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Greenfield Investment versus Acquisition: Positive Analysis

By B. Ferrett

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Abstract

The analysis is motivated by the observation that foreign direct investment (FDI) is in reality a heterogeneous flow of funds, composed of both greenfield-FDI ('greenfield investment') and acquisition-FDI (cross-border mergers and acquisitions), although previous game-theoretic analyses have concentrated exclusively on one form of FDI. We aim to isolate the determinants of the equilibrium form of FDI. We model the equilibrium industrial structures of a concentrated (two-incumbent) global industry that spans two (perfectly segmented) national product markets (i.e. an 'international oligopoly'). Firms' FDI decisions (i.e. whether to produce abroad and what form of FDI to choose) and process R&D decisions are made endogenously, and potential entry into the industry is allowed for. Key findings are that acquisition-FDI arises in medium-sized markets (where entry does not occur) and that necessary conditions for greenfield-FDI are a large market and a small sunk cost of additional plants. In future work the welfare properties of equilibria associated with the alternative forms of FDI will be compared.

JEL classification: F21, F23, L12, O31.

Keywords: greenfield-FDI, acquisition-FDI, international oligopoly, equilibrium industrial structure.

Outline

Non-Technical Summary

The analysis is motivated by the observation that foreign direct investment (FDI) is in reality a heterogeneous flow of funds, composed of both greenfield-FDI (‘greenfield investment’) and acquisition-FDI (cross-border mergers and acquisitions), although previous game-theoretic analyses of equilibrium FDI flows have concentrated exclusively on one type of FDI. We aim to isolate the determinants of the equilibrium form of FDI, which requires the development of a modelling structure where the form of FDI is endogenously selected (rather than exogenously imposed).

We model the equilibrium industrial structures of a concentrated (two-incumbent) global industry that spans two (perfectly segmented) national product markets (i.e. an ‘international oligopoly’). Firms’ FDI decisions (i.e. whether to produce abroad and what form of FDI to choose) and process R&D decisions are made endogenously, and potential entry into the industry is allowed for.

The game has four stages. In stage one, one of the incumbents may purchase the rival incumbent, thereby generating an international flow of acquisition-FDI. If an acquisition occurs, we then enter the Acquisition (A) subgame: in stage two the integrated incumbent (which owns a plant in each country) chooses how much to invest in process R&D. If no acquisition occurs in stage one, we enter the Greenfield (G) subgame: in stage two the incumbents non-co-operatively choose (i) whether to undertake (tariff-jumping) greenfield-FDI and (ii) how much to invest in process R&D. Stages three and four are identical in both the A and G subgames. In stage three the potential entrant decides whether to enter the industry by undertaking process R&D. In stage four market equilibrium in both countries is established via Bertrand competition. The A and G subgames are solved backwards (from stage four to stage two) to isolate their subgame perfect Nash equilibria (in pure strategies). The stage-one choice between the A and G subgames is determined by a decision rule conventionally used in co-operative merger games: acquisition-FDI occurs if and only if it is (strictly) profitable for the incumbents relative to the equilibrium of the G subgame (‘threat point’).

Two features of our modelling structure generate significant interest. First, the inclusion of potential entry means that the choice between the A and G subgames is not a (trivial) comparison of monopoly and duopoly profits. Second, the inclusion of endogenous R&D decisions implies that monopolization via acquisition-FDI could (logically) increase consumer welfare if R&D is undertaken in the A subgame but not in the G subgame. This in turn allows investigation of a common justification for acquisition-FDI in public policy (the ‘failing firm’ defence). These welfare issues will be examined in detail in furture work.

Key findings are that acquisition-FDI arises in medium-sized markets (where entry does not occur) and that necessary conditions for greenfield-FDI are a large market and a small sunk cost of additional plants. The use of greenfield-FDI to deter entry in the G subgame may prevent acquisition-FDI from arising in equilibrium by bolstering the incumbents’ ‘disagreement profits’ and rendering an acquisition unprofitable. The association between trade costs and equilibrium acquisition-FDI can be either positive (‘conventional’) or negative (‘perverse’), depending on the probability that R&D investments are successful.

1. Introduction.[1]

In reality foreign direct investment (FDI) is a heterogeneous flow of funds, composed of both greenfield-FDI ('greenfield investment'), which represents a net addition to the host country's capital stock, and acquisition-FDI, which represents a change in the ownership of pre-existing production facilities in the host country. Two questions are provoked by this observation. First, what determines the form of FDI that arises in equilibrium? Second, what are the comparative welfare properties of equilibria associated with the alternative forms of FDI? The current paper tackles the first question, and Ferrett (forthcoming) addresses the second.

To explore these questions, we model the equilibrium industrial structures of a concentrated global industry that spans two (perfectly segmented) national product markets (i.e. an 'international oligopoly'). Firms' FDI decisions (i.e. whether to produce abroad and what form of FDI to choose) and process R&D decisions are made endogenously. A key contribution of this paper is its incorporation of acquisition-FDI into a model of equilibrium industrial structures in an international oligopoly: precursor models in this tradition (e.g. Horstmann and Markusen, 1992; Rowthorn, 1992; Petit and Sanna-Randaccio, 2000; Ferrett, 2002) identified FDI in general with greenfield-FDI in particular. This contribution is potentially significant because, empirically, acquisition-FDI is the dominant form of FDI: UNCTAD (2000, pp. 14-18) reports that '[o]ver the past decade, most of the growth in international production has been via cross-border M&As [mergers and acquisitions]... rather than greenfield investment: the value of completed cross-border M&As rose from less than $100 billion in 1987 to $720 billion in 1999... *[when t]he ratio of the value of cross-border M&As to world FDI flows reached over 80 per cent'* (italics added).

A number of contributions have analysed equilibrium acquisition-FDI (e.g. Barros and Cabral, 1994; Falvey, 1998; Horn and Persson, 2001a, 2001b). All employ a decision rule for equilibrium selection pioneered by Salant, Switzer and Reynolds (1983): for a given cross-border acquisition to arise in equilibrium, the equilibrium profits of the resulting multinational enterprise (MNE)

[1] For brevity the Appendix material has not been included in this research paper. The Appendix is available from the author on request. This research paper is based on chapter 4 of my Warwick PhD thesis. The full text of the chapter is available from the author on request.
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must exceed the combined profits of the predator and target firms in product market equilibrium if the proposed cross-border acquisition does not occur. The equilibrium in the absence of acquisition provides a 'threat point', and therefore the decision rule selects acquisition iff an acquisition price exists that will make *both* the predator *and* the target firms better off (see Section 2). However, none of the analyses of equilibrium acquisition-FDI include greenfield-FDI as an alternative to acquisition-FDI: a firm's only alternative means of serving the foreign product market is to export from its domestic production base. This omission has two consequences. First, existing models of equilibrium acquisition-FDI cannot provide comparisons between greenfield- and acquisition-FDI: such comparisons require the development of a modelling structure where the *form* of FDI is endogenously selected. The current paper attempts to fill this gap. Second, the exclusion of greenfield-FDI as an alternative to acquisition-FDI implies that firms' profits at the threat point (i.e. their 'disagreement profits' if no acquisition occurs) may be incorrectly represented relative to reality, where firms *do* possess greenfield-FDI strategies. (Of course, firms' disagreement profits in existing models of acquisition-FDI are correctly represented in terms of those models' underlying assumptions on firms' strategies.) In turn, this will of course affect the validity of predictions concerning the emergence of acquisition-FDI in equilibrium (via the decision rule outlined above). (It should be noted that the exclusion of greenfield-FDI *does not* imply that disagreement profits will be 'too low'. If rival firms non-co-operatively choose between exporting and greenfield-FDI as means of serving the foreign product market when acquisition-FDI is ruled out, then greenfield-FDI can arise in (Prisoner's Dilemma) equilibria where both firms would prefer exporting: see Proposition 3 of Ferrett (2002).)

The modelling structure we develop in Section 2 captures the choice between greenfield- and acquisition-FDI formally; it also includes endogenous process R&D decisions. It is instructive to consider why these two innovations might be expected to produce interesting results. First, the greenfield/acquisition distinction is significant because FDI is likely to have different welfare effects depending on its form: insofar as foreign market entry via acquisition-FDI, rather than greenfield-FDI, results in a more concentrated market structure, acquisition-FDI will be associated with lower consumer welfare (i.e. higher prices) than greenfield-FDI. However, despite the fact that acquisition-FDI leaves the number of firms in the host country unchanged (i.e. it merely produces a change in ownership), it is wrong to conclude that host-country consumer welfare is the same under entering firm strategies of acquisition-FDI and no-FDI. Assume that the host country initially contains one indigenous firm, and a foreign firm is contemplating serving its product market via exporting, greenfield-FDI or acquisition-FDI; both firms have identical production costs, and the product is homogeneous. Greenfield entry will produce a symmetric duopoly in the host country, and entry via acquisition will produce a monopoly. However, in the absence of entry via either form of FDI, the indigenous firm may be constrained from monopolistic behaviour by the foreign firm's exporting option; most obviously, if the foreign firm chooses to export and Bertrand competition prevails, then the indigenous firm cannot (in equilibrium) set a price higher than the common marginal cost plus the trade cost, which might be beneath its monopoly price. Therefore, in consumer welfare terms, the best entry strategy is greenfield-FDI and the worst acquisition-FDI, with exporting lying between the two. The key point is that equilibrium outcomes if the foreign firm does not undertake FDI (but chooses instead to export to the host country) are not necessarily identical to those under entry via acquisition: the possibility of facing imports places a constraint on the indigenous firm's behaviour under the no-FDI (exporting) strategy, which is removed by acquisition.

Second, process R&D investments are determined endogenously within our modelling structure because the relationships between R&D and the two forms of FDI may be different, although it is unclear a priori whether acquiring firms or greenfield investors will have a greater propensity to undertake R&D. Investigating these relationships will allow us to test a hypothesis that frequently motivates public policy: an oft-cited benefit of inward investment in the form of acquisition-FDI is its ability to foster 'technological development', both via the ability of firms in a more concentrated market to bear the sunk costs of R&D and via the injection of superior technologies into the moribund target firm (a 'failing firm' defence). However, a simple theoretical example shows the issue is far from closed. Assume a Bertrand duopoly in a homogeneous-good market, where both firms initially have marginal costs of $c > 0$ and both have access to the same process innovation. The innovation is drastic and, at a sunk cost of I, will reduce the innovator's marginal cost to 0. The duopolists play a two-stage (non-co-operative) game, first choosing whether to invest in R&D and then competing in prices. There are two distinct pure-strategy equilibria. If $R^{M}(0) - I < 0$, there is a dominant strategy equilibrium where neither firm does R&D. However, if $R^{M}(0) - I > 0$, there are two asymmetric Nash equilibria where one firm only does R&D. If the two firms combine to form a monopoly, R&D will be undertaken iff $R^{M}(0) - I > R^{M}(c)$. It is clear that the 'incentive' to undertake R&D is greater for either duopolist than for the monopolist, in the sense that the critical level of I where R&D is abandoned is greater in the duopoly.

The remainder of the paper is organised as follows. In Section 2 the tools necessary for our analysis are developed. We set out the extensive form of the game that forms the core of our analysis, and we provide several idiosyncratic definitions. We assume that the world comprises two identical countries and that consumers are immobile internationally so that national product markets are perfectly segmented. There initially exist four plants to produce the homogeneous product, two in each country. There are three firms, two of which (the ‘incumbents’) own one plant each in different countries; the third firm (the ‘potential entrant’) owns one plant in each country. The potential entrant’s plants are initially (drastically) productively inefficient relative to the incumbents’ (their marginal production cost exceeds the monopoly price of an incumbent). By undertaking process R&D the potential entrant can lower her marginal production cost and sell strictly positive output in product market equilibrium. Therefore, ‘entry’ in our model occurs via R&D investment rather than via sunk investments in new plants (although process R&D investments do, of course, alter the *productivity* of existing plants), as in (e.g.) Gilbert and Newbery (1982). I have argued elsewhere (Ferrett, 2002) that this characterisation of the entry decision is consistent with entry by diversification.

