Why do foreign-owned firms in the UK have higher labour productivity?

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1. Introduction[1]

Foreign-owned firms in manufacturing have substantially higher labour productivity than domestically owned ones. This basic feature of the UK economy has been known for some time (Davies and Lyons 1991). The UK is not unique in this respect: the same is true of the US (Doms and Jensen 1998) and of Canada (Globerman *et al.* 1994). For the UK the productivity gap has been documented by Oulton (1998b); similar results have been reported by Griffith (1999a) and (1999b) and Wakelin *et al.* (1999).

The first aim of this chapter is to analyse the extent to which labour productivity differences are correlated with differences in input intensities. To what extent is the higher labour productivity in foreign-owned firms explained by the fact that they employ more physical or more human capital per unit of labour?

Foreign ownership is not confined to manufacturing which is only around a fifth of GDP anyway. So the second aim of this chapter is to see whether the foreign-domestic productivity gap is as large in the non-manufacturing part of the economy.

To anticipate the results, we find first that higher human and physical capital intensity can indeed account for most of the labour productivity gap in manufacturing. Second, we find similar gaps in the larger, non-manufacturing sector. Third, in the non-manufacturing sector too the productivity gap is largely explained by higher capital intensity. These findings prompt the question: if foreign-owned companies, located in Britain and employing British workers, use high human and physical capital intensity to achieve high productivity, why don't British-owned companies do the same?

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[1] Fuller versions of the research reported in this chapter will be found in two discussion papers, Oulton (1998b) and (1998c). A revised and expanded version of the second discussion paper is Oulton (2000). The research presented in the first discussion paper was financed by the Department of Trade and Industry, that in the second by the Leverhulme Trust as part of a wider project entitled *Job generation in the corporate sector* [F/59/AD]. To both of these I owe thanks. This chapter has benefited from helpful comments on earlier versions from Martin Baily, Peter Hart, Nicholas Owen, Nigel Pain, Martin Weale, and participants at the NIESR Conference on Foreign Investment in September 1999; I am grateful to all of these. I would also like to thank the staff of the Office for National Statistics at Newport, in particular Wendy Fader, for assistance in using the ARD. This research was carried out at the National Institute of Economic and Social Research prior to my taking up an appointment at the Bank of England. The views expressed are my own and are not necessarily those of any of the above persons nor of the Bank of England.

Below we discuss two alternative, not mutually exclusive, hypotheses capable of explaining these findings: first, the cost of capital is lower for foreign-owned companies; and second, foreign-owned companies use superior technology.

The two samples

The present study will employ two samples, one confined to manufacturing and the other covering the whole economy. Our first sample is of *establishments* (see below for the definition) in manufacturing and is drawn from the longitudinal database of the Annual Census of Production known as the ARD. We are particularly interested in capital intensity but the ARD contains no estimates of the capital stock, only of investment. So we use the investment series to construct our own estimates of the capital stock by a variant of the perpetual inventory method. Because we need a long series of investment, our sample excludes establishments which are only temporarily present in the ARD, i.e. establishments which are "born" or which "die" during the analysis period 1973-93. In fact our sample is of establishments continuously present in the ARD from 1973 to 1993 inclusive, which we call survivors. There were 1,752 such survivors of which 411 (24%) were foreign-owned in 1993. These survivors employed 1.8 million people in 1973, 27% of all employment recorded in the ARD, and 1.0 million in 1993, or 34.5% of ARD employment. The foreign-owned establishments employed 30.7% of the total in 1993.

The country of ownership of each survivor is known for every year. In practice, we use a threefold breakdown: US-owned, other foreign-owned, and UK-owned.

The ARD records the number of white collar and of blue collar workers separately, as well as the average wage of each of these groups. These measures are the basis for our estimates of human capital.

The findings cited above on productivity gaps in manufacturing for the UK, the US and Canada have been derived from studying longitudinal databases of each country's production census. Outside of manufacturing, no such source exists. Hence to study the non-manufacturing sector we utilise data drawn from company accounts.

Our second sample is of *companies* and is drawn from a large electronic database of company accounts, the OneSource database. This database, which has been employed in earlier work on employment growth (Hart and Oulton (1996), and (1999)) and productivity (Oulton 1998a), is described more fully below (section 4). In the version we use, the accounts relate to 1995. This second sample consists of some 32,000 companies employing 8.6 million people; of these, some 22,000 companies employing 5.2 million people were in the non-manufacturing sector. In this sample 35.0% of total employment is in foreign-owned companies.

In the companies sample we use the book value of fixed assets as our measure of physical capital. Obviously it would be better to use the value of fixed assets at current replacement cost but such figures are not published in company accounts. For labour input, the only measures available are the number of employees and the average wage.

The OneSource database covers both independent companies and subsidiaries. To avoid double-counting, e.g. including both the parent and the subsidiaries of which it is composed, we divide our companies into four groups: (1) subsidiaries owned by US companies; (2) subsidiaries owned by other foreign companies; (3) subsidiaries owned by UK companies; and (4) UK-registered independent companies which do not own any subsidiaries. So our breakdown by ownership is more detailed than in the ARD sample.

The two samples each have their own strengths and weaknesses. The quality of the measures of human and physical capital is higher for the ARD. On the other hand the ARD sample is confined to survivors in manufacturing only. The companies sample covers the whole corporate sector and has better information on ownership.

Outline of the chapter

The structure of the chapter is as follows. Section 2 describes our first data source, the ARD, and sets out how a sub-set of the ARD, consisting of those establishments which are continuously present from 1973 to 1993 inclusive, was constructed. For this sub-set we are able to make estimates of the physical capital stock. In section 3 we analyse the determinants of differences in human and physical capital intensity

between establishments, in particular the role of foreign ownership. We also quantify the relationship between labour productivity and the measurable inputs, human and physical capital. Section 4 then introduces our second data source, the OneSource database of company accounts, and describes how the companies sample was derived. Section 5 repeats for this sample the analysis of section 3 on the determinants of human and physical capital intensity and the causes of productivity differences. Then in section 6 we discuss two hypotheses which are capable of explaining the findings: Finally, section 7 summarises our conclusions.

2. The ARD

The ARD, or ABI Respondents Database to give it its full name, is an electronic database of the Annual Business Inquiry (Production), formerly known as the Annual Census of Production (ACOP). In principle, the ARD includes all the data collected under ACOP from 1970 to the present. It covers the whole of the production sector, manufacturing plus mining and quarrying and, for recent years, construction: see Oulton (1997) for a full description. The present chapter uses only the data for manufacturing.

The most basic unit in the ARD is the "local unit", defined as a plant or office at a single location. Above that is the establishment, which is the reporting unit. An establishment consists of at least one local unit (itself) and may consist of more. In recent years a bit under half of employment in "selected" establishments[2] has been in establishments consisting of just one local unit and nine tenths in establishments with no more than 10 local units. Most of the data in the ARD relate to the establishment as a whole. The establishment may or not be a company in the legal sense. In 1987, "company-based reporting" was introduced into the Census and the reporting units are now referred to as "businesses". But the larger companies continued to be split up into smaller units.[3]

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[2] A "selected" establishment is one which is required by law to fill in a return. Apart from being in scope to the inquiry, an establishment must be of a certain size, which normally means employing 20 or more people, to be selected.

[3] It is not clear without further research how much difference this change made. For clarity, and because most of the data used here were collected before the change to company-based reporting, we continue to use the term "establishment". Note that in American usage an establishment is a plant and this should be borne in mind when comparing the present results with US ones.

Three measures of output are available from the ARD. In descending order of size these are: gross output, net output and gross value added. Gross output and gross value added (GVA) are used, the latter mainly because it is additive across establishments and industries. Gross output and GVA which are reported in current prices were converted to 1990 prices using producer price indexes for each Class of the 1980 SIC (of which there are 22 within manufacturing: see Appendix A).[4] For the period studied here, industry is recorded in the ARD under the 1980 SIC.

Two measures of labour input are available from the ARD: the number of operatives and the number of administrative, technical and clerical employees (ATCs).[5] No data on hours worked are available at the establishment level. Apart from the split into operatives and ATCs, there are no data on skills. However, average wages for each group are given and these may be used as proxies for relative skills or human capital at a point in time.

Real intermediate input is also required for some of the comparisons but the ARD contains only nominal intermediate input. We deflate the latter, defined as nominal gross output minus nominal GVA, by the Producer Price Index for materials and fuel for each SIC80 Class.

