The impact of foreign direct investment in UK manufacturing, 1974-1995

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Abstract

Foreign direct investment (FDI) into UK manufacturing increased from 14.7 per cent in 1974 to 28.6 per cent by 1998. This increase in inward investment is part of a global phenomenon; however, the UK has been particularly successful, attracting 40 per cent of all European inward investment from the US, Japan and Asia in recent years. Economic theory indicates that FDI is the result of firm specific assets which may be exploited by locating plants overseas and because the return on the firm specific asset is high enough to off-set the additional costs associated with foreign market entry.

Using the Annual Respondents Database (ARD), the purpose of this thesis is to describe the development of FDI in UK manufacturing between 1974 and 1995. Broadly, it concentrates on three areas relating to FDI; firstly, it considers whether foreign owned plants are more productive than domestically owned plants, thus raising the overall level of productivity in UK manufacturing. Secondly, the thesis considers how far domestic plants experience positive externalities from the presence of foreign owned plants. These are considered to operate in three major directions; within the same industry, within the same product chain and within the same region. Finally, the nature of productivity before and after foreign acquisition is considered, in order to see if 'becoming foreign' improves plant-level productivity.

The findings indicate that foreign owned plants are generally more productive than domestically owned plants, however there is less evidence to support the claim that domestic plants benefit from the presence of foreign plants through positive externalities (spillovers); indeed, these may have a detrimental impact on productivity levels in some instances. Finally, there is evidence to suggest that foreign entrants in part perform better because they are able to 'cherry-pick' the best existing UK plants.

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List of tables and illustrations

List of abbreviations used

ACT	Administrative, technical and clerical (workers)
ARD	Annual Respondent's Database
ABI	Annual Business Inquiry
DPD	Dynamic Panel Data
DTI	Department of Trade and Industry (UK)
EU	European Union
FDI	Foreign Direct Investment
FO	Foreign Owned
GMM	General Method of Moments
HRM	Human Resources Management
ICT	Information and Communications Technology
IO	Industrial Organisation
JIT	Just in Time
LRD	Longitudinal Respondent's Database
OC	Old Commonwealth
ONS	Office for National Statistics
RSA	Regional Selective Assistance
SE	South East
SIC	Standard Industrial Classification
SSR	Standard Statistical Region
TFP	Total Factor Productivity
TQM	Total Quality Management
MNC	Multi-national Company
UK	United Kingdom
US	United States of America

Declaration

None of the material contained in this thesis has been submitted for a degree in any other university. The results contained in some of the empirical chapters are based on joint research articles with my supervisor, Professor Richard Harris, funded by *The Leverhulme Trust*, and where material is drawn from this joint work, proper reference has been made.

Statement of copyright

Statistical Disclaimer

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Over the past 4 years I have attended and presented at a number of conferences related to industrial economics, FDI and to use of the ARD. I would like to thank those who provided insightful comments on drafts of papers which have formed the basis of chapters contained herein.

I particularly need to thank Professor Richard Harris, firstly for generously 'sharing' access to the ARD with me and providing invaluable knowledge on its workings, and secondly for his guidance, support and patience over the past few years. I should also like to thank Mary O'Mahony for her encouragement and for allowing me to continue to pursue this goal after moving to the National Institute of Economic and Social Research.

Finally, my love and gratitude go to Stephen Drinkwater, without whose reassurance and constant nagging this would never have been completed – thank you, for all this and more.

To my family

In the memory of Mrs Glenys Robinson

Section I

Data description and statement of hypotheses

Introduction

UK manufacturing has undergone significant changes over the past thirty years. As well as a relative decline in the importance of manufacturing, there has been rapid development of information computing technology (ICT), which has revolutionised much of the production process[1]. New management techniques have been developed, moving manufacturing away from the traditional Fordist approach towards a newer 'Japanese' style of management[2]. In addition, we have seen the labour market dramatically altered (e.g. with the reduction in union powers and activity). The political ideology for most of this period has been liberal and market orientated which has encouraged both outward and inward investment in the move towards embracing globalisation.

One key feature of this liberalisation has been the increased openness of the UK economy, and in manufacturing particularly. Foreign Direct Investment (FDI) in UK manufacturing accounted for 14.7 per cent of gross output in 1974 and by 1998 this figure had risen to 28.6 per cent. Most importantly, this has happened against a background of declining domestic investment in manufacturing. In some industries such as motor vehicles and their engines (SIC3150), foreign ownership has become more dominant than domestic investment levels. The growth in FDI has led to the development of a number of theoretical models and paradigms (Dunning, 1958; 1998, Hymer, 1976) which have been extended and tested empirically (Gomes and Ramaswamy, 1999; Gorg and Strobl, 2001; Driffield, 2002). The increased attention

[1] The effect has been equally revolutionary in the service and retail sectors, though these are not subject for discussion within this thesis.
[2] For example, Just In Time (JIT) management practices (Sohal, Ramsay and Samson, 1993) and Total Quality Management (TQM) (Easton, 1993). For further discussion of these changes, see Harris and Robinson (2001).

given to international economics issues, globalisation and international trade also means that FDI has received significant attention from this branch of economics, though this is not a focus of discussion in this thesis.

Much of the work on foreign ownership has used data on flows and stocks of FDI, but it should be noted that foreign production (the amount of real activity) and foreign investment (the flow of financial capital) are not the same (Griffith, 1999), capturing very different effects. This thesis focuses on the former. The majority of empirical studies of FDI have been at the aggregate level, either at the national level or within specific sectors of the economy (e.g. Barrell and Pain, 1997). Whilst this has been very informative, to both further theoretical developments and from the perspective of policy formulation, there are a number of limitations to aggregate studies; these are discussed in the review of the literature in Section 2.

