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**Foreign Ownership and Productivity: New Evidence from
the Service Sector and the R&D Lab**

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Abstract

This paper examines the relationship between foreign ownership and productivity, paying particular attention to two issues neglected in the existing literature – the role of multinationals in service sectors and the importance of R&D activity conducted by foreign multinationals. We review existing theoretical and empirical work, which largely focuses on manufacturing, before presenting new evidence using establishment-level data on production, service and R&D activity for the United Kingdom. We find that multinationals play an important role in service sectors and that entry of foreign multinationals by takeover is more prevalent than greenfield investment. We find that British multinationals have lower levels of labour productivity than foreign multinationals, but the difference is less stark in the service sector than in the production sector, and that British multinationals have lower levels of investment and intermediate use per employee. We also find that foreign-owned multinationals conduct a substantial amount of UK R&D. We discuss the implications of these and other findings for the policy debate on incentives to influence multinational firms' location choices.

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1 Introduction

Foreign Direct Investment (FDI) has long been seen as a source of growth through spurring competition and facilitating the transfer of new technologies. Much work has investigated the existence and magnitude of these effects. However, to our knowledge, there has been little analysis of the role of foreign firms in service sectors. The first contribution of this paper is to document the importance of multinationals in UK service sectors and to examine their productivity characteristics. Our second main contribution is to consider both inward and outward FDI – that is, the role of both British and foreign-owned multinationals. Our third main contribution is to document, using newly available data, the extent of multinationals' involvement in conducting R&D in the UK. This is important in understanding their role in the creation and diffusion of knowledge.

Services account for an increasing share of GDP in developed countries and an increasing share of foreign investment and trade.¹ A prominent example of FDI into Britain is Walmart in the retail sector. Much of the recent debate about Europe's comparatively poor productivity performance, relative to the United States, has focused on the service sector and, in particular, on wholesale and retail trades. These are industries where the US has experienced a marked acceleration of productivity growth, which has not been seen to the same degree in Europe.² FDI is widely viewed as a potential conduit for knowledge spillovers and hence as a potential route to closing the productivity gap in services as well as manufacturing.

Of course FDI goes two ways - foreign firms invest in Britain, and British firms invest overseas. This is important in understanding whether foreign firms are more productive than their British counterparts. Is high productivity a feature of foreign firms *per se* or a generic feature of multinational firms? It is also important for the debate about knowledge spillovers from multinational firms. While outward investment may be an important conduit for technology transfer from source to host countries, technology sourcing has also

¹ For a recent analysis of deindustrialization in the OECD, see Nickell *et al.* (2004). See Griffith, Harrison, Haskel and Sako (2003) for an analysis of the importance of service sectors in the UK's productivity and technology performance.

² See, for example, the discussion in van Ark *et al.* (2003).

been seen as an increasingly important motivation for FDI.³ For each of these reasons, we are interested in documenting the importance of both British and foreign-owned multinationals in economic activity.

Many studies in the existing empirical literature on spillovers from inward FDI have measured foreign presence in an industry by the share of foreign firms in employment or the total number of firms. However, few have looked at the extent to which foreign firms undertake R&D activity within a host country. This is a primary indicator of technology and might have an important bearing on the extent of knowledge spillovers. We present evidence on the intensity of multinationals' R&D activity in Britain. While such activity undertaken by foreign multinationals might be motivated by technology sourcing, or be devoted to adapting products to local markets, it may also be a source of spillovers to domestic-owned establishments.

This paper provides a first analysis of these issues using newly available rich micro data. The structure of this paper is as follows. Section 2 documents the importance of both British and foreign multinational firms across production and service sectors. Multinationals account for a larger share of employment in the production sector, but they are important in some service sectors. We then look at how foreign multinationals enter the UK, and find that takeovers are a more frequent mode of entry than greenfield investment. Section 3 considers the characteristics of multinationals located in the UK. We start by reviewing the literature on multinational firms, focusing in particular on the question of whether foreign firms are more productive than their domestic-owned counterparts and the reasons for any differences in productivity. We then examine the characteristics of domestic firms and multinationals and show that there are differences not only in terms of

³ Serapio and Dalton (1999) argue that much of the globalisation of innovative activity has involved foreign firms locating R&D activities in the USA in order to benefit from technology sourcing at the leading edge of technological innovation: "Foreign parent companies, particularly in the drugs/biotechnology and electronics industries, have established or acquired foreign R&D laboratories in the US in order to gain access to science and technology, and enhance their global capabilities for technology development and innovation." They document the fact that UK firms are a particularly significant part of this development, with the third highest R&D expenditures in the USA in 1996 of all foreign countries. von Zedtwitz and Gassmann (2002) identify four archetypes of R&D internationalisation based on whether research, development or both are internationally dispersed. They find that motivations for internationalising research are largely driven by the desire to access new technologies, while motivations for internationalising development are usually associated with adapting existing products and/or concepts.

labour productivity but also in terms of other characteristics such as levels of investment and intermediate input usage per employee. Since takeovers are an important mode of foreign entry, this section also documents the changes in productivity and other characteristics that are concurrent with acquisition. In Section 4, we turn to the question of knowledge spillovers from foreign-owned multinationals. Here, we review the existing theoretical and empirical literature, before presenting some new evidence on R&D activities by foreign-owned multinationals, which is an important potential source of knowledge spillovers. Section 5 concludes and discusses implications for policy.