Under the heading of investment, ACOP and the ARD distinguish four categories: (1) new building work; (2) land & existing buildings; (3) plant & machinery; and (4) vehicles. Each category except the first is measured as acquisitions less disposals. This means that each category of investment except the first can be, and frequently is, negative for an individual establishment. From 1992, the breakdown by type is no longer available at the establishment level. A further difficulty is that prior to 1979 the four categories are only recorded in the ARD for a minority of establishments; the reason for this is not clear. The upshot is that a breakdown by category is only available for the period 1979-91 inclusive. Total investment, the sum over these four

[4] For Classes 21, 36 and 44 no PPI exists so the PPI for manufacturing as a whole was used. These deflators were obtained from Datastream.

[5] In addition there is the small category of "working proprietors". Where available this has been amalgamated with ATCs.

categories, is therefore used as the investment measure. Total investment can also be negative at the establishment level.

Investment is recorded gross of depreciation. From 1988, investment includes assets acquired under financial leasing. Prior to 1988, financial leasing was omitted. It is important to note that though asset disposals are given as well as acquisitions, "the figures for disposals exclude amounts written off for capital assets which are scrapped" (Introduction to the *Summary Volume* of the Census of Production, various issues). In other words, scrapping is not recorded.

Investment in the ARD is also in current prices. It was deflated to 1990 prices by the implicit deflator for manufacturing investment (the latter obtained by dividing total manufacturing investment in current prices by investment in constant 1990 prices, both from the Blue Book via Datastream).

For the analysis of productivity, we are usually more interested in the capital stock, rather than in investment. Here we run up against a difficulty. The ARD contains no data on capital stocks, not even book values. So we must estimate stocks by cumulating investment flows. To do so, we have to assume an initial, year zero, capital stock. If the year zero is sufficiently far in the past, and the depreciation rate sufficiently high, the stock estimates for later years will not be too sensitive to the assumed initial stock. But thousands of establishments are entering and leaving the ARD every year. Capital stock estimates based on only a few years of cumulated investment will be too unreliable to use.

Our strategy to deal with this problem is to create a dataset of survivors, in this case establishments who are continuously present in the ARD from 1973 to 1993. We proceed as follows. We start with a benchmark capital stock in 1973 for each establishment. We then estimate the stock K in subsequent years by the standard perpetual inventory method:

$$K_t = I_t + (1-\delta)K_{t-1}$$

where I is real investment and δ is the depreciation rate. Depreciation measures the decline in the stock due to physical wear and tear, gradual obsolescence, and scrapping or retirement. U.S. research suggests that depreciation rates much higher than those assumed by the ONS for their "net stock" estimates are appropriate (Fraumeni 1997). In line with these results, an annual rate of depreciation of 7.5% is assumed. To get the initial capital stock for each establishment, we multiply each establishment's 1973 employment level by the capital-labour ratio for the SIC80 Class to which the establishment belongs.[6]

3. The importance of being foreign-owned

Characteristics of survivors

There are 1,752 establishments which are present throughout the period 1973-93 (the latest available year when this research began[7]). In 1973 employment in these survivors was nearly 1.8 million and constituted 29.6% of all employment recorded in the ARD. In 1993, the corresponding figures were just over 1 million or 34.5% of total ARD employment (ARD employment is about 80% of total employment in manufacturing). These survivors exhibited a wide range of size. In 1973, the 28 establishments with 7,500 or more employees accounted for 24.9% of employment in survivors; by 1993 there were only 8 such establishments and their employment share had halved to 12.8%.

The rates of growth of capital (and other inputs) vary across establishments. That these differences are cumulative and not just transitory can be seen from Table 1 which shows the standard deviation of the log of the capital-labour ratio by SIC80 Class in 1993. Analysis of variance shows that most of the overall variation of this variable, 59%, is due to variation within Classes, not between them. This is rather remarkable given that the capital estimates assume that in 1973 the capital-labour ratio was identical for every establishment in a given Class.[8] The question then arises,

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[6] I am grateful to my former colleague Mary O'Mahony for supplying me with these capital-labour ratios. The initial capital stocks for each Class have been derived by the perpetual inventory method using similar but more detailed assumptions about depreciation rates to the one in the text.

[7] The earliest year in the ARD is 1970 but the data for the years 1970-72 were not in a form amenable to analysis when the research was carried out.

[8] If we disaggregate further, industrial structure will of course explain more of the variation. The 1,752 survivors fall into 198 4 digit Activity Headings. Analysis of variance using Activity Headings

are there any systematic factors behind these differences in capital stock growth rates and the eventual differences in levels to which they give rise? In this section, we consider the possible role of foreign ownership.

It has long been known from the published results of ACOP that foreign-owned firms tend to have higher labour productivity than domestically-owned ones. Only a part of this disparity can be explained by a relative concentration of foreign-owned firms in high productivity sectors (Davies and Lyons 1991). What has not been so clear is the source of the foreign-owned firms' advantage.

Of the 1,752 surviving establishments, 176 were US-owned and a further 235 were owned by non-US foreign interests in 1993 (the latest year available).[9] The US-owned firms accounted for 16.6% of total employment and the foreign, non-US ones for 14.1%. Thus getting on for a third of employment amongst survivors was in foreign-owned firms. Table 2 first documents that the productivity gap between UK- and foreign-owned firms applies to survivors, as well as to manufacturing as a whole. In 1993, value added per employee was 55% higher in US-owned establishments and 25% higher in non-US foreign-owned establishments than in UK-owned ones. These huge gaps are similar in size to the cross-country gaps which are estimated to exist between UK labour productivity in aggregate manufacturing on the one hand and US, Japanese or European productivity on the other (O'Mahony 1999).

We can also see from Table 2 that the average worker in a US-owned establishments had 54% more capital to work with, and the average worker in other foreign-owned establishments 47% more, than did their counterparts in UK-owned ones. We can also note that the proportion of employment which is white collar (ATCs) is 7-10 percentage points higher in foreign-owned establishments. White collar workers on average earn more than blue collar ones and we can also see that within each category wages are higher in foreign-owned establishments. For operatives, wages are 16-24% higher and for ATCs, 12-20% higher. Since companies do not pay higher wages out

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instead of Classes shows that industrial structure can explain 58% of the variance of the log of capital intensity in 1993. But the average number of establishments per Activity Heading is now less than 9 so the additional explanatory power is rather spurious. If we could disaggregate still further, eventually everything could be explained by industrial structure.

of the goodness of their hearts, this suggests that workers in foreign-owned establishments are more skilled. Thus it appears to be the case that foreign-owned establishments, particularly US ones, employ substantially higher physical and human capital per worker.

Because the ARD allows us to look at the history of individual establishments, we can also compare growth rates by type of ownership (Table 3). Again the performance of foreign-owned establishments stands out. Value added per employee and capital per employee have both been rising much more rapidly in foreign-owned establishments. The capital stock of UK-owned establishments grew on average at only 1.04% p.a. over 1973-93, while that of US-owned ones grew at 2.86% p.a. and that of other foreign owned ones at 2.23%. However, there is an important contrast between US and other foreign establishments. In US-owned establishments, value added has been rising while in other foreign owned ones it has been falling, as it has too in UK-owned establishments. Furthermore, while employment has been falling in all types of establishment, it has done so most in other foreign-owned plants and least in US-owned ones.

These differences cannot be dismissed as due solely to differences in industrial structure as between foreign and domestic establishments. In 13 out of 17 Classes foreign-owned establishments have substantially higher capital per employee and in 12 out of 17 they have substantially higher value added per employee. UK-owned establishments have substantially higher value added per employee in only one Class (35): see Oulton (1998b), Table 10.

Analysing the foreign advantage

We now take a more formal approach and test whether, after controlling for industrial structure, ownership is a significant determinant of input intensities. To test our hypothesis, we carry out a cross section, multiple regression analysis of the following model:

[9] Foreign-owned establishments include those deemed to be controlled by enterprises incorporated overseas, as well as those which are wholly owned.

$$Z = \beta_0 + \beta_1 US + \beta_2 NON\text{-}US + \sum_{j=1}^{S-1} \beta_{j+2} Class_j + \varepsilon \qquad (1)$$

where Z is alternately capital per employee (K/L), the operative wage (w_{OP}), the ATC wage (w_{ATC}), the ATC proportion (ATC/L), intermediate input per employee (M/L), and value added per employee (V/L); all these variables are in logs. *US* is a dummy variable taking the value 1 if the establishment is US-owned. *NON-US* is a similar dummy variable taking the value 1 if the establishment is foreign-owned but not US-owned. The *Class* variables are dummies for membership in each of the S classes within SIC80 manufacturing. In practice S=21 since there are no observations in Class 21; see Appendix A for the names of the Classes.