From a domestic perspective, host nations are keen to encourage foreign investment as a means of achieving higher growth rates, improved efficiency and access to the latest technology. These aspects of foreign investment have also led economists and governments to attempt to define where these benefits are likely to come from, when and where and to whom they will accrue. The ability to identify the source of, and the potential beneficiaries from, FDI advantages will determine how successful a nation is at targeting FDI and indeed whether the tax payer is able to get value for money from industrial policies (e.g. Regional Selective Assistance, see Harris and Robinson, 2001; 2001b). For this reason, the impact of FDI is of particular importance to policy makers.

The purpose in this thesis therefore is to explore some of the fundamentals of FDI at the microeconomic level; where it is, what industries it is locating in, where it comes from, how it affects local/domestic plants, whether it improves productivity, *per se*, and/or in domestic plants. Whilst attempts have been made to answer these questions in the past, this contribution is original in that it discusses the issue at a level of disaggregation not previously possible and uses best practice techniques for the analysis of panel data.

Section 1 firstly provides an overview of the data used throughout this thesis; the Annual Respondent's Database (ARD). This is owned by and held at the Office for National Statistics. Following on from this, a discussion of the nature of foreign direct investment in UK manufacturing is contained in Chapter 2. This chapter provides an overview at a relatively aggregated level of which nations have invested in UK manufacturing, and considers the changing pattern of FDI over time. Chapter 3 goes on to consider FDI in UK manufacturing at a more disaggregated level, looking at the regions and industries in which it is concentrated. The chapter also contains a multinomial logit model to explore the determinants of FDI in terms of the *net* effect of size, age, capital intensity and other characteristics relating to industry and region. This is split by source of FDI, broadly defined as US, EU and other nations.

The results from the multinomial logit model indicate that there is a substantial difference amongst different foreign investors in relation to single plant, domestically owned firms across industries. In addition, there are considerable changes over the period that may be captured using this type of analysis. However, overall it can be seen that foreign owned plants are larger (i.e. have higher total employment figures) and are generally more capital and intermediate input intensive, in line with expectations and previous analyses. This result is strongest for US plants, though is less clear for nations in the EU and other investors in the UK.

In Section 2 the theoretical literature on FDI is reviewed, starting with the foundations of industrial economics, which provide the building blocks of FDI theory. It should be noted that FDI theory has developed relatively recently (principally the work of Dunning consolidates much of the material developed in the 1950s and 1960s), due to the fact that FDI began to occur in any great sense only at the end of the 19th century. The theory of FDI is also very much complemented by trade theory and international economics, and this is also briefly considered in this section, in terms of what motivates firms to 'go global'. In addition to the theoretical motivation for FDI, the potential benefits that are likely to accrue to domestic plants in the form of spillovers are considered. Whilst this is much more of an empirical concept, the disparate literature is reviewed, and a typology of spillovers is provided. This material also relates to the literature on location theory since it is widely accepted that spillovers have a significant geographical dimension to them. Finally, this section includes a chapter that explains and discusses the approach used to measure and therefore compare productivity levels in domestic versus foreign owned plants in the empirical chapters that follow.

This section provides an overview of how FDI is, in theory, beneficial to host and home countries alike, and the direct and the indirect transmission of benefits from foreign plants to the domestic economy, at the plant and the regional level are reviewed. Following this, a number of hypotheses are stated, informed by both the existing literature and trends observed in UK manufacturing. These hypotheses are;

- Foreign owned plants in UK manufacturing are more productive than domestically owned plants;
- Spillovers from foreign owned plants to domestic plants are positive and significant in all industries in all areas, and
- Foreign owned firms are able to pick more productive plants in acquisitions.

In Section 3 these hypotheses are tested using the plant level productivity approach outlined in Chapter 6. Firstly, it can be seen that the presumption of all foreign plants demonstrating clear productivity advantages over domestically owned plants is misleading since productivity advantages differ by industry and by nationality of foreign owner. These differences are attributed in part to problems of absorption of techniques and best practice by domestic plants.

Secondly, following Aitken and Harrison (1999) productivity spillovers from foreign direct investment, i.e. the benefits accruing to domestic plants from the presence of foreign firms are estimated. The results indicate that positive spillovers are not as conclusively present as the literature and government support programmes perhaps suggest, and indeed in some industries are found to be negative.

Finally in the empirical section of the thesis, the differences between the performances of plants post acquisition are explored. The results indicate that foreign firms acquiring domestic plants select the most productive; however, it can also be seen that productivity, post-acquisition may decline, at least in the short run, as there is an adjustment period for foreign owner and the recently acquired plant.

Finally in this thesis, the policy implications of this work are briefly considered, with particular comment on industrial policy directed at attracting foreign direct investment into designated assisted areas of the UK. The findings within this thesis have wider implications for the future of UK manufacturing, which are also briefly discussed in the final section. Thus in addition to introduction and conclusions, the thesis is organised into three sections, each of which contains 3 chapters. References are provided at the end of the thesis.

Chapter 1:

The Annual Respondents Database

1.0 Introduction

In this section the ARD, which is the principle data source used throughout the thesis, is reviewed, drawing particularly from the reviews of Oulton (1997), Griffith (1999) and Barnes and Martin (2002) and from Harris (2002), but also from other users of the data. This Chapter firstly explains the data and then goes on to provide a list of key variables, definitions and, where relevant, details of their calculation. It goes on to highlight some of the limitations of the data set and some of the problems encountered. Finally, a brief discussion of some of the other uses the data has been put to by applied researchers is provided, commenting particularly on any differences in methodology and their treatment of the ARD.

1.1 What is the ARD?

The micro data that underlies the Annual Census of Production, more recently known as the Annual Business Inquiry Respondents Database (ARD) is reported in aggregate form in the ONS *(Business Monitor PA1002)* statistics publications. Collection is provided for under the Statistics and Trade Act of 1947 and is therefore compulsory (if requested) for all manufacturing units. Until very recently, access to the underlying data has been restricted to use by ONS personnel, however with the advent of the *1994 Deregulation and Contracting Out Act*, a number of academics were granted access in much the same way as access to the US Longitudinal Respondents Database (the LRD) was granted to US academics some years ago

(McGuckin, 1995). Such databases are available in a number of other OECD countries, for example, Canada, US and Sweden.