2 Multinational activity in Britain

2.1 Multinationals in the production and service sectors

So which sectors are multinationals involved in? We begin by using the detailed plant- and establishment-level data available in the British Annual Respondents Database (ARD) to examine the number of workers in each sector that are employed by firms that are (i) only located in Britain, (ii) British-owned multinationals, (iii) foreign-owned multinationals.⁴

Table 1 shows the numbers of workers employed in establishments in each category and industrial sector in Great Britain. It shows that there are differences in the extent of multinational activity across sectors. Production industries have the highest level of multinational involvement, with 38% of workers employed in either British or foreign multinationals. The share of workers employed by multinationals in service sectors is about half that, at 23%. However, some service sectors have substantial shares of employees working for multinationals - for example, in retail 43% of workers are employed in multinationals. The big difference however is that in the production industries there is about equal involvement of British and foreign-owned multinationals, while in retailing it is British-owned multinationals that dominate. Wholesale also has a high level of multinational activity (35% of employment), with about the same share of employment in foreign-owned multinationals as in the production sector.

⁴ See the Appendix for further discussion of the data. The ARD data relate to production activity and exclude non-production functions such as headquarter services.

Table 1: Percentage of employment by ownership type in 2001

	British only	Multinational		Total employment (thousands)
		British-owned	Foreign-owned	
Production	62.2%	18.2%	19.7%	5,302
<i>Mining</i>	46.2%	29.5%	24.3%	94
<i>Manufacturing</i>	55.8%	19.6%	24.6%	3,851
<i>Construction</i>	84.5%	10.9%	4.6%	1,228
<i>Utilities</i>	49.9%	37.8%	12.2%	129
Service sectors	77.3%	14.0%	8.8%	16,328
<i>Catering</i>	76.9%	14.7%	8.4%	1,569
<i>Motor trade</i>	82.9%	6.1%	11.0%	564
<i>Retail trade</i>	57.0%	34.9%	8.2%	2,661
<i>Wholesale</i>	65.1%	13.2%	21.6%	1,154
<i>Property</i>	91.7%	4.8%	3.4%	368
<i>Other services</i>	83.3%	9.2%	7.6%	10,012
Total	73.5%	15.0%	11.5%	21,630

Note: The following sectors are not included in the data: Agriculture, Public administration and defence, and Financial intermediation. The number of production sector establishments is 353,176 (345,088 British owned, 3,207 British-owned MNE, 4,881 Foreign-owned MNE), and the total number of service sector establishments is 1,329,603 (1,309,648 British owned, 6,304 British-owned MNE and 13,651 Foreign-owned MNE).

Source: ONS, authors' calculations using ARD establishment-level population data 2001, and Annual Inquiry into Foreign Direct Investment.

Much of the policy debate about multinationals has focused on the manufacturing sector, for example government subsidies in the form of Regional Selective Assistance grants are predominantly awarded in this sector. However, it is clear from the above that multinationals are prominent in many service sectors, with foreign-owned multinationals particularly evident in the wholesale trade.

2.2 Entry of foreign multinationals

We can see that multinational firms play an important role in the British economy. How they enter is also of interest. Although much of the popular discussion of FDI is in terms of greenfield investment, the most frequent mode of entry by foreign firms is through the

takeover of an existing production facility. Which form entry takes may have implications for the potential for knowledge spillovers. Firms that set up greenfield sites may be more likely to implement state-of-the-art technology. But entry through takeover of an existing plant may also be associated with technology transfer, an issue that is investigated below.

In Table 2 we consider how foreign firms enter the British market, and how this varies across sectors. Firms can either set up a new plant - greenfield entry - or they can take over an existing plant. We separate out takeovers by whether the plant that is taken over was previously British owned and not part of a multinational, part of a British-owned multinational or part of a foreign-owned multinational. The table shows that over the period 1999 to 2001 the most common form of entry for a foreign-multinational was by a takeover of a domestic-owned plant that was not part of a multinational group. This is particularly true for the production sector. While takeover was the predominant form of entry in both sectors, greenfield entry is relatively more important in services.

Table 2: How do foreign firms enter the UK?

1999-2001, Percentage entry by foreign-owned multinational				
Sector	Greenfield	Foreign firm takes over:		
		British domestic plant	British multinational plant	Foreign-multinational plant
Production	22.3%	53.8%	10.0%	13.9%
Service sectors	30.7%	46.0%	9.7%	13.5%

Note: The total number of production (service) sector entrants is 13,656 (65,409) plants.

Source: ONS: authors' calculations using ARD plant-level populations 1998 to 2001, Annual Inquiry into Foreign Direct Investment. Production sectors: mining, manufacturing, construction, and utilities. Service sectors: catering, motor trade, property, retail trade, other services, and wholesale.

Having documented the importance of multinational firms and the mode of entry by foreign-owned multinationals, we now turn to the implications of their presence for the British economy. We begin by examining the characteristics of establishments owned by different types of firms, before turning to the potential externalities affecting British firms from foreign multinational activity.

3 Characteristics of foreign-owned establishments

3.1 Theoretical background

From the early literature of Vernon (1966), Dunning (1977) and Caves (1974) onwards, the predominant model of the multinational firm has focused on the role played by intangible assets. It is typically more costly for firms to operate abroad than domestically. Local firms have superior knowledge of local markets, consumer preferences and business practices. Foreign firms must therefore have some other advantage over domestic firms to compete. This can be in the form of higher productivity levels, or through greater market power, for example through owning a patent. In addition, the firm must have some incentive to internalize the technology and not license it to foreign producers, for example due to the moral hazard problem arising from asymmetric information between the owner of the technology and the licensee and the inability to write an enforceable contract. Further, the firm must have an incentive to locate production in the host country rather than supplying foreign markets through international trade.