Table 4 shows the results. All the major differences noted above between foreign and UK-owned establishments turn out to be statistically highly significant, even when we correct for industrial structure. Both US and non-US owned foreign establishments have higher productivity, a higher ATC proportion, higher wages, and higher capital per worker than their domestic counterparts. By comparing the coefficients on the ownership dummies with the crude, percentage gaps in Table 2, we see that industrial structure does matter. But after adjustment, we still find large differences between foreign and UK-owned establishments. The largest adjusted difference is in intermediate input per employee: 55% for US-owned and 54% for other foreign owned establishments.[10]

However, we should also note from Table 2 that foreign establishments, particularly US ones, tend to be larger than domestic ones. It is generally believed that larger establishments pay higher wages than smaller ones and have higher labour productivity; this is true with our data too. So the foreign advantage might be an artefact. If size measured by employment is included, it is significant in the equations for wages, the ATC proportion and intermediate input but has little effect on the

[10] Doms and Jensen (1998) and Globerman *et al.* (1994) report similar findings for the US and Canada respectively, namely that foreign-owned firms have higher labour productivity, higher capital intensity and use more skilled labour and that these differences remain after controlling for industrial composition and size. As regards the role of capital intensity, note that these authors are forced to use proxies: book value in the case of Doms and Jensen and energy input in the case of Globerman *et al.* In this respect, the results in the present chapter may be regarded as stronger, at least for manufacturing.

coefficients on the ownership dummies. In any case, one might argue that size should be excluded since it is under the control of management.[11]

Turning to productivity, our hypothesis is that it may differ between establishments because (a) some establishments use more inputs per worker and (b) some establishments may have access to superior technology or superior business systems or may have superior products, i.e. products which can be sold at a higher price. Input intensity is measured by physical capital per worker and human capital per worker. We have no measures of superior technology or products but we can check whether, after controlling for input intensity, higher productivity is associated with ownership. Note that different types of ownership may be associated with greater or smaller input intensity. So ownership can have a direct effect on productivity, say if foreign-owned establishments have access to superior technology, and an indirect effect, say if they are more capital intensive. We therefore fit the following model:

$$\ln(V/L) = \beta_0 + \beta_1 \ln(K/L) + \beta_2 \ln(ATC/L) + \beta_3 \ln(w_{OP}) + \beta_4 \ln(w_{ATC}) + \beta_5 US + \beta_6 NON\text{-}US + \sum_{j=1}^{S-1} \beta_{j+6} Class_j + \varepsilon \quad (2)$$

This equation should not be interpreted as a structural relationship. Rather its aim is descriptive: how much of the variance of productivity can the included variables explain? The results of fitting this model for 1989 and 1993 appear in Table 5. 1993 is used because it is the latest year available and the influence of the starting values for the capital stock estimates will be minimised. On the other hand 1993 is a recession year while 1989 is a peak. The results for the two years are in fact very similar though slightly stronger for 1989.

We can explain about half the variance of labour productivity across establishments. Capital per worker is highly significant though the size of the coefficient is sensitive to the other variables included. The variables measuring human capital per worker are also highly significant. Including the wage variables adds considerably to the

[11] Results including employment size are in Oulton (1998b), Table 11. The role of size is discussed further in section 5 below.

explanatory power. But because the wage variables might be also picking up rent-sharing or union power, results are shown as well with these variables excluded.

The dummy for US ownership is significant but that for other foreign ownership is not. In other words, non-US foreign ownership leads to higher physical and human capital, but no further effect on productivity. But US-owned plants seem to have some additional advantage, over and above greater capital per worker of both types. This might be superior management, better process technology or better products (i.e. products able to command a higher price in the market). Whatever the source, US ownership conferred an additional advantage of between 9 and 20% in 1993 (14–21% in 1989).[12] However, since our analysis is confined to survivors we cannot allow for the impact of the more recent Japanese and Korean multinationals, who have made large, green field investments. If these could be included, we might need to take a more favourable view of non-US foreign ownership.

A possible way of minimising the effect of foreign ownership is to argue that foreign companies are just particularly good at picking winners. According to this view, the foreign-owned establishments would have been successful anyway. Perceiving the likelihood of success, foreign companies took them over. The problem with this argument is that it requires remarkable prescience on the part of the foreign companies, since many of these establishments have been in foreign ownership for much of the period studied. For example, 176 of the 1,752 survivors were in US ownership in 1993. Of these, three quarters had been US-owned for 15 years or more and over half for 20 years or more. (Other foreign ownership tends to be more recent. One half of the 235 establishments in this category in 1993 had been so for 6 years or less and less than a third for 15 or more.)

As an alternative to a dummy variable for current ownership, we can also measure the impact of ownership by the number of years in US or other foreign ownership. This is a rather different concept from current ownership status since some establishments

[12] If size (log employment) is included as an additional regressor in equation (2), its coefficient is significant and positive except in 1989 when wages are included. Its inclusion has little effect on the coefficient on capital intensity. The US ownership dummy remains significant, except in 1993 with wages included, but reduced in size. This suggests that part of the reason for US success may be that

may have been in US ownership for part of our period even though currently they are not. In fact, 183 establishments ceased to be US-owned and 193 became US-owned at some point over 1973-93. Altogether 305 establishments experienced some period of US ownership. Changes in and out of other foreign ownership were of similar frequency: 156 establishments ceased to be in this category while 327 entered it.

Instead of the ownership dummies, we can enter years under US ownership and years under other foreign ownership into the regression of equation (2). The third and sixth columns of Table 5 show the results. Years of US ownership are significant, while years of other foreign ownership are not. Each year under US ownership raises labour productivity by between 0.5 and 0.8%. The conclusion is that more than just picking winners is involved in the superior performance of US-owned firms.[13]

We can now employ the estimates reported in Tables 4 and 5 to decompose the productivity gap between foreign and UK-owned establishments into an explained and an unexplained portion. From Table 4, we see that, after controlling for industrial structure, US ownership confers an advantage in value added per worker of (exp[0.2756]-1 =) 31.7%. Other foreign ownership confers an advantage of 14.6%, again after controlling for industrial structure. These figures should be compared with the unadjusted gaps of 55% and 25% respectively (Table 2). The contribution of each measured input to the US advantage is calculated as its estimated coefficient in the regression for ln(*V/L*), from Table 5, multiplied by the estimated coefficient on the US ownership dummy in the regression with this input as the dependent variable (from Table 4). For example, the contribution of capital to explaining the US advantage in 1993, if the wage variables are excluded, is 0.2948 x 0.2643 = 0.0779 which expressed as a percentage is 8.1%. The contribution of each input to the other foreign advantage is calculated analogously.

The estimated contributions appear in Table 6. If the wage variables are excluded, capital intensity explains 26% of the US advantage and 60% of the other foreign advantage. With wages included, the contribution of capital is halved, to 12% and

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US owned establishments are larger (see Table 2). But it could equally well be argued that high productivity companies are able to become larger than their less productive competitors.

29% respectively. Interpreting the wage variables and the ATC proportion as measuring labour quality, between them they account for 49% of the US advantage and 68% of the other foreign advantage. All told, the measured inputs, including labour quality, account for 61% of the US advantage and 97% of the other foreign one.

4. The One Source database of company accounts

We now turn to the results employing company data. Our data are derived from the OneSource CD-ROM entitled "UK Companies, Volume 1" for December 1996. This contains the accounts of some 110,000 larger UK companies. The ultimate source is the accounts which companies are legally required to deposit at Companies House. The criteria for inclusion in "Volume 1" is stated by OneSource to be: "All public limited companies, all companies with employees greater than 50, and the top companies based on turnover, net worth, total assets, or shareholders funds (whichever is largest) up to a maximum of 110,000 companies". Only "live" companies are included. Companies which are dormant, dissolved, in liquidation, or in the process of being wound up are excluded.

The database contains the latest available accounts and related information for each included company, including the date of the end of the accounting period. Though the CD-ROM which we used is dated December 1996, the data relate to a somewhat earlier period, which varies between companies according to the date of their accounts. For the great majority of companies, this date falls within 1995 (the average is about two thirds of the way through 1995). Hence for simplicity we refer to the year to which the data relate as 1995.[14] Companies are classified under the 1980 SIC.

Output can be measured by either sales or value added (the latter defined as trading profit plus the wage bill). Physical capital is measured by the book value of fixed

[13] These results are thus in line with a large literature stressing the productive effects of foreign investment (e.g. Dunning 1981; Barrell and Pain 1997).

assets. Clearly, this is likely to be a very noisy measure of the true value, since it is in nominal terms and companies differ both in the time pattern of asset acquisition and in their depreciation practices. Employment is a headcount. There is no breakdown by type of labour or by skill but we can calculate the average wage which may serve as a proxy for the average level of human capital per worker.

For each company, OneSource gives first, the country of the holding company which owns the company in question and second, the country of the ultimate holding company. Either or both of these may of course be missing; "country" can include the UK. Foreign-owned companies are broken down into two groups, (a) US-owned companies and (b) other foreign-owned companies. A company is classified as US-owned if *either* the country of the ultimate holding company is the US *or*, if this is missing, the country of the holding company is the US. Other foreign ownership is determined analogously.