The game has four stages. In stage one, one of the incumbents may purchase the rival incumbent, thereby generating an international flow of acquisition-FDI. If an acquisition occurs, we then enter the Acquisition (A) subgame: in stage two the integrated incumbent (which owns a plant in each country) chooses how much to invest in process R&D. If no acquisition occurs in stage one, we enter the Greenfield (G) subgame, which is formally identical to the potential entry (PE) game set out in Ferrett (2002): in stage two the incumbents non-co-operatively choose (i) whether to undertake (tariff-jumping) greenfield-FDI and (ii) how much to invest in process R&D. Stages three and four are identical in both the A and the G subgames. In stage three the potential entrant decides whether to enter the industry by undertaking process R&D. In stage four market equilibrium in both countries is established via Bertrand competition (marginal costs are common knowledge).

Two features of our modelling structure generate significant interest. First, the inclusion of endogenous R&D investment decisions implies that consumer welfare need not necessarily be lower in more concentrated market equilibria because the (logical) possibility exists that equilibrium R&D investment may increase with concentration. Second, the inclusion of a third firm’s entry decision (stage three) implies that the stage-one choice between the two subgames is not a (trivial) comparison of monopoly and duopoly profits. It also allows us to compare ‘entry decisions’ in the two subgames.

In Section 3 we derive equilibrium industrial structures, conditional on the game's exogenous parameters. The A and G subgames are solved backwards to isolate subgame perfect Nash equilibria in pure strategies. In both subgames firms behave non-co-operatively. The stage-one choice of which subgame to play is determined by a co-operative decision rule: the A subgame is selected iff the integrated monopolist's profits are strictly greater than the combined profits of the incumbents in the G subgame. Therefore, the G-equilibrium represents a threat point if take-over negotiations break down. A sufficient condition for co-operative equilibria to be stable is that players can make binding commitments to each other. In the context of a cross-border acquisition it is reasonable to assume that binding commitments can be made because after a take-over control over the target firm is ceded to the acquirer. (Furthermore, it should be noted that the use of co-operative decision rules for mergers is widespread in the theoretical literature.) The key findings are that acquisition-FDI certainly arises in medium-sized markets and that greenfield-FDI arises in large markets if the sunk cost of greenfield-FDI is not 'too large'.

Finally, Section 4 offers some concluding comments.

2. The Modelling Structure.

2.1. Sequence of Moves and Corporate Structure Choices.

Figure 1 illustrates the extensive form of our four-stage game. (As we show below, Figure 1 incorporates the simplification of firms' strategic choices given in Lemma 1.) The stage-one choice between the two subgames is determined by the co-operative greenfield/acquisition decision rule (GADR), which is set out formally in Section 2.3. In stages two and three the incumbents and the potential entrant, respectively, choose their 'corporate structures'. In stage four market equilibrium is established in both countries via Bertrand competition. Firms have complete and perfect information.

A firm's corporate structure choice represents its strategic ('long-term') decisions vis-à-vis the location of production and the level of technology. The incumbents initially own one plant each, located in different countries, both of which can produce the homogeneous good at a constant marginal cost of $c \in (0, 1)$; they can serve the local product market at their marginal production cost but must pay a per-unit premium of t (the trade cost) if selling abroad via exporting rather than FDI. The potential entrant initially owns two plants, one in each country, whose marginal production costs are strictly greater than $x^{M}(c)$, the monopoly price associated with c (see Section 2.2). Firms can establish additional plants in either country at a sunk cost of G. Therefore, there are plant-level economies of scale, and (i) neither the potential entrant nor the acquirer will optimally establish additional plants (note that via take-over the acquirer gains the rival incumbent's 'home' plant); (ii) each incumbent will optimally establish at most one additional plant abroad in the G subgame.

[INSERT FIGURE 1]

Technological progress occurs via process R&D investments in steps, and each step incurs a sunk cost of I. The technological laggard (the potential entrant) can purchase the industry's best-practice technology (i.e. a marginal production cost of c) in one step. For firms on the technological frontier (i.e. the incumbents initially, and the potential entrant after sinking an investment of I to catch up) I purchases a process R&D investment with a risky outcome. With probability $p \in (0, 1)$ R&D investment 'succeeds' and the firm's marginal production cost falls to 0; however, with probability $(1 - p)$ R&D investment 'fails' and the firm's marginal production cost remains at c. The probability of success p is identical and independent across firms.

Given these characteristics of the firms' strategic choices, we can limit the strategy spaces of the acquirer and the potential entrant in the A subgame to $\{N, R\}$ and $\{\varnothing, E, R\}$ respectively. (The latter is also the potential entrant's strategy space in the G subgame.) N and $\varnothing$ both represent decisions not to invest in any process R&D, although they are taken from different marginal production costs (c for the acquirer and $> x^{M}(c)$ for the potential entrant). A choice of $\varnothing$ by the potential entrant is equivalent to a decision *not* to enter the industry. A choice of E by the potential entrant costs I and reduces its marginal production cost to c. A choice of R (investment in 'new' R&D from a social viewpoint, rather than just 'catching up') produces a marginal production cost of either 0 ('success') or c ('failure'), and it costs the acquirer I but the potential entrant $2{\cdot}I$. We show in Lemma 1 below that the potential entrant's strategy space can be simplified to $\{\varnothing, R\}$ because E is strictly dominated by $\varnothing$. Therefore, a choice of R by the potential entrant represents a decision to enter the industry.

The incumbents' stage-two strategy space in the G subgame is $\{(1, N), (1, R), (2, N), (2, R)\}$. (The G subgame is identical to the potential-entry (PE) game in Ferrett (2002), where the purpose was to examine the effects of an entry threat on equilibrium industrial structures.) The first component of a corporate structure pair indicates how many plants the incumbent will maintain (a choice of 2 costs G); the second component indicates whether (R) or not (N) the incumbent invests in process R&D at a sunk cost of I. Note that loss-making in equilibrium is ruled out by the inclusion of the (1, N) strategy, which incurs no sunk costs, and so an 'exit' (or 'inactivity') strategy may legitmately be ignored. Lemma 1 shows that (2, N) may be dropped from the incumbents' strategy spaces because it is strictly dominated by (1, N).

Lemma 1. (Ferrett, 2002) (i) In the A and G subgames the potential entrant will never optimally choose a corporate structure of E because it is strictly dominated by one of $\varnothing$. (ii) In the G subgame an incumbent will never optimally choose a corporate structure of (2, N) because it is strictly dominated by one of (1, N).

Proof. (*i*) If the potential entrant chooses E it sinks I to move onto the technological frontier and can produce at both its plants with a marginal cost of c. However, because both countries contain rivals' pre-existing plants with marginal costs of c, the potential entrant's expected global net revenues in Bertrand equilibrium remain 0. Therefore, choosing E over $\varnothing$ will reduce the entrant's expected profits by I, so $\varnothing$ strictly dominates E.

(*ii*) Because the two countries' product markets are perfectly segmented, choosing (2, N) rather than (1, N) has no effect on an incumbent's revenues from its home market: it continues to sell at home with a marginal cost of c. Its marginal cost abroad falls from $c+t$ to c, and it sinks G into greenfield-FDI. However, the incumbent's expected net revenues abroad in Bertrand equilibrium remain 0 because its foreign rival has a plant abroad with a marginal cost of c at most. Therefore, choosing (2, N) over (1, N) will reduce an incumbent's expected profits by G, so (1, N) strictly dominates (2, N). QED.

The assumptions on corporate structure choices outlined above imply that an active firm's marginal cost of serving either national product market can take four values:

$$\text{marginal cost} = \begin{cases} 0 \text{ if the firm's R\&D succeeds and it produces locally} \\ t \text{ if the firm's R\&D succeeds and it produces abroad} \\ c \text{ if the firm's R\&D fails and it produces locally} \\ c+t \text{ if the firm's R\&D fails and it produces abroad} \end{cases}$$

Throughout our analysis we maintain the following assumption (which seems intuitively reasonable) on t,c:

(A) $$0 < t < c < 1$$

2.2. Market Size and Net Revenue.

There are two countries in the world. Demand conditions in both are identical, and the product is homogeneous. Market demand in either country is

$$Q_j = m \cdot (1 - x_j) \tag{1}$$

Q_j and x_j are demand and price in country j respectively, $j \in \{1, 2\}$. National product markets are assumed to be perfectly segmented, so consumers in country j are constrained to make purchases only on their home market; thus, x_{-j} (the market price abroad) does not influence Q_j. m measures the 'size' of either national product market, and it can be interpreted as an index of the number of homogeneous consumers in each country, all of whom have a reservation price of 1.

Net revenue equals revenue minus variable costs. If either national product market is monopolised by firm i with a constant marginal cost of c_i, the monopoly price will be

$$x^M(c_i) = \frac{1}{2} \cdot (1 + c_i)$$

The monopolist's net revenue is

$$R^M(c_i) = \frac{m}{4} \cdot (1 - c_i)^2$$

If a national product market is served by a duopoly, then firm i's net revenue function is $R(c_i, c_j)$, where c_i is firm i's marginal cost and c_j is its rival's marginal cost. (The symmetry across countries – i.e. identical market demand functions – implies that $R^M(c_i)$ and $R(c_i , c_j)$ apply to both countries.) The exact functional form of $R(c_i , c_j)$ depends on the assumed form of duopolistic competition. At Bertrand equilibrium and if marginal costs are common knowledge

$$R(c_i, c_j) = \begin{cases} 0 \text{ for } c_i \in [c_j, 1) \\ m \cdot (1 - c_j) \cdot (c_j - c_i) \text{ for } c_i \in [(x^M)^{-1}(c_j), c_j] \\ R^M(c_i) \text{ for } c_i \in (0, (x^M)^{-1}(c_j)] \end{cases} \tag{2}$$

The results in (2) are standard. (Note that $(x^M)^{-1}(c_j)$ gives the marginal cost that is associated with a monopoly price of c_j.) If $c_i > c_j$ then firm i's rival optimally sets a price below c_i and captures the entire market. If $c_i = c_j$ the Bertrand equilibrium price equals the common level of marginal costs. A conventional assumption is that the market is divided equally between the two firms. If $c_i < c_j$ there are two possibilities. If the gap between c_i and c_j is 'small' ($x^M(c_i) > c_j$) firm i optimally sets a price below c_j, but the gap between the two firms' marginal costs is not large enough to allow firm i to charge its monopoly price. Therefore, i sets a price of $c_j - \varepsilon$, earns net revenue per unit of $c_j - c_i$ and serves the entire market with $m \cdot (1 - c_j)$ units. This 'undercutting equilibrium' is shown in the second line of (2). However, if the gap between c_i and c_j is 'large' ($x^M(c_i) < c_j$) firm i optimally sets its monopoly price, which is still less than c_j. This 'monopoly-pricing equilibrium' is shown in the bottom line of (2). If it is assumed that both firms initially have marginal costs of c_j, then the distinction between 'small' and 'large' levels of $(c_j - c_i)$ can be linked directly to the size of firm i's process innovation (i.e. nondrastic or drastic). Furthermore, net revenues at a Bertrand equilibrium with more than two firms can be straightforwardly described using (2) if c_j is reinterpreted as the minimum of firm i's rivals' marginal costs (i.e. $c_j \equiv \min\{c_1, c_2, ..., c_{i-1}, c_{i+1}, ..., c_N\}$).

