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Characteristics of Foreign-Owned Firms in British Manufacturing

Rachel Griffith and Helen Simpson

4.1 Introduction

The 1970s and 1980s saw an increase in the international openness of the British economy. By 1980 the British government had removed exchange controls and had joined the European Economic Community. By the late 1980s Britain was embarking on the European Union (EU) Single Market Program, which aimed to improve the international mobility of capital. Over the 1980s there were also large numbers of privatizations and reforms to product and factor markets. This opening up of the U.K. economy was expected to bring increased growth through a number of routes, one of which was through making the United Kingdom a more attractive location for internationally mobile investment. In this paper we focus on the impact of inward investment. From the early literature of Vernon (1966), Dunning (1977), and Caves (1974) it has been suggested that multinational firms are more productive and are concentrated in knowledge-intensive industries. The endogenous growth[1] and new trade literatures[2] focus on the role

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1. See, inter alia, Barro and Sala-i-Martin (1995), Aghion and Howitt (1998), and Grossman and Helpman (1991).

2. See, inter alia, Krugman (1991a,b, 1994), Venables (1994), Smith (1994), and Edwards (1998).

multinational firms play in transferring technology from the frontier to economies that lag behind technologically. Empirical work, largely at the aggregate level, has identified correlations between the openness of an economy and growth in productivity or export performance.[3]

Foreign direct investment (FDI) both into and out of the United Kingdom rose over the 1980s but fell off in the early 1990s, before recovering (strongly) in the middle to late 1990s. Here, rather than considering FDI flows, we consider real economic activity by looking at subsidiaries of foreign-owned multinationals operating in Great Britain. Like a number of other countries, the United Kingdom uses fiscal policy to attract foreign multinationals and hence potentially capitalize on technological spillovers. In the 1980s Regional Selective Assistance grants replaced Regional Development Grants as the main form of inducement. Regional Selective Assistance (RSA) grants are discretionary and are awarded to firms located in designated assisted areas. Although their primary aim is to create or safeguard employment, they are also used to attract inward investment. Over the four years from 1985 to 1988, foreign-owned firms accounted for only 8 percent of the total number of RSA offers. But grants to foreign-owned firms totaled around £325 million, representing 44 percent of the total value of offers over this period. The average grant offer was therefore higher for foreign-owned firms, as was the average grant per expected job created.[4]

Value added per worker in British manufacturing grew rapidly over the 1980s relative to the 1970s, with slower but continued growth during the 1990s (see fig. 4.1). But Britain remains at the bottom of the premier league of countries. Figure 4.2 compares labor productivity in the manufacturing sector within each of these countries. It shows that, while the position of the United Kingdom relative to the United States has improved somewhat, it still lags behind the United States and to a lesser extent behind France, Germany, and Japan. The figure shows labor productivity of manufacturing activity undertaken within these countries, by both domestic- and foreign-owned firms. Studies comparing total factor productivity show a similar picture.[5] One interesting question is whether improvements in the United Kingdom's relative position have been driven by the presence of foreign-owned multinational firms in the United Kingdom.

In this paper we investigate whether similar differences arise when we

3. These studies have generally used labor productivity; see, for example, Bernard and Jones (1996a,b) and Barrell and Pain (1997). Cameron, Proudman, and Redding (1998) look at total factor productivity. Studies using microdata include Blomstrom and Persson (1983), Davies and Lyons (1991), and Globerman (1979).

4. Source: Department of Trade and Industry (1993), section 2.4. Value of offers to foreign-owned firms is in 1990 pounds sterling.

5. See, inter alia, O'Mahony (1999), Dougherty and Jorgenson (1997), Nickell, Wadhwani, and Wall (1992), Layard and Nickell (1989), Bean and Crafts (1995), Bean and Symons (1989), Oulton and O'Mahony (1994), Mayes (1996), Cameron, Proudman, and Redding (1998), van Ark (1996), Lansbury (1995), and Oulton (1998).

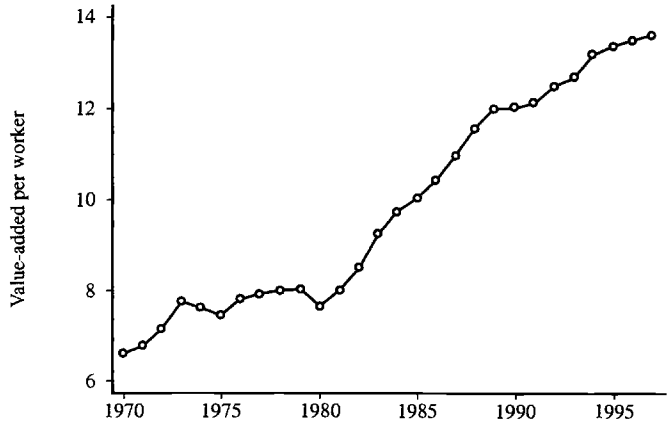

Fig. 4.1 Value added per worker (in thousands of 1980 UK£) in manufacturing
Source: Data from OECD STAN database.

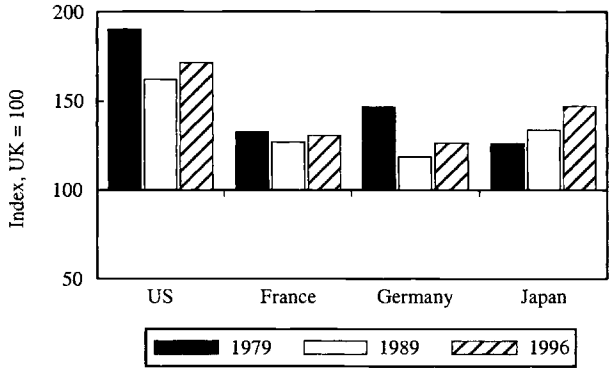

Fig. 4.2 Output per hour worked in manufacturing, by country of location
Source: O'Mahony (1999).

look across different nationalities of establishments operating within Britain. We examine differences in labor productivity and factor usage between foreign-owned and domestic-owned firms using establishment-level data. In doing so we control for industry, age, size, year of exit, and establishment-specific unobservable characteristics. This will be informative in understanding the extent to which it is physical location in Britain, as opposed to U.K. ownership, that underlies the observed international differences in labor productivity. If it is location in Britain that matters, this may point to factors such as national competition policy, employment laws, or the regulatory environment—for example, planning regulations, as highlighted in a recent report by McKinsey Global Institute (1998). However,

if we find labor productivity differences between foreign- and domestic-owned establishments both operating within Britain, this may indicate differences in the organization of production and input usage, or that domestic-owned establishments differ from their foreign-owned counterparts technologically.

There are many studies of labor productivity using establishment-level data in the United States and a growing number in the United Kingdom.[6] Two studies that are particularly relevant for our purposes are Doms and Jensen (1998) and Howenstine and Zeile (1994). Using U.S. data, Doms and Jensen show that there are substantial differences between domestic- and foreign-owned establishments. They find that foreign-owned establishments have higher labor productivity than the average U.S.-owned establishment, but lower labor productivity than those owned by U.S. multinationals. This indicates that what may be important in explaining productivity differences is ownership by a multinational rather than foreign ownership per se. They also find that foreign-owned establishments are more capital intensive and pay higher wages than the average U.S.-owned establishment. Howenstine and Zeile describe the characteristics of foreign-owned establishments in the United States. They find that foreign-owned establishments are larger and more capital intensive. They have higher average wage rates, but this is largely because they are in higher-wage industries, not because they pay workers higher wages compared to other firms in the same industry. Using Canadian plant-level data, Globerman, Ries, and Vertinsky (1994) have shown that there are significant differences between domestic- and foreign-owned plants. Foreign-owned establishments are found to have higher labor productivity, but after size, capital intensity, share of nonproduction workers, and share of male workers are controlled for these differences disappear.

A further motivation for this line of research is that establishment-level studies in both the United Kingdom and the United States have found that within-industry variation in labor productivity is greater than between-industry variation.[7] Understanding sources of within-industry variation helps explain both the determinants of productivity differentials between establishments, such as differences in capital intensity, and the determinants of industry-level productivity growth—for example, the replacement of low-productivity incumbents with high-productivity entrants.

Here we look at differences in characteristics between foreign- and domestic-owned establishments located in the United Kingdom. We consider establishments that do not change ownership nationality separately from those that experience a change in ownership nationality, due to a takeover

6. See Bartelsman and Doms (2000) for a review, also Caves (1998). For the United Kingdom see, for example, Harris and Robinson (2002), Disney, Haskel, and Heden (2003), and Griffith (1999).

