

research paper series

Globalisation, Productivity and Technology



Research Paper 2006/02

*Productivity Distributions in International Oligopolies:
Spillovers, Technology Transfer, and Heterogeneous FDI*

by

Ben Ferrett

The Author

Ben Ferrett is a Research Fellow in the Leverhulme Centre for Research on Globalisation and Economic Policy (GEP), University of Nottingham.

Contact Details: Ben Ferrett, School of Economics, University of Nottingham, University Park, Nottingham, NG7 2RD, UK. E-mail: ben.ferrett@nottingham.ac.uk

Acknowledgements

This paper is a substantially revised version of chapter 3 of my PhD thesis (submitted to Warwick University). For helpful comments, I am grateful to Keith Cowling, Mike Devereux, Bruce Lyons, Daniel Seidmann and Mike Waterson, and to seminar participants at Nottingham University, ETSG 2003 in Madrid, the Spring 2004 Mid-West International Economics Group meeting at Indianapolis, EARIE 2004 in Berlin, RES 2005 in Nottingham, and the June 2005 GEP conference on “Globalisation and Firm-Level Adjustment.” Financial assistance from the Leverhulme Trust (programme grant F114/BF) is also gratefully acknowledged. All errors are entirely my own.

Productivity Distributions in International Oligopolies: Spillovers, Technology Transfer, and Heterogeneous FDI

by
Ben Ferrett

Abstract

Foreign-owned firms exhibit widely-documented productivity advantages over domestic firms. To interpret this stylized fact, we model the relationships between FDI flows and national productivity distributions across firms in an international oligopoly. Industrial structure is determined endogenously, and both greenfield- and acquisition-FDI are allowed for. The technology gap between firms interacts with localized spillovers to determine greenfield-FDI incentives and with within-firm technology transfer to determine the profitability of acquisition-FDI. Greenfield- and acquisition-FDI also affect the profitability of entry into the industry differently. We contrast our results with the insights of Dunning's well-known OLI framework on the causes of FDI flows.

JEL classification: F23; L13; O33.

Keywords: acquisition-FDI; greenfield-FDI; technology transfer; spillovers; foreign-owned firms' productivity advantages.

Outline

- 1. Introduction*
- 2. Model*
- 3. Analysis*
- 4. Discussion*

Non-Technical Summary

It is well established that foreign-owned plants generally exhibit higher labour productivity than domestically-owned ones within the same industry. This stylized fact is robust across both host countries and host industries. We focus on that part of the productivity advantage which is due to higher total factor productivity (i.e., superior process technologies) in foreign-owned plants. We investigate the relationships between foreign direct investment (FDI) inflows and outflows and national TFP distributions across plants ("productivity distributions") in an international oligopoly. Our aim is to provide a theoretical analysis of the sources of foreign-owned firms' observed productivity advantages.

Our model allows for localized inter-firm productivity spillovers, within-firm (plant-to-plant) technology transfer, and two forms of FDI, greenfield and acquisition. National productivity distributions are determined endogenously in the perfect equilibrium of a game where firms first choose production locations (and, if relevant, the form of FDI) and then compete on national product markets. Although firms differ in their initial TFP levels, we assume potential host countries to be identical. Our model therefore follows recent empirical work in emphasising the role of firm types (MNE vs. non-MNE), rather than nationality of ownership *per se*, in explaining the observed productivity leads of foreign-owned plants.

Two characteristics of the national productivity distributions in the industry considered are endogenously determined in our model: first, plants can be either high- or low-productivity (there are two process technologies); and, second, the number of plants is endogenously determined at equilibrium (the model contains both incumbent firms and the possibility of de novo entry). Our analysis of equilibrium industrial structures generates several testable hypotheses on the relationships between FDI flows and structural parameters. First, both types of FDI flow are non-monotonic in the degree of economies of scale. For sufficiently large scale economies, acquisition-FDI (greenfield-FDI) flows are U- (hump-) shaped in the degree of economies of scale. Second, a rise in the magnitude of spillovers makes technological leaders (laggards) less (more) likely to choose greenfield-FDI over exporting. Third, for sufficiently large localized inter-firm spillovers, a widening of the technological gap between firms of different nationalities makes technological leaders (laggards) less (more) likely to choose greenfield-FDI over exporting. (If spillovers are weak, the converse effects will be observed.) Finally, a rise in the trade cost makes all firms more likely to choose greenfield-FDI over exporting.

We contrast our account of the relationship between FDI flows and MNEs' observed productivity advantages with that offered by Dunning's famous OLI paradigm. OLI argues that a necessary condition for undertaking FDI is that the potential MNE possess a (proprietary) "ownership advantage" relative to local rivals in the host country (e.g., a highly productive technology). This is needed to offset the increased costs of co-ordinating business activities across international borders. However, ownership advantages are unnecessary for greenfield-FDI in our model because the scale of potential entry is limited (and we respect the integer constraint on the number of firms), so even laggardly firms can earn supernormal profits in equilibrium. Moreover, in direct contrast to OLI, the presence of (sufficiently strong) localized spillovers means that an increase in the technological gap between firms weakens the leader's incentive for technology-dissipating greenfield-FDI but strengthens the laggard's incentive for technology-sourcing greenfield-FDI. The OLI paradigm draws no sharp distinction between greenfield- and acquisition-FDI. However, we find that the two forms of FDI are associated with different equilibrium industrial structures. Moreover, we show that whenever incentives for "technology-embodied" acquisition-FDI exist (leader buys laggard), so do those for "cherry-picking" acquisition-FDI (laggard buys leader), so the view that foreign MNEs' productivity advantages are necessarily embodied in their FDI inflows is without theoretical support from our model.

1 Introduction

It is well established that foreign-owned plants generally exhibit higher labour productivity than domestically-owned ones within the same industry. This stylized fact is robust across both host countries and host industries. For the UK, the data presented by Griffith *et al.* (2004, Table 3) imply that, over the period 1998-2001, foreign-owned plants in the production sector enjoyed, on average, 25% higher labour productivity (i.e., value-added per employee) than their UK-owned rivals. Importantly, this statistic controls for the inter-industry distribution of plants by disaggregating the overall production sector into more than 100 separate industries.¹ Moreover, international evidence suggests that the “productivity advantage” of foreign-owned firms is not a peculiar characteristic of the UK economy. Globerman *et al.* (1994) found a similar productivity gap between foreign- and domestically-owned plants in Canada, and in their study of US manufacturing Doms and Jensen (1998) found that, in terms of productivity gaps, the significant difference is between multinational enterprises (MNEs) and non-MNEs, not between foreign- and domestically-owned firms.²

Labour productivity can, of course, vary across plants for a variety of reasons in addition to total factor productivity (TFP) differences: e.g., differences in physical and human capital intensities and in monopoly power in the product market. However, in order to facilitate a clear and tractable analysis, we focus on that part of the “productivity advantage” which is due to higher TFP (i.e., superior process technologies) in foreign-owned plants.³ We investigate the relationships between foreign direct investment (FDI) inflows and outflows and national TFP distributions across plants (hereafter, “productivity distributions”) in an international oligopoly. Our aim is to provide a theoretical analysis of the sources of foreign-owned firms’ observed “productivity advantages.” Our model allows for localized inter-firm productivity spillovers, within-firm (plant-to-plant) technology transfer, and two forms of FDI, greenfield and acquisition.⁴ National productivity distributions are

¹ There is an expanding tradition of empirical work that catalogues the “productivity advantages” of foreign-owned firms in the UK. See, *inter alia*, Davies and Lyons (1991), Griffith (1999), Girma *et al.* (2001), Oulton (2001), Harris and Robinson (2003), and Griffith and Simpson (2004).

² The data on UK service sectors in Griffith *et al.* (2004) also highlight the importance of the MNE/non-MNE distinction. Criscuolo and Martin (2005) find that UK MNEs are as productive as non-US foreign MNEs in UK manufacturing.

³ For the UK, opinion is divided on whether TFP differences play a large (e.g., Harris and Robinson, 2003) or a small (e.g., Griffith and Simpson, 2004) role in explaining foreign-owned plants’ higher labour productivities (for a moderate position, see Oulton, 2001). All that is necessary to generate interest in our arguments is that *some* TFP difference exists, which all authors appear to accept.

