Playing away to win at home

Dermot Leahy [a], Stephen Pavelin [b],*

[a] *University College Dublin, Dublin,Ireland*
[b] *Economics Department, The Business School, University of Reading,*
Reading RG6 6AA, UK

Abstract

This paper presents a model of the interaction between two rival firms based in the same country. Each firm must decide how to serve a foreign market (export or foreign production) and how much to invest in a corporate-wide asset that reduces production costs and/or augments the willingness-to-pay for their product. In this scenario, the firms' foreign direct investment decisions are interdependent. Furthermore, strategic motives for FDI relate to a firm's domestic, as well as foreign, market profits. One possibility is that a firm sets up overseas production even though its foreign market profits would be higher by exporting.
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1. Introduction

Standard explanations of foreign direct investment (FDI) focus upon two motives: to lower the cost of supplying a market; and/or to improve access to some foreign market(s) (see Caves, 1996 for an overview). For the choice between foreign entry modes (say, exporting, licensing and FDI), explanations derived from transaction cost theory assert that a firm will choose the mode that minimises such costs (Agarwal & Ramaswami, 1992; Taylor, Zou, & Osland, 1998; Zhao, Luo, & Suh, 2004). Broadly speaking, transaction cost theory suggests that the FDI option will be favoured only if costs associated with other modes are prohibitively high (Gatignon & Anderson, 1988; Williamson, 1985). Furthermore, a number of recent contributions to the international business literature have sought to extend the transaction cost approach to

* Corresponding author. Tel.: +44 118 3785073.
  E-mail address: s.pavelin@reading.ac.uk (S. Pavelin).

include the cultural and institutional context of the firm and the relevant overseas business environment (Brouthers & Brouthers, 2000; Delios & Beamish, 1999; Tihanyi, Griffith, & Russell, 2005).

However, the theory of the multinational firm also accommodates other, complementary motives for FDI that derive from the strategic imperative for a firm to influence the behaviour of its rivals insofar as it is possible and that influence can be exerted to achieve a more beneficial outcome for the firm. In this paper, we highlight a possible strategic motive for FDI, such that: a firm may be motivated to set-up foreign production because by doing so they reduce a rival firm's commitment of resources to a corporate-wide investment that has a cost-reducing or demand augmenting effect. As the investment deterred has a corporate-wide impact on the rival, this effect of FDI serves to augment the firm's performance in the home, as well as the foreign, market. Indeed, even if the fixed cost of FDI is large enough to ensure that the firm's profits from serving the foreign market would be higher by exporting, the firm may nevertheless set-up a foreign plant. They do so because FDI is associated with an improvement in their home market profits—this is the scenario alluded to in the title.[1]

The international expansion of production activities is overwhelmingly associated with relatively large firms that tend to serve relatively large shares of the national markets in which they operate. After all, such a strategy is accompanied by substantial resource requirements in capital, managerial expertise and time, and so on. Also, a firm must overcome any disadvantage associated with its (at least initial) relative unfamiliarity and/or incompatibility with the foreign production environment, as compared to the indigenous industry. Therefore, firms that sustain multinational production are those that hold the firm-specific assets (of whatever kind) that secure a strong, perhaps dominant, presence in the market (Dunning, 1988; Teece, 1986). As a result, it is unsurprising that, in recent years, a notable academic literature has developed to explore the influence of market power on the evolution of multinational firms. Specifically, it has become more widely acknowledged that companies' foreign direct investment (FDI) decisions can be importantly interdependent, i.e. that one firm's FDI decision can be importantly influenced by the corresponding choice of a rival firm.

One mechanism through which such interdependence can arise is proposed by Knickerbocker (1973), who sought to explain the apparent clustering of FDI observed among US firms. He proposed that if one of a group of rival oligopolists sets-up production facilities overseas, uncertain foreign cost economies will threaten the status-quo in all markets (at home and abroad if the firms initially export). Risk-averse rival firms would then seek to minimise the prospect of upsetting the balance of competition by replicating an initial FDI by a rival, i.e. there is an incentive for follow-my-leader behaviour. This mechanism, which requires the presence of oligopoly, uncertainty and risk aversion, has since been formalised by Head, Mayer, & Ries (2002). Also, Leahy and Pavelin (2003) formally illustrate an alternative mechanism for positive interdependence between firms' FDI—that one firm undertaking FDI increases the incentive for rival firms to follow suit. They show that, without uncertainty about the foreign production environment or risk aversion, firms may engage in follow-my-leader FDI because of foreign cost advantages that would threaten tacit, oligopolistic collusion if FDI was not replicated across firms.