In the UK, academics are contracted to the ONS to carry out research, typically with policy relevance[1]. The data must not be removed from site and may not be published in a disclosive manner[2]. Both the researcher and the project for with the material is to be used must be approved and typically a contract is issued to the researcher, for which the researcher notionally is paid £1 to carry out on the behalf of the ONS[3].

The survey of manufacturing plants has been carried out since 1912, though only since 1970 has it been conducted annually. Unfortunately, micro-data prior to 1970 was destroyed and some of the early years of the micro data (1970-72) are discontinuous and therefore the data are only reliable from 1973. The ARD covers the whole of the UK manufacturing sector, including Northern Ireland, but excludes the Isle of Man and the Channel Islands. Changes in SIC classification over time has also made continuity problematic in the case of some industries (as in the case of fish processing, for example. See Reid and Robinson, 2003).

1.2 The Structure of the ARD

Data are collected in two forms and stored as either selected or non-selected files[4]. Data in the selected files are sampled as outlined below in Table 1.1 and consist of

[1] For further details regarding conditions of access contact ard.inquiries@ons.gov.uk.
[2] This means that both a threshold rule (no less than 3 enterprise groups to be reported on in one cell) and a dominance rule (the sum of all but the 2 largest values in a cell must be greater than 10 per cent of the largest observation) must be adhered to.
[3] This process has changed over time, but the terms under which access was granted to the author is outlined in the agreement with the ONS contained in Appendix A1.
[4] An example of the questionnaires sent out is contained in Appendix A2.

full financial information on outputs and expenditures. It can be seen that for firms with over 100 employees, the survey is a census, however for smaller firms, various sampling procedures have been used over time. The reporting units are known as establishments. In addition to these data, the whole population of establishments are required to return a form which contains the barest minimum data, on employment, classification of industrial activity and location, this therefore represents the 'children' of establishments that have to report and those plants that are not in the sampling frame. These are the non-selected data and are used when calculating weights for the data.

Table 1.1: The sampling frame of the ARD over time

Numbers employed	1-19	20-49	50-99	100+
1970-71	0*	All above 25	All	All
1972-77	0	All	All	All
1978-79	0	1 in 2	All	All
1980-84	0	1 in 4	1 in2	All
1984	0	1 in 2 (England) all elsewhere		All
1985-88	0	1 in 4		All
1989	0	1 in 2 (England) all elsewhere		All
1990-92	0	1 in 4	1 in 2	All
1993-95	some	1 in 5	1 in 2	All

* (the cut-off was 11 in some industries)

Source: Updated from Griffith (1999) and Oulton (1997).

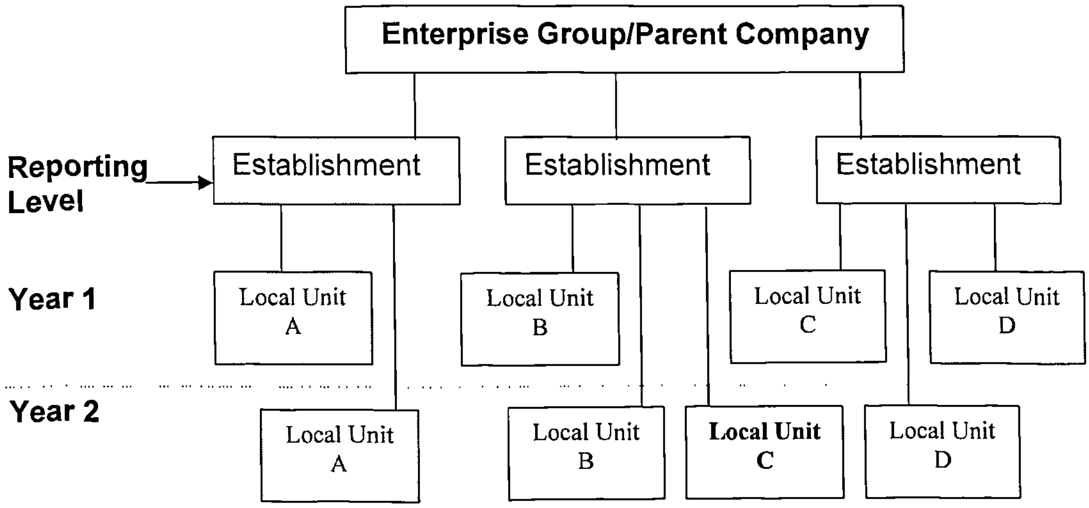
A number of ARD users initially undertook analysis without weighting the data (e.g. Griffith, 1999), and indeed there are sound reasons why one would expect the data to reflect the *true* underlying relationship between variables within an econometric model. However, more recently weighting the data has been generally recognised as being necessary because of the large enterprise sample bias (for a detailed discussion see Harris 2002).

It should be noted that, as with most surveys conducted within a dynamic system, the actual distribution of the data is not the same as the sampling frame, mainly as a result of business closures, moves and new openings. Further information on the actual distribution for 1980-1993 may be found in Griffith (1999), but in this thesis the data will be weighted to represent the entire population. Given this, the nature of the underlying sample is taken as representative.