⁴ The greenfield/ acquisition distinction is both qualitatively and quantitatively important: relative to greenfield entry, acquisition-FDI “concentrates” the product market (UNCTAD, 2000, documents a *persistent*

determined endogenously in the perfect equilibrium of a game where firms first choose production locations (and, if relevant, the form of FDI) and then compete on national product markets. Therefore, our paper contributes to the game-theoretic literature on endogenous market structures in international trade (e.g., Horstmann and Markusen, 1992; Rowthorn, 1992; Petit and Sanna-Randaccio, 2000). However, whereas that literature focussed on the greenfield-FDI vs. exporting decisions of identical firms in a cross-hauling setting, we allow for TFP differences across firms and for acquisition-FDI, both of which are empirically important. Although firms differ in their initial TFP levels, we assume potential host countries to be identical. Our model therefore follows recent empirical work (e.g., Doms and Jensen, 1998; Criscuolo and Martin, 2005) in emphasising the role of firm types (MNE vs. non-MNE), rather than nationality of ownership *per se*, in explaining the observed productivity leads of foreign-owned plants.⁵

Two characteristics of the national productivity distributions in the industry considered are endogenously determined in our model: first, plants can be either high- or low-productivity (there are two process technologies); and, second, the number of plants is endogenously determined at equilibrium (the model contains both incumbent firms and the possibility of de novo entry). There are three ways in which firms' FDI decisions interact with a national productivity distribution in the industry modelled. First, if an incumbent firm undertakes either form of FDI, productivity spillovers can occur between the MNE's newly-established branch plant abroad and rival firms located in the host country. Spillovers can only occur between plants located in the same country (i.e., they are localized), and they can flow in both directions between a foreign branch plant and local rivals. For example, a technological laggard may undertake FDI in an attempt to "source" technology via spillovers from (more productive) local firms.⁶ The relationship between FDI decisions and spillovers is two-way: if a foreign technological leader undertakes inward FDI, the productivity of local firms may be raised via spillovers; therefore, the technological leader will allow for this potential dissipation of its advantage when choosing between exporting and FDI.⁷

"concentration effect" of acquisition-FDI in the data); and neither type of FDI is ever reported as being trivially important in aggregate global flows (UNCTAD, 2000). Moreover, when specifically considering the genesis of national productivity distributions, the greenfield/ acquisition distinction matters because of a further qualitative difference: unlike greenfield, acquisition gives MNEs the option of buying technology.

⁵ Note that the only "nationality effect" highlighted by Oulton (2001) is US vs. non-US ownership.

⁶ A number of empirical studies find that FDI is used to "source" technology in this way. See, *inter alia*, Kogut and Chang (1991), Neven and Siotis (1996), van Pottelsberghe de la Potterie and Lichtenberg (2001), and Driffield and Love (2003).

⁷ Related analyses of the greenfield/exporting choice in the presence of spillovers are presented by Fosfuri and Motta (1999) and Siotis (1999).

The second way in which firms' FDI decisions interact with national productivity distributions is through within-firm transfers of technology between plants in MNEs. Technology is a public good within the firm, and firms use their most productive technology in all their plants.⁸ Our modelling structure allows the high-productivity incumbent to purchase the low-productivity incumbent abroad. Following this flow of acquisition-FDI, intra-firm technology transfer occurs: the high-productivity purchaser is able costlessly to install its (superior) technology in the acquired plant abroad.⁹ Therefore, increases in the acquirer's technological lead increase the profitability of acquisition-FDI. Intra-firm technology transfer also occurs when an initially-laggardly firm "brings home" a spillover received abroad by its foreign branch plant.¹⁰

Third, FDI decisions interact with national productivity distributions through the relationship between the incumbents' greenfield/acquisition choice and the potential entrant's decision. Greenfield- and acquisition-FDI result – when the potential entrant comes to make her choice – in different industrial structures, and thus different entry "incentives." Specifically, if the incumbents undertake acquisition-FDI, the industry becomes more "concentrated" than if they had remained as independent firms, and therefore the profitability of entry for the outside firm rises.¹¹ This explains why we find that the equilibrium occurrence of acquisition-FDI is non-monotonic in the fixed cost of additional plants. There exists a fixed-cost interval where acquisition provokes subsequent de novo entry into the industry but greenfield and exporting do not. Therefore, in this interval, acquisition-FDI is not profitable (in the sense of Salant *et al.*, 1983) because the acquirer's rents would be competed away by subsequent entry. However, on both sides of this interval, where the potential entrant's optimal choice is independent of the incumbents' greenfield/acquisition choice, acquisition-FDI does arise in equilibrium. Therefore, the equilibrium occurrence of acquisition-FDI is U-shaped in the plant fixed cost.

The remainder of the paper is organised as follows. Sections 2 and 3 contain, respectively, a formal description of our modelling structure and an analysis of its equilibrium properties.

⁸ Fors (1997) shows that substantial between-plant technology transfer occurs within Swedish MNEs.

⁹ Our concept of intra-firm technology transfer is identical to that used by Long and Vousden (1995), who assume that every plant in a merged firm operates at the minimum marginal cost of its constituent plants before the merger. Mattoo *et al.* (2004) present a model of costly technology transfer following acquisition-FDI; however, they do not allow for technology-sourcing motives for FDI, which appear empirically significant.

¹⁰ For an empirical analysis of this phenomenon, see Veugelers and Cassiman (2004).

¹¹ One might say that, relative to serving the foreign market by exporting or greenfield-FDI, acquisition-FDI is a "soft" response to the entry threat. UNCTAD (2000), in an empirical survey, shows that intra-industry acquisition-FDI is more likely to trigger entry into the industry than greenfield-FDI.

In Section 4 we conclude by contrasting our account of the relationship between FDI flows and MNEs’ observed “productivity advantages” with that offered by Dunning’s famous (1977) OLI paradigm.

2 Model

There are two countries in the world, 1 and 2, and two incumbent firms, one in each country. At the start of the game firm M (the potential MNE via acquisition-FDI) owns a plant in 1 and firm T (the potential acquisition target) owns a plant in 2. The firms in our model produce homogeneous goods for sale on the identical national product markets of 1 and 2, and international trade incurs a specific trade cost of t . Market demand in either country is

$$Q_d = \mu(1 - \text{price}), \quad (1)$$

where μ measures the “size” of either country.

There are two distinct technologies for producing the homogeneous product, both of which exhibit constant marginal costs. Technology is assumed to be a public good (i.e., non-rival) within the firm and intra-firm technology transfer is costless. Firm M ’s initial technology has a marginal production cost of c_M and firm T ’s has a marginal production cost of c_T . We assume that any difference between c_M and c_T is due entirely to differences in TFP between the two technologies.¹² We maintain the following assumption on c_M and c_T :

$$1 > c_T > c_M > 0 \quad (\text{A})$$

Assumption A implies that M ’s initial technology is more productive than T ’s. It is quite conventional in the literature to assume that acquiring MNEs possess “productivity advantages” over their targets (e.g. Mattoo, Olarreaga and Saggi, 2004). In Section 4 we discuss the reasons behind this conventional assumption and explore the implications of relaxing A to allow for $c_M > c_T$.

Given the initial conditions described above, Figure 1 depicts our four-stage game of complete information. In stage one, M chooses between $\{X, G, A\}$, where each element represents a different method of serving the product market in country 2. X is M ’s *exporting* option: M builds no additional plants, and it serves 1’s product market with local production at a marginal cost of c_M and 2’s product market via international trade at a marginal cost

¹² Factor prices are therefore implicitly assumed to be identical across countries.

of $c_M + t$. By choosing either G or A , M becomes a two-plant MNE. G represents *greenfield-FDI*: M builds an additional plant in 2 at a sunk cost of F and serves both countries' product markets from local production at a marginal cost of c_M . A represents *acquisition-FDI*: M makes T a take-it-or-leave-it offer of an acquisition price. If T accepts M 's offer, M transfers its superior technology to T 's plant and serves both countries' product markets from local production at a marginal cost of c_M ; thereafter, we skip stage two (T 's choice). If T rejects M 's takeover offer, then M must choose between X and G . These assumptions imply that the equilibrium takeover price equals T 's expected profits under M 's next-best (i.e., "threat point") strategy (X or G), and that M captures the entire surplus created by the takeover.¹³

[INSERT FIGURE 1 HERE]

In stage two, which only arises if M chooses X or G in stage one, T chooses from a strategy space of $\{X, G\}$, where the elements are analogous to those in M 's strategy space. The key difference is that T 's initial technology has a marginal production cost of $c_T > c_M$. To secure a marginal production cost of c_M , T must rely on productivity spillovers, which are described below.¹⁴

In stage three, a single potential entrant (firm E) decides whether to enter the industry with a single plant at a sunk cost of F (strategy G) or to remain outside the industry (strategy \emptyset). E 's marginal production cost is c_T , so M initially possesses a "productivity advantage" over both its rivals under assumption A. We make three important assumptions about E 's options. First, E can only enter with one plant. Second, E has insufficient "capacity" to absorb spillovers.¹⁵ Third, E cannot merge with another firm: greenfield entry is E 's only possible entry strategy. All three assumptions can be rationalised in terms of E 's being new to the industry.¹⁶

¹³ We show in Section 4 that the equilibria we derive are consistent with a much more general formulation of the bargaining process preceding the takeover.

¹⁴ As we shall see, by choosing G , M may lose its "productivity advantage" over T via spillovers in country 2. We assume that M *only* has access to technology c_M initially, so it cannot protect its "productivity advantage" by embodying an inferior technology in greenfield-FDI.

¹⁵ Therefore, M will always choose to transfer its superior technology to T 's plant following acquisition-FDI because there is no risk of a spillover to E .