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[1] The title draws upon the parlance of Association Football in the UK. For readers unfamiliar with such matters, a corresponding title for followers of American sport might be, *Home stand sweep secured on a road trip*, or more obscurely, *Red Sox visit Bronx*, *win at Fenway*.

An alternative approach employs an analysis of oligopoly that disregards risk-aversion and presumes complete information and non-cooperative behaviour. Seminal contributions in this area include those made by Smith (1987), Horstmann and Markusen (1992) and Motta (1992). That literature, upon which this paper builds and to which it contributes, reveals the tendency in FDI for negative interdependence between firms, i.e. the firms' actions are strategic substitutes. The underlying mechanism derives from the characterisation of FDI as a fixed cost (of building a foreign plant) in exchange for per-unit saving (on a transport cost and/or tariff associated with exporting) and the fact that if a firm undertakes FDI, the foreign-dedicated output of that firm is larger and that of its rival is smaller, ceteris paribus. Therefore, by undertaking FDI, a firm decreases its rival's incentive to follow suit by reducing that firm's optimal foreign-dedicated output and so decreasing the number of units across which it must recover the fixed cost of overseas operations. This interdependence gives rise to a potential strategic motive for FDI: when FDI by one firm deters FDI by a rival, this makes FDI more attractive for the former as it increases the profitability of its serving of the foreign market through local production.

As outlined previously, we will show that the range of strategic motives for FDI available to a firm is expanded by the addition of investment in some corporate-wide asset. In this connection, there is an extensive literature that discusses the complementary relationship between FDI and research and development (R&D) activities. Some have focussed upon the role of innovatory leadership in providing the firm-specific advantages necessary for the internationalisation of the firm (Caves, 1996; Dunning, 1977, 1981; Petit & Sanna-Randaccio, 1998); others have focussed upon the within-firm internationalisation of the innovation process (Archibugi & Michie, 1995; Cantwell, 1992, 1995; Cantwell & Piscitello, 1999, 2000; Granstrand & Sjolander, 1992; Kuemmerle, 1999; Zander, 1997). Most pertinently, Petit and Sanna-Randaccio (2000) and Sanna-Randaccio (2002) propose a formal theoretical model of the interaction between these two corporate behaviours in an oligopoly setting. Indeed, this model is similar to that which we present below. However, in the exposition of their model, they choose to focus upon the within-firm complementarity between FDI and R&D, the effect of technological spillovers and government policy on FDI, and the welfare implications of corporate behaviour. They choose not to extract, describe and discuss the distinctive motives for FDI present in such a framework, and upon which we will focus here.

The remainder of the paper is organised as follows: the next section describes the model; Section 3 presents results and some discussion; the final section offers concluding remarks.

2. The model

Consider the following model. There are two firms – Firm 1 and Firm 2 – that produce substitute goods. The firms compete in two markets: one in country A (the home market); and one in country B (the foreign market). Both firms have a production plant in country A but must decide whether to serve B with exports or, following FDI, from a new local plant. In addition to deciding whether or not to carry out this market-specific investment, each firm engages in corporate-wide investment, which lowers its production costs everywhere and/or raises demand for the firm's product everywhere. This corporate-wide investment expenditure is: κ_j for Firm $j=1,2$. There is a three-stage game as follows: in the first stage, the firms decide whether or not to carry out FDI; in the second stage, they set their R&D levels; and in the third stage, they play separate Cournot games in the two markets. That is they choose

their outputs to be dedicated to each of the two markets.[2] At each stage, the firms move simultaneously.[3]

The home market demand for Firm j is:

$$p_j^A = a + \lambda x_j - q_j^A - eq_k^A \quad j = 1, 2 \text{ and } k \neq j \tag{1}$$

where q_j^A represents the home market sales of Firm j. The parameter e is an inverse measure of product differentiation that takes a value of unity when goods are identical and zero when they are unrelated. Investment affects demand through $x_j = \sqrt{2\kappa_j/\gamma}$ (inverting we have $\kappa_j = \gamma x_j^2/2$ with the cost of investment determined by γ). The parameter λ is greater than zero if a firm's investment increases consumers' willingness to pay for the variety produced by that firm. The corresponding foreign market demand for Firm j is:

$$p_j^B = a + \lambda x_j - q_j^B - eq_k^B \quad j = 1, 2 \text{ and } k \neq j \tag{2}$$

where q_j^B represents the foreign market sales of Firm j.