Each plant has a unique identifier, initially called the CSO reference number and more recently, the interdepartmental business register (IDBR) number and these may be linked over time to create a panel. Plants belonging to a parent company (as opposed to a single plant/enterprise) are linked to the parent through an enterprise group reference number. One of the most contentious issues amongst the users of the ARD concerns whether the local unit or reporting unit is the most appropriate level of analysis. In many respects it can be argued that it depends on what is being analysed and at what level the analysis should be undertaken, defined by theory. For the current analysis, the plant level is considered to be the most appropriate level for the analysis in this thesis. In particular, establishments/reporting units do not represent an economic entity but an accounting one and firms are not obliged to report consistently over time. Figure 1.1 shows how this might work. The enterprise group or parent company is defined as one or more establishments under common ownership/control. In the case of local unit A, it effectively is the reporting unit/establishment. Local units are defined as a plant or office at a single geographical location. As Oulton puts it, 'all establishments are local units, but not all local units are establishments' (Oulton, 1997, p.48). Here it can be seen that an establishment may not report on the same units from one year to the next. For further explanation of the data organisation, see Oulton (1997).

Plant level data is calculated with the use of the non-selected data. Non-selected data comprises employment, location, industry and parent company (where plants are part of a larger company). This information allows for the financial data to be 'spread-back' to individual plants, pro-rata on the basis of employment. One drawback of this is that in so doing, in the first instance, all plants within the same establishment are assumed to have identical returns to labour. Whilst this is restrictive, it seems a more appropriate way of considering the data rather than analysing at the establishment/reporting unit level. This does have implications for biasing econometric analysis since plant data are effectively created, they are likely to have lower standard errors. However this may also be true for establishments, where different sized plants of varying productivity levels are aggregated (Harris 2002 p325).

Figure 1.1: An example of the structure and changes in reporting that can occur in the ARD.



1.3 What variables does it include?

Variables collected in the ARD fall into three main categories, core questions, characteristics and occasional questions. Core questions relate to output, employment and investment. Output is measured in terms of gross output, net output and gross value added at factor cost, defined below in Table 1.2. Gross output is fairly self-explanatory, however, in the case of net output, purchases exclude services and include foreign sources. In addition, the phrase 'cost of non-industrial services received' may be defined as including rents and hire charges (though not financial leasing), commercial insurance, bank charges, licensing for motor vehicles, rates and a general 'other' category which until 1996 included transport costs, postal costs and telecommunication services.

Employment data are collected in three broad groups, operatives, ATCs (administrative, technical and clerical workers) and finally working proprietors, though obviously this last category is very small. In addition to the number of those employed in each category, the ARD also contains wages data for the first of these two employment groups (further details are provided in Oulton, 1997). There were also some significant changes to the employment data collected in 1996.

Investment data are slightly more complicated. They are collected gross of depreciation and are categorised into 4 sources:

1. new building work
2. land and existing buildings
3. plant and machinery
4. vehicles

With the exception of new building work, these are collected as both acquisition and disposal separately. Stocks used to be collected separately for materials, stores and fuel, work in progress and goods in hand for sale, but this ceased to be the case after 1992.

Table 1.2: Definition of key variables

Variable	Definition
Gross output	Sales + work done + increase during the year, work in progress and goods on hand for sale.
Net output	Gross output – purchases + increase during the year, stocks of materials, stores and fuel – cost of industrial services received.
Gross value added at factor cost	Net output – cost of non-industrial services received.

Source: from Business Monitor (various years) and Oulton (1997)

In addition to the core questions, another set of questions relate to the characteristics of the establishment (at the local unit level). These include information on location, for as detailed a level as postcode since 1984 (Oulton, 1997). Local authority and regional variables have also been included in the data though they have been subject to changes over time. In addition, there are questions relating to the structure of the enterprise group, i.e. whether the local unit is a single plant or part of a larger establishment. Data are also collected relating to the organisational nature of the local unit, whether the enterprise is a sole proprietor or part of a nationalised industry (10 categories in all). In addition to the data collected, other data are matched into the ARD, most importantly here, the nationality of the 'ultimate owner' is provided by Dunn and Bradstreet, from their '*Who Owns Whom?*' database.

Each unit has a 4 digit Standard Industry Classification (SIC) classification, to which it is allocated by the ONS on the basis of its main product[5]. There have been a number of revisions to the SIC over time. From 1970-1979 the SIC68 was used, 1980-1993 the ARD reports the SIC80 and then in 1992, the SIC was replaced again with SIC92. In a number of the years, more than one classification is reported, which has assisted matching over time. Oulton (1997) states that the SIC68 is the most complete but also the most antiquated. Following Harris and Drinkwater (2000) and Harris (1999), SIC80 is used in this thesis since it is the most reliable for the 1974 to 1995 period and involves the least amount of matching. Industrial classifications have changed significantly and trying to fit 1974 data to SIC92 is not really meaningful, given the changes in the economic and industrial profile.

[5] A full list of the SIC is given in Appendix B, using the 1980 classification.

Finally, there are occasional questions. These have been added and removed over the years, depending on whether or not they are considered still relevant, and in particular if it is considered that such questions do not need to be asked as frequently. Examples include the addition of questions on pollution abatement and control between 1991 and 1994. Harris and Collins (2002) looked specifically at the impact of these costs on the chemical industry. Work has also been carried out by Haskel and Heden (1998) on the impact of expenditure on computing (which was asked in 1994) on firm productivity specifically they considered skill biased technological change.

The calculation of weights for the data is from Harris (2002) but for the sake of clarity, an explanation is also presented here: The weights are calculated at the 4-digit industry level, which are broken down into 5 size bands and classified into subgroups, according to whether they are new plants, closing the following year or are neither a new opening nor a just closing plant (i.e. a continuing plant). For each of these groups, the number of plants in the population (derived from the combined selected and non-selected data) is divided by the number of plants in the sample – this creates the weighting factor at the plant level. For some of the smaller groupings, where there were less than 5 observations in a sub-group of a size band within an industry, then size bands were amalgamated.