The $R(c_i, c_j)$ function is not well-behaved: it is continuous but not smooth (with kinks as we move between lines in (2)). $R(\cdot)$ is decreasing in c_i and increasing in c_j. The weak monotonicity of $R(\cdot)$ implies that realisations for given c_j can be ranked using the restrictions in assumption (A) as

$$\left.\begin{array}{l} R(0,0) = R(t,0) = R(c,0) = R(c+t,0) = 0 \\ R^M(0) \geq R(0,t) > 0 \text{ and } R(t,t) = R(c,t) = R(c+t,t) = 0 \\ R^M(0) \geq R(0,c) > R(t,c) > 0 \text{ and } R(c,c) = R(c+t,c) = 0 \\ R^M(0) \geq R(0,c+t) > R(t,c+t) > R(c,c+t) > 0 \text{ and } R(c+t,c+t) = 0 \end{array}\right\} \tag{3}$$

Likewise, it is possible to rank $R(c_i, c_j)$ for given c_i and different values of c_j. However, with only loose restrictions on t, c as in (A), it is impossible to rank $R(\cdot)$ definitively for different values of

c_i *and* c_j. This is a disadvantage created by the badly-behaved functional form of $R(\cdot)$. We return to this problem when deriving equilibrium solutions in Section 3 below.

To provide a feel for the implications of Bertrand competition and assumption (A) taken together, we make three final observations on the characteristics of market equilibria. First, if two firms produce locally to serve a product market (and entry does not occur in stage three), then either will only make strictly positive net revenue if it innovates successfully but its rival doesn't. Second, in the asymmetric industrial structure where one firm produces locally but its rival produces abroad (and serves the market by exporting) the local firm will make strictly positive net revenue *unless* its own R&D fails but its rival's succeeds; conversely, the exporting firm will *only* make strictly positive net revenue if its own R&D succeeds but the local firm's fails. Third, cross-hauling of international trade flows will never occur in equilibrium, although greenfield-FDI cross-hauling (in the G subgame) may occur. (To see this, note that a necessary condition for trade cross-hauling is that neither firm undertake greenfield-FDI. Given that, firm i will export to j's home market iff $c_j \in [c_i+t, 1)$, and firm j will export to i's home market iff $c_j \in (0, c_i-t]$, where c_i is i's marginal production cost. For $t > 0$ these two intervals do not overlap.)

2.3. Equilibrium Concepts.

Definitions 1 and 2 formally characterise the pure-strategy (subgame perfect) Nash equilibria of the A and G subgames. Definition 3 then sets out the greenfield/acquisition decision rule (GADR) that selects between the A- and G-equilibria to determine the equilibrium industrial structure of the overall game. We label the incumbents in the G subgame firms 1 and 2, the potential entrant in stage three firm 3, and the acquirer (integrated firm) in the A subgame firm A.

Definition 1. $\{S_A^*; S_3^*\}$ is the *equilibrium of the A subgame* iff

$$S_A^* = \underset{S_A}{\operatorname{argmax}}\, E\pi_A(S_A; S_3^{BR}(S_A)) \text{ and } S_3^* = S_3^{BR}(S_A^*)$$

where

$$S_3^{BR}(S_A) \equiv \underset{S_3}{\operatorname{argmax}}\, E\pi_3(S_A; S_3)$$

for all $S_A \in \{N, R\}$ and $S_3 \in \{\varnothing, R\}$

$S_3^{\mathrm{BR}}(S_{\mathrm{A}})$ gives the potential entrant's best response to any choice of S_{A} by the acquirer. Because the acquirer is the first-mover (and its corporate structure choice is observed by the potential entrant at the start of stage three), S_3^{BR} is endogenous when S_{A}^* is determined: the acquirer must take account of the knock-on effects of its own corporate structure choice on the potential entrant's behaviour. From this formulation of the A subgame's equilibrium it is clear that the acquirer can potentially use its corporate structure choice to influence the potential entrant's behaviour to its own advantage.

Definition 2. $\{S_1^*, S_2^*; S_3^*\}$ is the *equilibrium of the G subgame* iff

$$S_1^* = S_1^{\mathrm{BR}}(S_2^*);\ S_2^* = S_2^{\mathrm{BR}}(S_1^*);\ \text{and}\ S_3^* = S_3^{\mathrm{BR}}(S_1^*, S_2^*)$$

where the $S^{\mathrm{BR}}(\cdot)$ functions

$$S_1^{\mathrm{BR}}(S_2) \equiv \underset{S_1}{\operatorname{argmax}}\ Ep_1(S_1, S_2; S_3^{\mathrm{BR}}(S_1, S_2))$$
$$S_2^{\mathrm{BR}}(S_1) \equiv \underset{S_2}{\operatorname{argmax}}\ Ep_2(S_1, S_2; S_3^{\mathrm{BR}}(S_1, S_2))$$
$$S_3^{\mathrm{BR}}(S_1, S_2) \equiv \underset{S_3}{\operatorname{argmax}}\ Ep_3(S_1, S_2; S_3)$$
$$\text{for all } S_1, S_2 \in \{(1,N),(1,R),(2,R)\} \text{ and } S_3 \in \{\varnothing, R\}$$

give the firms' best responses to their rivals' corporate structure choices.

Because the potential entrant is the second-mover in the G subgame, it takes the incumbents' corporate structures as given when deriving its best response; therefore, S_3^{BR} depends on S_1, S_2. However, firms 1 and 2 must take account of the knock-on effects of their own corporate structure choices on the potential entrant's behaviour; therefore, S_3^{BR} is endogenized within $S_1^{\mathrm{BR}}, S_2^{\mathrm{BR}}$. By analogy with Definition 1, this formulation of the G subgame's equilibrium makes it clear that the incumbents can potentially use their corporate structure choices to influence the potential entrant's behaviour to their own advantage.

Definition 3. $\{S_{\mathrm{A}}^*; S_3^*\}$ (resp. $\{S_1^*, S_2^*; S_3^*\}$) is the *equilibrium industrial structure* of the game in Figure 1 iff

$$Ep_{\mathrm{A}}(S_{\mathrm{A}}^*; S_3^*) > \text{ (resp. } \leq \text{) } Ep_1(S_1^*, S_2^*; S_3^*) + Ep_2(S_1^*, S_2^*; S_3^*) \qquad (4)$$

We refer to (4) as the *greenfield/acquisition decision rule* (*GADR*). The GADR is used to select between the A- and G-equilibria, and we will say that the selected equilibrium (i.e. the equilibrium industrial structure of the overall game) *dominates* the rival candidate equilibrium.

The GADR is formally identical to the decision rule conventionally used in co-operative merger games (e.g. Salant, Switzer and Reynolds, 1983). The GADR selects the A-equilibrium iff an acquisition would be (strictly) profitable. To show this, assume for concreteness that the acquirer is firm 1. We can place lower and upper bounds on the take-over price that 1 will pay for 2. The lower bound, B_L, is such that 2 is indifferent between accepting the take-over offer and playing the G subgame (i.e. rejecting it); therefore, $B_L = E\pi_2(S_1^*, S_2^*; S_3^*)$. Likewise, the upper bound, B^U, is such that 1 is indifferent between playing the two subgames (because 2 captures the entire surplus); therefore, $E\pi_A(S_A^*; S_3^*) - B^U = E\pi_1(S_1^*, S_2^*; S_3^*)$. The GADR requires $B^U > B_L$, so that there exists a non-empty interval of take-over prices such that both firms are better off after the take-over. Note that the GADR requires take-overs to be *strictly* profitable. Following Gowrisankaran (RAND, 1999), this is a simple method of incorporating an infinitesimal sunk cost of administering the take-over.

One potential drawback of the GADR is that it does not determine the equilibrium take-over price. Therefore in the normative analysis of Ferrett (forthcoming) we focus on *global* social welfare (GSW), rather (e.g.) than trying to compare national welfare levels between acquisition-FDI source and host countries. The equilibrium take-over price would depend crucially on the specification of the bargaining mechanism that the take-over terms are negotiated through, which we do not model. (For example, if 1 makes 2 a take-it-or-leave-it offer, we would expect a price of (just above) B_L; conversely, if 2 makes 1 a take-it-or-leave-it offer, we would expect a price of (just below) B^U. A common practice – e.g. Hart and Moore – is to assume that the acquirer and the target share the surplus equally. Our GADR encompasses all these cases.)

Finally, we briefly illustrate how endogenous process R&D interacts with the GADR. Assume N ex ante identical firms compete à la Bertrand to serve a single market for a homogeneous product. Each firm possesses a process innovation that 'succeeds' with probability p and 'fails' with probability $(1 – p)$; 'success' and 'failure' are associated with marginal production costs of 0 and c respectively. In this setting (which has similarities to our modelling structure) the expected profit of any firm is $p \cdot (1-p)^{N-1} \cdot R(0,c)$; if two firms merge, then the expected profits of any firm in the new equilibrium are $p \cdot (1-p)^{N-2} \cdot R(0,c)$. It is straightforward to show that for $p \in$ [0, 0.5] the merger is unprofitable and for $p \in$ (0.5, 1] the merger is profitable *irrespective of N*. This contrasts sharply with outcomes in the same set-up without endogenous process R&D (i.e. where all firms' marginal production costs are fixed at *c*), where *only* a merger from duopoly to monopoly is strictly profitable (although for different reasons than those behind Salant, Switzer and Reynolds' (1983) similar finding).

3. Positive Analysis.

3.1. Equilibria in the A subgame.

Table 1 gives the payoff matrix in the A subgame. Because both the acquirer and the potential entrant own 2 plants, the trade cost *t* is irrelevant in the A subgame: international trade flows never occur in equilibrium. If the potential entrant chooses $\varnothing$, then the acquirer monopolises both product markets. If the potential entrant chooses *R*, then either firm must possess a marginal production cost advantage over its rival to earn $R(0, c)$ in both countries, which occurs with probability $p\cdot(1-p)$ when both firms undertake R&D.

Acquirer $\rightarrow$ Potential entrant $\downarrow$	N	R
$\varnothing$	$Ep_{\mathrm{A}} = 2 \cdot R^{\mathrm{M}}(c)$ $Ep_3 = 0$	$Ep_{\mathrm{A}} = 2 \cdot p \cdot R^{\mathrm{M}}(0) + 2 \cdot (1-p) \cdot R^{\mathrm{M}}(c) - I$ $Ep_3 = 0$
R	$Ep_{\mathrm{A}} = 0$ $Ep_3 = 2 \cdot p \cdot R(0,c) - 2 \cdot I$	$Ep_{\mathrm{A}} = 2 \cdot p \cdot (1-p) \cdot R(0,c) - I$ $Ep_3 = 2 \cdot p \cdot (1-p) \cdot R(0,c) - 2 \cdot I$

Table 1: Payoff Matrix in the A subgame

We consider the potential entrant's optimal decision first, which may be conditional on the acquirer's prior choice. If the acquirer chooses *N*, then the potential entrant has $R \succ$ (resp. $\prec$) $\varnothing$ as

$$m > \text{ (resp. } <\text{) } \frac{I}{\frac{1}{m} \cdot R(0,c) \cdot p} \qquad (5)$$

RHS(5) defines a critical m-value: because m enters $R(\cdot)$ multiplicatively, $(1/m)\cdot R(0,c)$ is independent of m. In (p,m)-space RHS(5) is a rectangular hyperbola, because a fall in p must be counterbalanced by a rise in m, which increases the payoff to *successful* R&D.

If the acquirer chooses R, then the potential entrant has $R \succ$ (resp. $\prec$) $\varnothing$ as

$$m > \text{ (resp. } < \text{)} \; \frac{I}{\frac{1}{m}\cdot R(0,c)\cdot p\cdot(1-p)} \tag{6}$$

RHS(6) is a U-shaped parabola in (p,m)-space, which is symmetric around $p = 0.5$ with asymptotes at $p = 0$ and $p = 1$. To earn strictly positive net revenue (and thereby finance the sunk costs of entry), the potential entrant requires a marginal production cost advantage over the acquirer (i.e. successful R&D is insufficient). This occurs with probability $p\cdot(1 - p)$, which approaches 0 as p approaches 1; therefore, for $p \cong 1$ a very large market is required to make $E\pi_3 > 0$ because the payoff to a marginal production cost advantage must rise to counterbalance a fall in its probability.

