_{m2})-t}{2}\right), \\ q_{m2}(q_1, q_{m1}) &= \left(\frac{a-(q_1+q_{m1})-t}{2}\right), \end{aligned}$$

leading to the following equilibrium output levels: $q_1^* = (a-3c+2t)/4$ and $q_{m1}^* = q_{m2}^* = (a+c-2t)/4$. Firms' equilibrium profits are $(a-3c+2t)^2/16$ for firm 1, and $(a+c-2t)^2/16$ for both MNF_1 and MNF_2.

(2) *MNF_1 exports, whereas MNF_2 makes a greenfield investment:* Firms' maximization problems give the following FOCs:

$$\begin{aligned} q_1(q_{m1}, q_{m2}) &= \left(\frac{a-(q_{m1}+q_{m2})-c}{2}\right), \\ q_{m1}(q_1, q_{m2}) &= \left(\frac{a-(q_1+q_{m2})-t}{2}\right), \\ q_{m2}(q_1, q_{m1}) &= \left(\frac{a-(q_1+q_{m1})}{2}\right), \end{aligned}$$

leading to the following equilibrium output levels: $q_1^* = (a-3c+t)/4$, and $q_{m1}^* =$

$(a+c-3t)/4$ and $q_{m2}^{*}=(a+c+t)/4$. Firms' equilibrium profits are $(a-3c+t)^2/16$ for firm 1, and $(a+c-3t)^2/16$ and $[(a+c+t)^2/16-f]$ for MNF_1 and MNF_2, respectively. As the game is symmetric, if MNF_1 makes a greenfield investment and MNF_2 exports, the equilibrium profits will be $[(a+c+t)^2/16-f]$ and $(a+c-3t)^2/16$ for MNF_1 and MNF_2, respectively.

(3) *Both MNFs make a greenfield investment:* Firms' maximization problems give the following FOCs:

$$
\begin{aligned}
q_1(q_{m1},q_{m2}) &= \left(\frac{a-(q_{m1}+q_{m2})-c}{2}\right), \\
q_{m1}(q_1,q_{m2}) &= \left(\frac{a-(q_1+q_{m2})}{2}\right), \\
q_{m2}(q_1,q_{m1}) &= \left(\frac{a-(q_1+q_{m1})}{2}\right),
\end{aligned}
$$

leading to the following equilibrium output levels: $q_1^{*}=(a-3c)/4$ and $q_{m1}^{*}=q_{m2}^{*}=(a+c)/4$. Firms' equilibrium profits are $(a-3c)^2/16$ for firm 1, and $[(a+c)^2/16-f]$ for both MNF_1 and MNF_2. ■

A.1.4 Two MNFs and one local firm: acquisition

Let MNF_1 acquire firm 1. MNF_2 will either export, or will make a greenfield investment.

(4) *MNF_1 acquires firm 1, whereas MNF_2 exports:* Firms' maximization problems give the following FOCs:

$$
q_{m1}(q_{m2})=\left(\frac{a-q_{m2}}{2}\right) \quad \text{and} \quad q_{m2}(q_{m1})=\left(\frac{a-q_{m1}-t}{2}\right),
$$

leading to the following equilibrium output levels: $q_{m1}^{*}=(a+t)/3$ and $q_{m2}^{*}=(a-2t)/3$. Firms' equilibrium profits are Ω (the acquisition price) for firm 1, and $[(a+t)^2/9-\Omega]$ and $(a-2t)^2/9$ for MNF_1 and MNF_2, respectively.