1.4 Data limitations and reporting problems

It is unreasonable to expect data collection methods and procedures not to change over time. Changes may in part be refinements in order to more usefully interpret data, or may be in response to changes in the economy as a whole, for example the introduction of computing facilities in the day to day activities of almost every business may require separate classification for such specific capital investment in order to analyse uptake[6]. Another example of the need for changes is with industrial classification; as changes in industrial structure occur, this may be seen particularly in the chemical, motor vehicle and electronics industries over the past thirty years[7]. The following section explores some of the changes and consequently the problems encountered when using the ARD as a panel data set.

As previously highlighted, although the sampling frame is designed to be representative, there may be reasons why, upon surveying, the target population is not fully captured. Given that the sample is sufficiently large, this may be taken into account when data are aggregated to represent national manufacturing figures using a weighting procedure. In addition, there are other changes to the data that may present problems when the data are used as a panel. It is worth pointing out that when data are collected by the ONS, there has been little in-house attempt to create the panel and the data have traditionally been used in more of a cross-sectional capacity[8] to provide what is in effect an annual review of manufacturing figures and performance.

In 1984, the adoption of a new VAT register resulted in the increased representation of small businesses and this visibly affects the raw data. A further problem was the switch from establishment based to company reporting which meant that companies

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[6] A special question in 1994 (Haskel and Heden, 1998; Barnes and Martin, 2002).

[7] Reid and Robinson (2002) in their discussion of ACOP data in relation to fish processing note changes to SIC classifications over the years, noting the problems this causes to mapping a consistent picture of the industry over time.

[8] In more recent years the ONS has increased its role in analysis of ARD as a panel (Barnes and Martin, 2002) and recently there has been the creation of CeRiBa, a joint Treasury-ONS –DTI sponsored unit, based at the ONS, headed by Jonathan Haskel, Queen Mary and Westfield College, University of London.

were no longer specifically requested to exclude non-production activities. The results, whilst described by the ONS as making 'little difference to the main economic series' (PA1002, 1990 p.3 in Oulton, 1997), resulted in the increase in the number of plants on the register and consequently in the micro database. Some of these impacts may be corrected for in the weighting process.

Initially, the Census of Production held a unique register but following the move of the Census of Employment to the ONS in 1995, there has been an amalgamation of these two registers into the IDBR. The ARD has used the IDBR since 1994 and the IDBR has been extended to other datasets as a sampling frame. These include, for example, the Community Innovation Survey (CIS3) and the E-Commerce surveys, although many of these datasets have only recently been linked through the IDBR and made available. Oulton (1997) states that this has improved the employment data and thus improved the stratification process in sampling.

In addition to this change, in 1994, both local unit and establishment reference numbers were changed. Look up tables for establishments were provided, but not so in the case of local units. These needed to be constructed in order for the data to be used at the plant level (as in Harris and Drinkwater 2000). This was carried out on the basis of industry classification, employment numbers and finally postcode. There have also been changes to the definition of variables over time, and the addition of new variables, either when it is deemed significant enough to be included or to answer specific but occasional questions. These changes have the potential to impact on analyses and therefore it is important to have some understanding of the development of the ARD over time.

All data are nominal and so have subsequently been double deflated using producer price indices (PPI) from official sources (Business Monitor). These are industry price indices at the 4 digit level, for both inputs and outputs. In many respects, a seriously limiting factor in the data used is the inability to identify UK multinationals. Foreign ownership is identified by a marker but UK plants include both domestic operations and those that operate overseas as well – i.e. British multinationals. It could be argued that by comparing foreign (multinational) plants with all domestic plants fails to compare the appropriate groups to establish whether foreignness matters. Work carried out by Curisco and Martin (2002) goes into this issue in some detail for 1998, the year for which they have an identifier of UK multinationals. They find that though more productive than domestic plants, UK multinationals fall behind other foreign owned. Some attempt is made in this thesis as far as possible to remove/account for this effect in the analysis by dealing with single plants separately to multiplant domestic entities, though this is clearly not capturing the same effect in the way that Criscuolo and Martin (2002) have for 1998. However, this thesis deals with ownership and not specifically 'foreignness'. More recently, the mapping of the AFDI into the ARD which has been undertaken by Criscuolo and Martin and the ONS allows for potentially more detailed work to be undertaken in this area in the future. The issue of matching across datasets is discussed more fully in section 1.6 below.

1.5 Missing variables

Being essentially a production dataset, the employment data in the ARD are not particularly sophisticated by way of disaggregation. It was not until 1996 that employment data were collected separately on the basis of being full time or part time[9]. An added complication was that the distinction between operatives and ATC was dropped at the same time. In addition, there is no gender breakdown available in the ARD. Of most significant limitation for productivity analysis, the ARD does not report hours worked data[10]. Another shortfall of the data set is that it does not contain very good information on research and development[11].

1.6 Other applications of the ARD

Given that the ARD sample is now drawn from the IDBR and that other government held data sets are collected on this basis, these may be matched together and some work in this area has already been undertaken. The ONS has recently established a Business Data Linking Unit to take the ARD and link it with other governmental data sets. Early work carried out on matching includes work by Hildreth and Pudney (1999) who linked the ARD to the New Earnings Survey (NES) and Griffith and Simpson (2000) linked into the R&D database BERD. Harris and Robinson (2001; 2001b) were also commissioned by the DTI to carry out matching with their in-house SAMIS database, which also involved linking data to the 1994 Community Innovation Survey (CIS2). As part of this initiative, the ONS and DTI have jointly funded a 2 year research group under the evidence based policy fund, based at the ONS with Queen Mary College, University of London (CeRiBA).

[9] And the analyses in this thesis covers the period up to 1995.
[10] Though it is perhaps questionable how reliable hours data can be. See Bell and Hart (1998) for a discussion of changes in working time behaviour in the UK.
[11] Prior to 1992 there was no R&D question, however a special question in 1992 asked whether the reporting unit employed anyone for R&D purposes on a regular basis, whilst the variable appears to be present in the ARD, there are no observations.