7. See, inter alia, Disney, Haskel, and Heden (2003) and Doms and Jensen (1998).

or merger. Both of these samples include both greenfield entrants and incumbents. The findings suggest that establishments that are always foreign owned have significantly higher labor productivity than those that are always domestic owned. In addition, labor productivity improves faster with age in foreign-owned establishments. This is matched by an equivalent difference in levels of investment per employee. Both the proportion of skilled workers employed in the workforce and wages for both skilled and operative workers are higher in foreign-owned establishments than domestic-owned ones, a finding that is in line with differences in labor productivity. For establishments that change nationality, differences in labor productivity are smaller. However, there is some evidence that labor productivity improves in domestic establishments after they are taken over by a foreign-owned firm compared to those that go from being foreign to domestic owned.

The remainder of the paper is structured as follows. The next section describes the data, and section 4.3 presents some descriptive statistics on trends in foreign ownership in Britain. Section 4.4 examines differences between domestic- and foreign-owned establishments, and a final section summarizes. A more detailed description of the data is given in an appendix.

4.2 Data Description

Our main data source is the Annual Respondents Database (ARD). This encompasses the plant- and establishment-level data that underlie the Annual Census of Production in Britain.[8] The ARD contains basic information on the population of production plants and establishments in Britain, including the industry, the number of employees, and the nationality of the ultimate owner. More detailed information, including output, intermediate inputs, and wages, is collected from a sample of establishments.[9] We do not observe capital stock in the ARD, but we do have information on purchases and sales of investment goods, and from this we construct a capital stock series using the perpetual inventory method (see the data appendix for details). We use both the basic information on the population of establishments and, for our main analysis, a cleaned-up sample of the more detailed establishment-level data, which we gross up to the population. The data appendix provides details on how we construct our sample and our grossing-up factors.

In 1980 there were around 29,000 incorporated establishments with at

8. An establishment can comprise a single plant or a group of plants under common ownership. The ARD is the British equivalent of the U.S. Census Bureau's Longitudinal Research Database. See Barnes and Martin (2002), Griffith (1999), Oulton (1997), and Perry (1995) for descriptions of the structure of the ARD.

9. The sample comprises a census of larger establishments and below a size threshold a stratified sample of smaller establishments. For most of the period considered the threshold was 100 employees.

least twenty employees in the manufacturing sector included in the ARD, as shown in the top section of table 4.1. By 1996 there were one thousand more, although total employment in British manufacturing fell during this period. Around 7 percent of these establishments were foreign-owned. These were on average larger than domestic-owned establishments, but the average size of both domestic- and foreign-owned establishments has fallen over time. Our sample contains around 12,000 annual observations on establishments, which account for around 70 percent of employment in the population. It contains a higher proportion of foreign-owned establishments than the population, and the establishments are on average larger (due mainly to the sampling procedure).

Figure 4.3 shows the distribution of the population of establishments by employment size band. Panels A and B show the distribution of foreign- and domestic-owned establishments across size bands in the population for 1980 and 1996, respectively. The largest group of domestic establishments is in the twenty-to-forty-nine-employee range, while foreign-owned establishments are fairly evenly distributed across size bands. There is a larger proportion of domestic-owned establishments in the smallest size band in 1996, due in part to efforts by the statistical authorities to improve the register of businesses, but also reflecting a trend toward downsizing. Panels C and D show the same distributions for our sample of establishments. In contrast to the population, domestic-owned establishments are more evenly distributed, and foreign-owned are concentrated in the larger size bands. In our regression analysis we gross up to population levels using grossing-up factors at the industry-size-year level (see the data appen-

Table 4.1 **Sample Statistics**

	1980	1996
Population		
Total employment (millions)	5.3	4.0
Number establishments	28,605	29,748
Foreign-owned establishments (%)	6.9	7.3
Average employment per domestic-owned establishment	167	114
Average employment per foreign-owned establishment	425	391
Sample		
Total employment (millions)	4.1	2.6
Number establishments	12,900	10,457
Foreign-owned establishments (%)	9.2	12.4
Average employment per domestic-owned establishment	295	205
Average employment per foreign-owned establishment	566	534

Notes: Establishments with less than twenty employees are excluded from both the population and the sample. Only incorporated establishments that are in production are included (sole proprietors, partnerships, government-owned, and other legal structures are excluded, as are plants that are not yet in production). See the appendix for details on the construction of the sample.

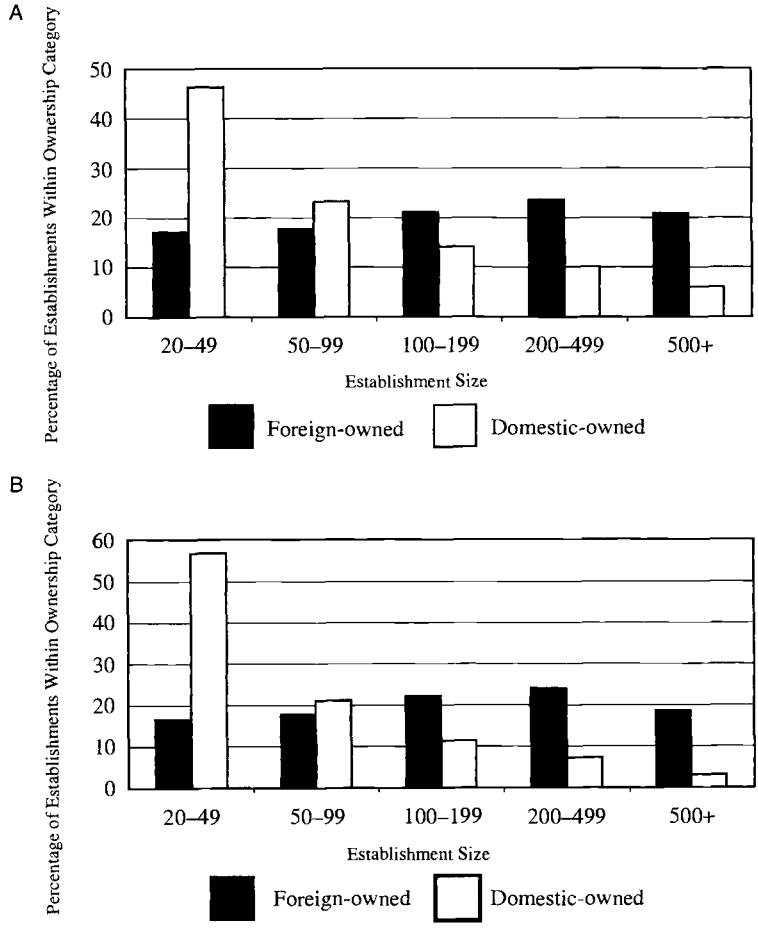

Fig. 4.3 ***A,*** **Employment size distribution population of establishments 1980;** ***B,*** **employment size distribution population of establishments 1996;** ***C,*** **employment size distribution sample of establishments 1980;** ***D,*** **employment size distribution sample of establishments 1996**

Source: Authors' calculations using the ARD.

dix for details). Figure 4.4 shows aggregate value added per worker calculated using our grossed-up sample. This is similar to figure 4.1, which was calculated using aggregate data from the Organization for Economic Cooperation and Development (OECD) STAN data set and gives an indication that our grossed-up sample is representative of manufacturing as a whole.

In our analysis we are interested in controlling for the age of an establishment and looking at how labor productivity changes with age. We do