These ideas are encapsulated in what has become known as the Ownership-Location-Internalization (OLI) framework. Multinational enterprises are explained by market power associated with the ownership (O) of products or production processes, location (L) advantages from the plant being in a foreign country rather than at home, and advantages from internalizing (I) foreign activities in fully-owned subsidiaries rather than making use of arms length transactions in the market. A more recent literature has sought to formalize these ideas in what has become known as the 'knowledge capital model' of the firm, with important early contributions by Markusen (1984) and Helpman (1984, 1985). Recent textbook expositions of this framework include Barba Navaretti, Venables et al. (2004) and Markusen (2002).

The theoretical literature distinguishes between horizontal multinationals, where the foreign subsidiary operates at the same stage of the production process as the parent firm, and vertical multinationals, where the foreign subsidiary operates at a different stage of

production to the parent.⁵ In the case of vertical multinationals, the affiliate may produce at either an earlier stage of production (upstream) or a later stage (downstream). In practice, multinational activity may involve elements of both, as when the affiliate produces at the same stage of production as the parent firm but uses headquarter services from the parent, including marketing, management, distribution and product-specific R&D.

Models of both horizontal and vertical multinational activity provide a natural explanation of why foreign firms are more productive than those that only serve the domestic market. If firms are heterogeneous and there is some cost to becoming a multinational (e.g. the fixed cost of setting up a foreign subsidiary), then only more productive firms will find it optimal to operate foreign subsidiaries in equilibrium. This idea is formalized in Helpman et al. (2004). Assuming that there is a fixed cost to exporting and an even larger fixed cost to becoming a multinational, they show that, in equilibrium, there is a natural ordering of firms in terms of their productivity, from the least productive firms who exit, through slightly more productive firms who serve only the domestic market, through more productive firms who serve the domestic market and export, to the most productive firms who serve the domestic market and undertake FDI.⁶

However, this literature emphasizes that it is multinational firms rather than foreign firms per se that are, on average, more productive than purely domestic-based firms. Therefore, in our analysis below we compare purely domestic firms with British multinationals and foreign multinationals. The fact that multinational firms (of whom foreign firms are a subset) are, on average, more productive than purely domestic firms also leads naturally to the idea that there may be knowledge spillovers to less productive domestic firms in the host country. Foreign multinationals may also play an important role in influencing the degree of competition in the domestic market. Entry by foreign multinationals may change market structure and intensify competition. We return to consider these ideas below.

⁵ See Markusen (1984) and Brainard (1997) for analyses of horizontal multinationals, and see Helpman (1984), (1985) for analyses of vertical multinationals.

⁶ Unfortunately the ARD data will not allow us to identify exporting firms.

3.2 Empirical evidence

It is well established that foreign-owned firms are more productive on average than domestic-owned firms within the same industry.⁷ More recent research has shown that a large part of this difference is between multinationals and non-multinationals rather than an effect of country of ownership *per se*.⁸

One reason for the observed higher productivity of foreign-owned multinationals at the economy-wide level might simply be that they are disproportionately concentrated in high productivity sectors. For example, models of vertical multinationals suggest that patterns of foreign-ownership should vary systematically with comparative advantage, while models of horizontal multinationals suggest that market size, the extent of competition and trade costs should play an important role. Levels of labour productivity vary substantially across sectors. In 2001, the average British worker in production industries produced just under £40,000 worth of goods, while the average British worker in hotels and restaurants and other services produced on average less than half this amount. In wholesale and retail trade, the average value of services produced per worker was £24,000. The interpretation of differences in labour productivity across sectors is notoriously problematic.⁹ But it is clear that variation in the composition of foreign multinationals across sectors will distort aggregate comparisons, and any comparison between establishments owned by foreign multinationals and those owned by other categories of firms should be undertaken within industries.

In our analysis, in order to abstract from factors that are associated with the characteristics of the industry in which an establishment operates or the point in the economic cycle, we measure everything relative to the industry and time mean. That is, we divide the productivity of each type of establishment (or the value of another characteristic) by the mean across establishments within the relevant four-digit industry in that year. Therefore,

⁷ See, for example, Griffith (1999) and Oulton (2000) for Great Britain. For a contrasting view, see Aitken and Harrison (1999).

⁸ See, in particular, Doms and Jensen (1998) and Howenstine and Zeile (1994) for the United States and Criscuolo and Martin (2003) for Great Britain.

⁹ See, for example, Baumol and Wolff (1984).

the mean establishment in an industry in any year will have a value of 100. Values greater (less) than 100 for a group of establishments imply that they are above average (below average).¹⁰ This normalisation means that we do not need to measure price indices, which is notoriously difficult in service industries, because industry level prices will drop out. We consider three characteristics - labour productivity (value-added per worker), investment per employee and intermediate inputs per employee.

Table 3 reports average values of these characteristics for establishments that are owned by British domestic firms, British multinationals and foreign multinationals. It first shows information on the average size of each type relative to the industry and year mean. In both the production and service sectors, on average British-domestic establishments are much smaller than multinational establishments. In the production sector, average employment in British-domestic establishments is 74% of the industry mean, while average employment in British-multinational establishments is 419% of the industry mean, and average employment in foreign-multinational establishments 293% of the industry mean. In service sectors, the difference is even more pronounced. Average employment in British-multinational establishments is nearly 20 times greater than the industry mean, while average employment in foreign-multinational establishments is just under 10 times greater. In both production and service sectors, establishments that are part of British-owned multinationals are larger than those that are part of foreign-owned multinationals. This may not be surprising given that the former are operating in their home market.