Work carried out on the ARD includes Disney, Haskel and Heden (2002) Gorg and Strobl (2001) and Griffith (1999). Some studies have looked at the use of computers (Haskel and Heden, 1998), entry and exit (Harris and Hassassadeh, 2002) and some have also considered the role of FDI (Gorg and Strobl *op cit*). More extensive discussions of their findings will be presented in subsequent chapters, where relevant to the topic of this thesis. Whilst the ARD currently is manufacturing sector only, service data has been recently made available but only from 1997. The availability of this data is likely to increase over time, with the encouragement of the ONS.

1.7 Summary

The Annual Respondents Database (ARD) offers applied micro economists opportunities to test current theory, the potential for which has been seen to be fulfilled in the US where the academic community has been allowed access to the LRD for a much longer period of time. The data that are available in relation to foreign ownership allows for comparisons to be made between plants owned by different nations in a much more rigorous fashion than has previously been possible. There are other opportunities for the ARD through linking the data to other datasets such as the NES, BERD dataset and the CIS, to name a few. This chapter has provided a description of what the data may offer in general, provided details of some of the limitations and problems encountered whilst using the data and highlighted the way in which the data has been used to date.

Chapter 2:

Foreign ownership in UK manufacturing

2.0 Introduction

The aim in this chapter is to describe the evolution of foreign presence in UK manufacturing since the 1970s. Specifically it considers the changes in the nature of foreign investment over time, which might impact on the ability to observe the costs or benefits from their presence. This chapter draws data mostly from the ARD[1], which forms the principal source of data for all subsequent analyses, but also from historical accounts of foreign ownership in UK manufacturing, most notably that of Dunning (1958; 1998), to provide a holistic impression of FDI in the UK.

In this chapter the existing evidence of the nature of foreign ownership in UK manufacturing will be reviewed and a picture of the dynamics of foreign ownership over the past 30 years will be presented. These trends underlie the questions posed regarding the impact of FDI on the domestic economy. In this chapter, the focus is on employment, output and value added, where value added nets out the effects of intermediate inputs. The following section reviews historical accounts of the development in multinational location in the UK. Sections 2.3 and 2.4 provide evidence from the ARD, based on the author's calculations, looking particularly at sources of FDI and provide some detail on a selected number of 4-digit industries. Finally, the findings are summarised and the implications for existing theories of foreign direct investment are highlighted.

[1] Discussed in greater detail in Chapter 1, and in Oulton (1997), Griffith (1999) and Harris (2002).

2.1 The importance of manufacturing

Post war British growth is considered to have been slow by international standards, and to place UK manufacturing in context, at the beginning of the period being considered in this thesis, UK inflation was running at over 20 per cent, the public sector borrowing rate was around 10 per cent of GDP, and public expenditure accounted for 48 per cent of output (Bacon and Eltis, 1996). The UK economic problems of the late 1970s were attributed to the substantial role that government played in trying to kick-start the economy (Bacon and Eltis, op cit). More public spending increased the wage bargaining power of highly unionised (increasingly public sector) workers and crowded out private investment, creating a vicious circle of inflation and borrowing. Therefore, the years at the beginning of the period considered were spent trying to break this cycle, and are perhaps best characterised by the advent of 'Thatcherism'.

In the latter half of the 1970s and the early 1980s, industrial policy was marked by the emergence of the theory of 'deindustrialisation'; the decline in manufacturing was seen to be largely absorbed by an expansion of the service sector. Freeman (1986) developed a 'long-wave' theory which described Britain's post war performance thus; a technological mature stage of development within production based industries, falling profits and labour and energy saving investment. This was followed by a period of structural change, marked by a shift in the pattern of demand, towards labour intensive sectors with lower average investment needs per unit of output, associated with major technical changes.

Regionally, manufacturing has always had an important role to play. In a regional analysis, Harris (1987) found that 'self-reliant' growth is an important contribution that manufacturing can bring to a region, but that development of tradeable services was also warranted. In later research, Harris (1988) provided an overview of the oligopolistic competitive environment of manufacturing in the UK, highlighting the role that this has played in the uneven regional development. Harris (*op cit*) also demonstrated the need to treat multiplant organisations differently to single plant operations because of the 'spatial consequences' of the branch plant operations.