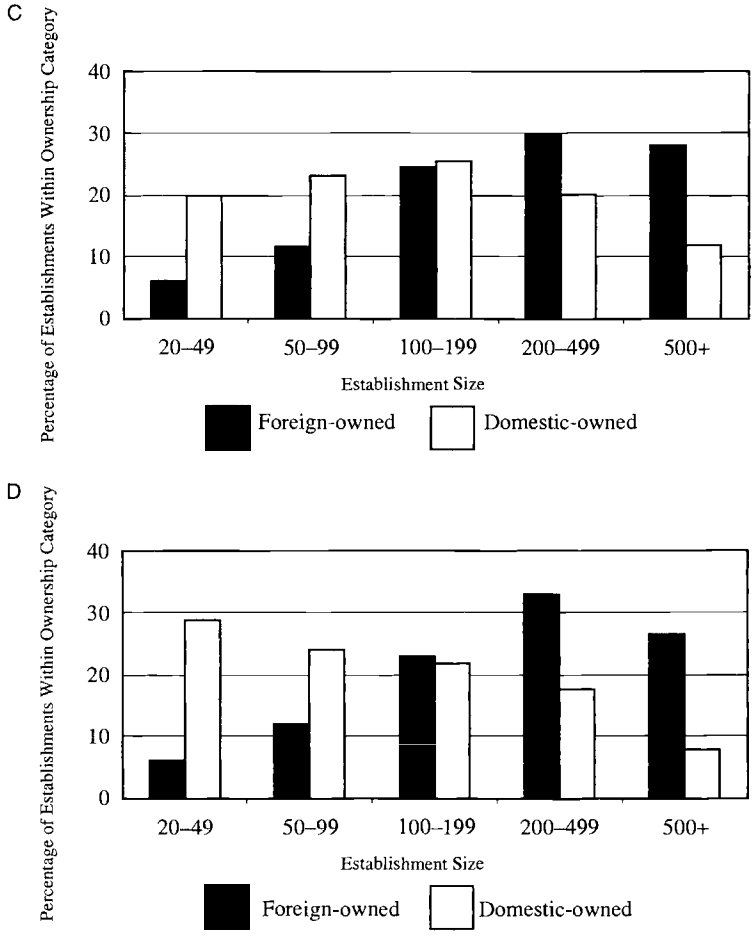

Fig. 4.3 (cont.) ***A*, Employment size distribution population of establishments 1980; *B*, employment size distribution population of establishments 1996; *C*, employment size distribution sample of establishments 1980; *D*, employment size distribution sample of establishments 1996**

Source: Authors' calculations using the ARD.

not observe the date that establishments were set up, but we can use information on the population of establishments back to 1973 to construct a truncated age variable. This gives us the length of time that a particular production facility has existed; that is, it is linked to the physical existence of the plant rather than to ownership.

Table 4.2 shows the age distribution of establishments in the sample in 1996 for both domestic- and foreign-owned establishments. The distribu-

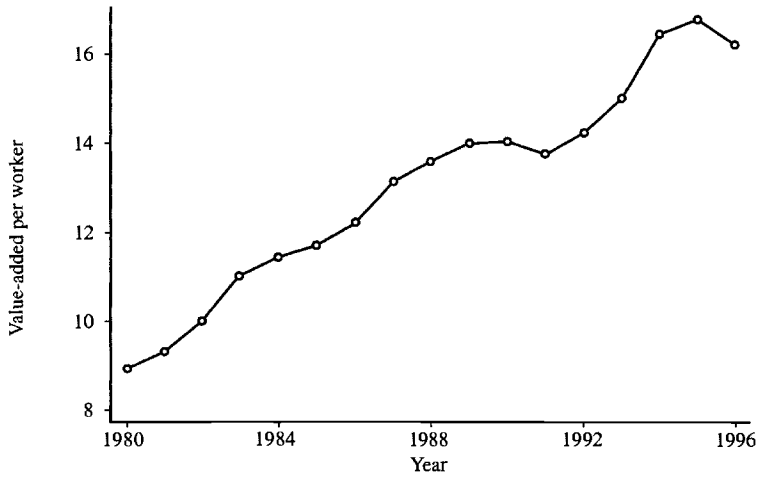

Fig. 4.4 Value added per worker (in thousands of 1980 UK£) in manufacturing
Source: Grossed-up ARD sample.

Table 4.2 Age Distribution of Establishments in 1996

Age	Domestic-Owned	Foreign-Owned
1–3	17.3	13.9
4–6	10.9	6.8
7–9	7.6	7.2
10–12	8.3	7.4
13–15	6.1	5.9
16–18	2.9	2.5
19–21	3.9	3.6
22+	42.9	52.6

Notes: See notes to table 4.1. Calculated for the sample of establishments.

tions are largely similar, although there is a larger proportion of young domestic-owned establishments.[10]

4.3 Trends in Foreign Ownership

This section describes the level of activity in foreign-owned establishments in British manufacturing over the period 1980 to 1996. We find that

10. Note that there are some problems with the continuity of the establishment-level identifier code that may affect the age calculation. In addition, age is calculated from 1973, so the largest proportion of establishments is always in the highest age category. See the appendix for details.

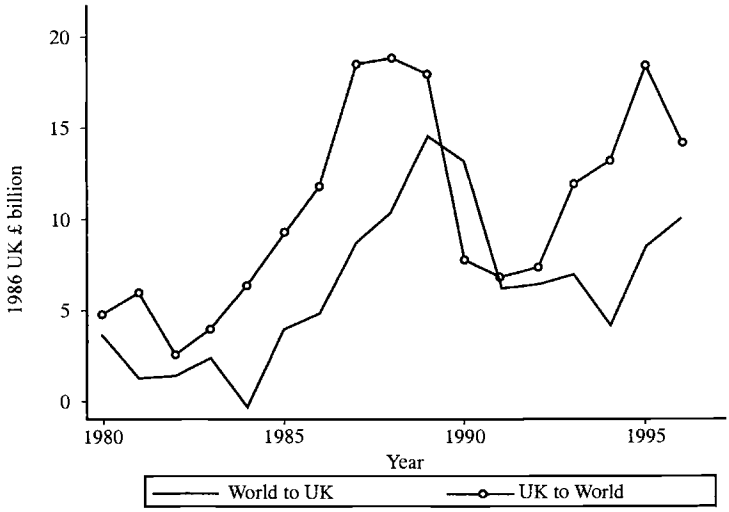

Fig. 4.5 Foreign direct investment
Source: OECD (www.sourceoecd.org).

the proportion of employment in foreign-owned establishments in the population of manufacturing establishments increased over the period from around 15 percent to 20 percent, and slightly more so in our sample. North American–owned[11] establishments represent by far the largest share, although there has been an increase in the presence of European Union– and Japanese-owned activity. We also look at the presence of foreign-owned establishments within two-digit industrial sectors and at the entry of foreign-owned establishments.

We analyze the real production activity of foreign-owned establishments located in Britain. Much empirical research addressing the issue of how multinational investment affects the local economy has used data on the flows or stocks of foreign direct investment. Figure 4.5 shows the time trend in inward and outward FDI[12] from the United Kingdom. This rose over the 1980s, fell off during the early 1990s, and recovered up to the mid-1990s (since 1996 it has grown much more rapidly). But foreign production (or even investment by foreign-owned firms) and FDI are not the same thing. The former is a measure of the amount of real activity that is undertaken by a firm that is resident in another country, while the latter is a measure of the flow of financial capital. They will differ to the extent that foreign-owned firms finance expenditure from local capital markets and repatriate profits back to the parent country. This difference is pointed out

11. U.S.- and Canadian-owned establishments.
12. Data from OECD SourceOECD database (www.sourceoecd.org).

by Auerbach and Hassett (1993). Grubert and Mutti (1991) show that the two series are unrelated using data on U.S. firms' investment in Canada.

Table 4.3 shows how employment, value added, and investment are broken down between different nationalities of ownership in our sample. The main entry rows give the totals of value added, employment, and investment. While employment declined over this period, total value added and investment have increased. In our sample the proportion of employment by foreign-owned establishments has risen by around 10 percentage points over this period, and the composition has changed. The proportion of employment in North American–owned establishments has fluctuated but increased over the whole period. There has also been an increase in the proportion of employment in European- and Japanese-owned establishments. Foreign-owned establishments account for a larger percentage of total value added and investment than they do the number of establishments (from table 4.1 we see that 12.4 percent of establishments in the sample

Table 4.3 **Percentage of Sample by Nationality of Owner**

	1980	1984	1988	1992	1996
Employment (millions)	4.1	3.6	5.0	3.0	2.6
U.K.-owned	83.7	83.9	90.3	78.8	73.1
North American	12.1	11.2	6.2	10.6	13.3
European Union	2.5	2.4	1.7	5.6	7.7
Other European	1.3	1.8	1.2	2.7	3.2
Japanese	0.0	0.1	0.3	1.8	2.0
Other foreign	0.4	0.6	0.3	0.6	0.7
Value added (1980 £millions)	37,924	39,991	45,229	40,991	43,363
U.K.-owned	80.5	79.1	79.8	73.5	65.6
North American	15.3	15.6	13.4	14.4	20.6
European Union	2.5	2.7	3.5	5.6	7.7
Other European	1.3	1.8	2.0	3.1	3.1
Japanese	0.0	0.1	0.5	2.3	1.9
Other foreign	0.4	0.7	0.9	1.0	1.0
Investment (1980 £millions)	4,573	4,760	6,125	5,779	6,973
U.K.-owned	79.1	79.4	77.9	68.0	60.7
North American	15.2	15.3	12.0	15.0	20.3
European Union	3.0	2.5	3.5	6.1	11.1
Other European	2.2	2.1	3.5	4.7	3.4
Japanese	0.1	0.3	2.5	5.2	3.2[a]
Other foreign	0.3	0.3	0.6	1.0	1.3

Source: Authors' calculations using ARD.