¹⁶ Being young, E has not yet developed the competence to operate more than one plant or absorb new technologies via spillovers. (Markusen, 1995, records that a firm's likelihood of undertaking FDI increases with its age, and this might well apply to absorptive capacity too.) An earlier version of this paper (available from the author on request) allowed E both to enter with one *or* two plants and to receive spillovers. This complicates the analysis considerably but does not alter the key qualitative results. The third assumption – that the sunk cost of merging with E is prohibitive – may be justified by the problems of fusing together different (incumbent and "new") corporate cultures.

Stage four is the market stage: at the end of stage four all firms in the industry compete à la Cournot to serve both national product markets. Spillovers occur at the start of stage four before the production of outputs. If firms M and T are located in the same country, then with probability θ M 's technology spills over to T .¹⁷ Therefore, spillovers are localized. If T owns two plants and receives a spillover in one country, it can costlessly apply its new technology to production in both countries (i.e., intra-firm technology transfer is costless). We assume that the probability of spillovers is identical and independent across countries. The magnitude of θ will be determined by factors such as the degree of skilled-worker mobility between firms and the scope of intellectual property rights protection (Blomström and Kokko, 1998). After spillovers have occurred, firms produce outputs. We assume that marginal production costs are common knowledge.

We solve the game backwards to isolate its subgame perfect Nash equilibria in pure strategies (firms are risk neutral). To avoid extensive and unrewarding taxonomy, we place restrictions on the marginal cost parameters, c_M , c_T and t , to ensure that all Cournot equilibria are interior. Given market demand in (1), firm i 's variable profits at an interior Cournot equilibrium are

$$\mu \left(\frac{1 - Nc_i + c_{-i}}{1 + N} \right)^2,$$

where N is the number of firms and c_i , c_{-i} are (respectively) i 's marginal cost and the sum of i 's rivals' marginal costs. The $(\cdot)^2$ term therefore represents variable profits *per head*. We will use the following notations for a firm's variable profits per head: $R^M(c_i)$ if i is a monopolist; $R^D(c_i, c_{-i})$ if i is a duopolist; and $R^T(c_i, c_{-i})$ if i is a triopolist. Given that $c_T > c_M$, we require $c_T + t \leq (1 + 2c_M)/3$ for *all* possible Cournot equilibria to be interior.¹⁸

Some of the equilibrium properties of our model are derived analytically; however, due to its mathematical intractability, we solve for the perfect equilibrium numerically for three sets of marginal cost parameters (all consistent with interior Cournot equilibria). These are:

$$c_M = 0.2, \quad c_T = 0.25, \quad t = 0.05 \tag{S1}$$

¹⁷ It is quite common in the R&D literature (e.g., d'Aspremont and Jacquemin, 1988) to leave the spillover mechanism as a "black box." Moreover, the simplicity of our spillover mechanism implies (ceteris paribus) a simple overall game structure relative to the case where the spillover mechanism is explicitly modelled (e.g., Fosfuri *et al.*, 2001). In turn, this allows us to extend the game structure in other directions while retaining tractability. For example, Fosfuri *et al.* (2001) restrict their attention to market equilibria in a single host country for greenfield-FDI. By contrast, our model comprises two host countries for FDI and two types of FDI.

¹⁸ The RHS is the equilibrium price in a Cournot duopoly where both firms have marginal costs of c_M . This condition ensures that E will export to the foreign country in the "most competitive" case where M and T both have plants there *and* T benefits from spillovers.

$$c_M = 0.2, \quad c_T = 0.3, \quad t = 0.05 \quad (\text{S2})$$

$$c_M = 0.2, \quad c_T = 0.25, \quad t = 0.1 \quad (\text{S3})$$

S1 is the benchmark case. S2 represents a widening of the productivity gap between M and T .¹⁹ Relative to S1, S3 represents a doubling of trade costs.

3 Analysis

3.1 The Potential Entrant's Decision

We begin with E 's entry decision in stage 3. We write E 's expected variable profits per head as $\pi_E(\cdot)$, where the arguments in (\cdot) are the firms' location choices (written in the order that they are taken – M then T then E). It is straightforward to show that²⁰

$$\begin{aligned} \pi_E(A, G) &= R^D(c_T, c_M) + R^D(c_T + t, c_M) \\ \pi_E(X, X, G) &= R^T(c_T, c_M + c_T + t) + R^T(c_T + t, c_M + c_T + t) \\ \pi_E(X, G, G) &= \pi_E(G, X, G) = \theta [R^T(c_T, 2c_M + t) + R^T(c_T + t, 2c_M)] \\ &\quad + (1 - \theta) [R^T(c_T, c_M + c_T + t) + R^T(c_T + t, c_M + c_T)] \\ \pi_E(G, G, G) &= \left\{ 1 - (1 - \theta)^2 \right\} [R^T(c_T, 2c_M) + R^T(c_T + t, 2c_M)] \\ &\quad + (1 - \theta)^2 [R^T(c_T, c_M + c_T) + R^T(c_T + t, c_M + c_T)] \end{aligned}$$

In response to A , (X, X) and (G, G) , E is indifferent between the two locations. However, in the (X, X) case, firms M and T are *not* indifferent about E 's location; for simplicity, we assume that, when indifferent, E picks country 1 to locate near M 's initial plant.²¹ In response to both (X, G) and (G, X) , E strictly prefers locating its single plant in the country containing only one plant (i.e., country 2 for (X, G) and country 1 for (G, X)), earning the same expected profits in both cases.²²

[INSERT FIGURE 2 HERE]

¹⁹ If firms' production functions exhibit constant returns to scale and take the form $AF(K, L)$, where A measures TFP and $F(\cdot)$ is common, then M has 25% higher TFP than T in S1 and 50% higher TFP in S2.

²⁰ By convention, E 's profits on *local* sales are written before its profits on *exports*. E 's total expected profits are $\mu\pi_E(\cdot, G) - F$.

²¹ Perhaps E hopes to receive spillovers from M at some indefinite future time. Alternatively, country 1 may be infinitesimally cheaper than 2 for E .

²² In response to both (X, G) and (G, X) , it is straightforward to show that E 's variable profits if it chooses the one-plant country are larger in both the "spillover" and "no spillover" states than if it locates in the two-plant country.

Figure 2 shows, in $(\theta, F/\mu)$ -space, the prior choices by firms M and T that will provoke subsequent entry by E .²³ Entry is “more likely” to occur when the incumbents monopolize the industry via acquisition-FDI than in any of the “duopoly” cases where M and T remain independent and choose between X and G . This is intuitive: post-entry, E would rather be a duopolist than a triopolist. Furthermore, within the “duopoly” cases where M and T remain independent, E is “less likely” to enter the industry, the more plants the incumbents establish via greenfield-FDI. This is because a choice by either incumbent of G over X lowers the general level of marginal costs in the industry (i.e., intensifies “competition”): the investing firm’s marginal cost of serving the foreign market falls by t , and the probability that T receives a spillover rises.

The comparative statics in Fig. 2 are intuitive: increases in F/μ and θ both make entry “less likely” (i.e. entry occurs in response to fewer pairs of prior choices). A rise in θ cuts the likelihood of entry because it raises the probability that T obtains a low marginal cost via spillovers. Rises in both c_T and t shift the inter-regional boundaries downwards because E ’s marginal costs rise.

3.2 Equilibrium Industrial Structures

In stage 2 T , if it remains an independent firm, chooses between X and G . Assume that M has previously chosen X and that $F/\mu > \pi_E(X, X, G)$ so that, for both choices by T , E chooses \emptyset (see Fig. 2). T ’s expected variable profits per head are

$$\begin{aligned}\pi_T(X, X, \emptyset) &= R^D(c_T, c_M + t) + R^D(c_T + t, c_M) \\ \pi_T(X, G, \emptyset) &= \theta [R^D(c_M, c_M + t) + R^D(c_M, c_M)] \\ &\quad + (1 - \theta) [R^D(c_T, c_M + t) + R^D(c_T, c_M)]\end{aligned}$$

and T optimally undertakes greenfield-FDI if and only if

$$\pi_T(X, G, \emptyset) - \pi_T(X, X, \emptyset) > \frac{F}{\mu}.$$

The L.H.S. term $\pi_T(X, G, \emptyset) - \pi_T(X, X, \emptyset)$ measures T ’s “incentive” to undertake greenfield-FDI. It is straightforward to verify that increases in t and θ both increase $\pi_T(X, G, \emptyset) - \pi_T(X, X, \emptyset)$. The former effect is due to a strengthened “tariff-jumping” motive for greenfield-FDI as trade costs rise (Motta, 1992),²⁴ and the latter reflects a strengthened “technology-

²³ Fig. 2 holds under the marginal cost parameters in S1, S2 and S3. It is straightforward to write down conditions on the marginal cost parameters to ensure the existence of Fig. 2 as drawn. It turns out that the representation in Fig. 2 is quite general.

²⁴ Note that, for all $\theta > 0$, $\pi_T(X, G, \emptyset) - \pi_T(X, X, \emptyset) > 0$ even at $t = 0$ because “technology sourcing” continues to motivate greenfield-FDI when trade is costless.

sourcing” motive for greenfield-FDI as spillovers become more likely. The effect of changing the productivity gap on T ’s greenfield-FDI incentive is more complex: increasing c_T makes greenfield-FDI less profitable for T if θ is small but more profitable if θ is large. These properties of T ’s greenfield-FDI incentive hold generally in our model.²⁵ T ’s expected profits under other pairs of choices by M and E are defined in the Appendix.