Marginal production costs are:

$$c_j = c_0 - \theta x_j \quad j = 1, 2 \tag{3}$$

where $\theta > 0$ if the investment is cost reducing, and the higher is x_j the lower is marginal cost.[4] The transport costs are t and the total production costs when a firm exports is: $c_j q_j^A + (c_j + t)q_j^B$. If the firm undertakes FDI, it pays a fixed cost, G, and avoids the transport costs. It is convenient to use a more compact notation and to define c_j^i as marginal cost for Firm $j = 1,2$, inclusive of any transport costs, of serving market $i = $ A,B. Now the profits of Firm j can be written as:

$$\pi_j = (p^A - c_j^A)q_j^A + (p^B - c_j^B)q_j^B - \left(\frac{\gamma x_j^2}{2}\right) - IG \tag{4}$$

where I is an indicator variable which is unity when FDI occurs and zero otherwise. The price-cost margin for Firm j in the home market is:

$$p_j^A - c_j = a - c_0 - q_j^A - eq_k^A + (\lambda + \theta)x_j \quad k \neq j \tag{5}$$

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[2] An alternative would be to assume that firms choose price, in other words that they play Bertrand, in the final stage of the game. However, provided that the goods are sufficiently differentiated to ensure interior solutions, our results are qualitatively unchanged. (An interior solution with both firms operating is not possible when firms have identical goods as it would then be impossible for both firms to make positive operating profits and thus they cannot both cover the investment costs.) That the results are qualitatively robust to the mode of competition is a little surprising as Bertrand prices are strategic complements unlike Cournot outputs which are strategic substitutes. However, R&D reaction functions slope down regardless of the mode of competition in the final stage and the negative interdependence between FDI decisions that we show below is also robust to the form of final stage competition. The positive impact of FDI on the incentive to do R&D is also qualitatively unaffected by the form of competition. Detailed derivations for the Bertrand case are available from the authors upon request.

[3] Were the corporate-wide investment chosen before the FDI decision the analysis would become more complicated but the positive relationship between the two forms of investment would persist. It seems reasonable to characterise FDI as a longer run commitment than investment in a particular research or marketing venture. For this reason, we believe that our move-order best captures the stylised facts. This issue is discussed in more detail in Section 3.5.

[4] For simplicity, we assume that there are no R&D spillovers. In this paper we wish to restrict attention to forms of corporate-wide investment that make the firm strategically 'tough' in the sense that it raises own output and reduces the output and the profits of rivals. Moderate R&D spillovers would not alter the fact that higher own R&D harms the rival. However, large enough spillovers would lead rival output and profits to increase in own R&D.

Table 1

	Rival exports	Rival does FDI
Firm j exports	$\alpha_j^B = a - c_0 - t$	$\alpha_j^B = a - c_0 - 2t$
Firm j does FDI	$\alpha_j^B = a - c_0 + t$	$\alpha_j^B = a - c_0$

Thus, regardless of whether it is cost-reducing or demand-enhancing more investment involves higher fixed costs in exchange for a larger price-cost margin in both markets. Thus, it makes no qualitative difference whether we model investment as willingness-to-pay augmenting or as cost-reducing. Without loss of generality we will set $\theta + \lambda = 1$.

For concreteness, in the remainder of the exposition of the model we will assume that investment is cost-reducing, rather than quality-enhancing, R&D and reserve comment on the demand-augmenting investment case to subsequent discussions (Section 3.4 and thereafter). Given a focus upon cost reduction rather than product differentiation, the size of $e > 0$ (the degree of product differentiation) has no qualitative impact on results and it will save on notation to set $e = 1$. Thus, we assume homogeneous products.[5]

3. Results

In solving the game we adopt the sub-game perfect equilibrium concept and proceed by solving the game backwards beginning with the third stage decision regarding outputs.

3.1. The output choices

In each market, there is Cournot competition such that outputs are set to satisfy the following first-order conditions:

$$\frac{\partial \pi_j}{\partial q_j^i} = (p^i - c_j^i) - q_j^i = 0 \quad i = A, B \tag{6}$$

The resulting equilibrium outputs are:

$$q_j^i = \frac{\alpha_j^i + 2x_j - x_k}{3} \quad i = A, B \text{ and } k \neq j \tag{7}$$

where $\alpha_j^A = a - c_0$ and α_j^B depends on the FDI choice of Firm j and its rival (see Table 1).