Note: Percentages are calculated from our cleaned-up sample. North American includes U.S.- and Canadian-owned. European Union countries are Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain.

[a]In the full sample, Japanese investment accounts for over 4 percent of total investment in 1996; however, some establishments are excluded from our sample because they have negative value added (see appendix).

were foreign owned in 1996). The proportions of value added and investment accounted for by each ownership nationality follow a broadly similar pattern to the employment shares, except for Japanese-owned establishments, which consistently accounted for a larger share of investment than employment or value added.

Table 4.4 shows how activity in foreign-owned establishments is divided across two-digit industries within the population. The first column gives the proportion of total manufacturing employment in foreign-owned establishments in each industry in 1980. Column (2) shows the same figure for 1996. In 1980 nearly 20 percent of all employment in foreign-owned firms was in the mechanical engineering industry (32). By 1996, the sector that accounted for the highest proportion of employment in foreign-owned firms was motor vehicles (35), which increased from around 11 percent of total employment in foreign-owned establishments in 1980 to 16 percent in 1996.

Foreign-owned firms may enter the United Kingdom either by taking over an existing establishment or by setting up a greenfield site. The final four columns of table 4.4 show how both foreign- and domestic-owned entrants of different types were distributed across industries. The distribution of foreign-owned greenfield entrants shown in column (3) can be compared to that of domestic-owned greenfield entrants in column (4). Foreign-owned greenfield entrants were more likely to be in high-tech sectors such as chemicals (25), office machinery and data processing equipment (33), and electrical and electronic engineering (34) than their domestic-owned counterparts, but less likely to be in the food, drink, and tobacco (41/42) and clothing (45) industries.

Table 4.5 shows the extent of foreign ownership within each sector. Columns (1) and (2) show that in most industries this period saw an increase in the proportion of employment that was in foreign-owned establishments, notably in the office machinery and data processing equipment (33) and motor vehicles (35) sectors, where in 1996 over 60 percent of employment was in foreign-owned establishments. Only two industries experienced a decline in the proportion of employment in foreign-owned establishments: instrument engineering (37) and other manufacturing (49).

Columns (3) to (5) show the proportion of greenfield entrants and exiting and incumbent establishments that were foreign owned for each industry. In almost all industries the proportion of greenfield entrants is less than the proportion of incumbents, which suggests that the growth in the share of employment is due more to changes in employment patterns between surviving establishments (i.e., employment growth in foreign-owned incumbents and a decline in employment levels in domestic incumbents) than to greenfield entry. The final three columns show the proportion of foreign entrants within an industry that enter via setting up a greenfield site versus a takeover. Takeover is the dominant form of entry in all industries

Table 4.4 **Sectoral Composition of Employment and Entry in the Population of Foreign-Owned Establishments**

Two-Digit Industry (SIC80)	Total Manufacturing Employment in Foreign-Owned Establishments (%) 1980 (1)	1996 (2)	Foreign Greenfield Entrants (%) (3)	Domestic Greenfield Entrants (%) (4)	Domestic-to-Foreign Takeovers (%) (5)	Foreign-to-Domestic Takeovers (%) (6)
22 metal manufacturing	3.3	1.9	2.8	1.7	3.3	3.5
24 nonmetallic mineral products	2.0	2.2	2.7	3.7	4.5	4.1
25 chemicals	12.5	11.8	9.6	3.0	8.9	8.7
31 metal goods not elsewhere specified	3.9	3.9	6.2	9.2	7.1	6.5
32 mechanical engineering	19.7	12.3	17.5	14.9	15.6	18.4
33 office machinery and data-processing equipment	2.4	4.4	3.4	1.5	1.7	1.2
34 electrical and electronic engineering	15.9	14.3	16.3	12.0	13.7	12.0
35 motor vehicles	10.5	16.2	3.6	2.4	4.3	4.4
36 other transport	0.6	4.1	2.5	2.1	2.3	1.5
37 instrument engineering	2.9	2.3	5.9	2.6	3.8	4.3
41/42 food, drink, and tobacco	9.0	9.5	4.6	8.2	6.4	6.6
43 textiles	1.2	1.4	1.8	3.1	2.5	3.0
45 clothing	1.5	1.0	0.9	7.8	1.6	1.6
47 paper and paper products	6.9	7.1	11.0	10.1	12.5	12.8
48 rubber and plastics	5.4	5.6	5.4	5.7	8.0	6.9
49 other manufacturing	1.1	0.8	3.1	3.7	1.4	1.4
Total (%)	100.0	100.0	100.0	100.0	100.0	100.0
Total number 1980–1996			1,519	28,547	2,055	1,093

Notes: Columns (1) and (2) show the distribution of total manufacturing employment in foreign-owned establishments across industries. Columns (3) through (6) show how establishments were distributed across industries for each category of entrant. These are the annual average percent for 1980–1996. The omitted sectors (21, 23, 26, 44, and 46) each accounted for less than 1 percent of employment in foreign-owned establishments.

Table 4.5 **Within-Industry Shares of Foreign Activity, 1980–1996**

Two-Digit Industry (SIC80)	Industry Employment in Foreign-Owned Establishments (%)		Foreign-Owned Establishments (%)			Industry Foreign Entrants (%)		
							Takeover	
	1980 (1)	1996 (2)	Industry Greenfield Entrants (3)	Industry Exits (4)	Industry Incumbents (5)	Greenfield (6)	D-F (7)	F-F (8)
22 metal manufacturing	16.2	15.7	7.8	9.4	11.5	36.8	59.75	—
24 nonmetallic mineral products	6.8	11.3	3.7	4.9	5.9	29.9	67.2	—
25 chemicals	31.2	38.0	14.5	21.1	23.5	41.2	51.4	7.4
31 metal goods not elsewhere specified	8.3	14.3	3.5	3.7	3.9	37.0	57.5	5.5
32 mechanical engineering	21.1	23.2	5.9	7.6	7.6	41.9	50.6	7.4
33 office machinery and data-processing equipment	48.3	67.4	10.7	13.4	17.9	58.4	38.2	—
34 electrical and electronic engineering	20.8	27.0	6.7	11.4	11.1	44.0	50.1	5.9
35 motor vehicles	23.1	61.9	7.3	7.4	10.0	36.0	58.7	5.3
36 other transport	3.0	18.6	6.1	6.2	6.2	41.8	51.7	6.6
37 instrument engineering	28.0	22.6	10.8	14.7	11.2	51.2	45.4	3.5
41/42 food, drink, and tobacco	11.5	16.7	2.9	4.6	5.3	33.0	62.3	4.7
43 textiles	3.3	7.5	3.0	2.9	2.6	32.1	60.7	7.1
45 clothing	3.8	4.8	0.6	1.2	1.5	28.6	67.4	—
47 paper and paper products	13.1	16.8	5.5	7.8	6.6	37.3	57.4	5.4
48 rubber and plastics	19.2	23.2	4.8	6.3	7.6	31.7	63.7	4.6
49 other manufacturing	14.9	12.0	4.3	6.2	4.5	58.8	36.3	—
Mean	18.7	24.7	7.8	9.4	7.9	41.3	51.3	7.4

Notes: D-F = domestic to foreign. F-F = foreign to foreign. Columns (1) and (2) show the annual average percentage of employment in foreign-owned establishments within each industry, 1980–1996. Columns (3) through (8) show the annual average percentage of establishments within each industry for each category, 1980–1996. The omitted sectors (21, 23, 26, 44, and 46) each account for less than 1 percent of employment in foreign-owned establishments. Dashes indicate that figures cannot be disclosed for data confidentiality reasons.

Table 4.6 Distribution of Establishments by Nationality

	Establishments	Observations
Always domestic	38,725	173,102
Always foreign	1,248	7,340
Domestic to foreign	2,342	21,028
Foreign to domestic	1,091	9,895

Note: Calculated from sample of establishments from 1980 to 1996.

except office machinery and data processing equipment (33) and instrument engineering (37), although in most cases it does not comprise a much higher proportion of entry than greenfield.

In the next section we compare the characteristics of domestic- and foreign-owned establishments and divide our sample into two groups: (1) establishments that are either always domestic owned or always foreign owned, and (2) establishments that change nationality between foreign and domestic ownership (at any point between 1973 and 1996). Note that the first group also includes establishments that are taken over—that is, those that go from domestic to domestic ownership or from foreign to foreign ownership. Note that all categories include both greenfield entrants and incumbents. Table 4.6 shows that the establishments that remain under U.K. ownership make up the largest proportion of establishments. The next largest category is those that are initially domestic and are taken over by a foreign-owned firm.