(5) *MNF_1 acquires firm 1, whereas MNF_2 makes a greenfield investment:* Firms' maximization problems give the following FOCs:

$$
q_{m1}(q_{m2})=\left(\frac{a-q_{m2}}{2}\right) \quad \text{and} \quad q_{m2}(q_{m1})=\left(\frac{a-q_{m1}}{2}\right),
$$

leading to the equilibrium output levels: $q_{m1}^{*}=q_{m2}^{*}=a/3$. Firms' equilibrium profits are Ω for firm 1, and $(a^2/9-\Omega)$ and $(a^2/9-f)$ for MNF_1 and MNF_2, respectively. ■

A.2 Proof of Remarks

A.2.1 Proof of Remark 1

MNF_1 prefers greenfield investment, irrespective of MNF_2's choice, if and only if $\pi_{m1}^{g(t)} \geq \pi_{m1}^{t(t)}$ and $\pi_{m1}^{g(g)} \geq \pi_{m1}^{t(g)}$. Solving $\pi_{m1}^{g(t)} \geq \pi_{m1}^{t(t)} \iff [(a+c+t)^2/16 - f] \geq (a+c-2t)^2/16$ and $\pi_{m1}^{g(g)} \geq \pi_{m1}^{t(g)} \iff [(a+c)^2/16 - f] \geq (a+c-3t)^2/16$ for f gives two different conditions: $f \leq 3t(2a+2c-t)/16$ and $f \leq 3t(2a+2c-3t)/16$, respectively. The necessary and sufficient conditions can be reduced to only one condition: $f \leq 3t(2a+2c-3t)/16$ as it is obvious that $f \leq 3t(2a+2c-3t)/16 \leq 3t(2a+2c-t)/16$. Similarly, MNF_2 prefers greenfield investment, irrespective of its rival's choice, if and only if $\pi_{m2}^{g(t)} \geq \pi_{m2}^{t(t)}$ and $\pi_{m2}^{g(g)} \geq \pi_{m2}^{t(g)}$. There is no need to show explicitly that this condition should apply to MNF_2 as $\pi_{m1}^{g(t)} = \pi_{m2}^{g(t)}$, $\pi_{m1}^{t(t)} = \pi_{m2}^{t(t)}$, $\pi_{m1}^{g(g)} = \pi_{m2}^{g(g)}$, and $\pi_{m1}^{t(g)} = \pi_{m2}^{t(g)}$ (see Appendix A.1). ■

A.2.2 Proof of Remark 2

MNF_1 prefers trade, irrespective of MNF_2's choice, if and only if $\pi_{m1}^{g(t)} \leq \pi_{m1}^{t(t)}$ and $\pi_{m1}^{g(g)} \leq \pi_{m1}^{t(g)}$. Solving $\pi_{m1}^{g(t)} \leq \pi_{m1}^{t(t)} \iff (a+c+t)^2/16 - f \leq (a+c-2t)^2/16$ and $\pi_{m1}^{g(g)} \leq \pi_{m1}^{t(g)} \iff (a+c)^2/16 - f \leq (a+c-3t)^2/16$ for f gives two different conditions: $f \geq 3t(2a+2c-t)/16$ and $f \geq 3t(2a+2c-3t)/16$, respectively. The necessary and sufficient conditions can be reduced to the condition $f \geq 3t(2a+2c-t)/16$ as it is obvious that $f \geq 3t(2a+2c-t)/16 \geq 3t(2a+2c-3t)/16$. Similarly, MNF_2 prefers greenfield investment, irrespective of its rival's choice, if and only if $\pi_{m2}^{g(t)} \leq \pi_{m2}^{t(t)}$ and $\pi_{m2}^{g(g)} \leq \pi_{m2}^{t(g)}$. There is no need to show explicitly that this condition should apply to MNF_2 as $\pi_{m1}^{g(t)} = \pi_{m2}^{g(t)}$, $\pi_{m1}^{t(t)} = \pi_{m2}^{t(t)}$, $\pi_{m1}^{g(g)} = \pi_{m2}^{g(g)}$, and $\pi_{m1}^{t(g)} = \pi_{m2}^{t(g)}$ (see Appendix A.1). ■