Turning to M ’s stage-one decision, we first consider the choice between X and G . Assume that T and E will play X and \emptyset respectively in response to either choice by M .²⁶ M ’s expected variable profits per head are

$$\begin{aligned}\pi_M(X, X, \emptyset) &= R^D(c_M, c_T + t) + R^D(c_M + t, c_T) \\ \pi_M(G, X, \emptyset) &= \theta [R^D(c_M, c_M + t) + R^D(c_M, c_M)] \\ &\quad + (1 - \theta) [R^D(c_M, c_T + t) + R^D(c_M, c_T)]\end{aligned}$$

and M optimally chooses G if and only if

$$\pi_M(G, X, \emptyset) - \pi_M(X, X, \emptyset) > \frac{F}{\mu}.$$

As with T , M ’s greenfield-FDI incentive is increasing in t . However, in contrast to T , M ’s greenfield-FDI incentive *weakens* if θ rises because the saving in trade costs from greenfield-FDI must be offset against a greater likelihood that M ’s technological lead will be dissipated via spillovers in the host country. Also in contrast to T , widening the productivity gap (i.e., cutting c_M) strengthens M ’s greenfield-FDI incentive if θ is small but weakens it if θ is large. M ’s expected profits under other pairs of choices by T and E are defined in the Appendix.

M ’s expected variable profits per head following acquisition-FDI are

$$\begin{aligned}\pi_M(A; \emptyset) &= 2R^M(c_M) \\ \pi_M(A, G) &= R^D(c_M, c_T) + R^D(c_M, c_T + t)\end{aligned}$$

Assume that E optimally chooses \emptyset following A and that the perfect equilibrium if A is ruled out is (X, X, \emptyset) .²⁷ Therefore, the smallest takeover price T will accept is

²⁵ For given choices by E , T ’s greenfield-FDI incentive weakens if M switches from X to G because T no longer *needs* to undertake greenfield-FDI to receive a spillover (although doing so increases T ’s probability of receiving a spillover from θ to $1 - (1 - \theta)^2 = \theta(2 - \theta)$). Given that E ’s optimal choice may depend on T ’s decision, T ’s greenfield-FDI incentive is strongest when greenfield-FDI deters entry that would occur under exporting and weakest when entry must always be accommodated (the case of blockaded entry is intermediate).

²⁶ This requires $F/\mu > \max\{\pi_E(X, X, G), \pi_T(X, G, \emptyset) - \pi_T(X, X, \emptyset)\}$. $F/\mu > \pi_E(X, X, G)$ ensures that E chooses \emptyset in response to (X, X) and therefore also in response to (G, X) . $F/\mu > \pi_T(X, G, \emptyset) - \pi_T(X, X, \emptyset)$ ensures that T chooses X in response to X when entry is blockaded; it follows that T will also choose X in response to G because $\pi_T(X, G, \emptyset) - \pi_T(X, X, \emptyset) > \pi_T(G, G, \emptyset) - \pi_T(G, X, \emptyset)$ (see previous footnote).

²⁷ $F/\mu > \pi_E(A, G)$ ensures blockaded entry. In addition, this scenario requires $F/\mu > \pi_T(X, G, \emptyset) - \pi_T(X, X, \emptyset)$ and $F/\mu > \pi_M(G, X, \emptyset) - \pi_M(X, X, \emptyset)$.

$\mu\pi_T(X, X, \emptyset)$, and acquisition-FDI occurs in equilibrium if and only if $\pi_M(A, \emptyset) - \pi_T(X, X, \emptyset) > \pi_M(X, X, \emptyset)$, which will always hold because acquisition-FDI results in both monopolization and cost reduction (i.e., savings in trade costs and elimination of the c_T technology from production). Moreover, the surplus from acquisition-FDI (defined as L.H.S. minus R.H.S. in the previous inequality), which is entirely captured by M , is increasing in the productivity gap because industry profits in (X, X, \emptyset) fall when c_T rises but $\pi_M(A, \emptyset)$ is independent of c_T .

Figures 3, 4 and 5 below plot the game's perfect equilibria for the parameter values in S1, S2 and S3 respectively.²⁸

[INSERT FIGURES 3, 4 AND 5 HERE]

All three Figures are divided into four regions by solid lines. In the bottom region, the perfect equilibrium is (G, G, G) : both incumbents undertake greenfield-FDI and entry occurs. Acquisition-FDI occurs in two distinct regions, a lower one where it is accompanied by entry and a higher one where it is not. Between these two acquisition-FDI regions lies an area where, in equilibrium, the incumbents choose either greenfield-FDI or exporting and no entry occurs. Therefore, our first observation is that the equilibrium occurrence of acquisition-FDI is non-monotonic in the per-capita fixed cost of additional plants. If we exclude the lowest (G, G, G) equilibrium region (i.e., consider sufficiently large F/μ), we find that the equilibrium occurrence of acquisition-FDI is U-shaped in F/μ .

The intuition behind this non-monotonicity result is straightforward. Entry is more profitable following acquisition-FDI when there is just one incumbent firm (and entry generates a duopoly) than when there are two incumbents (and entry generates a triopoly). This observation translates into Figs. 3-5 as follows. In the (G, G, G) and (A, G) regions, entry occurs *both* following acquisition-FDI *and* at the “threat point.”²⁹ The existence of the (A, G) region reflects a substitution of acquisition-FDI for greenfield-FDI at the threat point as F/μ rises. In the (A, \emptyset) region, entry is blockaded, so acquisition-FDI, which leads to monopolization and cost reduction,³⁰ is profitable. Between the (A, G) and (A, \emptyset) regions,

²⁸ In each simulation we considered a 55-cell grid in $(\theta, F/\mu)$ -space: θ ranged from 0 to 1 in steps of 0.25, and F/μ ($\times 100$) ranged from 0 to 10 in steps of 1. Further numerical experimentation has shown our qualitative results to be quite robust to changes in the marginal cost parameters.

²⁹ By “threat point” we mean the game's perfect equilibrium when M 's strategy space is restricted to $\{X, G\}$ – i.e., the alternative to acquisition-FDI. A full description of the game's threat points in S1, S2 and S3 is available from the author on request.

³⁰ Following acquisition-FDI, all units are produced at c_M and no international trade occurs.

entry occurs following acquisition-FDI but not at the threat point. Because acquisition-FDI provokes entry, which reduces the integrated firm's profits, the incumbents' joint profits are higher at the threat point, and acquisition-FDI does not occur in equilibrium.

Changing θ , the probability of spillovers, has two comparative-statics effects. First, it may imply a movement across a solid inter-regional boundary: as θ rises, the (A, G) region gets squeezed from both above and below.³¹ This occurs because the general level of industry marginal costs at the threat point is falling in θ , which cuts the profitability of acquisition-FDI where costs and profits are independent of θ .³² Second, where the incumbents choose between X and G in equilibrium, a rise in θ makes M "less likely" to undertake greenfield-FDI but T "more likely."³³ This follows from the link between greenfield-FDI and localized spillovers, which M wants to avoid but T wants to encourage.

Comparing Fig. 3 to Figs. 4 and 5, we can see that increasing c_T and t tends to shift the solid inter-regional boundaries downwards. This occurs because both changes cut the profitability of entry. Increasing c_T also makes T "more likely" to undertake technology-sourcing greenfield-FDI in the region where both incumbents choose between X and G and no entry occurs.³⁴ Finally, comparing Fig. 5 to Fig. 3 shows that both incumbents are "more likely" to choose greenfield-FDI over exporting when the trade cost rises.

Our analysis of equilibrium industrial structures has generated several testable hypotheses on the relationships between FDI flows and structural parameters. Four of these are brought together in the following Proposition.

Proposition. Comparative-statics predictions on equilibrium FDI flows:

- (i) Both types of FDI flow are non-monotonic in the degree of economies of scale (F/μ).
For sufficiently large scale economies, acquisition-FDI (greenfield-FDI) flows are U- (hump-) shaped in the degree of economies of scale.
- (ii) A rise in the magnitude of spillovers (θ) makes technological leaders (laggards) less (more) likely to choose greenfield-FDI over exporting.

³¹ The bottom of the (A, \emptyset) region is horizontal because E cannot absorb spillovers so $\pi_E(A, G)$ is independent of θ .

³² When M and T are co-located at the threat point, a rise in θ harms M but benefits T by more.

³³ In Figs. 3-5, there are two cases where a rise in θ causes M to switch from G to X between cells and one case of a switch in the opposite direction. There are three cases where moving rightwards prompts T to switch from X to G and only one in the opposite direction.

³⁴ In that region, T chooses G in 13 cells in Fig. 4 but only 4 cells in Fig. 3. M chooses G in 2 cells in both Figs. but, as we showed above, its greenfield-FDI incentive is weaker (for sufficiently large θ) in Fig. 4.