4.4 Characteristics of Establishments

This section compares the characteristics of foreign-owned manufacturing establishments that operate in Britain with U.K.-owned establishments. Figure 4.6 shows real value added per worker in French-, German-, Japanese-, and U.S.-owned establishments relative to U.K.-owned establishments. These were calculated by aggregating up the establishment-level data to the nationality-year level and constructing labor productivity measures in an analogous way to the aggregate measures shown in figure 4.2. Value added per worker in U.S.-owned establishments increased relative to that in U.K.-owned ones. This is in contrast to figure 4.2, where we saw that the level of labor productivity in manufacturing activity located in the United States became more similar to that located in the United Kingdom. This is interesting and suggests that one source of the convergence seen in figure 4.2 may be the increased productivity of U.S.-owned establishments located in Britain.

In this section we examine the differences between domestic- and foreign-owned establishments at the micro level. We first look at differences in labor

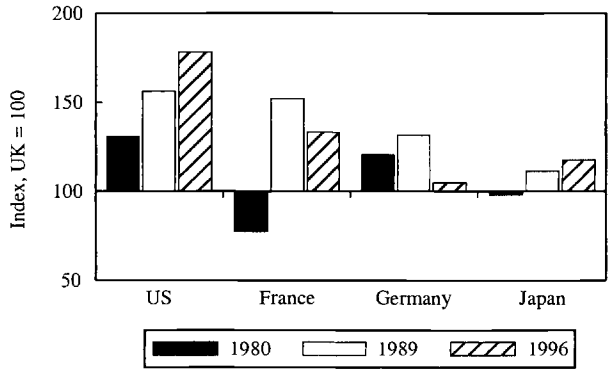

Fig. 4.6 Value added per worker in manufacturing, by nationality of ownership, establishments located in Britain
Source: Authors' calculations using the ARD.

productivity as measured by real value added per worker.[13] We also look at differences in the usage of intermediate inputs, in investment and in workforce composition. Differences in intermediates usage may reflect the fact that establishments are at different positions on the value added chain; for example, higher intermediates usage may indicate that an establishment is an assembly plant. Higher investment per worker will reflect more capital-intensive production and newer capital stock. These differences may to some extent explain differences in labor productivity. More intensive use of skilled workers may also explain labor productivity differences between establishments. We would expect labor productivity differences to be reflected in differences in wages. It may also be the case that the use of performance-related pay or efficiency wages induces higher labor productivity.[14]

4.4.1 Comparison of Firms That Are Always Foreign Owned

We first look at establishments that remain under either domestic or foreign ownership, over the entire period 1973–1996. Foreign-owned establishments are much larger than U.K.-owned, as is shown in table 4.7. They have higher output and value added per employee, invest more per employee, and use more intermediate inputs than U.K.-owned establishments. They also use a higher proportion of administrative, technical, and clerical (ATC) workers (used as a measure of skilled workers) and pay both ATC workers and operatives (OPS) higher wages.

13. We deflate reported value added by a four-digit output price deflator. Employment in the ARD is measured as the average number employed in an establishment during the year.

14. We do not present estimates of total factor productivity (TFP) because of a number of concerns we have about the appropriate methodology for measuring TFP in the presence of imperfectly competitive factor markets; see Hall (1988), Nickell (1996), and Klette (1999).

Table 4.7 Descriptive Statistics, Constant Nationality Sample

	1980		1996	
	Foreign	Domestic	Foreign	Domestic
Number of establishments	446	10,798	500	8,756
Gross output[a]	27,142	6,500	58,539	8,752
Value added[a]	8,982	2,312	15,798	3,013
Investment[a]	1,222	260	2,792	442
Intermediate inputs[a]	16,109	3,667	44,200	5,742
Employment	763	264	597	197
Output per employee[b]	40,541	22,891	87,570	37,461
Value added per employee[b]	13,326	8,071	25,869	13,028
Investment per employee[b]	1,948	808	3,528	1,709
Intermediate inputs per employee[b]	25,466	13,572	68,459	25,121
Employees ATC (%)	41	26	42[c]	33[c]
Average wage ATC[b]	6,797	5,874	9,984[c]	8,235[c]
Average wage OPS[b]	5,301	4,466	7,089[c]	5,414[c]

Source: Authors' calculations using the ARD data.

Notes: Price deflators for output and value added are at four-digit level and for investment are a combination of three-digit and aggregate. Wages are deflated by the Retail Prices Index. ATC = administrative, technical, and clerical; OPS = operatives.

[a]In 1980 UK£ (thousands).

[b]In 1980 UK£.

[c]Data are from 1995 (variable not available in 1996).

These findings are similar to the results seen in the U.S. work by Doms and Jensen (1998), where there were large unconditional differences in characteristics. That work found it to be important to compare domestic multinationals with their foreign-owned counterparts. It is not possible for us to differentiate U.K.-owned multinationals in our data. Instead we condition on observable and unobservable characteristics.

We concentrate on the following explanatory variables:

- nationality of parent, $f(F_i)$;
- age of the establishment, and a separate age profile for foreign-owned establishments, $g(\text{age}_{it}, F_i)$;
- size of establishment (measured by employment and normalized on mean four-digit industry employment), $h(\text{size}_{it})$;
- year of exit, exit_{it};
- time effects, and a separate time effect interacted with foreign ownership, $\delta(t_t, F_i)$,

where i indexes establishment and t time. We are concerned that there may be other unobservable differences in firms that may be correlated with age, size, or probability of exit. We allow for this by including a time-invariant firm-specific effect, η_i:

$$\ln(lp_{it}) = \beta f(F_i) + \gamma g(\text{age}_{it}, F_i) + \phi h(\text{size}_{it}) + \lambda \text{exit}_{it} + \delta t(t_t, F_i) + \eta_i + e_{it}.$$

We estimate this model in two steps (see Hsiao 1986). First we estimate

$$(1) \qquad \ln(lp_{it}) = \gamma g(\text{age}_{it}) + \phi h(\text{size}_{it}) + \lambda \text{exit}_{it} + \delta t(t_t) + \eta_i + e_{it}$$

using the within-groups estimator. Then we estimate the residual (including the fixed effect), take the time series mean, and estimate a regression of the form

$$(2) \qquad \overline{\hat{\eta}_i + \hat{e}_{it}} = \beta f(F_i) + u_i.$$

We assume a quadratic form for $g(\cdot)$ and $h(\cdot)$, while $f(\cdot)$ is represented by a series of dummies for different nationalities, and $t(\cdot)$ is a full set of time dummies (in some specifications interacted with a foreign-ownership dummy).

Table 4.8 compares differences in real value added per worker in establishments that do not change nationality (including greenfield entrants and incumbents). The top half of the table shows the first-step estimates (i.e., the coefficients from equation [1]), and the bottom half shows the second-step estimates (i.e., the coefficients from equation [2]). In column (1) labor productivity is regressed on age, size, a dummy for the year of exit, and a full set of time and industry dummies. In column (2) and subsequent columns the sample is restricted to only those establishments that we observe five or more times. Conditioning on this sample is necessary to enable us to use the within-groups estimator. This does not change the coefficients significantly. In column (3) individual establishment fixed effects are included. This changes the sign and significance of most variables.

In column (3) we see that labor productivity is increasing in age, and at an increasing rate, and is decreasing in size, although at a decreasing rate. This suggests that greenfield entrants (age equals 1) have lower value added per worker than incumbents. Establishments have lower labor productivity in their year of exit than in previous years. In column (4) we explore the idea that foreign-owned establishments may adapt to new technologies better than U.K.-owned establishments. We do this by interacting a foreign-ownership dummy with the age terms. If foreign-owned establishments improve their productivity faster with age, then this should be captured by this term. Although these interactions are not individually significant they are jointly significant (as indicated by the F-test). The domestic and foreign age effects are shown in figure 4.7 by the solid lines (the dashed lines are explained in the discussion after table 4.9). After twenty-four years the contribution of the age effect is almost twice as large in foreign-owned establishments as in domestic-owned ones. We also tried interacting the year dummies with foreign ownership. These were individually and jointly insignificant.