3.2. The R&D choices

In the second stage of the game, each firm chooses its R&D expenditure taking the FDI regimes as given. Since there is a one-to-one relationship between R&D expenditure κ_j and cost reduction x_j, we can model the firm as choosing x directly. This turns out to be algebraically simpler.

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[5] Given homogeneous products, there is just there is just one price in each market and we can write the market inverse demand as: $p^A = a - Q^A$ and $p^B = a - Q^B$ where Q^A is total sales in the home market and Q^B is total sales in the foreign market. Given purely cost-reducing investment and $\theta + \lambda = 1$, we have: $\theta = 1$ and $\lambda = 0$.

Substituting (6) and (7) into (4), profits net of FDI costs are:

$$\pi_j = \left(\frac{\alpha_j^A + 2x_j - x_k}{3}\right)^2 + \left(\frac{\alpha_j^B + 2x_j - x_k}{3}\right)^2 - \left(\frac{\gamma x_j^2}{2}\right) \tag{8}$$

Firm j's first-order condition for R&D is:

$$\frac{\partial \pi_j}{\partial x_j} = \frac{4}{3}\left(\frac{\alpha_j^A + 2x_j - x_k}{3}\right) + \frac{4}{3}\left(\frac{\alpha_j^B + 2x_j - x_k}{3}\right) - \gamma x_j = 0 \tag{9}$$

From this we can obtain the linearised R&D reaction functions in explicit form:

$$x_j = \frac{R[\alpha_j^A + \alpha_j^B - 2x_k]}{1 - 4R} \quad k \neq j \quad \text{where } R \equiv \frac{4}{9\gamma} \tag{10}$$

R is inversely related to the cost of investment, and is a measure of the *effective return* on R&D.[6] The denominator in (10) is positive from the second-order condition for R&D. Clearly, these reaction functions are negatively sloped implying that R&D levels are strategic substitutes. Firm j's Nash equilibrium level of cost reduction is:

$$x_j = \frac{R}{\Delta}[(1 - 4R)(\alpha_j^A + \alpha_j^B) - 2R(\alpha_k^A + \alpha_k^B)] \quad k \neq j \tag{11}$$

where $\Delta = (1 - 2R)(1 - 6R) > 0$. Stability considerations require this to be positive, i.e. we require that $R < 1/6$. (The cost parameter γ never appears independently of R. It is possible to see R as inversely related to cost of R&D and to place restrictions on it directly.) When a firm decides to do FDI rather than export, the value of α_j^B rises by $2t$ (see Table 1) and the value of α_k^B falls by t. From (10) we can see that this leads to a parallel outward shift of its own R&D reaction function and a parallel inward shift of its rival's R&D reaction function. From (11) we can see how this results in an increase in the R&D investment of the firm that does FDI and a fall in the other firm's R&D.

The use of (11) in (7) gives the following reduced form expressions for home market outputs (q_j^A) and foreign market outputs (q_j^B):

$$q_j^i = \frac{1}{3}\left(\alpha_j^i + \frac{R}{\Delta}[(2 - 6R)(\alpha_j^A + \alpha_j^B) - (\alpha_k^A + \alpha_k^B)]\right) \quad i = A, B \text{ and } k \neq j \tag{12}$$

As discussed earlier, FDI leads to an increase in α_j^B and Eq. (12) implies that firm j's outputs for both markets A and B are increasing in α_j^B. Thus, increases in both the foreign and domestic outputs of a firm follow from a choice to do FDI.

3.3. The FDI choices

We will now examine the first stage, that in which the firms choose whether or not to engage in FDI. Making use of first-order conditions for output (6) and the first-order conditions for

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[6] Since $R \equiv 4/9\,\gamma$ and $x_j = \sqrt{2\kappa_j/\gamma}$ yield $x_j = 3\sqrt{R\kappa_j/2}$, it follows that the larger is R, the more effective is κ_j in reducing costs (or enhancing demand if demand is increasing in κ_j).

investment (9), which can be rewritten as $x_j = 3R(q_j^A + q_j^B)$, allows us to write profits in terms of each firm's own outputs:

$$\pi_j = \left(q_j^A\right)^2 + \left(q_j^B\right)^2 - 2R\left(q_j^A + q_j^B\right)^2 - IG \tag{13}$$

From (12) it is clear that the outputs depend on the levels of R and α. Without loss of generality we can normalise the home market $\alpha_j^A = a - c_0$ as unity. The differences between regimes in both outputs and profits exclusive of FDI costs are explained by differences in the regime specific α_j^B levels which in turn depend on transport costs (see Table 1). There are three exogenous parameters in the model G, t and R – we replace γ with R for convenience – that will jointly determine the first stage equilibrium outcomes.