Amongst UK-owned companies we distinguish between subsidiaries of UK-owned companies and independent UK companies which do not own any subsidiaries. This is to avoid double-counting: if e.g. a UK-owned company owns five UK subsidiaries, we include the five subsidiaries but not the holding company.[15] Avoidance of double counting leads to the elimination of 21,009 companies. A company is classified as a UK-owned subsidiary if is not an ultimate holding company and *either* the country of its ultimate holding company is the UK *or*, if this is missing, the country of its holding company is the UK. A company is classified as a UK-owned independent without subsidiaries if it is not an ultimate holding company and it is not a subsidiary.

These four categories should be mutually exclusive but unfortunately this is not the case in practice. There is an inconsistency in the OneSource database: some companies are classified as subsidiaries by one variable, the subsidiary indicator variable, but as independent by the type of ownership variable; the latter variable is the one used to exclude ultimate holding companies. We cannot resolve this

[14] We excluded 1,104 companies whose accounts predated 1994. A few other companies were also excluded since they claimed to have zero employees, even though supposedly actively trading.

[15] The accounts for a holding company would normally be consolidated, i.e. they would incorporate the results of its subsidiaries. In some cases, the results of foreign subsidiaries may be included in the accounts of UK-based holding companies. Our procedure ensures that such results are also excluded.

inconsistency so we simply drop the companies which fall into more than one category. This leads to the elimination of 1,447 companies.

A further 45,260 companies are lost due to missing or zero values. In summary, we start with 107,829 companies (after eliminating companies with out-of-date accounts), we eliminate a further 67,716 and the sample is then 40,113 companies which employed collectively 10.020 million people. Value added is available for a smaller number: 36,226 companies employing 9.391 million. We also exclude loss-making companies, and so we arrive eventually at 31,954 companies employing 8.639 million employees (see Appendix B, Table B2).[16] The private sector, a wider category than the corporate sector, employed just over 17 million in mid-1995 when self-employment is excluded (*Economic Trends Annual Supplement 1997*, Table 3.8), so over half of employment in the corporate sector is covered by our analysis.

5. Ownership and productivity: results for company data

We start by considering some descriptive statistics (see Appendix B for the detail). Overall, UK subsidiaries account for 54.5% of employment, US-owned companies for 13.0% and other foreign-owned companies for 22.1%. The remainder, 10.5%, is in UK independents. But this latter figure is an underestimate of the population proportion since our sample excludes many smaller companies.

As a summary measure, we calculate the employment-weighted means of labour productivity (value added per employee, V/L) for each SIC80 Class and for the four types of ownership. We also calculate the employment-weighted means of the determinants or correlates of productivity: physical capital intensity (K/L) and human capital intensity (w). That is, each mean is an employment-weighted average over the companies within a particular Class. This information is summarised in Table 7, which shows quartiles of the distribution across Classes of these employment-weighted means.[17] Here the means are expressed as index numbers with the value for

[16] The maximum sample for which employment is available is 49,009 companies. These collectively employed 10.775 million: see Appendix B, Table B1 of Oulton (1998c).
[17] The detailed data are in Oulton (1998c), Appendix B, Table B2.

UK independents set equal to 100. The rank order for all three measures is foreign-owned first, UK subsidiaries second and last, UK independents. Clearly the distributions for US- and other foreign-owned companies tend to lie above those for UK independents and subsidiaries. Though the largest differences are between UK independents and the rest, the differences between UK subsidiaries and the foreign-owned companies are also substantial. Median productivity is 18% lower in UK subsidiaries than in US-owned companies, 10% lower than in other foreign companies. Foreign-owned companies have much higher capital intensity. Median capital per employee is 36% higher in US companies, 50% higher in other foreign companies. Foreign companies also pay much higher wages, indicating a considerably more skilled labour force. The median wage is 17% higher in US companies, 15% higher in other foreign ones.

In order to see whether these impressions stand up to more rigorous analysis, we regress input intensity and other characteristics of companies on the ownership dummies and the controls, following equation (1). We do these regressions separately for manufacturing (SIC80 Divisions 2-4) and non-manufacturing (Divisions 0,1, and 6-9): see Table 8.[18] Physical capital intensity is measured by the log of the capital-labour ratio, while the log of the wage acts as a proxy for human capital per worker. Here, in addition to the dummy variables for the SIC80 Class to which each company is assigned, we employ a number of other control variables. Since companies' accounts do not all relate to exactly the same period, the date of each company's financial year end is included. We include too company age since new companies may have not yet reached their optimal scale. The three ownership dummies are: *US* (=1 if US-owned), *NON-US* (=1 if foreign- but not US-owned), and *UKSUB* (=1 if owned by a UK company), with UK independents being the omitted category.[19]

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[18] Table 8 excludes companies which had losses in 1995; that is, companies where the wage bill exceeded value added; there were 4,272 such companies. For comparable results where such companies are included, see Tables 2 and 3 of Oulton (1998c).

[19] US companies are significantly larger in employment terms than all other types of company in both manufacturing and non-manufacturing (Appendix B, Table B2), and this remains true even after controlling for industrial composition. Other foreign-owned companies are larger than UK independents and UK subsidiaries in manufacturing; in non-manufacturing, while being considerably larger than UK independents, they are a little smaller than UK subsidiaries. Hence it could be argued that some of the advantages of foreign ownership which we find may really be advantages of size. We therefore tried to test for the presence of economies of scale by including two measures of size, employment and value added, both in logs. These two measures, while highly significant, have opposite signs: the coefficient on log employment is negative (except in the equation for *K/L* in

The foreign ownership dummies are highly significant in both manufacturing and non-manufacturing. Table 9, which derives from Table 8, shows the percentage effect of type of ownership on the determinants of labour productivity, capital intensity and skill (proxied by wages), and their effect on labour productivity itself. In general and relative to UK independents, foreign ownership, whether US or other, is associated with substantially higher capital intensity and higher skill (wages). UK subsidiaries tend to have lower capital intensity than even UK independents but similar skill levels. Foreign ownership has a much bigger effect on capital intensity in manufacturing than in non-manufacturing. But for skill the foreign ownership effect is much larger in non-manufacturing.

Foreign ownership is therefore positively correlated with input intensity. So we shall obtain a maximum estimate of the effect of foreign ownership by regressing productivity on ownership plus controls only (see the lower panel of Table 9). In manufacturing, relative to UK independents, US ownership raises labour productivity by 35%, while other foreign ownership raises it by 23%. In non-manufacturing the US effect is even larger, 49%, while the other foreign effect is not much less, 46%. UK subsidiaries also have an advantage over UK independents, but it is much smaller, 6% in manufacturing and 9% in non-manufacturing. Hence UK subsidiaries have substantially lower productivity than foreign-owned ones.[20]

The productivity gap in manufacturing using company data is remarkably similar to the gap estimated from the ARD sample: From the companies sample, US ownership raises labour productivity by 35% after controlling for industrial structure, other foreign ownership raises productivity by 23% (Table 9). The corresponding figures from the ARD sample are 32% and 15% (Table 6). Since the two samples are independent and employ different units (establishments versus companies), this adds

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manufacturing) while that on log value added is positive. Since economies of scale cannot be both increasing and decreasing, these variables cannot be measuring economies of scale. Employment is in the denominator of each of the dependent variables in Table 8, while value added is related to the numerator. So the effects captured by these variables are probably spurious (division bias).

[20] When companies making losses are included, the advantage of foreign ownership are reduced somewhat while still remaining very substantial, and the gap between UK subsidiaries and UK independents virtually disappears (see Tables 2 and 3 of Oulton (1998c)).

confidence to the conclusions. It suggests that the use of survivors is not distorting the ARD-based results.

Next in Table 10 we shows the results of running the regression of equation (2) on the companies sample. It turns out that the regressions can explain some 67-71% of the variance of log productivity. Despite the fact that both physical and human capital[21] are poorly measured in our data, each of these variables is highly significant.

In both manufacturing and non-manufacturing, UK independents (the omitted category amongst the ownership dummies) are at a substantial disadvantage vis-à-vis both UK subsidiaries and foreign-owned companies. Being a UK subsidiary seems to confer no disadvantage vis-à-vis non-US companies in manufacturing nor vis-à-vis US companies in non-manufacturing. But US companies have a substantial productivity advantage over all other kinds of company in manufacturing, while other foreign-owned companies have a similar advantage in non-manufacturing.[22]

In the regressions of Table 10, the ownership dummies measure the direct effects of ownership; the indirect effects via input intensity must also be taken into account. We have already seen from Tables 8 and 9 that ownership has highly significant effects on input intensity.