- (iii) For sufficiently large localized inter-firm spillovers, a widening of the technological gap between firms of different nationalities ($c_T - c_M$) makes technological leaders (laggards) less (more) likely to choose greenfield-FDI over exporting. (If spillovers are weak, the converse effects will be observed.)
- iv A rise in the trade cost (t) makes all firms more likely to choose greenfield-FDI over exporting.

4 Discussion

By way of conclusion, we compare the relationships between national productivity distributions and FDI flows in our model to those highlighted by Dunning’s (1977) OLI (ownership-location-internalisation) framework. OLI argues that a necessary condition for undertaking FDI is that the potential MNE possess a (proprietary) “ownership advantage” relative to local rivals in the host country (e.g., a highly productive technology). This is needed to offset the increased costs of co-ordinating business activities across international borders.³⁵

It follows that the observed productivity advantages of foreign-owned MNEs are *embodied* in their FDI inflows: either a highly productive new plant is established via greenfield-FDI, or the technology in a pre-existing plant is upgraded following acquisition-FDI (intra-firm technology transfer).

In our model, in contrast, the possession of firm-specific ownership advantages is evidently *unnecessary* for greenfield-FDI. Although firm M , the technological leader, can be observed undertaking greenfield-FDI in equilibrium, so can firm T , the laggard. Ownership advantages are unnecessary for greenfield-FDI in our model because the scale of potential entry is limited (and we respect the integer constraint on the number of firms), so even laggardly firms can earn supernormal profits in equilibrium. Moreover, in direct contrast to OLI, the presence of (sufficiently strong) localized spillovers means that an *increase* in M ’s technological lead *reduces* its incentive for technology-dissipating greenfield-FDI but *strengthens* T ’s incentive for technology-sourcing greenfield-FDI.³⁶

³⁵ Markusen (1995) describes the OLI framework. OLI’s conclusions are consistent with an assumption of monopolistic competition (although such an assumption is not explicitly stated). If the representative local firm earns only normal profits in long-run equilibrium (due to free entry) and foreign MNEs face higher costs than local firms, then an ownership advantage is *necessary* to make FDI break even. (For FDI to occur, OLI also requires “location” and “internalisation” advantages, neither of which are relevant to our analysis.) Therefore, our model can be viewed as examining whether OLI-type insights generalize to a Cournot oligopoly with limited potential entry.

³⁶ The fact that, in the presence of sufficiently strong localized spillovers, an increase in a firm’s technological lead decreases its greenfield-FDI incentive might help explain why foreign-to-domestic horizontal spillovers

The OLI paradigm draws no sharp distinction between greenfield- and acquisition-FDI.³⁷ However, we found that the two forms of FDI are associated with different equilibrium industrial structures. Through its effect on concentration and therefore E 's entry incentives, the greenfield/acquisition choice exerts an important influence on equilibria. Furthermore, although we set the model up by *assuming* that M is the purchaser, this assumption is not necessary to support our perfect equilibria (Figs. 3-5). We could relabel the model with firm T , the low-productivity incumbent, as the potential acquirer without altering its equilibrium predictions.³⁸ Therefore, short of assuming a purchaser, the international direction of acquisition-FDI flow in equilibrium in our model is indeterminate. It follows that whenever incentives for “technology-embodied” acquisition-FDI exist (leader buys laggard), so do those for “cherry-picking” acquisition-FDI (laggard buys leader), and the view that foreign MNEs' productivity advantages are *necessarily* embodied in their FDI inflows is without theoretical support from our model.³⁹

This paper has examined the relationships between FDI flows and national productivity distributions in an international oligopoly. We have generated a number of testable hypotheses on the relationships between FDI flows and structural parameters (e.g., the non-monotonicity of acquisition-FDI flows in F/μ , which could be interpreted empirically as scale economies). We have also questioned the applicability of some of the insights of the OLI framework to an explicitly oligopolistic market structure with limited potential entry. Our model could be extended in several directions. In particular, the magnitude of θ , the probability of spillovers, could be determined endogenously by firms' actions. A technological leader would want to minimize θ (e.g., by adopting hard-to-copy technologies, retaining trained workers with wage premia, and lobbying for tough patent protection), but a laggard would want to maximize it. Investigating this and other issues will form the basis of future work.

have proved rather difficult to locate in the data (Görg and Greenaway, 2004). Perhaps the fear of spillovers deters inward greenfield-FDI by foreign technological leaders, which lowers the volume of realised spillovers.

³⁷ We speculate that under monopolistic competition, where the long-run number of plants is tied down by free entry, the greenfield/acquisition distinction is probably less interesting than in our context (see footnote 35).

³⁸ This relabelling is possible because the acquisition decision rule is co-operative (i.e., the decision depends only on the sum of threat-point profits) and the integrated firm's marginal cost is independent of the purchaser's identity. Of course, such a relabelling would have to preserve M 's ability to move before T if no acquisition occurred.

³⁹ The equivalence in incentives for the two types of acquisition-FDI might help explain why empirical results for the UK are very mixed on whether acquired firms are TFP laggards (Conyon *et al.*, 2002) or leaders (Harris and Robinson, 2002).

5 Appendix

5.1 T 's expected variable profits per head

$$\begin{aligned}
\pi_T(X, X, G) &= R^T(c_T, c_M + c_T + 2t) + R^T(c_T + t, c_M + c_T) \\
\pi_T(X, G, G) &= 2\theta R^T(c_M, c_M + c_T + t) + 2(1 - \theta) R^T(c_T, c_M + c_T + t) \\
\pi_T(G, X, \emptyset) &= \theta [R^D(c_M, c_M) + R^D(c_M + t, c_M)] \\
&\quad + (1 - \theta) [R^D(c_T, c_M) + R^D(c_T + t, c_M)] \\
\pi_T(G, X, G) &= \theta [R^T(c_M, c_M + c_T + t) + R^T(c_M + t, c_M + c_T)] \\
&\quad + (1 - \theta) [R^T(c_T, c_M + c_T + t) + R^T(c_T + t, c_M + c_T)] \\
\pi_T(G, G, \emptyset) &= 2 \left\{ 1 - (1 - \theta)^2 \right\} R^D(c_M, c_M) + 2(1 - \theta)^2 R^D(c_T, c_M) \\
\pi_T(G, G, G) &= \left\{ 1 - (1 - \theta)^2 \right\} [R^T(c_M, c_M + c_T + t) + R^T(c_M, c_M + c_T)] \\
&\quad + (1 - \theta)^2 [R^T(c_T, c_M + c_T + t) + R^T(c_T, c_M + c_T)]
\end{aligned}$$

5.2 M 's expected variable profits per head

$$\begin{aligned}
\pi_M(X, X, G) &= R^T(c_M, 2c_T + t) + R^T(c_M + t, 2c_T + t) \\
\pi_M(X, G, \emptyset) &= \theta [R^D(c_M, c_M) + R^D(c_M + t, c_M)] \\
&\quad + (1 - \theta) [R^D(c_M, c_T) + R^D(c_M + t, c_T)] \\
\pi_M(X, G, G) &= \theta [R^T(c_M, c_M + c_T + t) + R^T(c_M + t, c_M + c_T)] \\
&\quad + (1 - \theta) [R^T(c_M, 2c_T + t) + R^T(c_M + t, 2c_T)] \\
\pi_M(G, X, G) &= 2\theta R^T(c_M, c_M + c_T + t) + 2(1 - \theta) R^T(c_T, 2c_T + t) \\
\pi_M(G, G, \emptyset) &= 2 \left\{ 1 - (1 - \theta)^2 \right\} R^D(c_M, c_M) + 2(1 - \theta)^2 R^D(c_M, c_T) \\
\pi_M(G, G, G) &= \left\{ 1 - (1 - \theta)^2 \right\} [R^T(c_M, c_M + c_T) + R^T(c_M, c_M + c_T + t)] \\
&\quad + (1 - \theta)^2 [R^T(c_M, 2c_T) + R^T(c_M, 2c_T + t)]
\end{aligned}$$