We will use E to represent the strategy choice export and M is used to represent strategy choice of a firm that does FDI and thus becomes a multinational. Let Π_{jk}^j be the profits for Firm j exclusive of FDI costs when Firm j chooses mode of serving the foreign market $j = E,M$ and Firm k chooses mode $k = E,M$. Given that Firm k chooses $k = E,M$, Firm j compares Π_{Ek}^j and $\Pi_{Mk}^j - G$, and chooses the one that yields higher profits. Setting these equal gives us the two thresholds for Firm j: $G_k^j = \Pi_{Mk}^j - \Pi_{Ek}^j$, $k = E,M$.

The results are presented graphically in G, t space in Fig. 1. The two thresholds divide the space into three regions. In the figure, G and t are given as a proportion of $a - c_0 = 1$. Clearly therefore, t must lie below 0.5 to ensure that all α_j^B are positive, i.e. that both firms can profitably serve the foreign market in all circumstances (see Table 1). In the figure, we hold the value of R constant at 0.03. Increases in the level of R will shift the threshold loci demarcating the different regions upwards increasing the size of the regions in which firms become multinational, but it will not qualitatively affect the diagram.

3.4. Discussion: playing away to win at home

In this model, there is potential for FDI to be critically motivated by its ability to increase home market profits—a hypothetical example would be a UK company setting up production
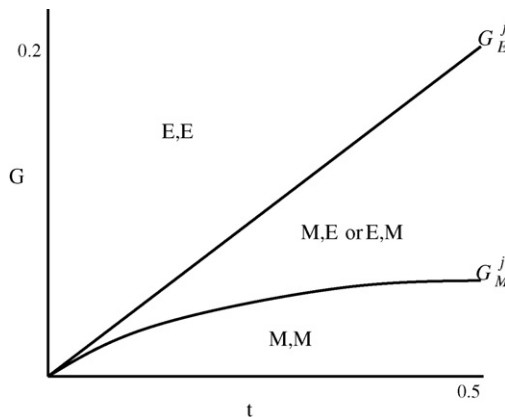

Fig. 1. The equilibrium outcomes regarding the mode of serving the foreign market: exporting (E) or multinational production following FDI (M)—E,E indicates that both firms export; M,E and E,M indicate that one firm exports and the other undertakes FDI; M,M indicates that both firms undertake FDI. Both G and t are measured as fractions of $a - c_0 = 1$, and R is set at 0.03.
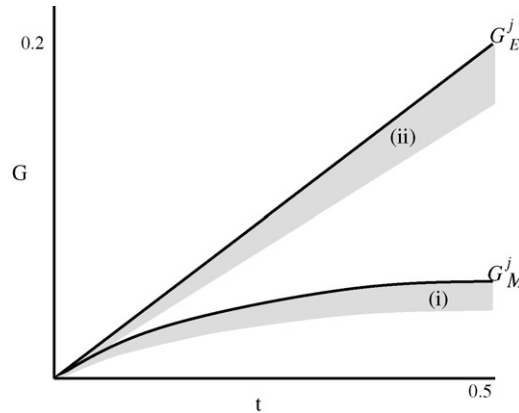
Fig. 2. The combinations of G and t, given R, for which a firm chooses to undertake FDI when its foreign market profits would be higher as an exporter are indicated by shaded regions. In region (i), the equilibrium outcome is M,M; in region (ii), it is M,E or E,M. Both G and t are measured as fractions of $a - c_0 = 1$, and R is set at 0.03.

in France for its effect on domestic profits and specifically an augmentation of its competitive position in the UK market relative to other UK companies. To reveal the extent to which the FDI observed in Fig. 1 is thus motivated, we must find those combinations of R, G and t for which a firm chooses FDI when its foreign market profits would be higher as an exporter. We isolate such combinations in G, t space by recalculating the thresholds G_k^j ($k = $E,M) disregarding home market profits; the relevant parameterisations lie in-between the original and recalculated thresholds (the latter of which lie below the former in both cases) and are shaded in Fig. 2 regions (i) and (ii).