A.2.3 Proof of Remark 3

MNF_2 prefers greenfield investment when MNF_1 opts for trade if $\pi_{m2}^{g(t)} \geq \pi_{m2}^{t(t)}$. Similarly, MNF_2 prefers trade when MNF_1 opts for greenfield investment if $\pi_{m2}^{g(g)} \leq \pi_{m2}^{t(g)}$. From Appendix A.2.1 and A.2.2, $\pi_{m2}^{g(t)} \geq \pi_{m2}^{t(t)} \implies f \leq 3t(2a+2c-t)/16$ and $\pi_{m2}^{g(g)} \leq \pi_{m2}^{t(g)} \implies f \geq 3t(2a+2c-3t)/16$. When $3t(2a+2c-3t)/16 \leq f \leq 3t(2a+2c-t)/16$, MNF_1 opts for greenfield investment if $\pi_{m1}^{g(t)} \geq \pi_{m1}^{t(g)} \implies f \leq t(a+c-t)/2$, which always holds for any $f \in [3t(2a+2c-3t)/16, 3t(2a+2c-t)/16]$ as $3t(2a+2c-t)/16 \leq t(a+c-t)/2$. ■

A.2.4 Proof of Remark 4

MNF_2 prefers greenfield investment when MNF_1 acquires firm 1 if $\pi_{m2}^{g(a)} \geq \pi_{m2}^{t(a)}$. Solving $\pi_{m2}^{g(a)} \geq \pi_{m2}^{t(a)} \iff a^2/9 - f \geq (a-2t)^2/9$ for f gives the condition $f \leq 4t(a-t)/9$. ■

A.3 Entry deterrence

A higher per-unit trade cost may deter one or both multinational firms from entering the market. For instance, given the per-unit trade cost $t \in [(a+c)/3, (a+c)/2]$, one firm stays out of the market unless the fixed greenfield cost is either sufficiently low ($f < (a+c)^2/16$) or sufficiently high ($f > f_u$). Note that given the per-unit trade cost $t \in [(a+c)/3, (a+c)/2]$, trade will yield positive profits so long as the rival multinational prefers either trade or staying out to greenfield investment (see equations (1), (2), (3) and Appendix A.1.1). If the fixed greenfield cost is sufficiently high ($f > f_u$), trade will be the only entry mode allowing both multinationals to make positive profits. Consequently, both multinationals will enter the market by exporting. If, however, the fixed greenfield cost is sufficiently low ($f < (a+c)^2/16$), greenfield entry will be MNF_2's dominant strategy. In such a situation, MNF_1 will be able to make positive profits if (and only if) it undertakes greenfield investment as well (see equation (4)). The reason is that the per-unit trade cost is not sufficiently low, allowing MNF_1 to compete against MNF_2, which will undertake greenfield investment, irrespective of MNF_1's entry mode choice.

By contrast, if the fixed greenfield cost is neither sufficiently low nor sufficiently high (i.e., $(a+c)^2/16 < f < f_u$), one multinational will not be able to enter the market. It is MNF_2, which stays out, if the fixed cost of investment is such that $(a+c)^2/16 < f < (a+c)^2/9$, or MNF_1 if the fixed cost of investment is such that $(a+c)^2/9 < f < f_u$. The intuition is as follows: (i) given the fixed greenfield cost such that $(a+c)^2/16 < f < (a+c)^2/9$, MNF_1 can deter MNF_2 from entering the market by undertaking greenfield investment as the fixed investment cost does not permit two multinational firms to enter the same market by undertaking greenfield investment and as the per-unit trade cost does not allow for a positive profit when the rival is undertaking greenfield investment; and (ii) given the fixed greenfield cost such that $(a+c)^2/9 < f < f_u$, greenfield entry will not bring positive profits to either multinational firm unless the rival opts for trade. However, neither multinational makes non-negative profits by exporting unless the rival stays out of the market. Consequently, MNF_1 will stay out of the market and make zero profit, and MNF_2 will export as it will be the single firm entering the market. ■

References

[1] Albornoz, F., Calvo Pardo, H.F., Corcos, G., Ornelas, E. 2012. Sequential exporting. *Journal of International Economics* 88, 17-31.