For $p \in (0, 1]$ RHS(6) > RHS (5), so there are three distinct situations to be faced by the acquirer when making her stage-two (see Figure 1) decision. For m < RHS(5) entry is *blockaded*: regardless of the acquirer's choice, the potential entrant chooses $\varnothing$. In this case the acquirer has $R \succ$ (resp. $\prec$) N as

$$m > \text{ (resp. } < \text{)} \; \frac{I}{\frac{2}{m}\cdot[R^{\mathrm{M}}(0)-R^{\mathrm{M}}(c)]\cdot p} \tag{7}$$

For $m \in$ (RHS(5), RHS(6)) the potential entrant's optimal decision is conditional on the acquirer's choice: by choosing R, the acquirer can *deter entry*; however, entry will occur if the acquirer chooses N. Therefore, the acquirer has $R \succ$ (resp. $\prec$) N as

$$m > \text{ (resp. } < \text{)} \; \frac{I}{\frac{2}{m}\cdot R^{\mathrm{M}}(c)+\frac{2}{m}\cdot[R^{\mathrm{M}}(0)-R^{\mathrm{M}}(c)]\cdot p} \tag{8}$$

Finally, for m > RHS(6) the potential entrant chooses R regardless of the acquirer's prior choice, so the acquirer must *accommodate* entry. Therefore, the acquirer has $R \succ$ (resp. $\prec$) N as

$$m > \text{ (resp. } < \text{)} \ \frac{I}{\frac{2}{m} \cdot R(0,c) \cdot p \cdot (1-p)} \tag{9}$$

By comparing RHS(8) and RHS(9) to RHS(7), we derive the following result.

Lemma 2. Relative to the benchmark of blockaded entry, (i) the acquirer is 'more likely' to invest in R&D when entry can be deterred; and (ii) if entry must be accommodated, the acquirer is 'less likely' to invest in R&D for large p, but 'more likely' for small p.

Proof. Part (i) requires RHS(7) > RHS(8), so that an interval of m-values exists where the acquirer undertakes R&D to deter entry that would not be undertaken if entry were blockaded. RHS(7) > RHS(8) is clear from straightforward inspection.

Part (ii) (the 'less likely' result) requires RHS(7) < RHS(9) for large p, so that an interval of m-values exists where the acquirer undertakes R&D when entry is blockaded that would not be undertaken if entry had to be accommodated. RHS(9) > RHS(7) iff $R^{\mathrm{M}}(0) - R^{\mathrm{M}}(c) > R(0,c) \cdot (1-p)$, which clearly holds for $p \cong 1$. A necessary-and-sufficient condition for RHS(9) > RHS(7) on $p \in (0, 1]$ is $R^{\mathrm{M}}(0) - R^{\mathrm{M}}(c) - R(0,c) > 0$. This condition does not hold: for $c \geq 0.5$ $R(0, c) = R^{\mathrm{M}}(0)$, so LHS = $-R^{\mathrm{M}}(c)$; for $c \leq 0.5$ $R(0, c) = m \cdot (1 - c) \cdot c$ and LHS > 0 iff $c > 2/3$, which is a contradiction. Therefore, for $p \cong 0$ RHS(7) > RHS(9) (the 'more likely' result). QED.

The result in Lemma 2 allows us to characterise the acquirer's optimal behaviour in terms of Fudenberg and Tirole's (1984) taxonomy of an incumbent's investment strategies in anticipation of entry. When entry can be deterred, the acquirer behaves as a 'top dog' (part (i)). However, when entry must be accommodated, the acquirer behaves as a 'puppy dog' for large p but as a 'top dog' for small p (part (ii)). The 'top dog' invests in 'strength' (by undertaking extra sunk investments) to look tough and ward off rivals, whereas the 'puppy dog' conspicuously avoids looking 'strong' (by reducing spending on sunk investments) to appear inoffensive and avert aggressive reactions from rivals. In part (ii) we compare the optimal R&D behaviour of a monopolist to that of a duopolist, and the result reflects variations in the strength of Arrow's 'replacement effect': insofar as undertaking R&D gives the acquirer a chance to 'escape competition' in the duopoly (i.e. when accommodating entry), the acquirer will have a stronger incentive to undertake R&D as a duopolist than as a monopolist. When p is small, so there is little chance that the potential entrant's R&D will succeed, the 'replacement effect' in duopoly is strong, and thus the acquirer is 'more likely' to undertake R&D when entry must be accommodated than under blockaded entry. However, when p is large, the 'replacement effect' in duopoly is weak: the potential entrant's R&D is likely to succeed, so that R&D success will not allow the acquirer to 'escape competition'. Therefore, for large p the acquirer is 'more likely' to undertake R&D under blockaded, rather than accommodated, entry.

The equilibria of the A subgame are plotted in (p,m)-space in Figure 2. For $m <$ RHS(5) the acquirer optimally chooses R iff (7) holds. It is straightforward to show that RHS(5) > RHS(7); therefore , for $m <$ RHS(7) < RHS(5) the A-equilibrium is $\{N; \varnothing\}$, and for $m \in$ (RHS(7), RHS(5)) the A-equilibrium is $\{R; \varnothing\}$. The $\{N; \varnothing\}$ and $\{R; \varnothing\}$ A-equilibria are represented in regions I and II of Figure 2 respectively. For $m \in$ (RHS(5), RHS(6)) the acquirer optimally chooses R iff (8) holds. In Lemma 2(i) we showed that RHS(7) > RHS(8); therefore, because RHS(5) > RHS(7) (see n. 20 above), the A-equilibrium on $m \in$ (RHS(5), RHS(6)) is $\{R; \varnothing\}$, which is represented in region II of Figure 2. For $m >$ RHS(6) the acquirer optimally chooses R iff (9) holds. Clearly RHS(9) < RHS(6), so the A-equilibrium for $m >$ RHS(6) (i.e. region III of Figure 2) is $\{R; R\}$.

[INSERT FIGURE 2]

Key to Figure 2

Region	A-equilibrium
I	$\{N; \varnothing\}$
II	$\{R; \varnothing\}$
III	$\{R; R\}$

An interesting feature of Figure 2 is the lack of an A-equilibrium of $\{N; R\}$. The key reason for this is the sequential-moves structure of the A subgame. If the acquirer and the potential entrant chose their corporate structures simultaneously, then $\{R; \varnothing\}$would arise in A-equilibrium (which we label case α for ease) iff $U_\alpha > I > L_\alpha$, where $U_a \equiv 2\cdot[R^M(0) - R^M(c)]\cdot p$ and $L_a \equiv R(0,c)\cdot p\cdot(1-p)$; and $\{N; R\}$ would arise in A-equilibrium (case β) iff $U_\beta > I > L_\beta$, where $U_b \equiv R(0,c)\cdot p$ and $L_b \equiv 2\cdot R(0,c)\cdot p\cdot(1-p)$. U and L define (respectively) upper and lower bounds on I for the existence of the A-equilibrium. Clearly, $L_\beta > L_\alpha$ and $U_\alpha > U_\beta$ for $p \neq 0$ (see n. 20), so that in the simultaneous-moves version of the A subgame whenever $\{N; R\}$ is an A-equilibrium, so is $\{R; \varnothing\}$. (The reason for this is that the potential entrant's sunk cost of R is twice as large as the acquirer's. This in turn *decreases* L_α relative to L_β, because L defines the I-value where the non-innovating firm is indifferent between its two strategies, and *increases* U_α relative to U_β, because U defines the I-value where the innovating firm is indifferent between its two strategies. If the potential entrant could 'catch up' at zero sunk cost, so that R cost I for both firms, then we would have $L_\alpha = L_\beta$ and $U_\beta > U_\alpha$ for $p \neq 0$. $U_\beta > U_\alpha$ reflects the potential entrant's stronger incentive to choose R via Arrow's 'replacement effect'.)

In the sequential-moves version of the A subgame that we have analysed, the acquirer – as first-mover – chooses between A-equilibria of $\{R; \varnothing\}$ and $\{N; R\}$. The acquirer prefers $\{R; \varnothing\}$ iff $I < U_a + 2 \cdot R^{\mathrm{M}}(c)$, which must hold whenever $\{N; R\}$ arises as an A-equilibrium in the simultaneous-moves version because $U_\alpha > U_\beta$. (Therefore, the acquirer's R&D investment is pre-emptive in this case.) The acquirer's preference for $\{R; \varnothing\}$ over $\{N; R\}$ whenever $\{N; R\}$ arises under simultaneous-moves reflects the 'efficiency effect' (see Tirole, 1988, p. 393): the acquirer's gain from selecting $\{R; \varnothing\}$ over $\{N; R\}$ (i.e. monopoly vs. duopoly profits) is greater than the potential entrant's gain from becoming a duopolist in $\{N; R\}$.

Finally, note that although the entry threat in the A subgame does alter the acquirer's 'incentives' to invest in R&D (see Lemma 2), it does not alter the acquirer's equilibrium behaviour relative to the benchmark of blockaded entry. In the absence of a potential entrant, the acquirer would optimally choose R (resp. N) iff $m >$ (resp. $<$) RHS(7); this also describes the acquirer's equilibrium behaviour in the presence of an entry threat (see Figure 2).

3.2. Equilibria in the G subgame.

The G subgame is solved and extensively discussed in Ferrett (2002); here, we present the solution and catalogue its properties that are relevant for our purpose. Table 2 gives the G subgame's payoff matrix. Rather than discussing the derivation of expected profits in each industrial structure, we highlight several general features and then present a specimen derivation. First, note that we adopt the convention throughout, where a firm earns strictly positive net revenue in both countries in Bertrand equilibrium, of writing domestic net revenue as the first term in square brackets and foreign net revenue as the second. Expected profits can be viewed as a weighted average of realized profits across all possible ‘states of nature’, where each state is associated with a distinct configuration of R&D outcomes across firms and the weight applied equals the probability of that state’s occurrence. (Recall from Section 2.1 that the probability of R&D success p is identical and independent across firms; at the end of Section 2.2 we provide a brief discussion of how firms’ realized net revenues are influenced by their R&D outcomes and location choices.)

For illustrative purposes, consider the firms’ expected profits when firms 1 and 2 choose corporate structures of (1, *R*) and (2, *R*) respectively. If the potential entrant chooses $\varnothing$, then the incumbents’ expected profits are

$$E\pi_1 = p\cdot(1-p)\cdot[R(0,c)+R(t,c)]-I$$
$$E\pi_2 = p\cdot(1-p)\cdot[R(0,c+t)+R(0,c)]+p^2\cdot R(0,t)+(1-p)^2\cdot R(c,c+t)-G-I$$

Because firm 2 has a local plant in country 1, firm 1 must possess a marginal *production* cost advantage if it is to earn strictly positive net revenue. This occurs with probability $p\cdot(1-p)$ when 1’s R&D investment succeeds but 2’s fails. On the other hand, firm 2 can earn strictly positive net revenue *at home* when the firms’ marginal production costs are the same because the trade cost insulates its domestic plant from foreign competition.