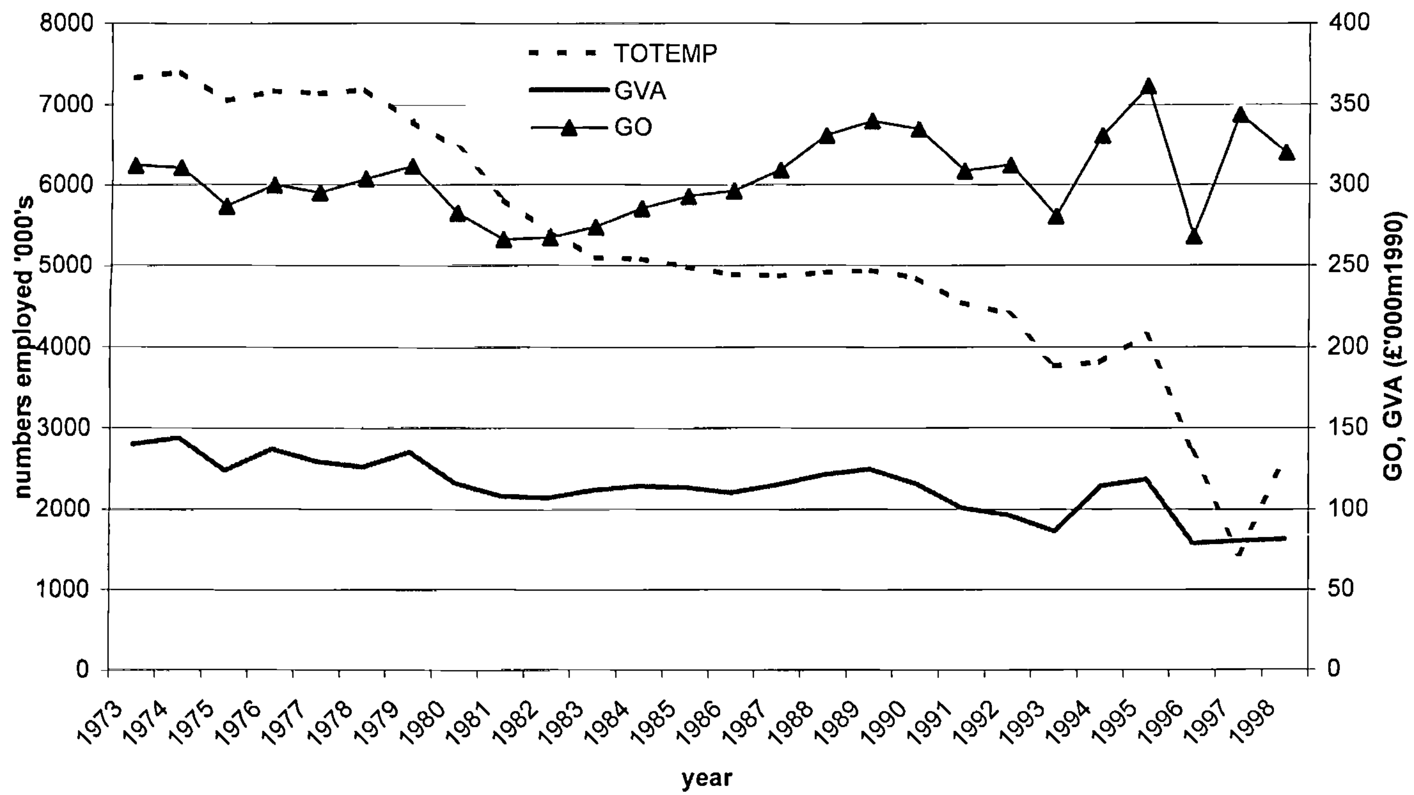
From a contemporary perspective, manufacturing may now be seen to be a large but decreasing proportion of the whole economy (around 20 per cent in the 1980s and 1990s [O'Mahony, 1999]). However, its maintenance is thought to be crucial to an innovative and growing economy (The Economist, 2002). It is generally recognised that the significance of manufacturing in the UK has been eroded over time as the service sector has increased in importance. This has been even more marked with the advent of information and communication technologies (ICT) (Berndt and Morrison, 1995).

Figure 2.1 provides an overview of employment, output and value added from the 1970s to the 1990s, from the ARD. It can be seen that employment[2] has seen a significant decline overall, from over 7 million people employed in 1973 to around 2.8 millions by 1998. This decline has been relatively steady, with the exception of 1996/97 (though perhaps this is a measurement error, given the subsequent increase in 1998), in line with expectation. Gross output shows some clear cyclical patterns, more erratic in the later years, overall though it remains relatively unchanged over the period. Gross value added on the other hand shows a gradual decline over time. All of which points to significant increases in labour productivity which has allowed levels of production to remain relatively unchanged over the period (however, the decline in gross value added is suggestive of an absolute decline in the manufacturing sector overall).

In an international context, productivity levels in the UK have generally lagged behind Germany, France and the US since 1945; this is not just in manufacturing. The labour productivity gap between the UK and the US in the mid 1990s showed a US lead of around 40 percent in chemicals, metals and textiles, double the UK output per worker in food, drink and tobacco and engineering and a US lead of around 15 percent in the miscellaneous other manufacturing categories (O'Mahony, 1999). A recent McKinsey report puts the labour productivity discrepancy between the US and UK manufacturing at 55 percent (McKinsey, 2002). Historically the reasons for the gap were couched in terms of economies of scale and mass production techniques in the US (Broadberry, 1997) coupled with higher US intensity of physical capital, higher level labour force skills and R&D. Recently the focus has moved to faster diffusion of new technology (O'Mahony, *et al*, 2003).

[2] Defined as numbers employed. It is recognised that man-hours worked would be desirable however the ARD has not collected these data.

Figure 2.1: Manufacturing in the UK, employment, output and value added, 1973-1998.