In region (i), if the firms were to ignore the effect of FDI on home profits, the outcome would be M,E (or E,M) rather than M,M. This is because, given that its rival chooses FDI, the foreign market profits of a firm (taking account of FDI costs) would be higher if it exported rather than undertook FDI. The firm chooses FDI because, were it to export, its home market profits would be lower due to the accompanying differences in investment behaviour—rather than the symmetrical R&D of the M,M outcome, a sole multinational out-invests its rival in R&D.

In region (ii), if the firms were to ignore the effect of FDI on home profits, the outcome would be E,E rather than M,E (or E,M). This is because, given that its rival chooses to export, the foreign market profits of a firm (taking account of FDI costs) would be higher if it exported rather than undertook FDI. The firm chooses FDI because, were it to export, its home market profits would be lower due to the accompanying differences in investment behaviour—rather than the multinational out-investing its rival in R&D as in the M,E/E,M outcome, there is symmetrical R&D in exporting duopoly (E,E).

The 'playing away to win at home' scenario arises because of the effect of a firm's FDI on the investment behaviour of both firms. Thus, there are two mechanisms at work: one is the within-firm complementarity between FDI and R&D; the other is the strategic effect of FDI across firms which depresses the R&D of the rival. The former derives from the increased incentive to invest in R&D that accompanies FDI due to a rise in the firm's total output (owing to a lower variable cost of serving the foreign market); the latter derives from the decreased incentive to invest in R&D that accompanies a rival's FDI due to a fall in the firm's total output (owing to an improvement in the relative position of the rival in the foreign market). The effect of each is to improve the home

(as well as foreign) market position associated with the FDI option. Thus with the inclusion of a corporate-wide investment, the strategic motives for FDI extend to a firm's home market, where one effect of FDI is to reduce the rival's price-cost margin.

3.5. Discussion: move order

As explained previously, the move order employed in our model is: the firms simultaneously set FDI; then simultaneously set R&D expenditures; and then simultaneously set outputs. Therefore, we have it that FDI is fixed at the point when the corporate-wide investment is chosen. Alternatively, one might assume that all choices are made at the same time or that R&D is set first and FDI second, such that corporate-wide investment would be fixed at the point when the firms decide whether to undertake FDI. Before proceeding with further exposition of our findings, it is worth pausing to reflect on the manner in which the results would, under these alternative specifications, be qualitatively different from those previously described in this section.

If the FDI and R&D decisions are made concurrently, there is less scope for firms to invest strategically, such that the 'playing away to win at home' motive is weaker and arises for a smaller set of parameterisations. If all investment decisions are made at a single point in time, there is no potential for a firm to commit to a high level of one kind of investment in order to manipulate a subsequent investment of its rival. In our model, one firm can, through prior FDI, deter its rival from investing in R&D, such that the latter is caused to invest some lesser amount in R&D. Appendix A outlines the concurrent case and shows that, as a result of this restriction of strategic motives, FDI is less prevalent than in our model (i.e. it occurs for a narrower range of parameterisations).

If the two investment decisions were made sequentially, but the ordering were reversed relative to our model (i.e. R&D is set first and FDI second), the 'playing away to win at home' scenario would potentially arise but in a different form. Due to the separation in time of the two investment decisions, a firm would be able to commit to a high level of one kind of investment in order to manipulate a subsequent investment of its rival. However in contrast to our model, the initial investment would, in that case, be R&D (rather than FDI) and the subsequent investment would be FDI (rather than R&D). Therefore, the strategic motive would drive up a firms' investment in R&D for the purpose of subsequently deterring a rival from undertaking FDI (and instead exporting).

We do, however, regard the move ordering employed in our model to be the most appropriate. As the ownership of some firm-specific advantage, perhaps generated by judicious investment in R&D, is regarded a necessary condition for multinational production (Caves, 1996), one might argue that the R&D choice should precede that for FDI. However, in deciding upon move order the most pertinent characteristic is the frequency with which the firm can be said to face the relevant decision, with more frequent decisions properly staged later in the game. This is because move ordering crucially determines which strategies are taken to be fixed when each decision is made—earlier decisions are fixed at the point that later decisions are made.

That output choices reside in a final stage implies that firms adjust output more frequently than their strategies regarding either R&D or FDI—and so the latter two are fixed for the duration of the period for which output is set; that R&D choices are staged in a second stage implies that firms adjust such investments less frequently than their output strategies, and more frequently than their strategies regarding either FDI; that FDI choices are staged first implies that firms adjust FDI strategy less frequently than their strategies regarding either R&D or output. Thus, the move ordering adopted in our model implies that the investment decisions are longer term decisions

than those regarding output, and that the decision to set up and operate overseas is fixed for a longer term than is the level of R&D expenditure. This, we propose, best reflects the stylised facts.