If the potential entrant chooses *R*, then the firms’ expected profits are

$$E\pi_1 = p\cdot(1-p)^2\cdot[R(0,c)+R(t,c)]-I$$
$$E\pi_2 = 2\cdot p\cdot(1-p)^2\cdot R(0,c)+p^2\cdot(1-p)\cdot R(0,t)-G-I$$
$$E\pi_3 = 2\cdot p\cdot(1-p)^2\cdot R(0,c)+p^2\cdot(1-p)\cdot R(0,t)-2\cdot I$$

Firm 1 faces two local rivals and must possess marginal production cost advantages over both with probability $p\cdot(1-p)^2$ to earn $R(0, c)$ at home and $R(t, c)$ abroad. If firm 2 alone innovates successfully, it earns $R(0, c)$ in both countries; additionally, because firm 2 faces only one local rival (the potential entrant, firm 3), if both incumbents’ R&D investments succeed but the potential entrant’s fails, then firm 2 earns $R(0, t)$ at home. If the potential entrant alone innovates successfully, then it earns $R(0, c)$ in both countries; if only firm 2’s R&D fails, then the potential entrant earns $R(0, t)$ in country 2. (Note that, when the potential entrant chooses *R*, the incumbents’ expected net revenues have a factor of $p\cdot(1-p)$: because the potential entrant owns a plant in each country, a necessary condition for an incumbent to earn strictly positive net revenue is that its own R&D succeeds but the potential entrant's fails. Furthermore, entry reduces the incumbents' expected profits.)

Because of the complexity of the G subgame we place restrictions on the four cost parameters t,c,G,I when deriving its solution. We show in Ferrett (2002) that the following two assumptions are sufficient to fix the form of a plot of G-equilibria in (p,m)-space.

(B) $$R(0,c+t) - R(c,c+t) + R(t,c) - R(0,c) > 0$$

(C) $$G \geq I > 0$$

Assumption (B) on t,c is only slightly more restrictive than our maintained assumption (A). (In general (B) holds if the gap $(c-t)$ is sufficiently large.) By invoking (B) and (C), both of which hold under wide ranges of variation in the cost parameters, we can draw general conclusions about equilibrium behaviour in the G subgame. (We term variations in t,c,G,I that are consistent with both (B) and (C) continuing to hold *nondrastic* variations; *drastic* variations violate (B) or (C) or both.) Given assumptions (B),(C), Figure 3 illustrates the equilibria of the G subgame in (p,m)-space. The inter-regional boundaries in Figure 3, equations (10) to (19), are defined in the Appendix.

[INSERT FIGURE 3]

Key to Figure 3

Region	Equilibrium Industrial Structure under PE
I	$\{(1, N), (1, N); \varnothing\}$
II	$\{(1, N), (1, R); \varnothing\}$
III	$\{(1, R), (1, R); \varnothing\}$
IV	$\{(1, R), (1, R); \varnothing\}$; $\{(1, N), (2, R); \varnothing\}$
V	$\{(1, R), (1, R); \varnothing\}$; $\{(1, N), (1, N); R\}$ or $\{(1, N), (2, R); \varnothing\}$
VI	$\{(1, R), (1, R); R\}$* or $\{(1, R), (2, R); \varnothing\}$
VII	$\{(2, R), (2, R); \varnothing\}$*
VIII	$\{(1, R), (1, R); R\}$; $\{(1, R), (1, R); R\}$ or $\{(2, R), (2, R); \varnothing\}$
IX	$\{(1, R), (1, R); R\}$
X	$\{(2, R), (2, R); R\}$*

(Note: * denotes a dominant strategy equilibrium.)

Firm 1→ Firms 2 and 3↓	(1, N)	(1, R)	(2, R)
(1, N); ∅	$Ep_1 = Ep_2 = R(c,c+t)$	$Ep_1 = p \cdot [R(0,c+t)+R(t,c)] + (1-p) \cdot R(c,c+t) - I$ $Ep_2 = (1-p) \cdot R(c,c+t)$	$Ep_1 = p \cdot [R(0,c+t)+R(0,c)] + (1-p) \cdot R(c,c+t) - G - I$ $Ep_2 = 0$
(1, N); R	$Ep_1 = Ep_2 = 0$ $Ep_3 = 2 \cdot p \cdot R(0,c) - 2 \cdot I$	$Ep_1 = p \cdot (1-p) \cdot [R(0,c)+R(t,c)] - I$ $Ep_2 = 0$ $Ep_3 = 2 \cdot p \cdot (1-p) \cdot R(0,c) + p^2 \cdot R(0,t) - 2 \cdot I$	$Ep_1 = 2 \cdot p \cdot (1-p) \cdot R(0,c) - G - I$ $Ep_2 = 0$ $Ep_3 = 2 \cdot p \cdot (1-p) \cdot R(0,c) - 2 \cdot I$
(1, R); ∅	$Ep_1 = (1-p) \cdot R(c,c+t)$ $Ep_2 = p \cdot [R(0,c+t)+R(t,c)] + (1-p) \cdot R(c,c+t) - I$	$Ep_1 = Ep_2 = p \cdot (1-p) \cdot [R(0,c+t)+R(t,c)] + p^2 \cdot R(0,t) + (1-p)^2 \cdot R(c,c+t) - I$	$Ep_1 = p \cdot (1-p) \cdot [R(0,c+t)+R(0,c)] + p^2 \cdot R(0,t) + (1-p)^2 \cdot R(c,c+t) - G - I$ $Ep_2 = p \cdot (1-p) \cdot [R(0,c)+R(t,c)] - I$
(1, R); R	$Ep_1 = 0$ $Ep_2 = p \cdot (1-p) \cdot [R(0,c)+R(t,c)] - I$ $Ep_3 = 2 \cdot p \cdot (1-p) \cdot R(0,c) + p^2 \cdot R(0,t) - 2 \cdot I$	$Ep_1 = Ep_2 = p \cdot (1-p)^2 \cdot [R(0,c)+R(t,c)] + p^2 \cdot (1-p) \cdot R(0,t) - I$ $Ep_3 = 2 \cdot p \cdot (1-p)^2 \cdot R(0,c) + 2 \cdot p^2 \cdot (1-p) \cdot R(0,t) - 2 \cdot I$	$Ep_1 = 2 \cdot p \cdot (1-p)^2 \cdot R(0,c) + p^2 \cdot (1-p) \cdot R(0,t) - G - I$ $Ep_2 = p \cdot (1-p)^2 \cdot [R(0,c)+R(t,c)] - I$ $Ep_3 = 2 \cdot p \cdot (1-p)^2 \cdot R(0,c) + p^2 \cdot (1-p) \cdot R(0,t) - 2 \cdot I$
(2, R); ∅	$Ep_1 = 0$ $Ep_2 = p \cdot [R(0,c+t)+R(0,c)] + (1-p) \cdot R(c,c+t) - G - I$	$Ep_1 = p \cdot (1-p) \cdot [R(0,c)+R(t,c)] - I$ $Ep_2 = p \cdot (1-p) \cdot [R(0,c+t)+R(0,c)] + p^2 \cdot R(0,t) + (1-p)^2 \cdot R(c,c+t) - G - I$	$Ep_1 = Ep_2 = 2 \cdot p \cdot (1-p) \cdot R(0,c) - G - I$
(2, R); R	$Ep_1 = 0$ $Ep_2 = 2 \cdot p \cdot (1-p) \cdot R(0,c) - G - I$ $Ep_3 = 2 \cdot p \cdot (1-p) \cdot R(0,c) - 2 \cdot I$	$Ep_1 = p \cdot (1-p)^2 \cdot [R(0,c)+R(t,c)] - I$ $Ep_2 = 2 \cdot p \cdot (1-p)^2 \cdot R(0,c) + p^2 \cdot (1-p) \cdot R(0,t) - G - I$ $Ep_3 = 2 \cdot p \cdot (1-p)^2 \cdot R(0,c) + p^2 \cdot (1-p) \cdot R(0,t) - 2 \cdot I$	$Ep_1 = Ep_2 = 2 \cdot p \cdot (1-p)^2 \cdot R(0,c) - G - I$ $Ep_3 = 2 \cdot p \cdot (1-p)^2 \cdot R(0,c) - 2 \cdot I$

Table 2: Payoff Matrix in the G subgame

(The incumbents are firms 1 and 2, and the potential entrant is firm 3. If 3 chooses ∅, $Ep_3 = 0$ (not reported for brevity).)

In the key to Figure 3 multiple equilibria within a region are separated by semicolons. Where G-equilibria are separated by 'or', the relevant equilibrium depends on whether entry by firm 3 is accommodated (R) or strategically deterred ($\varnothing$) by the incumbents. We highlight three properties of Figure 3 that are relevant for our purposes.

G1. (Ferrett, 2002, p. 39) The shapes of regions V and VII in Figure 3 depend on whether

$$2 \cdot \frac{I}{G} \cdot [R(0,c) - R(t,c)] - R(0,t) > 0 \qquad (20)$$

is satisfied. (The general shapes of all other regions in Figure 3 are robust to changes in the cost parameters, provided that assumptions (B) and (C) continue to hold.) If (20) fails, then (i) the bottom boundary of region V, RHS(14), will extend to $p = 1$, rather than meeting RHS(12) in the interior of Figure 3; and (ii) region VII ceases to exist. While (20) holds when $G = I$, some G, I that satisfy assumption (C) imply LHS(20) < 0. Intuitively, for $G \gg I$ LHS(20) $\cong -R(0, t)$, so (20) fails.

G2 and G3 concern equilibrium selection (entry-deterrence vs. -accommodation) in regions V, VI and VIII of Figure 3. G2 and G3 use necessary-and-sufficient conditions for the entry-deterring G-equilibrium to be selected for all m that are presented in Ferrett (2002).

G2. (Ferrett, 2002, Proposition 6 and Lemma 8) If $G = I$, then (i) $\{(1, N), (2, R); \varnothing\}$ is selected over $\{(1, N), (1, N); R\}$ for all (p, m) in region V of Figure 3; (ii) given sufficiently high p, a second equilibrium of $\{(2, R), (2, R); \varnothing\}$ exists for all m in region VIII of Figure 3; and (iii) given t sufficiently greater than 0, $\{(1, R), (2, R); \varnothing\}$ is (certainly) selected over $\{(1, R), (1, R); R\}$ for all (p, m) in region VI of Figure 3.

Note in part (iii) of G2 that the requirement for t sufficiently greater than 0 *is consistent* with our earlier requirement in assumption (B) that the gap $(c - t)$ be sufficiently large. Finally, G3 reports on the effects of setting $G > I$.

G3. (Ferrett, 2002, Proposition 7) (i) Rises in G ceteris paribus weakly increase the size of the m-interval for any p where entry-accommodation is selected in equilibrium in regions V, VI and VIII of Figure 3. (ii) In the limit as $G \to \infty$, entry-deterrence is never selected in equilibrium in region VI, although entry-deterrence is always selected for some (p, m)-pairs in regions V and VIII.

The intuitive justification for the results in G2 and G3 concerning the influence of G relative to I on equilibrium selection is that, whereas the potential entrant must undertake R&D but not greenfield-FDI to enter the industry, the incumbents' entry-deterring strategies always entail greenfield-FDI. Therefore the result stems directly from our modelling structure. (Because the potential entrant initially owns 2 plants, the cost of additional plants, G, is irrelevant to its entry decision. However, the incumbents must invest in greenfield-FDI to deter entry.)

3.3. Equilibrium industrial structures: A-equilibrium vs. G-equilibrium.

In this Section we compare the A- and G-equilibria for given parameter values to derive (overall) equilibrium industrial structures and the equilibrium mode of FDI. This task comprises two steps. (The mechanics are presented in the Appendix.) First, we locate the inter-regional boundaries in the A subgame (Figure 2) relative to those in the G subgame (Figure 3), so that both the A- and G-equilibria are fixed for given parameter values. Second, we determine the equilibrium industrial structure by using the GADR to select between the A- and G-equilibria. A complication arises when there are multiple G-equilibria (A-equilibria are always unique: see Figure 2). In this case the selected subgame may depend on which G-equilibrium is selected *within* the G subgame. Of course, if the A-equilibrium dominates all the G-equilibria, then we can unambiguously conclude that the A subgame will be played in equilibrium (and vice versa). Figure 4 illustrates the model's equilibrium industrial structures in (p, m)-space.