The productivity gaps associated with ownership which are revealed in tables 8 and 9 — the 35% lead of US companies over UK independents in manufacturing or their 49% lead in non-manufacturing — are much larger than the direct ownership effects of Table 10. We therefore conclude that most of the effects of ownership on productivity are indirect, i.e. foreign ownership leads to higher human and physical

[21] As mentioned above, since human capital is proxied by the wage, there is the possibility of reverse causation here: high productivity may lead to high wages through rent-sharing or union bargaining power.

[22] Similar results were obtained with sales per employee as the dependent variable. But the foreign ownership effects are larger. This suggests that foreign ownership affects the extent to which companies use intermediate input. In other words, foreign-owned companies tend to be more reliant on outsourcing. We also tested for scale effects by including either the log of employment or the log of value added. Once again, these variables had opposite signs, negative on employment and positive on value added. Hence they cannot be interpreted as measuring economies of scale. These results are in Oulton (2000), Table 5.

capital intensity and this accounts for the productivity gap.[23] So in this respect too, the companies sample confirms conclusions derived from the ARD sample.

6. Interpreting the findings: two alternatives

The substantial productivity lead of foreign-owned companies shown by our results is in line with a large literature stressing the productive effects of foreign investment (e.g. Dunning 1981; Barrell and Pain 1997). But now the obvious question to ask is, if foreign-owned companies, located in Britain and employing British workers, use high human and physical capital intensity to achieve high productivity, why don't British-owned companies do the same? We explore two alternative, not mutually exclusive, hypotheses capable of explaining our findings: first, the cost of capital is lower for foreign-owned companies; and second, foreign-owned companies use superior technology.

Do UK-owned companies face a higher cost of capital?

The first explanation is that UK-owned companies face a higher cost of capital than foreign-owned ones, for a number of possible reasons. Financial constraints are now widely believed to be an important influence on investment (Caballero 1997; Chirinko 1993; Hubbard 1998). Foreign companies are not presumably constrained to acquire funds for investment from the UK financial system, or at least not to the same extent as UK ones, so deficiencies in the UK system may be hindering investment by UK companies. Foreign companies may also have a lower cost of internal funds (Miles 1993). An obvious objection to this is that large UK companies are themselves multinationals and face the same global capital market as foreign multinationals. However, the argument may have some force for smaller companies. And it is still possible that when making investment decisions out of retained profits even large UK companies are constrained by the short-termist views of the UK stock exchange.[24]

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[23] Oulton (2000) takes this argument a bit further by calculating TFP differences between companies. These differences are found to be only weakly correlated with ownership.

[24] I owe this point to Steve Bond.

A second reason why UK firms may have a higher cost of capital is that they face a less favourable risk-return trade-off than foreign ones; consequently they may prefer less capital-intensive technologies. UK companies, even the large multinational ones, almost certainly make a higher proportion of their sales in the UK than do foreign companies. They may be heavily influenced in their investment decisions by the memory of bad experiences in the three long recessions of the last 25 years (the working lifetime of the people now running UK companies). If the UK is perceived as having greater macro instability than other countries, then even if UK firms are no more risk averse than foreign ones, they will perceive their overall risk level as higher. By contrast, the large foreign multinationals which operate in UK manufacturing may be better able to balance the risk of poor outcomes in the UK against the chance of good ones elsewhere. Consequently, their preferred capital-labour ratio may be higher. This argument assumes that capital intensive technologies are riskier. This in turn may be justified if investment in physical capital is at least partially irreversible while labour and other inputs may be adjusted at relatively low cost.

Empirically, the second reason would be hard to distinguish from the first. In both cases, companies would act as if they faced a higher cost of capital, though the reason for the higher cost differs.

Capital-skill complementarity and the cost of capital

A lower cost of capital for foreign-owned firms in conjunction with capital-skill complementarity could account for our findings. It has often been argued that capital and skilled labour are complements: see e.g. Griliches 1965; Fallon and Layard 1975; Berman *et al*. 1994; Goldin and Katz 1998. Assume that competition prevails and that output (value added) is produced under constant returns to scale by means of three inputs: capital, skilled labour and unskilled labour. Assume too that capital costs are lower for foreign-owned firms, while wages for given skills are the same. If capital and skilled workers are complements, then foreign-owned firms will employ a higher ratio of skilled to unskilled workers. This is consistent with what we observe in manufacturing using the ARD sample. The capital-skill complementarity hypothesis implies too that the average wage in foreign-owned companies will be

higher than in domestically owned ones, consistent with what we observe in the companies sample.

If capital and skilled workers are complements, then capital and unskilled labour must be substitutes. This leads to foreign-owned firms using a higher ratio of capital to unskilled workers. But, even though firms with lower capital costs use more skilled workers, it can be shown that such firms will nonetheless have a higher ratio of capital to total labour (skilled plus unskilled). This is also consistent with observation.

These propositions are derived rigorously under the assumption of a translog cost function in Oulton (2000). There it is also shown that the hypothesis implies that the share of capital costs in total costs will be higher for foreign-owned companies. This proposition is tested using the companies sample and support is found for manufacturing, but not for non-manufacturing. Therefore the ultimate reason why UK companies invest less than foreign-owned ones outside of manufacturing remains to be found.

Foreign ownership and macroeconomic instability

A lower cost of capital for foreign-owned firms has another implication. UK-owned companies which are damaged by a recession may be unable to invest as much as comparable companies which have been less damaged. A recession may drain a company's financial resources and make it more dependent on an unsympathetic capital market. But foreign-owned companies may be able to rely on the strength of their parent or on a supposedly more sympathetic foreign capital market. We can test this hypothesis with the ARD sample. The ARD does not contain any balance sheet variables which would enable us to measure a company's financial health directly. But we can measure the size of the shock that an establishment suffers in a recession by, for example, the change in output. This suggests testing the following equation:

$$\Delta_s \ln(K_{it} / L_{it}) = \beta_0 + \beta_1 \Delta_r \ln Y_{i,t-s} + Controls + \varepsilon_{it} \qquad (3)$$

The dependent variable is the growth in capital intensity during the course of a boom taking place from time *t-s* to *t*. The main explanatory variable is the growth of gross

output over the preceding recession from *t-s-r* to *t-s*. The controls used are the SIC80 Class dummies and a foreign ownership dummy (*FOREIGN* = 1 if foreign-owned). The growth of capital intensity is used in preference to the growth of capital since a fall in output may indicate not just bad luck but poor prospects for the company. Such a company might rationally wish to invest less. But there seems no reason, other than financial difficulties, why a company which survives should use a less capital intensive technique just because its future growth prospects are not so good as they may once have appeared. Nevertheless, results are presented also for capital stock growth as the dependent variable.

The hypothesis to be tested is $\beta_1 > 0$: the greater the fall in output during a recession, the lower the rise in capital intensity in the subsequent boom. But we also allow for the possibility that β_1 differs between foreign and domestically-owned companies by interacting the output growth variable with the foreign ownership dummy: i.e., we assume $\beta_1 = \beta_2 + \beta_3 \cdot FOREIGN$. If foreign-owned companies are less affected by recessions, then the coefficient on this interaction variable will be negative.

The results of estimating this equation over two boom-recession periods are in Table 11. The first boom is 1975-79, following a recession from 1973-75. The second is 1981-89, following the 1979-81 recession. It will be seen that β_1 is significantly positive so macroeconomic instability does indeed appear to damage investment, whether capital intensity or capital growth is the dependent variable. However, the interaction variable in Table 11 is never significant. In other words, foreign-owned firms reduce their investment just as much as UK-owned ones as a result of bad experiences during a recession. This is evidence *against* the view that the difference in capital intensity between foreign and UK-owned companies is due to the UK financial system.[25]

Do foreign-owned companies employ superior technology?

The second hypothesis to explain the findings is that foreign companies are using superior technology and business methods. For this hypothesis to be a complete

[25] The conclusion is not altered if separate dummies are introduced for US and non-US ownership. Note that during the 1979-81 recession the mean fall in output was about the same for foreign as for UK establishments.

explanation, these superior technologies must be more intensive in both capital and skilled labour. UK companies may just be slow to learn from and apply the best foreign practice, for several possible reasons. First, the relevant knowledge may be commercially confidential or located in the heads of foreign managers. Second, there may be work force resistance to change. In the latter case, it might not pay for an established firm to adopt the superior technology because of the upfront cost of strikes, etc. This will be all the more likely if the firm is a satisficer rather than a maximiser.[26]

Objections can be raised against this second explanation too. It would seem rather odd if superior technology is in general more intensive in both capital and skilled labour. Some superior business methods, e.g. just in time, require less (inventory) capital not more. Also, the larger UK companies at least must be well aware of their foreign rivals' technology and could hire foreign managers if they so desired. And how potent is work force resistance after the trade union reforms of the 1980s? While there are few areas of manufacturing which are not exposed to foreign competition, the same is not true of services. So the fact that the productivity gap seems to be about the same in manufacturing as in non-manufacturing argues against competition or the lack of it being the explanation.