¹⁰ Four-digit industries are highly disaggregated and there are more than 100 within the manufacturing sector alone. The averages we use are actually weighted averages to reflect variation in the relative importance of establishments in terms of their size. The data we use are a random stratified sample so the weights also reflect sampling probabilities. To ensure that our results are not driven by outlying observations, we dropped establishments in the 1st and 99th percentile of the distribution of each of the variables used to calculate the measures reported in tables 3 and 4. We also checked that our results are robust to dropping four-digit industries with small numbers of establishments in any ownership category.

Table 3: Comparing the characteristics of foreign-owned and host country establishments

	British domestic	British-owned multinationals	Foreign-owned multinationals
Production			
Employment	74	419	293
Value-added / employee	92	102	116
Investment / employee	94	98	115
Intermediate inputs / employee	88	103	126
Service sectors			
Employment	83	1,966	884
Value-added / employee	94	113	120
Investment / employee	96	105	119
Intermediate inputs / employee	93	108	133

Notes: all results are sample and employment weighted. All index measures are first calculated relative to the four-digit-industry-year average, which is set equal to 100. All figures are means of the index measures within the production and service sectors across the years 1998 to 2001. The average number of establishments across the years in the sample within each ownership category are as follows: production sector: 11,222 British owned, 1,199 British-owned MNE, 1,335 foreign-owned MNE; service sectors 26,904 British owned, 668 British owned MNE and 1,124 foreign-owned MNE.

Source: ONS: authors' calculations using ARD establishment-level sample, Annual Inquiry into Foreign Direct Investment. Production sectors: mining, manufacturing, construction, and utilities. Service sectors: catering, motor trade, property, retail trade, other services, and wholesale.

In both the production and service sectors, multinational establishments are more productive than those owned by purely domestic firms, consistent with the idea that there may be fixed costs to becoming a multinational and only those productive enough to incur these fixed costs become multinational firms. Focusing on the production sector alone, establishments that are part of foreign-owned multinationals have higher labour productivity than those owned by British multinationals. That is, even conditional on being part of a multinational firm, British-owned establishments have lower labour productivity than those that are foreign-owned. This may be linked to the fact that foreign multinationals are operating outside their home market, and this may require them to possess some additional advantage in order to be able to compete effectively. The observed differences in labour productivity are mirrored in differences in investment per employee, and the intensity with which intermediate inputs are used. This suggests that labour productivity

differences are not only due to differences in technical efficiency (or total factor productivity (TFP)), but also differences in input usage.¹¹ After controlling for input usage, Criscuolo and Martin (2003) find that British-multinational establishments are as productive as non-US foreign-multinational establishments, while US multinational-establishments enjoy a small productivity advantage over those owned by multinationals from Britain and other countries.

Turning now to the service sector, we find that British-owned multinationals again have lower levels of labour productivity than foreign-owned multinationals, but the difference is less stark than in the production sector. Again British-owned multinationals have lower levels of investment and intermediate usage per employee than foreign-owned multinationals. Much of the existing theoretical and empirical literature has focused on the question of whether there are differences in technical efficiency between foreign and domestic multinationals. The variation in levels of investment and intermediate input use per employee is also of interest. An outstanding research question is the extent to which this can be explained by variation in technology that affects the relative rate of return to using different factors of production, and the extent to which it can be explained by variation in the real cost of capital and of intermediate input use.

3.3 Foreign and domestic takeovers

We saw earlier that there are various ways by which foreign firms can enter the British market, and we introduced the idea that the effect of foreign entry may depend on the mode chosen. Greenfield investment that involves the creation of a new production facility with state of the art technology may have different effects on productivity from the foreign takeover of a British-owned firm.¹² In the first case, knowledge spillovers might arise from other domestic-owned firms observing the use of new production technology. In the second case, the adoption of improved managerial practices, which improve the performance of the firm being acquired, and from which other domestically owned firms can learn, might play

¹¹ Differences in labour productivity may also be accounted for by factors such as economies of scale.

¹² Recent literature has focussed on entry as mechanism for adopting new technologies, in particular for the introduction of new information and communication technology (ICT) in retail sectors (see van Ark et al (2003)).

a greater role.¹³ Given the predominant role of takeovers, this section examines the empirical evidence on the impact of this mode of entry on productivity.

Three issues are of particular interest. First, is the observed labour productivity advantage of foreign-owned multinationals the result of them taking over high productivity British establishments ('cherry-picking')? Second, does takeover by a foreign multinational lead to an improvement in performance at a previously British establishment, which could provide an alternative explanation for higher observed productivity of foreign-owned multinationals. Third, is takeover by a foreign multinational associated with a greater improvement in performance at a previously British establishment than takeover by another British firm. In other words, does any change in performance at the acquired establishment reflect the impact of takeovers by foreign firms or the impact of takeovers in general? The idea here is to use domestic takeovers to control for the overall impact of takeovers, and look at whether productivity improves after a foreign takeover over and above that.

Table 4 shows characteristics of establishments that have been taken over. We consider British-owned establishments that were taken over by a foreign multinational, and compare them with British-owned establishments taken over by another British-owned establishment (domestic or multinational). We compare the characteristics before and after takeover for each category. We first turn to pre-acquisition characteristics, to examine whether there is any evidence that foreign-multinationals are cherry picking high-performing establishments. Looking at domestic to foreign takeovers in column (1a), the domestic-owned establishments that foreign-owned multinationals acquire are much larger than average (over three times larger, as measured by employment). Although not shown, the establishments that are acquired and that are not part of a UK multinational are still much larger than average for that group (the definition of domestic-owned establishments in table 4 includes both those that are owned by British multinationals and those that are not).