Figure 4 provides implications for the relationships between p, m and equilibrium industrial structures; however, the derived relationships can be quite complex. Consider first the effects of changes in m in small-p industries. If t is small, increasing m shifts the equilibrium industrial structure successively from $\{N; \varnothing\}$ (region I); to $\{R; \varnothing\}$ (regions II and III); to $\{(1, R), (1, R); \varnothing\}$ (region IV); to $\{(1, R), (2, R); \varnothing\}$ for small G or $\{(1, R), (1, R); R\}$ for large G (region V); to $\{(1, R), (1, R); R\}$ (region VI); to $\{(2, R), (2, R); R\}$ for small G, I or $\{R; R\}$ for large G, I (region VIII). For large t the sequence of equilibrium industrial structures is $\{(1, N), (1, N); \varnothing\}$ (region I); $\{R; \varnothing\}$ (regions II and III); $\{(1, R), (2, R); \varnothing\}$ for small G or $\{R; R\}$ for large G (region V); $\{(1, R), (1, R); R\}$ for small I or $\{R; R\}$ for large I (region VI); $\{(2, R), (2, R); R\}$ for small G, I or

[INSERT FIGURE 4]

Key to Figure 4

Region	Equilibrium Industrial Structure
I	$\{(1, N), (1, N); \varnothing\}$ (resp. $\{N; \varnothing\}$) iff $t \geq$ (resp. $<$) $x^{M}(c) - c$
II	$\{R; \varnothing\}$ (Region II exists iff (A1) fails.)
III	$\{R; \varnothing\}$
IV	$\{(1, R), (1, R); \varnothing\}$ (Region IV exists iff $t < 0.5$.)
V	**G-equilibrium is {(1, *R*), (1, *R*); *R*}** Small p: $\{(1, R), (1, R); R\}$ (resp. $\{R; R\}$) for small (resp. large) t Large p: $\{R; R\}$ **G-equilibrium is {(1, *R*), (2, *R*); Æ}** $\{(1, R), (2, R); \varnothing\}$ (resp. $\{R; R\}$) for small (resp. large) G
VI	**G-equilibrium is {(1, *R*), (1, *R*); *R*}** Small p: $\{(1, R), (1, R); R\}$ (resp. $\{(1, R), (1, R); R\}$ for small I; $\{R; R\}$ for large I) for small (resp. large) t Large p: $\{R; R\}$ (resp. $\{(1, R), (1, R); R\}$ for small I; $\{R; R\}$ for large I) for small (resp. large) t
VII	**G-equilibrium is {(2, *R*), (2, *R*); Æ}** Small p (*within* region VII): $\{(2, R), (2, R); \varnothing\}$ (resp. $\{R; R\}$) for small (resp. large) t Large p: $\{(2, R), (2, R); \varnothing\}$ (resp. $\{(2, R), (2, R); \varnothing\}$ for small G, I; $\{R; R\}$ for large G, I) for small (resp. large) t
VIII	Small p (< 0.5): $\{(2, R), (2, R); R\}$ (resp. $\{R; R\}$) for small (resp. large) t, G, I Large p (≥ 0.5): $\{R; R\}$

$\{R; R\}$ for large G, I (region VIII) (note that region IV does not exist for large t). These sequences are summarised for ease of reference in Table 3.

Table 3: Summary of determinants of equilibrium industrial structures in Figure 4

<table>
<tr><th rowspan="2">Region*</th><th colspan="2">Small p</th><th colspan="2">Large p</th></tr>
<tr><th>Small t</th><th>Large t</th><th>Small t</th><th>Large t</th></tr>
<tr><td>I</td><td>$\{N; \varnothing\}$</td><td>$\{(1, N), (1, N); \varnothing\}$</td><td>$\{N; \varnothing\}$</td><td>$\{(1,N), (1,N); \varnothing\}$</td></tr>
<tr><td>II, III</td><td colspan="4">$\{R; \varnothing\}$</td></tr>
<tr><td>IV</td><td>$\{(1, R), (1, R); \varnothing\}$</td><td>N/A</td><td>$\{(1, R), (1, R);\varnothing\}$</td><td>N/A</td></tr>
<tr><td>V</td><td>Small G:
$\{(1, R), (2, R); \varnothing\}$
Large G:
$\{(1, R), (1, R); R\}$</td><td colspan="3">Small G: $\{(1, R), (2, R); \varnothing\}$
Large G: $\{R, R\}$</td></tr>
<tr><td>VII</td><td colspan="2">N/A</td><td>$\{(2, R), (2, R); \varnothing\}$</td><td>Small G, I:
$\{(2, R), (2, R); \varnothing\}$
Large G, I:
$\{R; R\}$</td></tr>
<tr><td>VI</td><td>$\{(1, R), (1, R); R\}$</td><td>Small I:
$\{(1, R), (1, R); R\}$
Large I:
$\{R; R\}$</td><td>$\{R; R\}$</td><td>Small I:
$\{(1, R), (1, R); R\}$
Large I:
$\{R; R\}$</td></tr>
<tr><td>VIII</td><td colspan="2">Small G, I: $\{(2, R), (2, R); R\}$
Large G, I: $\{R; R\}$</td><td colspan="2">$\{R; R\}$</td></tr>
</table>

(* Regions appear in Figure 4. Movements down a column reflect increases in m.)

The choice between $\{(1, N), (1, N); \varnothing\}$ and $\{N; \varnothing\}$ in region I depends on t in an intuitively-appealing way: large t affords the incumbents in the G subgame sufficient protection to monopoly-price, implying no (strict) profitability gains from acquisition-FDI; but if t is small, acquisition-FDI increases aggregate profits by eliminating the 'import competition' faced by each G-incumbent. In regions II and III the generation of acquisition-FDI in equilibrium is unsurprising because the acquirer is a global monopolist in A-equilibrium (no entry occurs). (The difference between regions II and III concerns the discarded G-equilibrium, which is $\{(1, N), (1, N); \varnothing\}$ in II and $\{(1, N), (1, R); \varnothing\}$, $\{(1, R), (1, R); \varnothing\}$, $\{(1, N), (2, R); \varnothing\}$ or $\{(1, N), (1, N); R\}$ in III; section 4 explores the significance of this difference in welfare terms.) In region IV the equilibrium industrial structure is the G-equilibrium of $\{(1, R), (1, R); \varnothing\}$ because both the A- and G-equilibria are duopolistic. Entry is 'more likely' to occur in the A subgame than in the G subgame if the entry-deterring G-equilibrium is played (if not, entry could occur in a G-equilibrium of $\{(1, N), (1, N); R\}$ in region III where the A-equilibrium is $\{R; \emptyset\}$), which makes intuitive sense because the entrant faces a monopoly in the A subgame but a duopoly in the G subgame. Therefore, for intermediate m-values (regions IV, V and VII) entry is deterred in G-equilibrium but accommodated in A-equilibrium and acquisition-FDI *does not* generate a 'more concentrated' industrial structure (in terms of firm numbers), which implies that the profitability gains from acquisition-FDI are limited (and perhaps non-existent).

In regions V, VI and VIII the equilibrium industrial structures are identical in the small- and large-t cases (for small p) if G, I are small. Increasing G, I causes substitution in equilibrium away from industrial structures that involve greenfield-FDI and (relatively) large numbers of R&D investments. Therefore, in region V increasing G replaces (one-way) greenfield-FDI in equilibrium with equilibrium industrial structures involving either no FDI (small t) or acquisition-FDI (large t). In similar fashion, increasing I shifts the equilibrium industrial structure for large t in region VI from $\{(1, R), (1, R); R\}$ to $\{R; R\}$, which halves the incumbents' combined spending on R&D. (In region VIII the equilibrium industrial structure is independent of t, and large G, I cause the substitution of $\{R; R\}$ for $\{(2, R), (2, R); R\}$.) For large G, I increasing t generates 'tariff-jumping' acquisition-FDI in equilibrium in regions V and VI (recall that for small G, I equilibrium industrial structures are independent of t): $\{R; R\}$ displaces $\{(1, R), (1, R); R\}$ in both V and VI. We examine tariff-jumping acquisition-FDI in more detail below and contrast it with (the more familiar) tariff-jumping greenfield-FDI.

Finally, we can draw some tentative generalisations on the effects of changes in m on equilibrium FDI flows and industrial structures in small-p industries. In small markets (region I) the industry is served either by two national firms (for large t) or by a monopolistic MNE (for small t), created by acquisition-FDI; R&D is never undertaken. In medium-sized markets (regions II and III) the equilibrium industrial structure is a monopolistic MNE, created by acquisition-FDI, which invests in R&D. In large markets (regions V, VI and VIII) the equilibrium industrial structure is the G-equilibrium for small G, I; both G-incumbents undertake R&D and greenfield-FDI flows may be one-way (region V), non-existent (region VI) or cross-hauled (region VIII). For large G, I in large markets the equilibrium industrial structure is two MNEs (the G-incumbents integrate via tariff-jumping acquisition-FDI and entry occurs), both undertaking R&D, when t is large; when t is small the equilibrium industrial structure is $\{(1, R), (1, R); R\}$ (regions V and VI) or $\{R; R\}$ (region VIII). Greenfield-FDI never occurs in large markets for large G, I.

We now turn to consider the effects of changes in m in large-p industries. If t is small, increasing m shifts the equilibrium industrial structure successively from $\{N; \varnothing\}$ (region I); to $\{R; \varnothing\}$ (regions II and III); to $\{(1, R), (1, R); \varnothing\}$ (region IV); to $\{(1, R), (2, R); \varnothing\}$ for small G or $\{R; R\}$ for large G (region V); to $\{(2, R), (2, R); \varnothing\}$ (region VII); to $\{R; R\}$ (regions VI and VIII). For large t the sequence of equilibrium industrial structures is $\{(1, N), (1, N); \varnothing\}$ (region I); $\{R; \varnothing\}$ (regions II and III); $\{(1, R), (2, R); \varnothing\}$ for small G or $\{R; R\}$ for large G (region V); $\{(2, R), (2, R); \varnothing\}$ for small G, I or $\{R; R\}$ for large G, I (region VII); $\{(1, R), (1, R); R\}$ for small I or $\{R; R\}$ for large I (region VI); $\{R; R\}$ (region VIII) (note that region IV does not exist for large t). See table 3 for a summary of these sequences.

Equilibrium selection in regions I to IV is identical in the large- and small-p cases. In region VIII acquisition-FDI always arises in equilibrium for large p regardless of t, G, I (the irrelevance of G, I stems from the fact that the acquirer's expected *net revenues* are greater than the G-incumbents' for $p > 0.5$ in region VIII). In regions V and VII the equilibrium industrial structures are identical in the small- and large-t cases if G, I are small, with one-way greenfield-FDI in V and greenfield-FDI cross-hauling in VII. Increasing G, I again causes substitution in equilibrium away from industrial structures involving greenfield-FDI and (relatively) large numbers of R&D investments: acquisition-FDI arises in region V and (for large t) in region VII, displacing greenfield-FDI flows and halving the incumbents' combined R&D spending. In region VI acquisition-FDI arises in equilibrium for small t, but it is replaced by $\{(1, R), (1, R); R\}$ for large t if I is small. (If I is large, then $\{R; R\}$ is the equilibrium industrial structure for all t in region VI.) This implies that for small I *increasing* t in region VI will cause $\{(1, R), (1, R); R\}$ to replace $\{R; R\}$, which appears to contradict the explanation of equilibrium acquisition-FDI in terms of 'tariff-jumping' motives.