In the bottom half of the table we use the estimates from the top half to obtain estimates of the unexplained part of labor productivity, $\overline{\hat{\eta}_i + \hat{e}_{it}}$,

Table 4.8 **Differences in Real Value Added per Worker, Constant Nationality Sample**

	(1)	(2)	(3)	(4)
Dependent variable: $\ln(lp_{it})$				
Age	−0.005	−0.011	0.018	0.017
	(0.003)	(0.003)	(0.003)	(0.003)
Age^2	−0.00001	0.0002	0.0003	0.0003
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Foreign · age	—	—	—	0.014
				(0.013)
Foreign · age^2	—	—	—	0.0001
				(0.0004)
Size	0.029	0.032	−0.034	−0.034
	(0.002)	(0.003)	(0.006)	(0.006)
Size^2	−0.0007	−0.0009	0.001	0.0007
	(0.0001)	(0.0001)	(0.0002)	(0.0002)
Exit	−0.079	−0.099	−0.094	−0.093
	(0.027)	(0.028)	(0.022)	(0.022)
No. of observations	180,442	131,097	131,097	131,097
F-test, foreign-age interaction				21.45
P-value				0.00
Year	yes	yes	yes	yes[a]
Industry	yes	yes		
Within groups			yes	yes
Dependent variable: $\overline{\hat{\eta}_i + \hat{e}_{it}}$				
North American	—	—	0.517	0.311
			(0.042)	(0.044)
European Union	—	—	0.424	0.202
			(0.086)	(0.076)
Other European	—	—	0.351	0.168
			(0.052)	(0.053)
Japanese	—	—	0.496	0.376
			(0.132)	(0.132)
Other foreign	—	—	0.572	0.432
			(0.146)	(0.153)
No. of observations			13,909	13,909

Notes: Numbers in parentheses are robust standard errors. All regressions are grossed up to population weights and weighted by establishments' employment. $\ln(lp)$ = log of real value added per worker. Year indicates full set of year dummies; industry indicates full set of four-digit industry dummies. Size is number of employees normalized on four-digit industry-year average employment. Columns (2) to (4) contain only establishments that we observe at least five times.

[a]Includes interaction of year dummies with foreign-ownership dummy.

and regress this on dummies for different nationalities of ownership, as described in equation (2). The results in column (3) suggest that North American–owned establishments have around 68 percent higher labor productivity than U.K.-owned, EU-owned around 53 percent higher, other European-owned 42 percent higher, Japanese-owned around 64 percent,

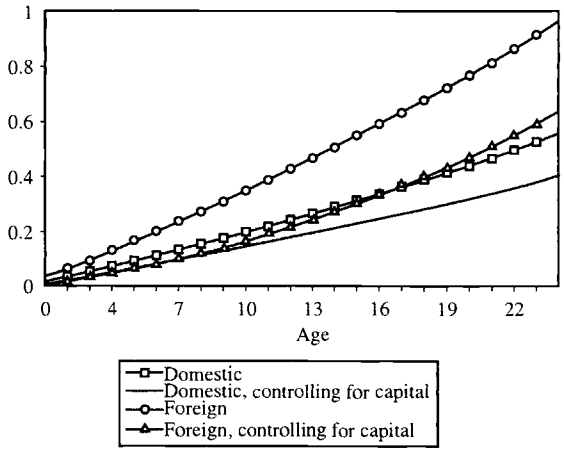

Fig. 4.7 Age effect on real value added per employee

and other foreign-owned around 77 percent higher.[15] These are all significant and quite large differences. In column (4) we repeat this exercise. Conditioning on differences in the age profile explains some of the differences in labor productivity, but large and significant differences remain. North American–owned establishments have around 36 percent higher labor productivity than U.K.-owned, EU-owned around 22 percent higher, other European-owned 18 percent higher, Japanese-owned around 46 percent, and other foreign-owned around 54 percent higher.

Differences in inputs are investigated in table 4.9. In the first column we see that investment per employee is increasing in age, at an increasing rate. The profile for foreign firms is different. While the coefficients on the interaction between the foreign dummy and age are individually insignificant, they are jointly significant. Not surprisingly, establishments invest less per employee in their final year before exit. In the bottom half of the table the unexplained part of investment per employee is regressed against the nationality of ownership dummies using the same procedure as before and as described by equation (2). The coefficients are all positive and significant. Their magnitude is larger than those for labor productivity. North American–owned establishments invest twice as much per worker as U.K.-owned, EU-owned around twice as much, other European-owned two and a half times as much, Japanese-owned around eight times as much, and other foreign-owned around twice as much. This suggests that the differences in value added per worker seen in table 4.8 are largely attributable to differences in investment levels.

15. $\exp(\beta) - 1$ is approximately the proportional difference, where β is the coefficient on a dummy variable in a log-linear regression.

Table 4.9 **Differences in Inputs, Constant Nationality Sample**

	Dependent Variable			
	ln(investment per employee)$_{it}$ (1)	ln(proportion skilled workers)$_{it}$ (2)	ln(average skilled wage)$_{it}$ (3)	ln(average operative wage)$_{it}$ (4)
Age	0.010	0.003	0.024	0.012
	(0.005)	(0.002)	(0.001)	(0.001)
Age^2	0.0007	0.00014	−0.00014	0.00004
	(0.0002)	(0.00007)	(0.00005)	(0.00004)
Foreign · age	−0.010	−0.0001	−0.002	0.005
	(0.018)	(0.0055)	(0.004)	(0.005)
Foreign · age^2	0.0009	−0.0001	0.0003	−0.0001
	(0.0006)	(0.0002)	(0.0001)	(0.0002)
Size	−0.031	−0.004	−0.0007	−0.010
	(0.009)	(0.003)	(0.002)	(0.003)
Size^2	0.0008	0.00003	0.0002	0.0002
	(0.0003)	(0.00013)	(0.0001)	(0.0001)
Exit	−0.106	−0.013	−0.009	−0.012
	(0.042)	(0.013)	(0.010)	(0.009)
No. of observations	122,398	125,917	125,910	124,525
F-test, foreign-age interaction	8.08	3.25	31.29	4.03
P-value	0.00	0.04	0.00	0.02
Year	yes	yes	yes	yes
Within groups	yes	yes	yes	yes
Dependent variable: $\widehat{\eta_i + e_{it}}$				
North American	0.817	0.386	0.183	0.179
	(0.095)	(0.055)	(0.022)	(0.021)
European Union	0.713	0.418	0.197	0.108
	(0.097)	(0.074)	(0.024)	(0.027)
Other European	0.934	0.166	0.157	0.136
	(0.137)	(0.088)	(0.026)	(0.038)
Japanese	2.25	0.012	0.271	0.166
	(0.39)	(0.066)	(0.075)	(0.109)
Other foreign	1.09	0.448	0.133	0.185
	(0.31)	(0.131)	(0.092)	(0.096)
No. of observations	13,898	13,908	13,908	13,832

Notes: Numbers in parentheses are robust standard errors. All regressions are grossed up to population weights and weighted by establishments' employment. Year indicates full set of year dummies. Size is number of employees normalized on four-digit industry–year average employment.

In figure 4.7 we investigate the extent to which the steeper age profile for labor productivity in foreign-owned establishments is explained by differences in their capital stocks. We run a regression of capital stock per employee similar to that shown in column (1). We take the coefficients on the age and foreign-age profiles and subtract them, multiplied by the average share of capital in value added, from the age profiles for labor productivity

from column (4) in table 4.8.[16] These capital-adjusted age profiles for labor productivity are shown by the dashed lines in figure 4.7. We see that the age profiles are now very close for the first ten years. This is because foreign-owned firms have both higher labor productivity and a correspondingly higher capital stock. After twenty-two years the adjusted profiles diverge by around 20 percentage points.

Finally we investigate differences in the type of workers employed and their average wages. In column (2) we see that the proportion of skilled workers in an establishment's workforce is increasing in age and in size. We also see that foreign-owned establishments employ more skilled (ATC) workers. This could also partly explain higher levels of labor productivity. In columns (3) and (4) we see that wages are increasing in age, decreasing in size, and lower in the year before exit. We see that foreign-owned establishments pay higher wages to both skilled workers and OPS, which is consistent with higher levels of labor productivity.

4.4.2 Comparison of Firms That Change Nationality

In this section we compare establishments that change nationality and look at how their characteristics compare before and after the ownership change. Table 4.10 describes establishments that change nationality (at some point between 1973 and 1996).[17] The first two columns consider establishments that go from being U.K. owned to foreign owned and describe their characteristics before and after the takeover. The size of establishment does not change noticeably, apart from a fall in average employment. Labor productivity, investment per employee, and wages all increase. The final two columns describe establishments that go from being foreign to U.K. owned. We observe fewer of these. Labor productivity prior to takeover is higher than for the domestic to foreign takeovers. The size of establishment is on average less after the change of ownership, while labor productivity remains fairly stable.