¹³ For a theoretical analysis of greenfield versus other FDI, see Ferrett (2003) and Nocke and Yeaple (2004).

Table 4: Characteristics of establishments that are taken over

	Domestic to Foreign Takeovers		Domestic to Domestic Takeovers	
	Before (Domestic) (1a)	After (Foreign) (1b)	Before (Domestic) (2a)	After (Domestic) (2b)
Production				
Employment	317	329	197	200
Value-added / employee	97	102	91	99
Investment / employee	130	115	93	96
Intermediate Inputs / employee	117	141	83	93
Service sectors				
Employment	627	862	420	438
Value-added / employee	115	117	94	101
Investment / employee	142	157	99	101
Intermediate Inputs / employee	124	146	96	99

Notes: all results are sample weighted. All index measures are first calculated relative to the 4-digit-industry-year average, which is set equal to 100. All figures are means of the index measures within the production and service sectors across the years 1998 to 2001. The average number of establishments across the years in the sample within each category are as follows: production sector: 117 before (B) - domestic (D), 192 after (A) - foreign (F), 610 B-D, 2,792 A-D; and for the service sectors: 149 B-D, 195 A-F, 1,183 B-D, 3,564 A-D. Takeovers are identified using changes in the ownership and nationality of ownership codes within the population of establishments.

Source: ONS: authors' calculations using ARD establishment-level sample and population, Annual Inquiry into Foreign Direct Investment. Production sectors: mining, manufacturing, construction, and utilities. Service sectors: catering, motor trade, property, retail trade, other services, and wholesale.

Column (1a) also shows that the British-owned establishments that were acquired by foreign-owned multinationals have lower than average labour productivity, but higher than average investment per employee and higher than average usage of intermediate inputs per employee in the production sectors. In services they have higher than average labour productivity as well.

Making a comparison with column (2a) we see that across both sectors domestic-owned establishments that are taken over by foreign multinationals are larger, are more investment intensive and are more intensive in their use of intermediate inputs than those acquired by British-owned firms. What is interesting is that in the production sector establishments that are acquired by either foreign or British-owned firms have lower than average labour productivity. This is consistent with the theory of firms choosing to acquire under-

performing plants. However in the service sector the establishments acquired by foreign-owned multinationals do have higher than average labour productivity, and although not shown in the table this also applies to those that are acquired that are not owned by British multinationals. In services, establishments acquired by foreign multinationals also have higher labour productivity than those acquired by British-owned firms. This provides some indicative evidence that foreign-multinationals may be cherry picking establishments in the service sector. Indeed across both the production and service sectors foreign multinationals also appear to be selecting to acquire more investment intensive (and therefore potentially more capital and technologically intensive) establishments than domestic-owned firms.

To examine whether takeover by a foreign multinational is associated with an improvement in performance we consider post-takeover characteristics. We consider an establishment after takeover for a maximum of three years including the year of acquisition. As we might expect takeovers in general to be associated with changes in performance, we compare the *change* in performance (before to after) for domestic establishments taken-over by foreign multinationals with the *change* in performance for those taken over by other British-owned firms. In this way we try to isolate changes in performance that are associated with *foreign* acquisition.

Comparing before and after a foreign takeover (column (1a) with (1b)) we see a very small improvement in labour productivity. If anything improvements appear to be greater for those acquired by UK-owned firms (comparing column (2a) with column (2b)). Following a foreign-acquisition there is some evidence of an increase in intermediates usage, (more so than in the case of an acquisition by a UK-owned firm) and of investment per employee falling in production but rising in services.

How does this compare with the literature? The existing evidence on the effects of foreign takeovers on performance is somewhat mixed, and more generally the literature on takeovers has not found large effects on productivity. Harris and Robinson (2002) look at changes to total factor productivity following a foreign takeover using the same data source as here for the manufacturing sector and for an earlier but longer time period. They find some evidence that performance declined post acquisition. Conyon et.al (2002) using a

different UK data source do find a labour productivity increase as a result of foreign acquisition.¹⁴

4 Technology spillovers and technology sourcing

Having examined the characteristics of foreign-owned multinationals and the impact of takeover by a foreign-owned multinational on the acquired establishment, we now move on to examine the broader issue of whether there are any externalities from multinational activity. Governments in both developed and developing countries spend large sums of money attracting foreign firms. For example, the UK government offers grants to firms to locate and remain in the UK. Nissan was given a Regional Selective Assistance grant of £35 million in 1987 for a car plant to locate in Sunderland and a further £14 million in 1991 to keep it there. The justification for such policies to influence multinational firms' location choices rests on some form of market failure, for example an externality.

4.1 Existing theoretical and empirical literature

A major strand of research has emphasized knowledge spillovers from FDI. These may arise from both inward FDI (spillovers to British firms from foreign-owned multinationals producing in Great Britain) and from outward FDI (spillovers to British firms from British-owned multinationals sourcing technology from abroad).

Much of the existing theoretical and empirical literature has focussed on knowledge spillovers from inward FDI. Here, distinctions are drawn between knowledge flows within the own industry (e.g. from foreign affiliates in machine tools to domestic firms in machine tools), knowledge flows to upstream industries (from foreign affiliates in machine tools to domestic firms in fabricated metals), and knowledge flows to downstream industries (from foreign affiliates in machine tools to domestic firms in the car industry).