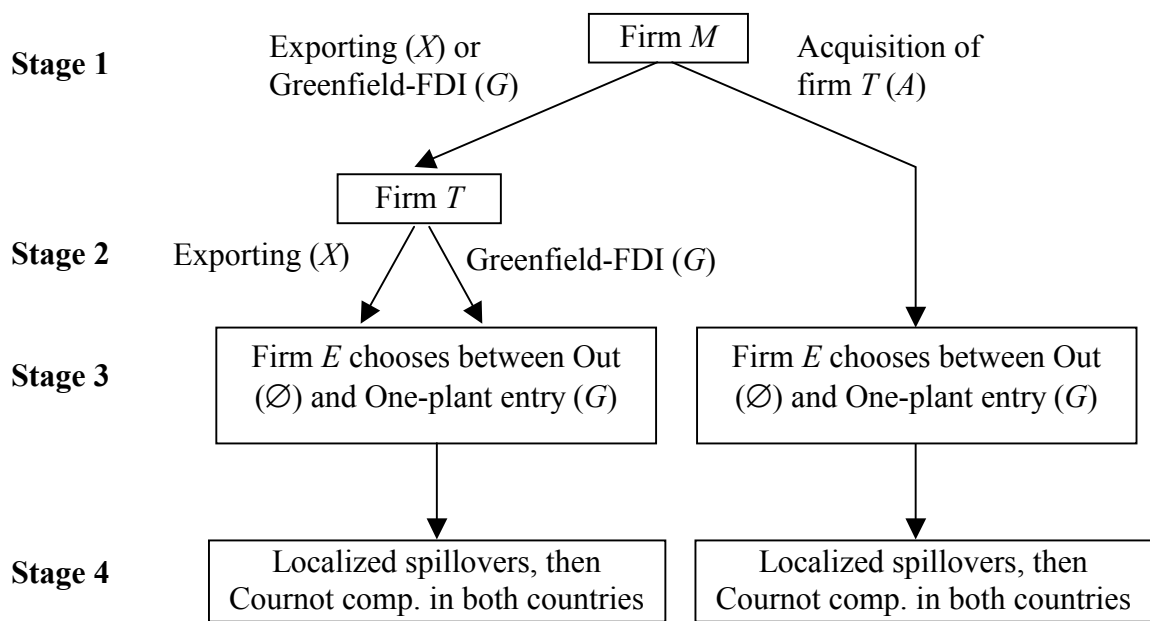
References

- d'Aspremont, C., and Jacquemin, A. (1988), "Cooperative and noncooperative R&D in duopoly with spillovers", *American Economic Review*, 78, pp. 1133-7.
- Blomström, M., and Kokko, A. (1998), "Multinational corporations and spillovers", *Journal of Economic Surveys*, 12(2), pp. 1-31.
- Conyon, M. J., Girma, S., Thompson, S., and Wright, P. W. (2002), "The productivity and wage effects of foreign acquisition in the United Kingdom", *Journal of Industrial Economics*, 50(1), 85-102.

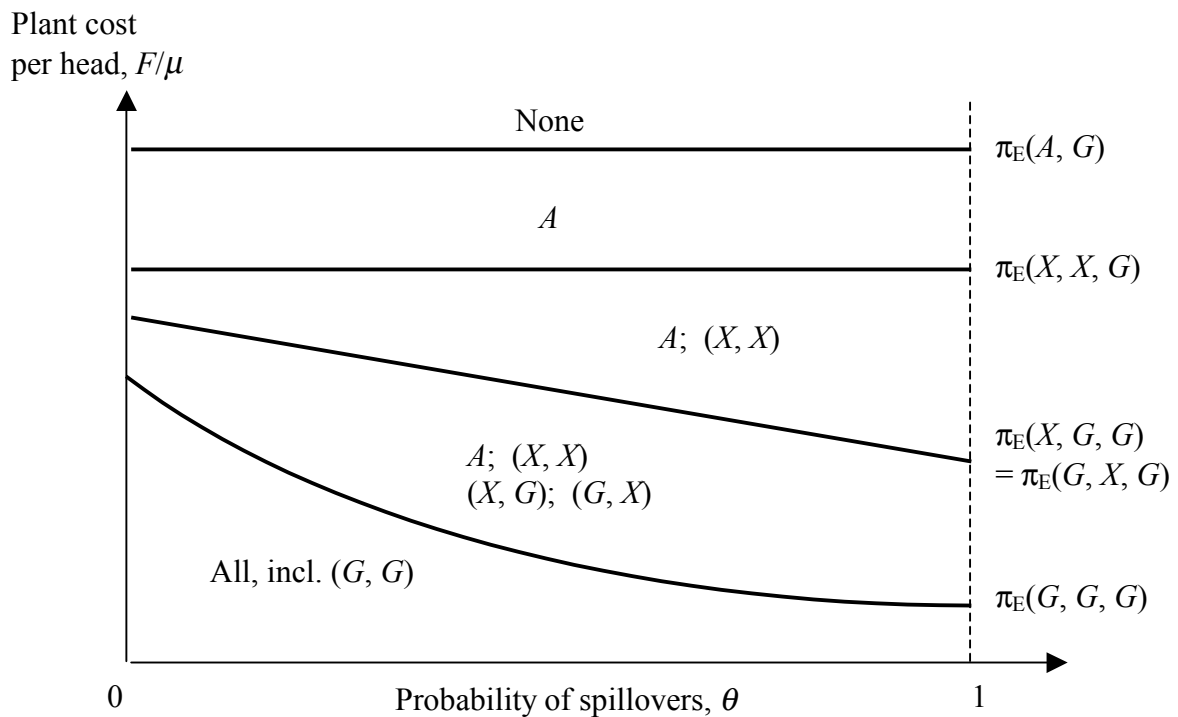
- Criscuolo, C., and Martin, R. (2005), “Multinationals and US productivity leadership: evidence from Great Britain”, AIM Working Paper, London.
- Davies, S. W., and Lyons, B. R. (1991), “Characterising relative performance: the productivity advantage of foreign owned firms in the UK”, *Oxford Economic Papers*, 43, pp. 584-95.
- Doms, M. E., and Jensen, J. B. (1998), “Comparing wages, skills, and productivity between domestically and foreign-owned manufacturing establishments in the United States”, in R. E. Baldwin, R. E. Lipsey, and J. D. Richardson, eds., *Geography and Ownership as Bases for Economic Accounting*, NBER Studies in Income and Wealth, Chicago and London: University of Chicago Press.
- Driffield, N., and Love, J. H. (2003), “Foreign direct investment, technology sourcing and reverse spillovers”, *Manchester School*, 71(6), pp. 659-72.
- Dunning, J. (1977), “Trade, location of economic activity and the MNE: a search for an eclectic approach”, in B. Ohlin, P. Hesselborn, and P. Wijkman, eds., *The International Allocation of Economic Activity: Proceedings of a Nobel Symposium held at Stockholm*, Macmillan.
- Fors, G. (1997), “Utilization of R&D results in the home and foreign plants of multinationals”, *Journal of Industrial Economics*, 45(2), pp. 341-55.
- Fosfuri, A., and Motta, M. (1999), “Multinationals without advantages”, *Scandinavian Journal of Economics*, 101, pp. 617-630.
- Fosfuri, A., Motta, M., and Rønde, T. (2001), “Foreign direct investment and spillovers through workers’ mobility”, *Journal of International Economics*, 53, pp. 205-22.
- Girma, S., Greenaway, D., Wakelin, K., and Sousa, N. (2001), “Host country effects of FDI in the UK: recent evidence from firm data”, in N. Pain, ed., *Inward Investment, Technological Change and Growth: The Impact of Multinational Corporations on the UK Economy*, London: Palgrave.
- Globerman, S., Ries, J. C., and Vertinsky, I. (1994), “The economic performance of foreign affiliates in Canada”, *Canadian Journal of Economics*, 27, pp. 143-56.
- Görg, H., and Greenaway, D. (2004), “Much ado about nothing? Do domestic firms really benefit from foreign direct investment?”, *World Bank Research Observer*, 19(2), pp. 171-97.
- Griffith, R. (1999), “Using the ARD establishment level data to look at foreign ownership and productivity in the United Kingdom”, *Economic Journal*, 109, pp. F416-42.
- Griffith, R., and Simpson, H. (2004), “Characteristics of foreign-owned firms in British manufacturing”, in D. Card, R. Blundell, and R. B. Freeman, eds., *Seeking a Premier Economy: The Economic Effects of British Economic Reforms, 1980-2000*, University of Chicago Press.
- Griffith, R., Redding, S., and Simpson, H. (2004), “Foreign ownership and productivity: new evidence from the service sector and the R&D lab”, IFS Working Paper No. 04/22, Institute for Fiscal Studies: London.