3.6. Discussion: playing away to win at home and consumer surplus

It is worth noting the effect on consumer surplus in the home market of the FDI we observe that is critically motivated by its positive effect on home market profits. From Fig. 1, we can see such promotion of FDI: M,M rather than M,E or E,M (region (i) of Fig. 2); M,E or E,M rather than E,E (region (ii) of Fig. 2). These shifts in regime act to augment per-unit consumer willingness-to-pay and/or depress the variable costs at which the market is served in two ways. Firstly, one firm need not incur the per-unit transport cost, t. Secondly, and as a result of the first, FDI is associated with greater investment in the corporate-wide asset. This is because as an exporter a firm invests less than it would as a multinational, ceteris paribus, owing to the increased marginal return to investment associated with larger outputs.

Fig. 3 shows consumer surplus (CS) in the home market in equilibrium (represented by black lines) across the same range of t shown in Figs. 1 and 2. In order to illustrate the manner in which CS varies with t not only within but also between FDI regimes, we draw the figure given a fixed cost of FDI for which we observe all regimes (E,E, M,E/E,M and M,M) across the relevant range of t, i.e. G must be sufficiently low for M,M to be observed at the highest levels of t. In Fig. 3, we see that within regimes CS either falls (as in E,E and M,E/E,M) or remains constant (as in M,M) as t rises. Comparing across FDI regimes for $t > 0$, the highest level of CS is found under multinational duopoly (M,M) and shifts in regimes towards ones exhibiting greater FDI (E,E to M,E/E,M to M,M) tend to be associated with a higher level of CS.

From Fig. 3, we can also inspect the effect of playing-away-to-win-at-home FDI on CS in the home market. The shaded regions, (i) and (ii), correspond to the identically labelled regions in
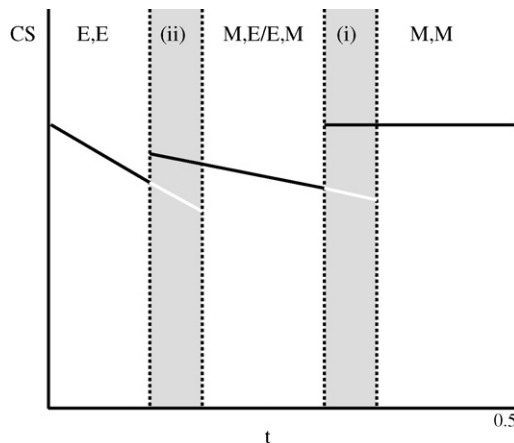

Fig. 3. The effect of trade liberalisation on consumer surplus in the home country market: the figure shows equilibrium consumer surplus (CS; represented by black lines) across the same range of t (measured as a fraction of $a - c_0 = 1$) shown in Figs. 1 and 2. CS given FDI choices disregarding home market profits are represented by a white line (the shaded regions, (i) and (ii), correspond to the identically labelled shaded regions in Fig. 2).

Fig. 2. In region (i) both firms choose to undertake FDI in equilibrium (M,M) but disregarding the effect of FDI on home market profits, the outcome would instead be M,E or E,M. The CS that would be observed in the latter case is indicated by a white line in region (i) of Fig. 3. In region (ii), one firm chooses to undertake FDI in equilibrium (M,E or E,M) but disregarding the effect of FDI on home market profits, the outcome would instead be E,E. The CS that would be observed in the latter case is indicated by a white line in region (ii) of Fig. 3. By comparing the white lines with the black lines in regions (i) and (ii), we observe that playing-away-to-win-at-home FDI acts to drive up consumer surplus in the home country market above the level it otherwise would be. Therefore, FDI thus motivated benefits home consumers.

4. Conclusion

This paper presents a simple model of the interaction between two rival firms based in the same country. Each firm must decide how best to serve a foreign market (export or foreign production) and how much to invest in a corporate-wide asset that acts to reduce production costs and/or augment the willingness-to-pay for their product. We show that in this scenario, the firms' foreign direct investment decisions are interdependent. Furthermore, strategic motives for FDI relate not only to a firm's foreign market profits but also to those from their domestic market. One possibility is that a firm sets up a plant overseas even though its profits from serving the foreign market would be higher by exporting.