Despite the large amount of research in this area, the exact mechanisms through which FDI facilitates knowledge spillovers are not well understood. Candidates that have been proposed include pure demonstration effects and the mobility of skilled workers across

¹⁴ See also Criscuolo and Martin (2003), Harris and Hassaszadeh (2002), Girma and Gorg (2003).

production facilities within countries. Another potential mechanism is the transfer of knowledge from foreign affiliates to upstream domestic component suppliers. Particularly in developing countries, the more exacting quality and product specification demands of multinational firms are thought to promote improvements in product quality and technology in upstream suppliers, the benefits of which may not be fully internalized by multinational firms.¹⁵

Knowledge spillovers are not the only potential externality from foreign affiliates to domestic firms. Particularly in concentrated domestic markets, another important effect of entry by foreign firms may be an increase in the degree of product market competition, with attendant benefits to consumers in the form of lower prices and implications for domestic firms' incentives to innovate.¹⁶ Such an effect on the degree of product market competition requires either foreign firms not to have exported to the domestic market previously or the effects of the entry of foreign production facilities to be different from entry through international goods markets.

This is an example of a pecuniary externality from entry by foreign firms (i.e. an externality transmitted through the market rather than through non-market based flows of technological knowledge). There may be other pecuniary externalities to foreign entry. In particular, if there are vertical linkages between industries, increasing returns to scale in production, and trade costs, the expansion of a downstream industry induced by foreign entry may act as a catalyst that stimulates the development of upstream industries supplying parts or components, which may in turn stimulate the development of other downstream industries that use those parts and components.¹⁷

Thus, the theoretical literature paints a rich picture of the mechanisms through which foreign affiliates may influence domestic firms. Distinguishing between these alternative and often complementary mechanisms is extremely hard empirically. The most common

¹⁵ See, *inter alia*, Blomstrom (1989)

¹⁶ In principle, enhanced product market competition may either increase or decrease incentives to innovate: see, for example, Aghion and Howitt (1997), Aghion et al. (2002), Blundell, Griffith and Van Reenen (1999), Nickell (1996) and Aghion et al (2003).

¹⁷ For a formalization of this argument, see Markusen and Venables (1999). For recent empirical evidence see Gorg and Strobl (2004).

approach to examining externalities to FDI in the existing empirical literature is to regress the productivity levels or growth rates of domestic-owned firms on a measure of foreign presence within an industry, such as the share of foreign firms in employment, sales or the total number of firms.

This empirical literature has yielded mixed results. For example, Aitken and Harrison (1999) find that there are no externalities to domestic firms from FDI using panel data on Venezuelan firms. However, recent panel data studies for the United Kingdom (Haskel et al. 2002) and for the United States (Keller and Yeaple 2003) find evidence of positive externalities.¹⁸ In order to assimilate foreign technologies, domestic-owned firms may require an appropriate level of ‘absorptive capacity’, and a few empirical papers have considered and found support for this idea.¹⁹

An alternative empirical approach is adopted by Griffith, Redding and Simpson (2003), who use an establishment’s distance from the technological frontier²⁰ as a direct measure of the potential for technology transfer. This allows for knowledge spillovers from both foreign-owned multinationals and highly productive domestic firms (including domestic multinationals which may be sourcing technologies from abroad). They find foreign-owned multinationals are frequently the technological leader within UK industries and that technology transfer from these technological leaders makes a substantial contribution to productivity growth in domestic-owned establishments. There is also some evidence that industries with a large presence of foreign multinationals exhibit faster rates of technological transfer from the frontier, which is consistent with foreign presence intensifying competition and enhancing incentives to adopt technologies.

¹⁸ Other empirical analysis of knowledge spillovers from FDI include, among others, Blomstrom (1989), Globerman (1979), Görg and Greenaway (2004), Harris and Robinson (2002) and Teece (1977). For surveys of this literature, see Blomstrom (1991), Görg and Strobl (2001) and Lipsey (2002).

¹⁹ See, for example, Kinoshita (2000) and Girma (2002). For a broader analysis of absorptive capacity and technology transfer, see Cameron (1996), Cameron, Proudman and Redding (1998), and Griffith et al. (2003), (2004).

²⁰ This is the distance an establishment lies from the most efficient technology (the frontier) within an industry, for example, as measured by an establishment’s TFP relative to the maximum TFP observed within the industry.

Recent empirical studies have also begun to examine spillovers from FDI in upstream and downstream industries. Using a firm-level panel data set from Lithuania, Smarzynska Javorcik (2004) finds evidence of positive productivity spillovers from FDI in upstream industries.²¹ These spillovers are found to arise when there is shared domestic and foreign ownership ('joint ventures') but not from fully-owned foreign investments. Using micro-data from Indonesia, Blalock (2001) also finds positive productivity spillovers from FDI in upstream industries.

A much smaller body of work has examined spillovers from outward FDI or 'technology sourcing'. This uses patent citations to measure the role of foreign direct investment in mediating flows of knowledge between countries. Branstetter (2003) and Iwasi and Odagiri (2002) find evidence suggesting technology sourcing is important for Japanese firms investing in the US. Griffith, Harrison and Van Reenen (2004) find evidence of UK firms technology sourcing from the US. Using panel data on British and US firms, they show that the growth of the US R&D stock disproportionately benefited British firms with US-based inventors. The parameter estimates imply that UK manufacturing TFP would be 5% (about \$14bn) lower had it not been for US R&D growth in the 1990s. Singh (2003) finds that greater multinational subsidiary activity increases cross-border knowledge flows between the host country and the multinational home base.