For this group of establishments, those that change nationality, we consider the same variables as for the constant nationality group, and we additionally consider the number of years since the establishment changed nationality (t.o.) and whether the change of ownership was from domestic to foreign or vice versa. In this case we can estimate the equation directly because the foreign-ownership dummies are now time varying:

$$(3)\quad \ln(lp_{it}) = \beta f(F_{it}) + \gamma g(\text{age}_{it}, \text{t.o.}) + \phi h(\text{size}_{it}) + \lambda \text{exit}_{it} + \delta t(t_i) + \eta_i + e_{it}.$$

16. The coefficients are age (0.015), age^2 (0.00035), age · foreign (0.0657), and age^2 · foreign (0.0015). The average share of capital in value added is 0.26.

17. We do not necessarily observe input and output data on an establishment both before and after the change in ownership nationality due to the random sampling.

Table 4.10 **Descriptive Statistics, Changing Nationality Sample**

	Domestic-to-Foreign Takeover		Foreign-to-Domestic Takeover	
	Before (domestic)	After (foreign)	Before (foreign)	After (domestic)
No. of observations	8,846	11,117	4,598	4,828
Gross output[a]	19,927	18,330	17,089	13,075
Value added[a]	7,104	6,014	5,541	4,439
Investment[a]	1,019	945	692	647
Intermediate inputs[a]	12,201	12,453	10,972	8,538
Employment	563	379	388	296
Output per employee[b]	35,804	45,764	39,903	39,402
Value added per employee[b]	12,385	15,098	13,428	13,580
Investment per employee[b]	1,633	2,101	1,587	1,769
Intermediate inputs per employee[b]	22,848	31,181	25,327	25,993
Employees ATC (%)	35	38	38	36
Average wage ATC[b]	7,509	7,824	7,365	8,113
Average wage OPS[b]	5,510	5,876	5,514	5,755

Source: Authors' calculations using the ARD data.

Notes: Price deflators for output and value added are at four-digit level, and for investment they are a combination of three-digit and aggregate. Wages are deflated by the RPI.

[a]In 1980 UK£ (thousands).

[b]In 1980 UK£.

The coefficient on the foreign nationality dummies, β, now picks up the difference in the level of labor productivity between when the establishment was domestic owned and when it was foreign owned.

Column (1) of table 4.11 shows estimates for the coefficients from this model including only nationality dummies and year effects (i.e., not controlling for unobservable firm-specific characteristics). This suggests that establishments have around 13 percent higher labor productivity when they are North American–owned, other European-owned around 5 percent higher, and other foreign-owned around 30 percent higher than when they were U.K.-owned.

In column (2) we condition on establishments that we observe at least five times; this makes little difference to the coefficient estimates. In column (3) we add four-digit industry dummies. This reduces the North American difference to around 6 percent. Japanese-owned establishments exhibit around 11 percent lower labor productivity, and other foreign-owned have around 9 percent higher labor productivity. In column (4) we condition on age, size, and year of exit. This drives the Japanese-owned dummy into insignificance. Labor productivity is increasing in size and is lower in the year before exit.

Table 4.11 **Differences in Real Value Added per Worker, Changing Nationality Sample**

	Dependent Variable				
	$\ln(lp_{it})$ (1)	$\ln(lp_{it})$ (2)	$\ln(lp_{it})$ (3)	$\ln(lp_{it})$ (4)	$\ln(lp_{it})$ (5)
North American	0.123	0.123	0.055	0.058	–0.018
	(0.021)	(0.021)	(0.023)	(0.021)	(0.030)
European Union	0.006	0.009	0.004	0.006	–0.041
	(0.028)	(0.029)	(0.031)	(0.029)	(0.039)
Other European	0.048	0.047	0.032	0.035	0.069
	(0.027)	(0.028)	(0.022)	(0.021)	(0.035)
Japanese	0.045	0.049	–0.113	–0.077	–0.205
	(0.083)	(0.084)	(0.060)	(0.061)	(0.089)
Other foreign	0.260	0.277	0.083	0.068	–0.012
	(0.052)	(0.054)	(0.041)	(0.040)	(0.040)
Age				0.003	0.025
				(0.007)	(0.011)
Age^2				0.00004	0.0002
				(0.00026)	(0.0003)
Size				0.036	–0.035
				(0.005)	(0.010)
$Size^2$				–0.0015	–0.00003
				(0.0003)	(0.00041)
Year of exit				–0.157	–0.118
				(0.049)	(0.046)
No. of observations	26,651	24,070	24,070	24,070	24,070
Year	yes	yes	yes	yes	yes
Industry			yes	yes	
Within groups					yes

Notes: Numbers in parentheses are robust standard errors. All regressions are grossed up to population weights and weighted by establishments' employment. Year indicates full set of year dummies; industry indicates full set of four-digit industry dummies. Size is number of employees normalized on four-digit industry-year average employment. Columns (2) to (4) include only establishments that we observe at least five times.

In column (5) we use a within-groups estimator to condition on establishment-specific unobservables. This means that the nationality coefficients are capturing the difference in productivity that arises due to different ownership. This drives the coefficient on North American ownership into insignificance. Establishments have around 7 percent higher labor productivity when they are owned by other European firms, compared to U.K.-owned. Those that are owned by Japanese firms have around 23 percent lower labor productivity compared to U.K.-owned firms.

We also experimented with allowing separate profiles for the number of years since the change in the nationality of ownership and whether it was domestic to foreign or foreign to domestic. This was intended to capture

learning effects. The coefficients were not significant. However, from table 4.10 it is clear that there is an improvement in value added per worker when establishments go from being domestic to foreign owned (from 12,385 to 15,098), whereas when they go in the other direction there is no increase.[18] In all specifications establishments have lower labor productivity in the year before they exit.

In table 4.12 we compare input usage in establishments that change nationality. In column (1) we regress the log of investment per worker on nationality dummies, age, size, year of exit, and year and industry dummies. In column (2) we use a within-groups estimator to control for unobservable differences in establishments. Establishments invest more per worker when they are North American, EU, or Japanese owned than when U.K. owned. Finally we look at whether differences in labor productivity are reflected in the type of labor used and in wages. In columns (3) and (4) we see that a higher proportion of skilled workers are employed when an establishment is under North American ownership than when it is U.K. owned. In columns (5) and (6) we see that skilled workers are paid more in Japanese-owned establishments, and in columns (7) and (8) we see that operatives are paid more when establishments are EU or other European owned.

4.5 Summary and Conclusions

This paper has investigated differences in characteristics between U.K.-owned and foreign-owned manufacturing establishments in Britain over the period 1980 to 1996. At the aggregate level we see that value added per worker has grown rapidly in the United Kingdom since the early 1980s. But the United Kingdom remains behind other Group of Five (G5) countries in the league tables. We see a somewhat similar picture when we look within the United Kingdom. In aggregate, U.K.-owned firms have lower labor productivity than firms of other nationalities operating in Great Britain. There are some differences between the international picture and that within Britain. Comparing across countries, over the period 1980 to 1996, the United Kingdom caught up with the United States, but looking within Britain we see that North American–owned firms widened the gap with domestic-owned firms.

When we look at the micro level we find that establishments that are always foreign owned have significantly higher labor productivity than those that are always domestic owned. In addition, labor productivity improves faster with age in foreign-owned establishments. This is matched, however, by an almost equivalent increase in levels of investment per employee.

18. Harris and Robinson (2002) look at TFP using the same data as here. They find some evidence that performance declined after acquisition. Conyon et al. (2002), using a different U.K. data source, do find a labor productivity increase as a result of foreign acquisition.