This explanation really boils down to the assertion that TFP levels differ between foreign-owned and UK firms. But we have already seen that, after controlling for differences in input intensities, ownership alone cannot explain very much of the productivity gap (Tables 6 and 10). So this hypothesis fails to convince.[27]

Multinationals: a third hypothesis?

Doms and Jensen (1998) in their study of US manufacturing were able to break down their domestically owned (i.e. US) firms into those which are multinationals and those

[26] Baily and Gersbach (1995) argue that the crucial factor in inducing firms to adopt best practice technology is exposure to global, not just local or regional, competition. See also Nickell (1995, chapter 4) and (1996) on the beneficial effects of competition on productivity.

[27] Oulton (2000) presents estimates of TFP levels for the companies sample, using two alternative methods. This study finds that TFP in UK subsidiaries is similar to that of all foreign-owned companies in non-manufacturing and to that of US companies in manufacturing; TFP is lower in UK independents. Even for the latter group TFP differences account for less than a third of the labour productivity gap with US-owned companies.

which operate only in the home market. They find that the real difference is between multinationals and non-multinationals, not foreign and domestically owned firms. This suggests a third explanation based on the theory of foreign investment. At any moment there is a range of capabilities amongst a country's firms. The better companies develop specific advantages. These allow them to compete successfully in foreign markets and consequently to go multinational (Dunning 1981). The foreign-domestic productivity gap which we observe simply reflects this process. Indeed, the observed gap is on this view rather misleading since the performance of the more successful, domestically owned multinationals is being obscured by their less successful colleagues who operate only in the home market.

Whether this explanation works for the UK as well as for the US is unclear. It would require much more work beyond the scope of this chapter to identify the UK multinationals in the OneSource or ARD databases. But even if some British multinationals have high productivity, they must still represent a comparatively small proportion of UK employment, otherwise we would not find that the employment-weighted mean of productivity is generally lower in UK subsidiaries (Table 7). In any case, it is not clear that this third explanation is different from the other two since the specific advantages of multinationals have to show up in some measurable way (e.g. in technology or in the cost of capital).

7. Conclusions

Results for manufacturing based on the ARD

We have developed a dataset of 1,752 establishments which appear continuously in the ARD from 1973 to 1993 inclusive. For each of these survivors, we have been able to estimate the capital stock. Of course these survivors are atypical by virtue of the fact simply that they have survived. Nevertheless, they make up about a third of the employment recorded in the ARD, they contain a wide range of sizes (the average is 590 employees), and have a foreign-owned proportion which is similar to the overall figure. Based on this dataset, our main results are as follows:

1. There are large differences in capital intensity (the capital-labour ratio), between establishments located in the same 2-digit Class (of which there are 22 in

manufacturing). These current differences in capital intensity arise solely from differences in cumulated investment over the period 1973-93, since the capital intensity of all establishments in a given Class was of necessity assumed to be identical in 1973.

2. The differences between establishments in productivity and capital intensity are not just random. There are systematic factors at work as well. Foreign-owned establishments, and in particular US-owned ones, substantially outperform UK-owned ones. On average foreign-owned establishments operate with 50% more capital per worker and achieve 38% higher value added per worker. Their labour forces are more white collar and considerably better paid. These disparities in performance cannot be dismissed as due simply to the concentration of foreign ownership in high productivity or high capital intensity sectors.
3. We found that physical and human capital intensity are significant determinants of productivity at a point in time. Our cross section regressions, which control for industrial structure as well, can account for about a half of the variation across establishments in value added per worker. In addition, US-ownership is found to confer a productivity advantage of between 9 and 20%, over and above the advantage conferred by higher capital intensity in US-owned establishments.
4. The total US advantage in value added per worker is 31.7%, after controlling for industrial structure. The measured inputs, capital intensity and labour quality, can explain 61% of this gap. In the case of other foreign owned establishments, the labour productivity advantage is lower, 14.6% after controlling for industrial structure, and the measured inputs account for 97% of this gap.

Results based on the companies sample

The Introduction asked, do foreign-owned companies have as big a lead in labour productivity in the rest of the economy as they do in manufacturing? The answer is yes. In fact the lead is larger. After controlling for industrial composition and other factors, US ownership was found to raise productivity by 35% in manufacturing, relative to UK independents; other foreign ownership raises it 23%. In the rest of the economy, US and other foreign ownership raise productivity by even more, 49% and 46% respectively. In manufacturing, the companies sample and the ARD sample tell much the same story. For both manufacturing and non-manufacturing, the foreign lead over UK subsidiaries is not much lower than the lead over UK independents.

The foreign productivity lead can very largely be explained, or at least accounted for, by higher capital per employee and a more skilled labour force.

We have suggested that these findings are broadly consistent with the hypothesis that the cost of capital is lower for foreign-owned companies. If in addition capital and skilled labour are complements, foreign-owned companies would employ more physical capital and a higher proportion of skilled workers and thus enjoy higher labour productivity on both counts. Oulton (2000), using a cost function approach, finds empirical support for this proposition in manufacturing using the companies sample, but not in non-manufacturing.

A further bit of evidence which tends against the cost of capital hypothesis is the investment behaviour of establishments in booms and recessions. Establishments which suffered more severely in the two recessions of 1973-75 and 1979-81 increased their capital intensity less in the subsequent booms than did more fortunate establishments. However, there was no difference in this respect between foreign and UK-owned establishments. In other words, macroeconomic instability seems to have had some adverse effects on investment, but no more so for domestic than for foreign companies. This is *some* evidence against the view that the shortfall in investment by UK-owned companies is due to the UK financial system.

If we ask the question — why is labour productivity so much lower in UK subsidiaries and independents in non-manufacturing? — the proximate answer is clear. These companies use substantially lower capital and skill inputs (Table 9). It is not surprising therefore that their labour productivity level is much lower. But we have not found an explanation as to why, faced apparently with the same input prices, these companies employ less capital and less skilled labour.

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APPENDIX A

Divisions and Classes of SIC80

Division 0 Agriculture, forestry and fishing
01 Agriculture and horticulture
02 Forestry
03 Fishing

Division 1 Energy and water
11 Coal extraction and manufacture of solid fuel
12 Coke ovens
13 Extraction of mineral oil and natural gas
14 Mineral oil processing
15 Nuclear fuel production
16 Production and distribution of electricity, gas and other forms of energy
17 Water supply industry

Division 2 Metals, mineral products and chemicals
21 Extraction and preparation of metalliferous ores
22 Metal manufacturing
23 Extraction of minerals not elsewhere specified
24 Manufacturing of non-metallic mineral products
25 Chemical industry
26 Production of manufacturing-made fibres

Division 3 Metal goods, engineering and chemicals
31 Manufacture of metal goods not elsewhere specified
32 Mechanical engineering
33 Manufacturing of office machinery and data processing equipment
34 Electrical and electronic engineering
35 Manufacture of motor vehicles and parts
36 Manufacture of other transport equipment
37 Instrument engineering

Division 4 Other manufacturing industries
41/42 Food, drink and tobacco manufacturing industries
43 Textile industry
44 Manufacturing of leather and leather goods
45 Footwear and clothing industries
46 Timber and wooden furniture industries
47 Manufacturing of paper and paper products; printing and publishing
48 Processing of rubber and plastics
49 Other manufacturing industries

Division 5 Construction
50 Construction

Divisions and Classes of SIC80 (continued)

Division 6 Distribution, hotels and catering, and repair

61 Wholesale distribution (except dealing in scrap and waste materials)
62 Dealing in scrap and waste materials
63 Commission agents
64/65 Retail distribution
66 Hotels and catering
67 Repair of consumer goods and vehicles

Division 7 Transport and communications

71 Railways
72 Other inland transport
74 Sea transport
75 Air transport
76 Supporting services to transport
77 Miscellaneous transport services and storage not elsewhere specified
79 Postal services and telecommunications

Division 8 Banking, insurance and real estate

81 Banking and finance
82 Insurance, except for compulsory social security
83 Business services
84 Renting of movables
85 Owning and dealing in real estate

Division 9 Social and personal services

91 Public administration, national defence and compulsory social security
92 Sanitary services
93 Education
94 Research and development
95 Medical and other health services: veterinary services
96 Other services provided to the general public
97 Recreational services and other cultural services
98 Personal services
99 Domestic services

APPENDIX B

The companies sample

Table B1
Summary statistics for variables and sample used in the regression analysis, 1995