While a number of empirical studies find evidence of knowledge spillovers from FDI, it is fair to say that there is less consensus in this literature than on the finding that both foreign and domestic-owned multinationals are more productive than local firms producing for the domestic market. The most convincing studies are those that trace the mechanism through which knowledge spillovers occur, and there remains scope for further theoretical and empirical work to deepen our understanding of these mechanisms. This remains a prerequisite for evaluating the economic case for the large incentive packages given by governments to multinational firms.

²¹ See also Driffield et al. (2002) for an analysis using industry level data for the UK.

4.2 R&D activity by foreign multinationals

While many studies in the existing empirical literature on spillovers have measured foreign presence in an industry by the share of foreign firms in employment or the total number of firms, the extent to which foreign firms undertake R&D activity within a host country might have an important bearing on the extent of knowledge spillovers. In this section we present some evidence on the intensity of foreign-owned multinationals' R&D activity in Britain. While such activity might be motivated by technology sourcing, or be devoted to adapting products to local markets, it may also be a source of spillovers to domestic-owned establishments.

Table 5 uses newly available establishment-level data on R&D activity in the UK to look at the extent to which R&D expenditure is accounted for by foreign-owned multinationals, British-owned multinationals and by other domestic-owned firms, and the intensity with which they conduct R&D activity in the UK. The table splits the R&D activity into different product groups or industries for which it is being carried out. For example, a research laboratory carrying out R&D for the pharmaceuticals sector will be classified in the pharmaceuticals product group. We first look at the share of in-house 'intramural' R&D expenditure that is accounted for by each type of establishment within each product group.²² We then look at three measures of the intensity with which R&D activity is carried out relative to production or service sector activity in the corresponding industry.

The first question we ask is, do multinationals and foreign-owned multinationals account for a significant proportion of R&D activity in the UK? The rows in bold in table 5 show that within all product groups the majority of R&D expenditure is carried out by multinational enterprises, and in all product groups apart from mechanical engineering and electrical machinery, establishments that are part of British-owned multinationals account for a larger share of R&D activity than foreign-owned multinationals. As we saw in table 1 multinationals also make up a significant proportion of employment in the manufacturing and service sectors. Therefore, a natural second question is - do multinationals, and foreign multinationals in particular, carry out R&D activity more intensively than domestic-owned

²² Expenditure on outsourced 'extramural' R&D is not included as it is very small.

firms, i.e. do they account for a larger proportion of R&D expenditure and R&D employment in the economy than they do value-added or production employment?

We consider three different intensity measures. First, we compare the amount of intramural R&D expenditure carried out by each type of firm as a percentage of value-added generated by that same type of firm (this includes value-added in non-R&D doing firms). Second, we measure the amount of intramural R&D expenditure per production or service sector employee, and finally we measure R&D employees – scientists, engineers and technicians - as a percentage of production or service sector employment. We can compare each of these measures for individual industries and across ownership types within industries.

Not surprisingly, these measures suggest that R&D activity is carried out most intensively in the pharmaceuticals and chemicals sector. In three sectors, pharmaceuticals & chemicals, transport equipment & aerospace and services, British-owned multinationals are more R&D intensive relative to their respective production activity than foreign-owned multinationals, which might be expected given the well documented home bias of R&D activity, and the fact that British-owned multinationals are operating in their home market. However, in the remaining two sectors foreign-multinationals appear to exhibit similar R&D intensity to their British-owned counterparts. Across all the sectors foreign-owned multinationals are at least as, if not more research intensive than British-owned non-multinationals, with the largest differences in the most R&D intensive sectors.

Table 5: R&D activity and ownership

R&D product group	British-owned domestic	British-owned Multinational	Foreign-owned Multinational
Pharmaceuticals & Chemicals (total intramural R&D expenditure £3.42 billion, total production employment 0.26 million)			
% total intramural R&D expenditure	16%	52%	32%
Intramural R&D expenditure as % of value-added	19%	42%	23%
£s intramural R&D per production employee	£7,660	£27,320	£16,170
R&D employees as % production employees	12%	28%	12%
Mechanical Engineering & Electrical Machinery (total intramural R&D expenditure £2.36 billion, total production employment 1.29 million)			
% total intramural R&D expenditure	16%	36%	48%
Intramural R&D expenditure as % of value-added	3%	13%	11%
£s intramural R&D per production employee	£920	£4,830	£4,160
R&D employees as % production employees	2%	7%	4%
Transport equipment & Aerospace (total intramural R&D expenditure £1.85 billion, total production employment 0.39 million)			
% total intramural R&D expenditure	10%	52%	38%
Intramural R&D expenditure as % of value-added	6%	29%	14%
£s intramural R&D per production employee	£1,760	£11,820	£5,700
R&D employees as % production employees	3%	11%	7%

Table 5: R&D activity and ownership *continued*

R&D product group	British-owned domestic	British-owned Multinational	Foreign-owned Multinational
Other manufacturing (total intramural R&D expenditure £1.08 billion, total production employment 1.90 million)			
% total intramural R&D expenditure	42%	38%	21%
Intramural R&D expenditure as % of value-added	2%	3%	2%
£s intramural R&D per production employee	£660	£1,560	£1,180
R&D employees as % production employees	1%	3%	2%
Services (total intramural R&D expenditure £2.25 billion, total service employment 16.3 million)			
% total intramural R&D expenditure	39%	43%	17%
Intramural R&D expenditure as % of value-added	1%	2%	1%
£s intramural R&D per production employee	£250	£1,180	£660
R&D employees as % service employees	1%	2%	1%

Source: ONS: authors' calculations using micro-level Business Expenditure on R&D, ARD establishment-level sample and population, Annual Inquiry into Foreign Direct Investment.