In models of equilibrium greenfield-FDI with segmented national product markets increasing t unambiguously increases a firm's 'incentive' to undertake greenfield-FDI abroad (see Ferrett, 2002, for elaboration of this point). Because national product markets are perfectly segmented, undertaking greenfield-FDI *only* affects a firm's profits from abroad (ceteris paribus). Foreign profits are (by definition) independent of t if greenfield-FDI is undertaken and *decreasing* in t if the foreign market is served by exporting from a domestic plant; therefore, the difference greenfield-FDI profits and exporting profits is increasing in t, creating the conventional tariff-jumping motive for greenfield-FDI.

In our modelling of acquisition-FDI the decision rule for acquisition-FDI (the GADR) compares the G-incumbents' combined profits to the acquirer's profits (which are independent of t because the potential entrant has two plants so international trade does not occur in the A subgame), which is a qualitatively different comparison to that for greenfield-FDI. Under {(1, R), (1, R); R} the derivative of the G-incumbents' expected profits with respect to t is $2 \cdot p \cdot (1-p) \cdot \left[p \cdot \frac{\mathrm{d}R(0,t)}{\mathrm{d}t} + (1-p) \cdot \frac{\mathrm{d}R(t,c)}{\mathrm{d}t} \right]$, where [·] is a convex combination of dR(0, t)/dt and dR(t, c)/dt. For small p the derivative approximately equals $2 \cdot p \cdot (1-p)^2 \cdot \frac{\mathrm{d}R(t,c)}{\mathrm{d}t} < 0$, so increases in t reduce the G-incumbents' profits under {(1, R), (1, R); R} and strengthen the incentive to undertake (tariff-jumping) acquisition-FDI. This effect was observed for small p and large G, I in regions V and VI. However, for large p the derivative approximately equals $2 \cdot p^2 \cdot (1-p) \cdot \frac{\mathrm{d}R(0,t)}{\mathrm{d}t} \geq 0$, so increases in t increase the G-incumbents' profits under {(1, R), (1, R); R} and weaken the incentive for acquisition-FDI. This latter effect occurs for large p and small I in region VI. Aside from regions V and VI, changes in t also cause switches between acquisition-FDI and G-equilibria involving no greenfield-FDI in region I, where the relationship is again perverse: *decreases* in t generate acquisition-FDI (because dR(c, c+t)/dt ≥ 0).

In general, changes in m affect equilibrium FDI flows and industrial structures for large p as follows. In small (region I) and medium-sized (regions II and III) markets the equilibrium industrial structures are identical to those for small p. In large markets (regions V, VI, VII and VIII) the equilibrium industrial structure is two MNEs, one created by acquisition-FDI, for large G, I. For small G, I the equilibrium industrial structure is either {R; R} in 'very large' markets (regions VI and VIII) or the G-equilibrium (regions V and VII), where entry never occurs, both G-incumbents undertake R&D, and greenfield-FDI flows are either one-way or cross-hauled.

By comparing the small- and large-p cases, we can gain some intuition on the effects of changes in p on equilibrium industrial structures. In small (region I) and medium-sized (regions II and III) markets the equilibrium industrial structures are independent of p. In large markets (regions V, VI, VII and VIII) increases in p make acquisition-FDI 'more likely'. This is clear in region VIII, and also for small t in region VI and region V (if G large). Note, moreover, that there are *no* t, G, I where *deceasing* p switches the equilibrium industrial structure to include acquisition-FDI where previously the G-equilibrium was selected. To provide intuition on this (weak) positive relationship between p and acquisition-FDI flows, compare the incumbents' net revenues between the G and A subgames in region VIII. The probability that the acquirer earns net revenue of $R(0, c)$ in each country is $p \cdot (1 - p)$; the equivalent probability for the G-incumbents is $2 \cdot p \cdot (1 - p)^2$: the G subgame offers two chances to win both markets, but each is less likely than the acquirer's single chance. Clearly, $p \cdot (1 - p) > 2 \cdot p \cdot (1 - p)^2$ iff $p > 0.5$, which is merely a straightforward comparative mathematical property of the probabilities of winning the markets, so acquisition-FDI certainly arises in equilibrium in region VIII for $p > 0.5$ because acquisition *also* reduces the incumbents' sunk costs.

Proposition 1summarises the comparative-statics effects on the equilibrium industrial structure of variations in p, m, t, G, I that were discussed above.

Propositon 1. (*i*) *A* (*weak*) *positive association exists between p and equilibrium acquisition-FDI.* (*ii*) *The association between m and equilibrium acquisition-FDI can be positive, negative, U-shaped or hump-shaped.* (*iii*) *The association between t and equilibrium acquisition-FDI is positive* (*'conventional'*) *for small p but negative* (*'perverse'*) *for large p.* (*iv*) *There are negative associations between G, I and* (*respectively*) *the equilibrium levels of intra-industry greenfield-FDI flows and industry R&D spending. Increases in G can cause substitution in equilibrium of acquisition-FDI for greenfield-FDI.*

The equilibrium properties of the model described in Proposition 1 are clear from Figure 4 and Table 3 (and the preceding discussion). Two comments are in order. First, Proposition 1 refers to associations between structural variables and acquisition-FDI, rather than acquisition-FDI *flows*. Recall that the size and direction of acquisition-FDI *flows* are not explicitly determined in our model; therefore, Proposition 1 is best interpreted as highlighting associations between structural variables and the *occurrence of acquisition-FDI*. Second, although some of the associations in Proposition 1 (e.g. in part (ii)) can take several forms, this *does not* imply that they are indeterminate. For example, the form of the association between acquisition-FDI and m is determined by p, t, G, I as follows: (a) *positive* for {large p; large t; all G, I} and for {small p;

large t; large G, I}. (b) *negative* for {small p; small t; small G, I}. (c) *U-shaped* for {small p; small t; large G, I} and for {large p; small t; all G, I}. (d) *hump-shaped* for {small p; large t; small G, I}.

Figure 4 and Table 3 also allow us to substantiate a claim made in the Introduction: that by excluding strategies of greenfield-FDI from the determination of the threat point, previous models of equilibrium acquisition-FDI may 'misleadingly' predict the occurrence of acquisition-FDI in equilibrium. (Note that these models are 'misleading' in terms of their application to reality, where firms *can* undertake greenfield-FDI; they are correct in terms of their own assumptions on firms' strategy spaces.) Observe in region V of Fig. 4 that if p is large then {R; R} is selected over {(1, R), (1, R); R}. However, for sufficiently small G {(1, R), (2, R); ∅} is selected over {R; R}. Therefore, if greenfield-FDI strategies were excluded, then {R; R} would arise in equilibrium for large p in region V. However, if greenfield-FDI strategies are admitted, then (for sufficiently small G) {(1, R), (2, R); ∅} is chosen over {(1, R), (1, R); R} in the G subgame *and* over {R; R} in the overall game. Greenfield-FDI is used by one G-incumbent to deter entry and bolster the G-incumbents' profits, thereby rendering acquisition-FDI unprofitable. Therefore, in order to explain acquisition-FDI in equilibrium, greenfield-FDI strategies must also be included in the model.

4. Concluding Comments.

By building a model where the *form* of FDI is endogenously selected, the aim of this paper was to isolate the determinants of the equilibrium form of FDI. Proposition 1 describes in detail the associations between our model's structural parameters and equilibrium acquisition-FDI, which are perhaps 'more interesting' than the relationships between equilibrium greenfield-FDI and the structural parameters because the present paper is the first in the literature initiated by Horstmann and Markusen (1992) and Rowthorn (1992) to admit acquisition-FDI flows. However, for greenfield-FDI to arise in equilibrium, two conditions are necessary (see Table 3): large m and small G. An extension of the analysis in this paper, see Ferrett (forthcoming), is to compare the welfare properties of the A- and G-equilibria. If significant contrasts are found, then modelling the distinction between greenfield- and acquisition-FDI will have proved useful.