- Harris, R., and Robinson, C. (2002), "The effect of foreign acquisitions on total factor productivity: plant-level evidence from UK manufacturing, 1987-1992", *Review of Economics and Statistics*, 84(3), pp. 562-68.
- Harris, R., and Robinson, C. (2003), "Foreign ownership and productivity in the United Kingdom: estimates for UK manufacturing using the ARD", *Review of Industrial Organization*, 22, pp. 207-23.
- Horstmann, I., and Markusen, J. (1992), "Endogenous market structures in international trade (natura facit saltum)", *Journal of International Economics*, 32, pp. 109-129.
- Kogut, B., and Chang, S. J. (1991), "Technological capabilities and Japanese foreign direct investment in the United States", *Review of Economics and Statistics*, 73, pp. 401-13.
- Long, N. V., and Vousden, N. (1995), "The effects of trade liberalisation on cost-reducing horizontal mergers", *Review of International Economics*, 3(2), pp. 141-55.
- Markusen, J. (1995), "The boundaries of multinational enterprises and the theory of international trade", *Journal of Economic Perspectives*, 9, pp. 169-189.
- Mattoo, A., Olarreaga, M., and Saggi, K. (2004), "Mode of foreign entry, technology transfer, and FDI policy", *Journal of Development Economics*, 75, pp. 95-111.
- Motta, M. (1992), "Multinational firms and the tariff-jumping arguments", *European Economic Review*, 36, pp. 1557-71.
- Neven, D., and Siotis, G. (1996), "Technology sourcing and FDI in the EC: an empirical evaluation", *International Journal of Industrial Organization*, 14, pp. 543-60.
- Oulton, N. (2001), "Why do foreign-owned firms in the UK have higher labour productivity?", in N. Pain, ed., *Inward Investment, Technological Change and Growth: The Impact of Multinational Corporations on the UK Economy*, London: Palgrave.
- Petit, M.-L., and Sanna-Randaccio, F. (2000), "Endogenous R&D and foreign direct investment in international oligopolies", *International Journal of Industrial Organization*, 18, pp. 339-67.
- van Pottelsberghe de la Potterie, B., and Lichtenberg, F. (2001), "Does foreign direct investment transfer technology across borders?", *Review of Economics and Statistics*, 83, pp. 490-97.
- Rowthorn, R. (1992), "Intra-industry trade and investment under oligopoly: the role of market size", *Economic Journal*, 102, pp. 402-414.
- Salant, S., Switzer, S., and Reynolds, R. (1983), "Losses due to merger: the effects of an exogenous change in industry structure on Cournot-Nash equilibrium", *Quarterly Journal of Economics*, 98, pp. 185-99.
- Siotis, G. (1999), "Foreign direct investment strategies and firms' capabilities", *Journal of Economics and Management Strategy*, 8(2), pp. 251-70.
- UNCTAD (2000), *World Investment Report 2000: Cross-border Mergers and Acquisitions and Development*, United Nations: New York and Geneva.

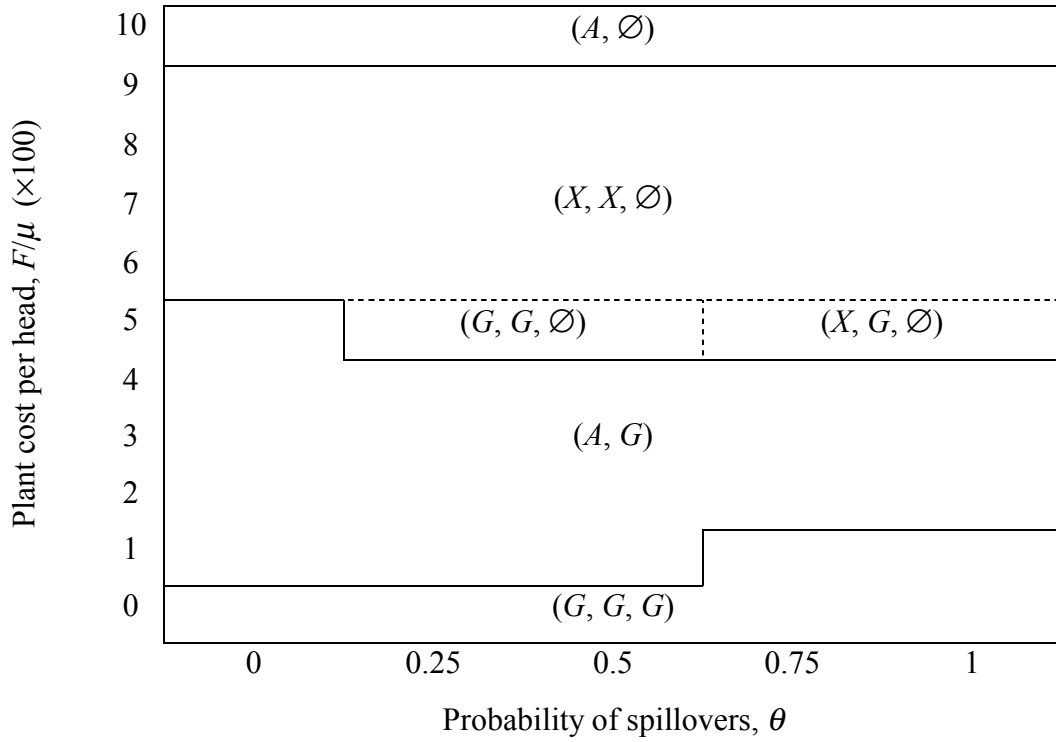
Veugelers, R., and Cassiman, B. (2004), "Foreign subsidiaries as a channel of international technology diffusion: some direct firm level evidence from Belgium", *European Economic Review*, 48, 455-76.



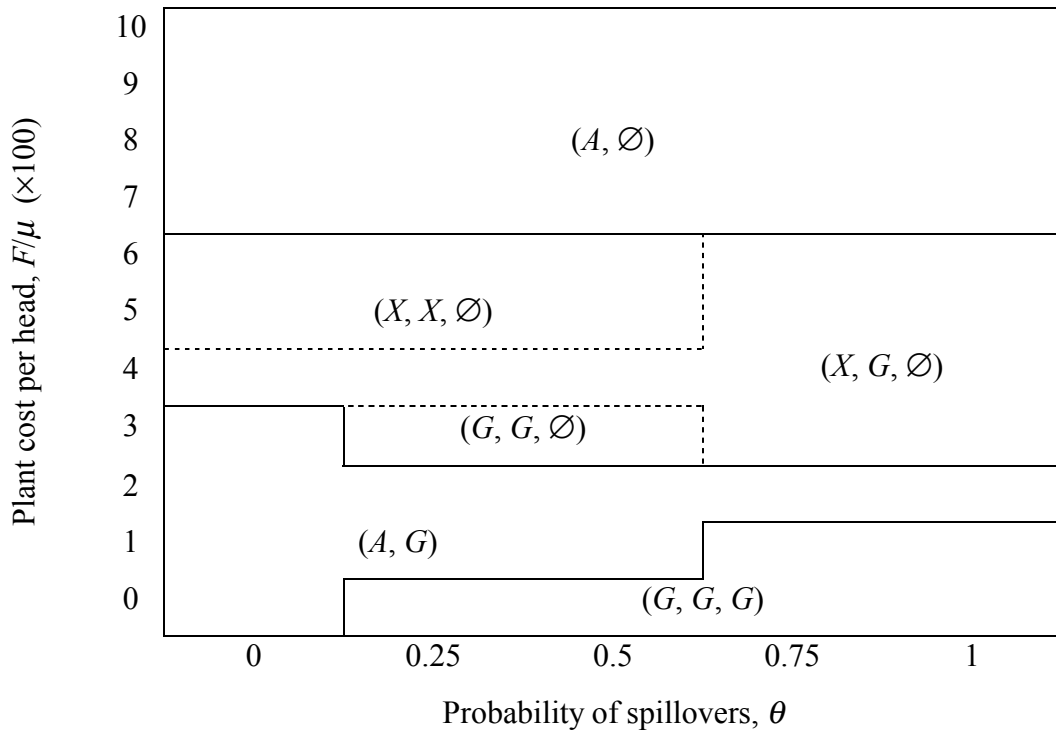
(Above) **Figure 1: Game Tree**



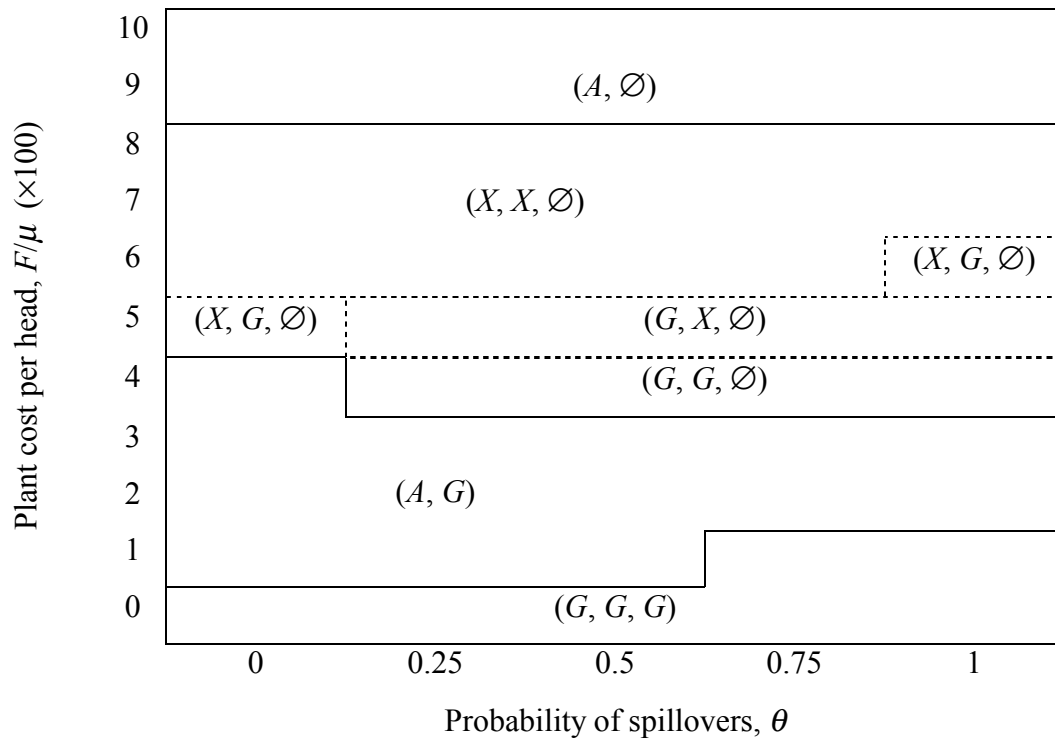
(Above) **Figure 2: Prior Choices by *M* and *T* that Provoke Entry by *E***