Table 4.12 **Differences in Inputs, Changing Nationality Sample**

	Dependent Variable							
	$\ln(\text{investment per employee})_{it}$		$\ln(\text{proportion skilled workers})_{it}$		$\ln(\text{average skilled wage})_{it}$		$\ln(\text{average operative wage})_{it}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
North American	0.118	0.067	0.076	0.048	0.062	0.011	0.046	0.007
	(0.028)	(0.041)	(0.010)	(0.013)	(0.006)	(0.009)	(0.007)	(0.008)
European Union	0.140	0.134	0.004	0.005	0.017	0.013	0.017	0.026
	(0.034)	(0.043)	(0.016)	(0.015)	(0.008)	(0.012)	(0.008)	(0.010)
Other European	0.051	0.069	–0.055	–0.037	0.030	0.015	0.031	0.033
	(0.048)	(0.062)	(0.020)	(0.022)	(0.011)	(0.016)	(0.009)	(0.010)
Japanese	0.481	0.461	–0.057	–0.028	0.009	0.105	–0.021	0.028
	(0.092)	(0.120)	(0.045)	(0.039)	(0.027)	(0.042)	(0.023)	(0.036)
Other foreign	–0.000	–0.146	–0.093	0.028	0.060	0.022	0.005	–0.018
	(0.096)	(0.105)	(0.040)	(0.021)	(0.019)	(0.018)	(0.017)	(0.015)
Age	–0.046	–0.010	0.009	0.010	–0.010	0.021	–0.009	0.013
	(0.012)	(0.015)	(0.004)	(0.005)	(0.003)	(0.003)	(0.002)	(0.002)
Age^2	0.0013	0.0018	–0.000	–0.0002	0.0002	0.0001	0.0002	0.0001
	(0.0005)	(0.0005)	(0.000)	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Size	0.075	–0.034	–0.002	–0.014	0.022	–0.002	0.028	–0.006
	(0.007)	(0.016)	(0.003)	(0.005)	(0.002)	(0.003)	(0.002)	(0.003)
Size^2	–0.0023	0.0007	0.0004	0.0009	–0.0009	–0.0001	–0.0089	0.0002
	(0.0003)	(0.0005)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0001)
Year of exit	–0.165	–0.109	0.038	0.030	0.014	0.020	0.036	0.023
	(0.104)	(0.092)	(0.035)	(0.027)	(0.029)	(0.025)	(0.028)	(0.023)
No. of observations	22,717		23,011		23,009		22,680	
Year	yes	yes	yes	yes	yes	yes	yes	yes
Industry	yes		yes		yes		yes	
Within groups		yes		yes		yes		yes

Notes: Numbers in parentheses are robust standard errors. All regressions are grossed up to population weights and weighted by establishments' employment. Year indicates full set of year dummies; industry indicates full set of four-digit industry dummies. Size is number of employees normalized on four-digit industry-year average employment.

Once we take these differences in capital intensity into account there is little difference between firms of different nationalities. When we look at establishments that change nationality, differences in labor productivity between foreign- and domestic-owned establishments are smaller.

These findings suggest that investment patterns, and usage of other inputs such as skilled workers, may go a long way toward explaining differences in value added per worker between establishments. This raises the question of why foreign-owned establishments are investing more and using more skilled workers. Do U.K.-owned establishments face some constraint, or is there some other explanation?

Appendix

Data

Our main data source is the Annual Respondents Database (ARD). These data are collected annually by the Office for National Statistics (ONS).[19] Two types of information are contained in the ARD. First, information on employment, industry, and group structure is available for the population of local units and establishments involved in production. A local unit is the smallest entity reported in ARD—effectively a plant (a single address).[20] An establishment can comprise one or more local units, (almost) always within the same four-digit industry (five-digit after 1992). Three main identifier codes are given—at the local unit, establishment, and enterprise group level. These indicate which local units and establishments are linked through common ownership.

Second, additional detailed information on inputs and output is collected for a sample of establishments. The sample comprises a census of larger establishments and, below a size threshold, a stratified sample of smaller establishments. For most of the period we consider the threshold was 100 employees. When collecting production-sector data the ONS asks that all nonproduction activities undertaken within the production establishments be excluded. There is no information on activities located in other countries.

We use data on the population of manufacturing establishments (we construct the population from the raw data), and to look at labor productivity and input usage we use a sample of manufacturing establishments. We gross up the sample in our main analysis. Further details of how we

19. See Barnes and Martin (2002), Griffith (1999), Oulton (1997), and Perry (1995) for descriptions of the structure of the ARD.

20. There are a small number of cases where the local unit is reporting for several plants. Since 1993 the list of local units comes from the InterDepartmental Business Register.

identify entrants, exitors, and ownership changes, of the grossing-up factors and of the sample we use, are given herein.

The ARD categorizes establishments into seven types: incorporated or company, sole proprietor, partnership, public corporation, central government body, local authority, and other (including non–profit-making bodies). We only use those classified as incorporated or company.[21] We exclude establishments that are not yet in production.

The entry and exit year of an establishment is calculated by identifying the first and last years that it is present in the population of incorporated establishments that are in production. We do this using data on the population back to 1973. The ONS has made changes to the establishment identifier codes several times. Where possible we map over coding changes using postal code and industry code information. If an establishment changes from a public corporation to being incorporated it counts as an entrant, as are establishments that go from being "not yet in production" to "in production."

The ARD gives the country of residence of the ultimate owner of the local unit, or establishment. The domestic-to-foreign and foreign-to-domestic takeovers are identified using the nationality of ownership indicator. There appear to be some miscodings in this variable. Where we observe the indicator changing for one year and then reverting to its previous value we assume that this is a miscoding. We discard establishments that appear to be taken over more than twice during the period.

The foreign ownership data in the ARD are collected under a separate annual survey that is also used for the FDI statistics: Thus, the ownership data for FDI are exactly the same as for ARD. These data are augmented with information from Dun and Bradstreet. The definition of FDI into Britain used for statistical purposes in collecting the 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 20% or more in the foreign enterprise. Other investments in which the investor does not have an effective voice in the management of the enterprise are mainly portfolio investments. (Central Statistical Office [CSO] 1996)

We allocate establishments to their mode four-digit standard industrial classification (SIC) code (so it is time invariant for each establishment). From 1992 we map SIC92 codes to SIC80 codes. The mapping is constructed using data from 1992 and 1993 when both industry codes are reported in the ARD. For each SIC92 we use the SIC80 from which the

21. At the local unit level these represent 96 percent of local units on average over the period 1980–1996.

largest number of local units was recoded. We verify these mappings using *Indexes to the Standard Industrial Classification of Economic Activities 1992* (ONS 1997).

We create grossing-up factors using employment in the population of establishments. Two populations are used for this purpose. The first contains all establishments that are always under either domestic or foreign ownership, and the second contains establishments that change ownership nationality due to a takeover. Grossing-up factors are calculated at the four-digit SIC80-size-year level. Grossing-up factors are not calculated by ownership nationality, as there are too many empty cells, where no foreign-owned establishments in a particular industry and size category are observed in the sample, but they are in the population.

Our Sample

In the establishment sample, output, investment, employment, and intermediate inputs are reported in nominal terms. We use price deflators for output and intermediate inputs at the four-digit industry level obtained from the ONS directly. Price indexes for investment in plant and machinery are at the two- and three-digit level from *Price Index Numbers for Current Cost Accounting* (CSO, various years). For investment in buildings and land an annual price index from *Price Index Numbers for Current Cost Accounting* (CSO, various years) is used. For vehicles an annual price index is obtained using prices series for road motor vehicles from three series from *Price Index Numbers for Current Cost Accounting* (CSO, various years). The first series ran from 1974 to 1983 (1980 = 100) and the second from 1984 to 1993 (1985 = 100), but there was no common year to convert it. The price index for private vehicles published in *Retail Prices 1914–1990* (CSO, 1991, tables 70 and 71) is used to merge the two series. The third series runs 1994 to 1996 (1995 = 100). The retail price index (RPI) is available at the aggregate level (www.statistics.gov.uk). Price deflator series for output and inputs are interpolated using the RPI up to 1996, where there are missing data.

Capital stock data are not available in the ARD, and we construct these data using the perpetual inventory method (PIM) at the establishment level. To do this we need to approximate the first-period capital stock. We do this by allocating each establishment a share of an estimated three-digit industry-level capital stock. The industry-level capital stocks are estimated using a 1979 value from a study by Oulton and O'Mahony (1990) and then using the PIM, with three-digit industry-level investment calculated by aggregating the ARD and grossing it up. An initial capital stock for each establishment is then estimated by using that establishment's share of energy usage within its three-digit industry in that year. Where the capital stock is negative we set the capital stock to zero.

Around 1 percent of observations in the sample have negative value

Table 4A.1 **Characteristics of Establishments with Wage Bill Greater Than Value Added**

Characteristic	Dummy = 1 if Wage Bill Greater than Value Added
Value added per employee	–0.37
	(0.01)
Investment per employee	–0.23
	(0.02)
Wage ATC	–0.01
	(0.01)
Wage OPS	–0.02
	(0.01)

Notes: The coefficients are from weighted regressions of log characteristic on a dummy equal to 1 for observations to be dropped from the sample, industry, and time dummies. Standard errors are in parentheses.

added (expenditure on intermediate goods is greater than the value of output). We drop these observations. Around 20 percent of observations have a wage bill that is greater than value added (that is, variable costs are greater than the value of output). This occurs more often in recessions but is spread fairly evenly over years, industries, ages of establishments, and foreign and domestic establishments. These observations have lower value added per employee, have lower investment, and pay lower wages, as shown in table 4A.1.

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