		Manufacturing			*Non-manufacturing*		
Variable	*Ownership*	*N*	*Mean*	*s.d.*	*N*	*Mean*	*s.d.*
ln(*K*/*L*)	US	954	2.725	1.008	1,265	2.302	1.473
	Other foreign	1,720	2.812	1.078	3,448	2.396	1.609
	UK subsidiary	4,181	2.289	1.101	7,687	2.157	1.600
	UK independent	3,206	2.346	0.983	9,493	2.303	1.365
ln(*w*)	US	954	2.860	0.337	1,265	3.158	0.533
	Other foreign	1,720	2.813	0.341	3,448	3.008	0.630
	UK subsidiary	4,181	2.686	0.359	7,687	2.716	0.569
	UK independent	3,206	2.666	0.417	9,493	2.632	0.602
ln(*V*/*L*)	US	954	3.384	0.502	1,265	3.742	0.790
	Other foreign	1,720	3.290	0.494	3,448	3.685	0.976
	UK subsidiary	4,181	3.094	0.482	7,687	3.301	0.851
	UK independent	3,206	3.020	0.480	9,493	3.111	0.729
ln(*L*)	US	954	5.290	1.464	1,265	4.236	1.643
	Other foreign	1,720	4.967	1.397	3,448	3.789	1.655
	UK subsidiary	4,181	4.725	1.283	7,687	4.073	1.555
	UK independent	3,206	3.977	0.915	9,493	3.345	1.192
ln(*V*)	US	954	8.673	1.514	1,265	7.978	1.627
	Other foreign	1,720	8.257	1.430	3,448	7.473	1.590
	UK subsidiary	4,181	7.819	1.316	7,687	7.374	1.489
	UK independent	3,206	6.997	0.863	9,493	6.456	1.041

Source OneSource.

Note Value added (*V*), capital (*K*) and the wage (*w*) are in units of thousands of pounds; labour (*L*) is number of employees. The wage is calculated as the wage bill divided by the number of employees. Data are for 1995.

Table B2
Employment by ownership type, 1995

Ownership	*Manufacturing*			*Non-manufacturing*		
	Companies	*Employment*		*Companies*	*Employment*	
	number	*number*	*%*	*number*	*number*	*%*
US	954	596,559	17.5	1,265	522,501	10.0
Other foreign	1,720	846,286	24.9	3,448	1,058,736	20.2
UK subsidiary	4,181	1,690,324	49.7	7,687	3,014,726	57.6
UK independent	3,206	269,871	7.9	9,493	639,990	12.2
Total	10,061	3,403,043	100.0	21,893	5,235,952	100.0

Source OneSource.

Table 1
Capital intensity (*K/L*) amongst 1973-93 survivors: manufacturing, by SIC80 Class, 1993

Class	*N*	*Mean*	*Median*	*s.d. of ln(K/L)*
22	73	58,990	48,805	0.698
24	98	45,633	34,182	0.741
25	164	83,732	59,240	0.686
31	130	28,058	24,429	0.544
32	214	28,413	22,704	0.611
34	122	28,414	21,573	0.621
35	47	48,983	37,800	0.885
36	41	31,029	26,361	0.608
37	32	22,125	19,184	0.563
41	86	47,103	24,748	0.871
42	84	63,993	49,736	0.613
43	143	24,180	21,054	0.589
45	96	6,732	5,960	0.554
46	51	15,809	12,056	0.497
47	245	37,996	29,792	0.599
48	75	39,179	32,013	0.536
49	23	26,144	24,674	0.547
All classes[a]	1,747	39,140	27,276	0.827

Source ARD.

a. Including omitted Classes (23, 26, 33 and 44).

Note Capital intensity is *K/L* where *K* is the capital stock in 1990 £ and *L* is total employment. 5 Classes omitted due to zero or small numbers. See the Appendix for the names of the Classes.

Table 2
Descriptive statistics in 1993 for 1973-93 survivors in manufacturing, by ownership

Variable	*Ownership*	*N*	*Mean*	*Ratio to UK-owned mean*	*S.D.*	*Median*
Y/L	Foreign, non-US	235	95,542	1.52	84,985	75,824
	US-owned	176	105,185	1.68	77,606	81,059
	UK-owned	1336	62,781	1.00	67,898	47,006
V/L	Foreign, non-US	235	28,316	1.25	18,839	24,434
	US-owned	176	35,008	1.55	22,924	29,191
	UK-owned	1336	22,615	1.00	16,929	19,306
K/L	Foreign, non-US	235	51,358	1.47	47,154	39,264
	US-owned	176	54,073	1.54	45,695	36,911
	UK-owned	1336	35,024	1.00	47,906	24,538
L	Foreign, non-US	235	619	1.16	1,037	351
	US-owned	176	975	1.82	2,375	485
	UK-owned	1336	535	1.00	1,290	270
w_{OP}	Foreign, non-US	233	14,935	1.17	3,936	14,595
	US-owned	176	16,078	1.26	5,149	15,627
	UK-owned	1324	12,736	1.00	4,074	12,627
w_{ATC}	Foreign, non-US	235	19,876	1.12	4,628	19,090
	US-owned	176	21,858	1.24	6,863	20,475
	UK-owned	1336	17,668	1.00	5,157	17,127
ATC/L	Foreign, non-US	235	0.389	1.20	0.188	0.338
	US-owned	176	0.407	1.26	0.182	0.370
	UK-owned	1336	0.323	1.00	0.189	0.281
M/L	Foreign, non-US	232	72,395	1.70	79,215	54,398
	US-owned	174	74,851	1.75	68,785	56,058
	UK-owned	1325	42,671	1.00	59,314	28,742

Source ARD.

Note *Y*: Gross output (1990 £k); *V*: gross value added (1990 £k); *L*: total employment (number); *ATC*: Administrative, technical and clerical employees (number); *K*: Capital stock (1990 £k); w_{OP}: operative wage (£, current prices); w_{ATC}: ATC wage (£, current prices); *M*: intermediate input (1990 £k).

Table 3
Growth rates of output, employment and capital, 1973-93:
1973-93 survivors in manufacturing, by ownership in 1993 (% p.a.)

Variable	*Ownership*	*N*	*Mean*	*S.D.*	*Median*
V/L	NON-US	232	2.19	3.09	2.15
	US	173	2.23	3.30	1.93
	UK	1326	1.76	2.92	1.82
K/L	NON-US	235	4.60	3.17	4.56
	US	176	4.27	3.41	4.38
	UK	1336	2.85	3.36	2.84
K	NON-US	235	2.23	3.90	2.20
	US	176	2.86	4.06	2.40
	UK	1336	1.04	3.89	0.63
L	NON-US	235	-2.38	3.79	-2.52
	US	176	-1.41	3.56	-1.33
	UK	1341	-1.82	3.95	-1.66
V	NON-US	232	-0.16	4.46	-0.07
	US	173	0.89	4.64	0.65
	UK	1326	-0.06	4.78	0.08

Source ARD.

Note *L*: total employment; *V*: gross value added (1990 prices); *K*: Capital stock (1990 prices).

Table 4
Comparison of foreign and UK-owned establishments in manufacturing: cross section regressions, 1973-93 survivors in 1993

	Dependent variable					
	ln(K/L)	*ln(ATC/L)*	*ln(w_{OP})*	*ln(w_{ATC})*	*ln(M/L)*	*ln(V/L)*
US	0.2643**	0.1149**	0.1499**	0.1431**	0.4356**	0.2756**
	(0.0526)	(0.0384)	(0.0241)	(0.0211)	(0.0552)	(0.0443)
NON-US	0.2832**	0.0768*	0.1050**	0.0796**	0.4297**	0.1362**
	(0.0450)	(0.0341)	(0.0195)	(0.0170)	(0.0448)	(0.0379)
N	1747	1752	1733	1747	1752	1736
R^2	0.427	0.283	0.330	0.170	0.324	0.269

Source ARD.

Note Model fitted by OLS is equation (1). Constant and dummies for 20 out of 21 SIC80 Classes included but not reported. Robust standard errors are in parentheses. Maximum possible number of observations is 1,752 but a few observations are lost for some dependent variables due to missing values. *US*=1 if US-owned; *NON-US* =1 if foreign-owned but not US-owned.