Note: all figures are for the year 2000, apart from the total employment figures given for each product group, which are for 2001. No. of observations from the BERD *population* and ARD *sample* on which the calculations are based are as follows (BERD / ARD): Pharmaceuticals & Chemicals, British owned (312/355) British MNE (117/103) Foreign MNE (103/146); Mech. Eng. & Elec. Mach., British owned (1,265/2,746) British MNE (382/400) Foreign MNE (313/452); Transport equip. & Aerospace, British owned (186/373) British MNE (63/66) Foreign MNE (57/120); Other manufacturing, British owned (1,196/3,965) British MNE (320/549) Foreign MNE (200/457); Services, British owned (3,760/30,025) British MNE (258/783) Foreign MNE (252/1,169). All figures use imputations or sampling weights so are representative of the population.

Foreign-owned multinationals appear to be co-locating a significant amount of R&D activity together with production or service sector activity in the UK. Together with their observed high productivity they might therefore be an important source of technological spillovers for domestic-owned firms. However, the same might also be said for British-owned multinationals' domestic operations. That foreign-multinationals carry out significant research activity in Britain might also be evidence of technology sourcing, either directly through the acquisition of research facilities in Britain, or indirectly from proximity to the British research base. The extent to which this R&D intensity is mirrored in other countries, together with information on technological advancement and the quality

of the research base, might shed some light on whether such investment is motivated by technology sourcing.

5 Conclusions

The effects of Foreign Direct Investment (FDI) on economic performance in source and host countries have been the subject of perennial academic and popular debate. On the one hand, anti-globalization protesters have railed against the low wages paid in developing country affiliates relative to those in developed source countries. Others have concerned themselves with the potentially negative effects of entry by foreign firms, with their global production networks, on domestic suppliers of parts and components in upstream industries. On the other hand, most economists would point to the higher levels of productivity and higher wages paid by foreign affiliates relative to other domestic producers in the host country, and would emphasize the potential externalities from FDI including, but not limited to, knowledge spillovers from foreign affiliates to their less productive domestic counterparts.

This paper has examined the relationship between foreign ownership and productivity, paying particular attention to two issues neglected in the existing literature – the role of multinationals in service sectors and the importance of R&D activity conducted by foreign multinationals. We review existing theoretical and empirical research, which has largely focused on the manufacturing sector, and present new evidence using establishment-level production, service sector and R&D data for Great Britain.

We examine patterns of multinational activity across sectors. Although much of the policy debate focuses on manufacturing, multinational firms have a substantial presence in service sectors. Foreign multinationals are particularly prominent in the wholesale sector. Since services are less tradable than manufactures, this suggests foreign multinationals may have a particularly important role to play in this sector in increasing competitive pressure. We also present empirical evidence on how foreign firms enter Britain, and find that takeovers are the most frequent mode of entry.

Establishments owned by multinational firms (whether British or foreign) are substantially more productive than those owned by purely domestic firms, consistent with the idea that

there are fixed costs to becoming a multinational and only those firms productive enough to incur these fixed costs choose to become multinational. There is also some evidence that establishments owned by foreign multinationals have higher labour productivity than those owned by British multinationals, which partly reflects greater investment and intermediate use per employee. We find that the difference in labour productivity between establishments owned by British and foreign multinationals is smaller in the service sector than in the production sector.

With takeovers a predominant mode of entry by foreign multinationals, higher observed labour productivity at foreign-owned establishments might reflect the selection of high productivity establishments for takeover ('cherry-picking') or might reflect changes in performance at establishments acquired by foreign multinationals. We find clear evidence of cherry-picking in service sectors, but there is less evidence in either service or production sectors that acquisition by a foreign multinational significantly improves productivity or leads to a greater increase in productivity than acquisition by another British firm.

The rationale for policy measures to attract foreign multinationals relies on there being some form of market failure, in the form for example of an externality. We review the existing theoretical and empirical literature on spillovers from inward and outward FDI. Here, there is less consensus than, for example, on the finding that multinational firms are more productive than purely domestic firms. The most convincing studies are those that trace the mechanism through which externalities occur. We contribute to the literature on knowledge spillovers from multinational firms by exploiting highly disaggregated establishment-level data on the extent to which foreign-owned multinationals undertake R&D activity in Britain. This R&D activity may be motivated by technology sourcing or be devoted to adapting products to local markets. We find that foreign multinationals undertake a substantial amount of British R&D in many sectors, and this provides a potentially important source of knowledge spillovers to domestic-owned establishments.

Appendix

Our data come from the Annual Respondents Database (ARD) (see Barnes and Martin (2002) and Griffith (1999) for a description of these data), the annual Business Enterprise Research and Development (BERD) survey and the Annual Inquiry into Foreign Direct Investment (AFDI). It is a legal requirement for firms to respond to these surveys under the 1947 Statistical Trade Act. For years after 1997 the data cover all sectors of the economy except Agriculture, Public administration and defence and Financial intermediation. Headquarter activities of firms are not included in the ARD (whether they are domestic or foreign).

The foreign ownership data in the ARD is collected under a separate annual survey that is also used for the foreign direct investment (FDI) statistics. This data is augmented with information from Dun and Bradstreet. This information is used to define foreign- and British-owned multinationals. The definition of foreign direct investment used for statistical purposes in collecting the inward and outward FDI data is, *“investment that adds to, deducts from or acquires a lasting interest in an enterprise operating in an economy other than that of the investor, the investor’s purpose being to have an “effective voice” in the management of the enterprise. (For the purposes of the statistical inquiry, an effective voice is taken as equivalent to a holding of 10% or more in the foreign enterprise).”* Office for National Statistics (2000).

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