As explained previously, the corporate-wide investment need not be exclusively interpreted as cost-reducing R&D. The results of the model would not be qualitatively different if the investment instead had a positive effect on the demand for the firm's products. For the purposes of our analysis we require the investment to: have a corporate-wide effect; require a fixed cost; and exert positive and negative influences on the output levels (and market shares) of the investing firm and its rival, respectively. Therefore, these results are applicable not only to R&D expenditures for cost reduction but also to R&D that enhances product quality. Hence, there are a variety of mechanisms through which the effects of rivals' FDI can be felt in all markets in which they compete, permitting the motive for foreign production to reside at home.

Acknowledgement

Appendix A

A.1. FDI and R&D chosen concurrently

Suppose that the firms choose FDI and R&D concurrently in stage 1 and then choose output in stage 2. The firms continue to move simultaneously at every stage. Let us call this the concurrent FDI and R&D game. As in the sequential FDI and R&D game examined in the text the outcome of the game clearly depends on the parameters G and t.

To understand how this game differs from that in the text we must recognise that a firm in the concurrent game chooses FDI and R&D taking both the FDI and the R&D level of its rival as given. It does not expect to have an affect on rival R&D when it changes its decision regarding
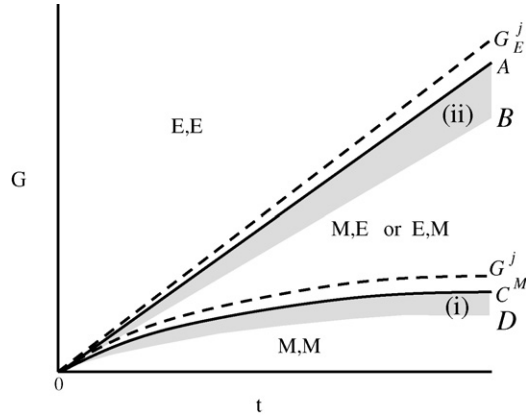
Fig. 4. The concurrent case—FDI and R&D chosen at the same time: the upper bounds on both the M,M and M,E (or E,M) outcomes are lower in the concurrent case than in the sequential case presented in Figs. 1 and 2 (see the dotted lines in the figure). In region (i), the equilibrium outcome is M,M, M,E, or E,M; in region (ii), it is E,E, M,E, or E,M.

FDI. In contrast, in the sequential setting used in the text, the firm will factor in the R&D response of its rival to a change in its own FDI decision. In particular, it expects that a decision to do FDI will reduce the rival firm's R&D. A reduction in rival R&D is helpful to a firm as it means that its rival's marginal costs are higher. This belief regarding the response of rival R&D to a change in a firm's FDI is the key difference between the two games.

The different equilibrium constellations are represented in Fig. 4. Above the locus OA both firms export, EE is the unique equilibrium of the concurrent game. Below the locus OD both firms carry out FDI and MM is the unique equilibrium. Between OB and OC only the asymmetric equilibria ME and EM occur. The concurrent FDI and R&D game gives rise to greater multiplicity of equilibria than the sequential FDI and R&D game we have considered the text. For instance with concurrent moves (but not with sequential moves) the upper bound on MM is above the lower bound on ME and EM. The intuition for this is that starting at a MM equilibrium, a firm will deviate (the MM Nash equilibrium will cease to exist) when the G is so high that it pays to do E and adjust R&D appropriately given that the rival does M and keeps R&D fixed at the MM level. But starting at an EM equilibrium, a firm will deviate when the G is so low that it pays to do M and adjust R&D appropriately given that the rival does M and keeps R&D fixed at the EM level.

Rival R&D is higher under EM than MM (i.e. all other things equal the rival firm will do more R&D in the equilibrium in which it is the only firm that is doing FDI than in the equilibrium in which both do FDI.) The benefits of doing FDI are greater when you expect that your rival will have lower R&D. Hence the upper bound on MM (the locus OC in the figure) is above the lower bound on EM (the locus OD). The same type of argument can be used to show that the upper bound on ME (EM) is above the lower bound on EE.

In the sequential FDI-R&D game we studied in the main text, there is an incentive to use FDI strategically to reduce rival R&D and thus raise own profits. This effect is absent in the concurrent game. It is not surprising therefore that there is an important sense in which there is more FDI in the sequential FDI and R&D game than in the concurrent game. To be more precise, the upper bound on the MM and ME, EM regions are lower in the concurrent game than in the sequential game. The appropriate boundaries for the sequential game are represented by the dotted loci in

the figure. There is never less and there is sometimes more FDI in the sequential model than in the concurrent game. This is because of the additional strategic incentive to do FDI.

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