* Significant at the 5% level
** Significant at the 1% level

Table 5
Regressions explaining productivity differences amongst survivors in manufacturing: dependent variable is log of value added per employee, 1989 and 1993

	1993	*1993*	*1993*	*1989*	*1989*	*1989*
	(1)	(2)	(3)	(4)	(5)	(6)
ln(*K/L*)	0.1448*	0.2948*	0.1441**	0.1582**	0.2937**	0.1569**
	(0.0244)	(0.0221)	(0.0242)	(0.0199)	(0.0251)	(0.0199)
ln(*ATC/L*)	0.0830**	0.1150**	0.0795**	0.1105**	0.1764**	0.1094**
	(0.0235)	(0.0242)	(0.0235)	(0.0213)	(0.0218)	(0.0214)
ln(w_{OP})	0.6342**	—	0.6315**	0.6380**	—	0.6357**
	(0.0597)		(0.0598)	(0.0427)		(0.0427)
ln(w_{ATC})	0.3053**	—	0.2987**	0.2620**	—	0.2601**
	(0.0454)		(0.0451)	(0.0455)		(0.0456)
US	0.0895*	0.1834**	—	0.1337**	0.1889**	—
	(0.0399)	(0.0418)		(0.0332)	(0.0354)	
NON-US	-0.0012	0.0432	—	-0.0243	0.0074	—
	(0.0325)	(0.0355)		(0.0368)	(0.0399)	
US years	—	—	0.0054*	—	—	0.0081**
			(0.0023)			(0.0022)
NON-US years	—	—	0.0026	—	—	0.0021
			(0.0024)			(0.0029)
N	1717	1731	1717	1739	1744	1739
R^2	0.475	0.379	0.476	0.512	0.415	0.511

Source ARD.

Note Model fitted by OLS is equation (2). Constant and dummies for 20 out of 21 SIC80 Classes included but not reported. Robust standard errors are in parentheses. Maximum possible number of observations is 1,752 but a few observations are lost due to missing values. *US*=1 if US-owned; *NON-US* =1 if foreign-owned but not US-owned. *US years*: number of years in US ownership. *NON-US years*: number of years in other foreign ownership.

* Significant at the 5% level
** Significant at the 1% level

Table 6
Contribution of measured inputs to explanation of productivity gap between foreign and UK-owned establishments: manufacturing in 1993 (1973-93 survivors)

	US				*NON-US*			
	Wage variables included		*Wage variables excluded*		*Wage variables included*		*Wage variables excluded*	
Input	*Contrib-ution*	*% of total*	*Contrib-ution*	*% of total*	*Contrib-ution*	*% of total*	*Contrib-ution*	*% of total*
K/L	3.90	12.29	8.10	25.54	4.19	28.69	8.71	59.67
ATC/L	0.96	3.02	1.33	4.19	0.64	4.38	0.89	6.08
w_{OP}	9.97	31.43	—	—	6.89	47.19	—	—
w_{ATC}	4.47	14.07	—	—	2.46	16.86	—	—
Total measured	19.30	60.82	9.43	29.73	14.17	97.12	9.59	65.75
Non-specific[a]	9.36	29.51	20.13	63.44	0.00	0.00	0.00	0.00
Total explained	28.66	90.32	29.56	93.16	14.17	97.12	9.59	65.75
Unexplained	3.07	9.68	2.17	6.84	0.42	2.88	5.00	34.25
TOTAL	31.73	100.00	31.73	100.00	14.59	100.00	14.59	100.00

a. The non-specific advantage is the estimated coefficient on the US or non-US ownership dummy in equation (2).

Source Coefficient estimates in Tables 4 and 5. See text for explanation.

Table 7
Labour productivity and its determinants by ownership type, 1995: distribution of within Class means across SIC80 Classes (UK independents=100)

Variable	*Ownership*	*Quartiles*		
		25th	*50th*	*75th*
V/L	*US*	113.0	139.0	170.9
	Other foreign	113.1	126.8	150.0
	UK-owned	99.6	113.8	126.0
K/L	*US*	124.2	149.9	217.9
	Other foreign	135.6	165.4	226.1
	UK-owned	91.8	110.1	139.6
w	*US*	103.9	119.5	145.8
	Other foreign	104.4	117.5	128.2
	UK-owned	92.1	101.9	113.8

Source Oulton (1998c), Appendix B, Table B2.

Note 36 SIC80 Classes (35 for US-owned). Within-Class means are employment-weighted.

Table 8
Ownership and the determinants of labour productivity in 1995

	Manufacturing				*Non-manufacturing*		
	Dependent variable				*Dependent variable*		
	ln*(K/L)*	ln*w*	ln*(V/L)*		ln*(K/L)*	ln*w*	ln*(V/L)*
	(1)	(2)	(3)		(4)	(5)	(6)
ln(*age*)	0.0601**	0.0119**	-0.0151**		0.1451**	-0.0035	-0.0464**
	(0.0104)	(0.0042)	(0.0051)		(0.0106)	(0.0042)	(0.0055)
US	0.3544**	0.1452**	0.3038**		0.1215**	0.3429**	0.4004**
	(0.0342)	(0.0127)	(0.0177)		(0.0415)	(0.0149)	(0.0216)
NON-US	0.3906**	0.1039**	0.2091**		0.1226**	0.2629**	0.3797**
	(0.0301)	(0.0107)	(0.0142)		(0.0291)	(0.0118)	(0.0160)
UKSUB	-0.1050**	0.0007	0.0553**		-0.2199**	0.0320**	0.0839**
	(0.0227)	(0.0086)	(0.0107)		(0.0210)	(0.0082)	(0.0106)
N	10,061	10,061	10,061		21,893	21,893	21,893
R^2	0.183	0.151	0.158		0.177	0.273	0.329

Source OneSource.

Note Companies included are either subsidiaries or independents which do not own any subsidiaries. *US*=1 if US-owned; *NON-US*=1 if foreign but not US-owned; *UKSUB*=1 if company is a subsidiary of a UK company. Omitted category is UK independent companies which do not own any subsidiaries. Companies with negative profits excluded. Constant and dummies for the 60 SIC80 Classes included but not reported. Estimated by OLS. Robust standard errors are in parentheses.

* Significant at the 5% level
** Significant at the 1% level

Table 9
Effect of ownership on labour productivity and its determinants (per cent)

		Manufacturing	*Non-manufacturing*
Variable	*Ownership type*	*(1)*	*(2)*
K/L	*US*	+43	+13
	NON-US	+48	+13
	UKSUB	-10	-20
w	*US*	+16	+41
	NON-US	+11	+30
	UKSUB	0	+3
V/L	*US*	+35	+49
	NON-US	+23	+46
	UKSUB	+6	+9

Source Table 8.

Note Each entry shows the percentage effect of a particular type of ownership on the dependent variable, relative to the omitted type of ownership, UK independents. Each entry is calculated as $100*[\exp(\hat{\beta})-1]$ where $\hat{\beta}$ is the estimated regression coefficient on the ownership dummy.

Table 10
Effect of ownership on labour productivity (value added per employee): manufacturing versus non-manufacturing companies in 1995 (dependent variable is ln(*V*/*L*))

	Manufacturing	*Non-manufacturing*
	(1)	(2)
ln(*K*/*L*)	0.1067**	0.1234**
	(0.0054)	(0.0040)
ln(*w*)	0.9063**	0.8530**
	(0.0190)	(0.0116)
ln(*age*)	-0.0323**	-0.0612**
	(0.0033)	(0.0039)
US	0.1345**	0.0928**
	(0.0120)	(0.0154)
NON-US	0.0732**	0.1403**
	(0.0090)	(0.0113)
UKSUB	0.0658**	0.0838**
	(0.0063)	(0.0072)
N	10,061	21,893
R^2	0.672	0.682

Source OneSource.

Note Companies included are either subsidiaries or independents which do not own any subsidiaries. *US*=1 if US-owned; *NON-US*=1 if foreign but not US-owned; *UKSUB*=1 if company is a subsidiary of a UK company. Omitted category is UK independent companies which do not own any subsidiaries. Constant and dummies for the 60 SIC80 Classes included but not reported. Estimated by OLS. Robust standard errors are in parentheses.

* Significant at the 5% level
** Significant at the 1% level

Table 11
Effect of recessions on capital stock growth in subsequent booms: manufacturing, 1973-93 survivors

	Dependent variable			
	1981-89		*1975-79*	
	Growth of capital stock	*Growth of capital intensity*	*Growth of capital stock*	*Growth of capital intensity*
FOREIGN	0.072*	0.149**	0.045*	0.030
	(0.029)	(0.031)	(0.018)	(0.018)
$\Delta_r \ln Y_{t-s}$	0.297**	0.110*	0.220**	0.179**
	(0.045)	(0.048)	(0.026)	(0.027)
*FOREIGN**$\Delta_r \ln Y_{t-s}$	-0.047	-0.010	-0.014	-0.100
	(0.095)	(0.101)	(0.058)	(0.060)
N	1700	1700	1752	1752
R^2	0.110	0.080	0.101	0.077

Source ARD.

Note OLS estimates of equation (3). Constant and dummies for SIC80 Class included but not reported. The output growth variable ($\Delta_r \ln Y_{t-s}$) is the growth in output during the preceding recession, 1979-81 in the case of the 1981-89 boom and 1973-75 in the case of the 1975-79 boom. *FOREIGN* = 1 if foreign-owned. For 1981-89, 52 establishments which switched their SIC80 Class over this period were excluded.

* Significant at the 5% level
** Significant at the 1% level