[2] Altomonte, C., Rungi A. 2014. Global supply chains and international competitiveness. Robert Schuman Centre for Advanced Studies Policy Paper 2014/04, European University Institute.

[3] Andrade, G., Mitchell, M., Stafford, E. 2001. New evidence and perspectives on mergers. *Journal of Economic Perspectives* 15, 103-120.

[4] Barros, P.B. 1998. Endogenous mergers and size asymmetry of merger participants. *Economics Letters* 60, 113-119.

[5] Bjorvatn, K. 2004. Economic integration and the profitability of cross-border mergers and acquisitions. *European Economic Review* 48, 1211-1226.

[6] Bulow, J., Geanakoplos, J., Klemperer, P. 1985. Multimarket oligopoly: strategic substitutes and complements. *Journal of Political Economy* 93, 488-511.

[7] Calderón, C., Loayza, N., Servén, L. 2004. Greenfield foreign direct investment and mergers and acquisitions: feedback and macroeconomic effects. World Bank Policy Research Working Paper 3192, World Bank.

[8] Caves, R.E. 1996. *Multinational enterprise and economic analysis.* Cambridge: Cambridge University Press.

[9] Defever, F., Heid, B., Larch, M. 2014. Spatial exporters. *Journal of International Economics* (forthcoming). doi: 10.1016/j.jinteco.2014.11.006

[10] Deneckere, R., Davidson, C. 1985. Incentive to form coalitions with Bertrand competition. *Rand Journal of Economics* 16, 473-486.

[11] Dunning, J.H., Lundan, S.M. 2008. *Multinational enterprises and the global economy.* Cheltenham: Edward Elgar.

[12] Eicher, T., Kang, J.W. 2005. Trade, foreign direct investment or acquisition: optimal entry modes for multinationals. *Journal of Development Economics* 77, 207-228.

[13] Farrell, J., Shapiro C. 1990. Horizontal mergers: an equilibrium analysis. *American Economic Review* 80, 107-126.

[14] Görg, H. 2000. Analyzing foreign market entry: the choice between greenfield investment and acquisitions. *Journal of Economic Studies* 27, 165-181.

[15] Hennessy, D.A. 2000. Cournot oligopoly conditions under which any horizontal merger is profitable. *Review of Industrial Organization* 17, 277-284.

[16] Javorcik, B.S., Saggi, K. 2010. Technological asymmetry among foreign investors and mode of entry. *Economic Inquiry* 48: 415-433.

[17] Lommerud, K.E., Sorgard, L. 1997. Merger and product range rivalry. *International Journal of Industrial Organization* 16, 21-42.

[18] Mukherjee, A., Sengupta, S. 2001. Joint ventures versus fully owned subsidiaries: multinational strategies in liberalizing economies. *Review of International Economics* 9, 163-180.

[19] Müller, T. 2007. Analyzing modes of foreign entry: greenfield investment versus acquisition. *Review of International Economics* 15, 93-111.

[20] Navaretti, B.G., Venables, A.J. 2004. *Multinational firms in the world economy.* Princeton: Princeton University Press.

[21] Neary, J.P. 2009. Trade costs and foreign direct investment. *International Review of Economics and Finance* 18, 207-218.

[22] Norbäck, P.J., Persson, L. 2008. Globalization and profitability of cross-border mergers and acquisitions. *Economic Theory* 35, 241-266.

[23] Perry, M.K., Porter, R.H. 1985. Oligopoly and the incentive for horizontal merger. *American Economic Review* 75, 219-227.

[24] Salant, S., Switzer, S., Reynolds, R.J. 1983. Losses from horizontal merger: the effects of an exogenous change in industry structure on Cournot-Nash equilibrium. *Quarterly Journal of Economics* 98, 185-199.

[25] Stigler, G.J. 1950. Monopoly and oligopoly by merger. *American Economic Review* 40, 23–34.

[26] UNCTAD 2006. *World Investment Report 2006: FDI from developing and transition economies—implications for development.* New York and Geneva: United Nations.