(Above) **Figure 3: Equilibria in S1** ($c_M = 0.2$, $c_T = 0.25$, $t = 0.05$)

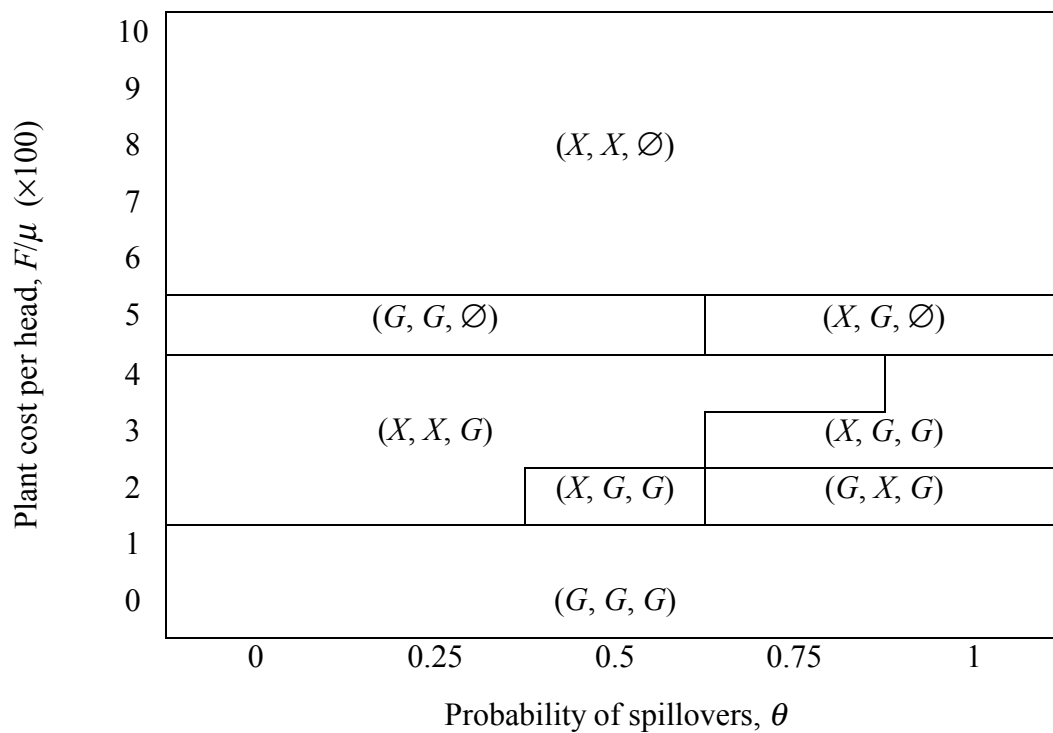


(Above) **Figure 4: Equilibria in S2** ($c_M = 0.2$, $c_T = 0.3$, $t = 0.05$)

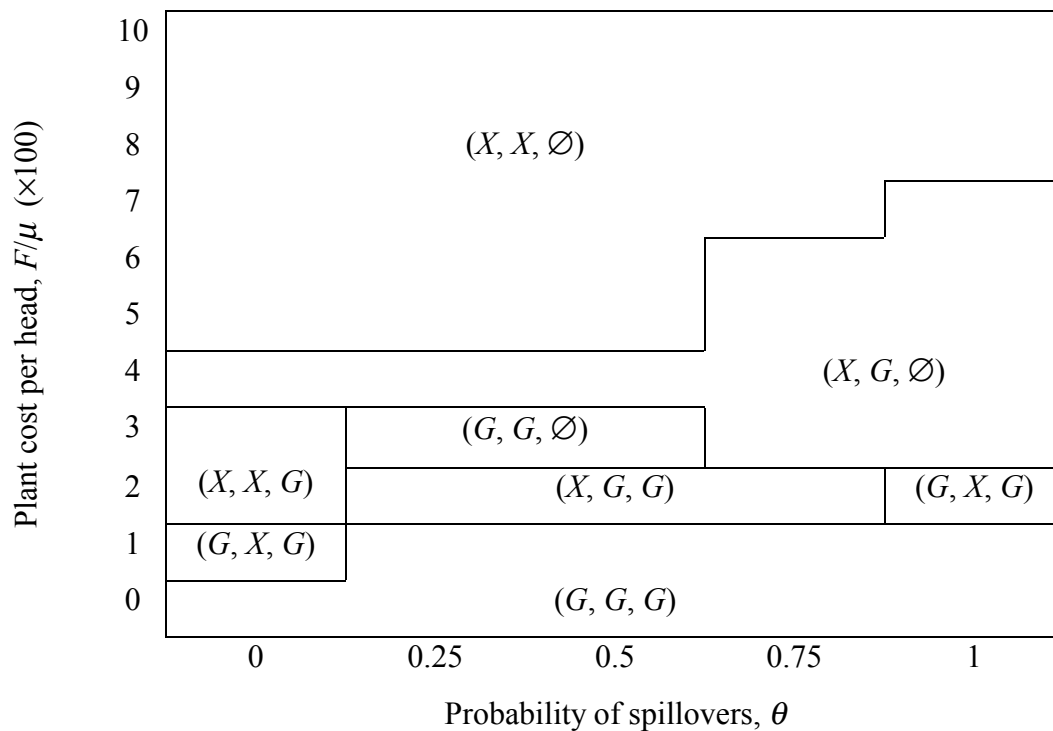


(Above) **Figure 5: Equilibria in S3** ($c_M = 0.2$, $c_T = 0.25$, $t = 0.1$)

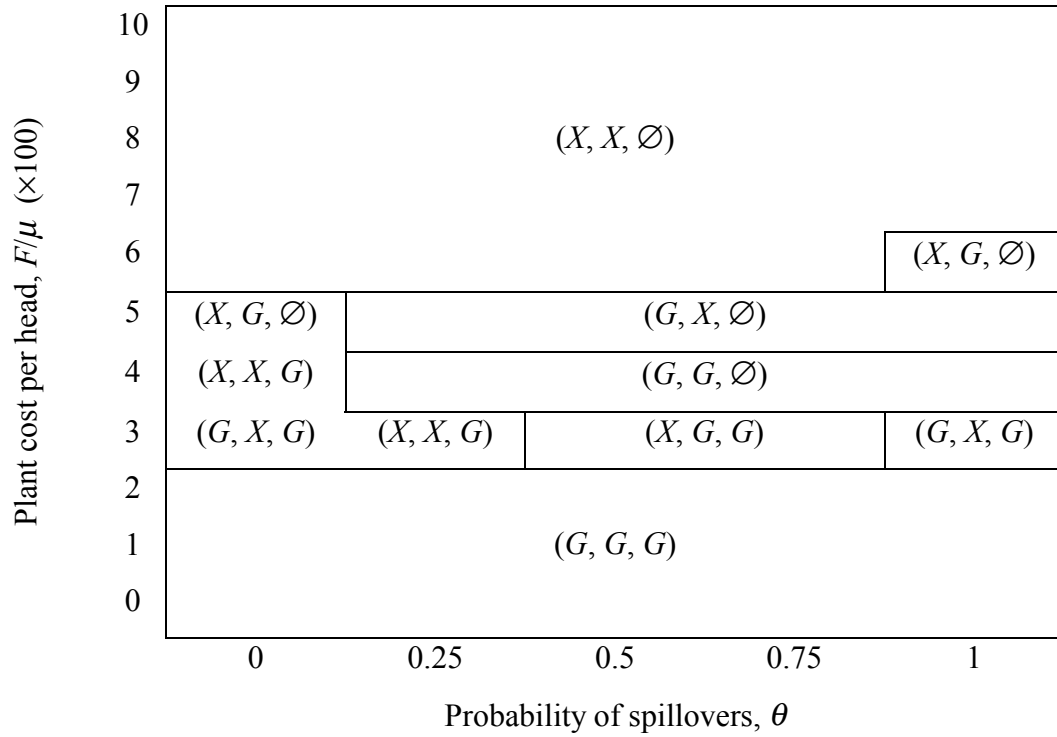
Threat Points in S1, S2 and S3



(Above) **Threat Points in S1** ($c_M = 0.2, c_T = 0.25, t = 0.05$); $\pi_E(A, G) \times 100 = 9.4$



(Above) **Threat Points in S2** ($c_M = 0.2, c_T = 0.3, t = 0.05$); $\pi_E(A, G) \times 100 = 6.8$



(Above) **Threat Points in S3** ($c_M = 0.2$, $c_T = 0.25$, $t = 0.1$); $\pi_E(A, G) \times 100 = 8.2$