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FIGURES

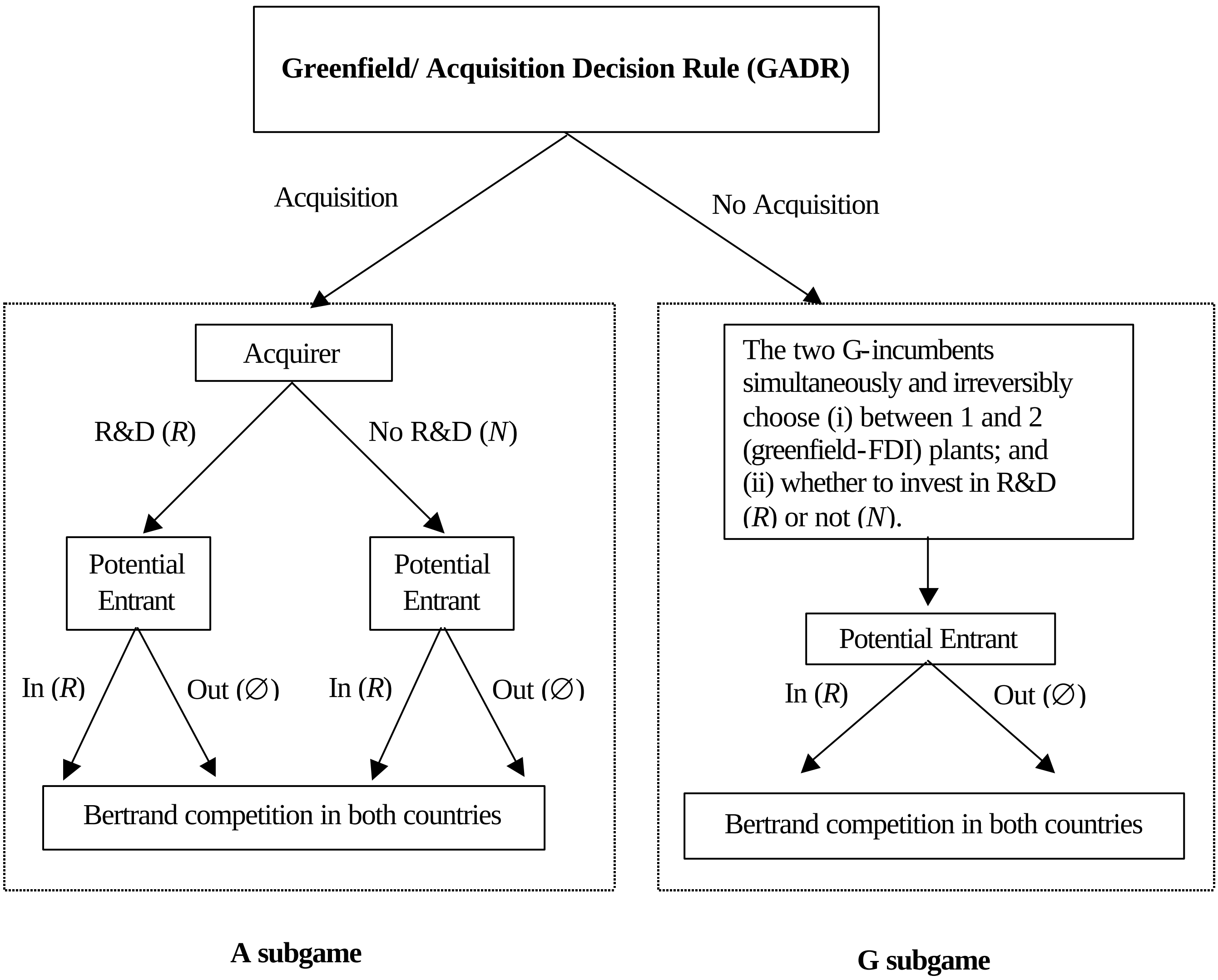

Figure 1: Game Tree

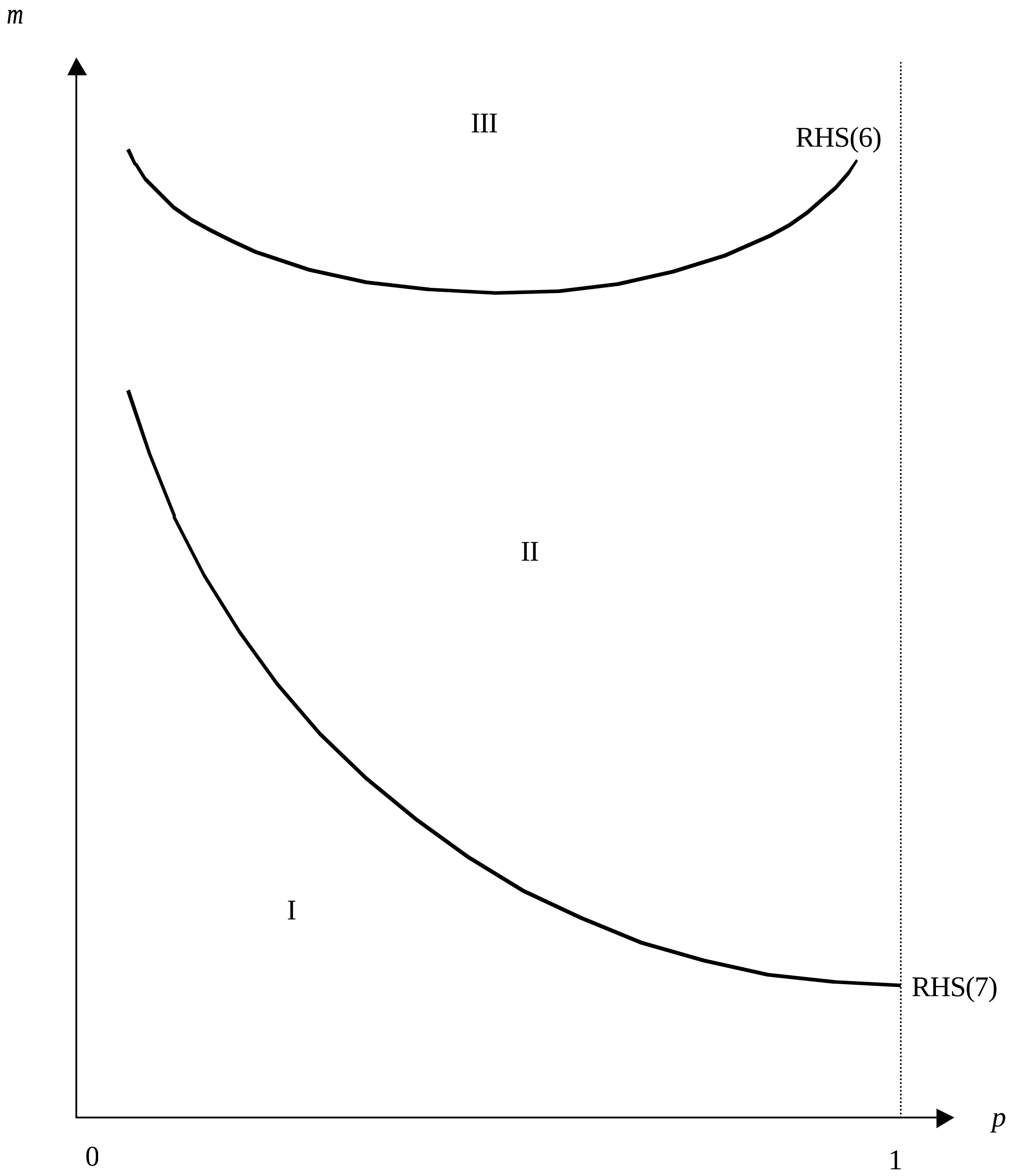

Figure 2: A-equilibria

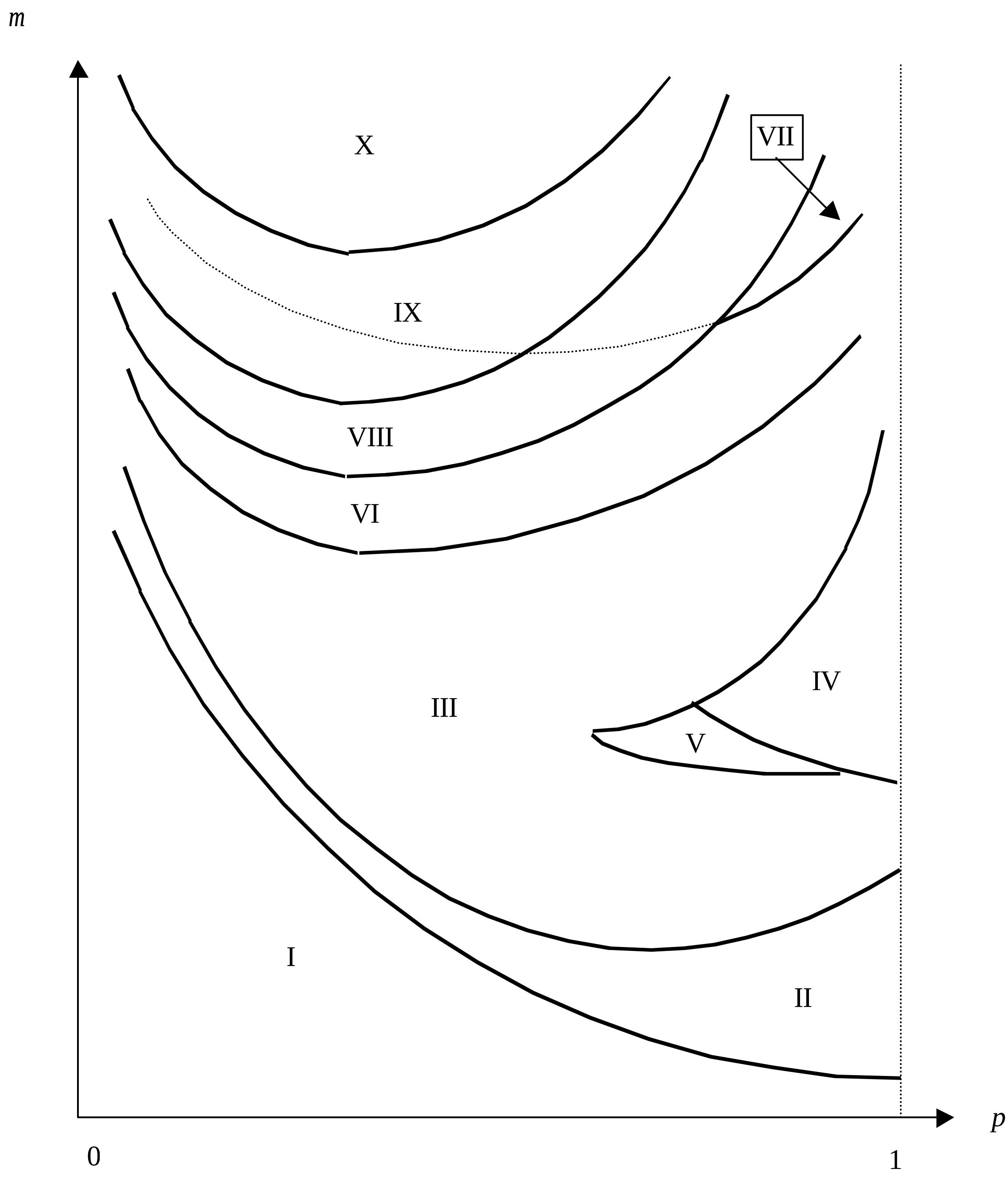

Figure 3: G-equilibria

Inter-regional boundaries: I/II boundary is RHS(10); II/III boundary is RHS(11); III/IV lower boundary and IV/V boundary is RHS(12); III/IV upper boundary and III/V upper boundary is RHS(13); III/V lower boundary is RHS(14); III/VI boundary is RHS(15); VI/VII boundary is RHS(16); VI/VIII boundary and VII/VIII boundary is RHS(17); VIII/IX boundary is RHS(18); IX/X boundary is RHS(19).

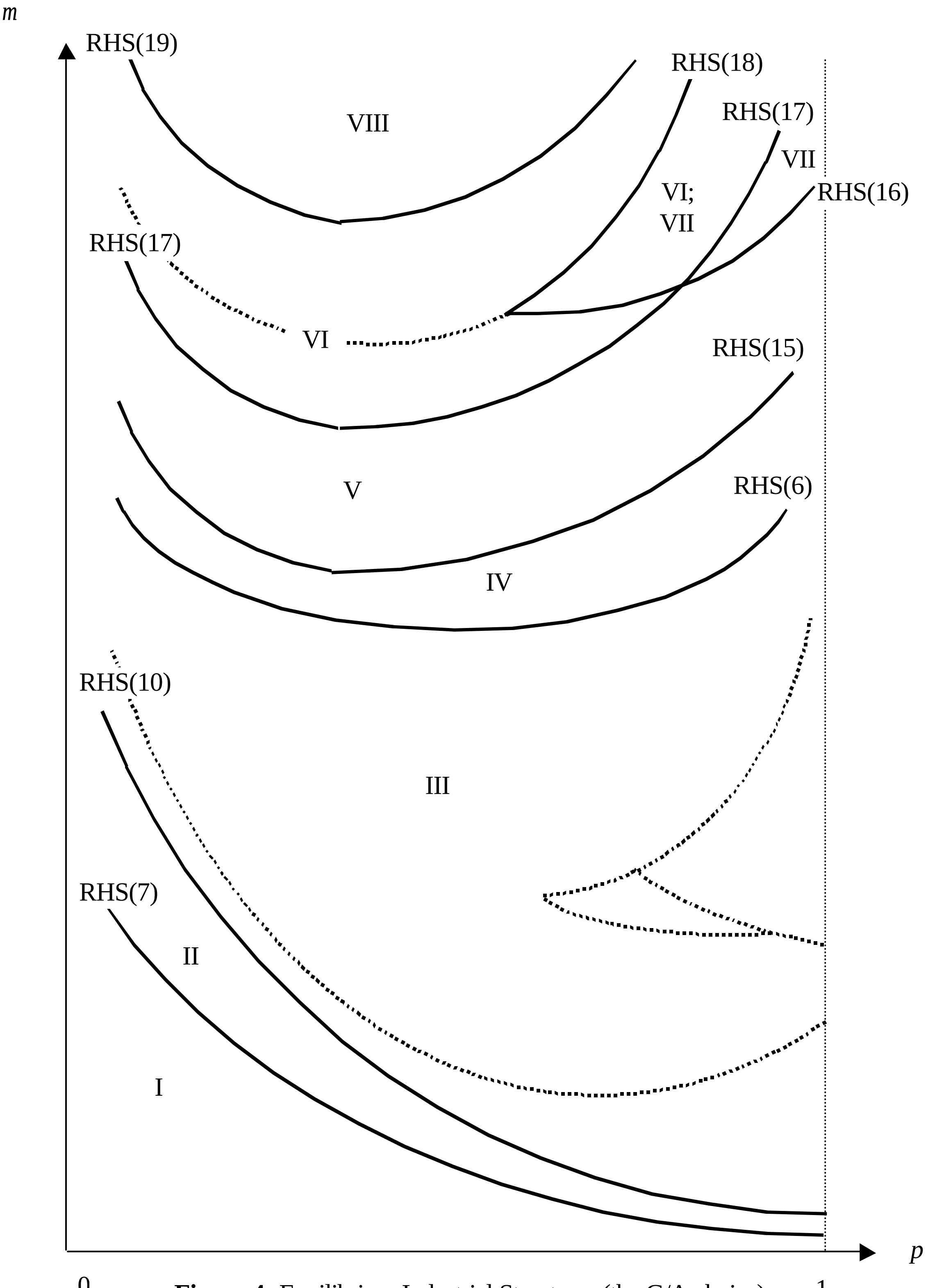

Figure 4: Equilibrium Industrial Structures (the G/A choice)

Bold inter-regional boundaries are labelled in the Figure. Dashed lines are inter-regional bounaries from the G subgame (included for comparison).