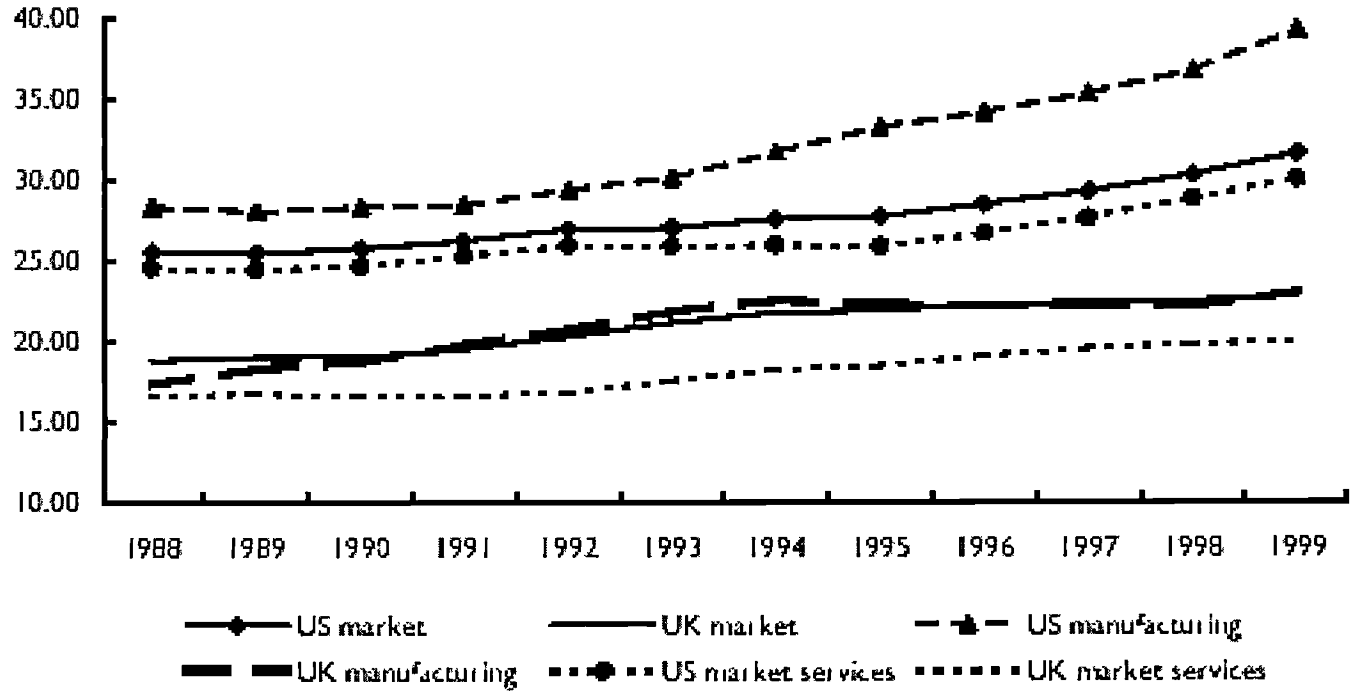


Population weighted, author's own calculations from the ARD

In the context of the international economy, with reference to the UK and the US, the latter is widely recognised to be the best practice frontier in the majority of industries. Figure 2.2 shows trends in labour productivity from 1988 to 1999 in the market economy, and in manufacturing and market services separately.[3] Figure 2.2 shows the acceleration in aggregate market sector US labour productivity growth is apparent in both manufacturing and market services. In the UK the whole market trend is mirrored by the manufacturing sector, whilst in the US the manufacturing sector, in labour productivity terms, has experienced far superior growth rates. Indeed the fortunes of the UK and US manufacturing sectors appear to be diverging, rather than there being any clear evidence of catch up.

[3] The 'market economy' excludes non-market services, i.e. health, education and public administration, and imputed rent from owner occupied dwellings; market services is the sum over transport, communications, distributive trades, financial intermediation, business and personal services.

Figure 2.2: Trends in US and UK labour productivity, 1988-99 (1995 US$ per hour worked).



Source: O'Mahony and Robinson (2003)

2.1.1 Industrial breakdown in UK manufacturing

Table 2.1 provides an overview of the distribution of total manufacturing output amongst the various industrial classifications, at the two-digit level. For simplicity, this table provides for a series of snapshots rather than a continuous series over the period 1974-1998 using the ARD. It can be seen that whilst there have been small changes in the proportion each industrial classification accounts for, generally, the overall balance between all sectors remains relatively similar at this level of aggregation. There has been a decline in the importance of a number of sectors, in terms of share of gross output. Metal manufacturing (22), the production of man made fibres (26), mechanical engineering (32) and textiles (43), show particular decline. Generally these industries are largely very traditional industries producing products in the mature stage of their life cycles. In contrast, office machinery (33) and Electronic and electrical engineering (34) show significant increases in their overall importance in terms of share of gross output. This increase is technology driven and linked to the near-global growth in ICT, known as 'the new economy'.

This overview is useful when considering the impact of foreign direct investment in various sectors, to put the contributions FDI makes to the manufacturing sector as a whole into context. It can also be seen from the table that the most important sectors in terms of share of gross output are Chemicals (25), Mechanical engineering (32), Electronic and electrical engineering (34) and sugar and sugar by-products (42). These are largely high-tech and/or global industries which are therefore likely to attract a large proportion of foreign investment. They are also among the very few areas of manufacturing that can be identified as expanding at a time of general manufacturing shrinkage. The following section considers the history and development of FDI in the UK in manufacturing before exploring the location of foreign investment, in terms of which counties and regions attracted most FDI in the following chapter.

Table 2.1: Percentage of total manufacturing real gross output by 2 digit SIC, various years

2digit sic80	Industrial Sector	1974	1980	1990	1998
22	Metal manufacturing	7.56	4.65	4.42	4.12
23	Extraction of minerals not elsewhere specified	0.09	0.99	0.49	0.04
24	Manufacture of non-metallic mineral products	4.95	5.94	6.52	4.35
25	Chemical industry	9.33	9.11	10.76	11.09
26	Production of man made fibres	0.55	0.34	0.31	0.27
31	Manufacture of metal goods not elsewhere specified	5.20	4.82	4.39	3.50
32	Mechanical engineering	11.78	12.02	9.81	9.30
33	Manufacture of office machinery and data processing equipment	0.44	0.51	2.59	4.77
34	Electrical and electronic engineering	6.21	7.41	8.25	12.08
35	Manufacture of motor vehicles and parts	7.12	6.87	7.30	8.30
36	Manufacture of other transport equipment	3.96	3.97	4.64	5.15
37	Instrument engineering	0.80	1.07	1.22	0.79
41	Food products	7.17	7.52	7.71	7.15
42	Sugar and sugar by-products, drink and tobacco	13.88	14.62	10.88	6.75
43	Textile industry	3.58	3.00	2.25	1.72
44	Manufacture of leather and leather goods	0.11	0.08	0.07	0.23
45	Footwear and clothing industries	2.45	2.61	2.16	1.59
46	Timber and wooden furniture industries	3.06	2.72	2.87	2.85
47	Manufacture of paper and paper products; printing and publishing	7.47	7.71	8.46	9.38
48	Processing of rubber and plastics	3.07	3.23	4.06	4.25
49	Other manufacturing industries	1.23	0.82	0.84	2.31
TOTAL		**100**	**100**	**100**	**100**

(Source: ARD)

2.2 The history of foreign direct investment in the UK

The UK has one of the longest histories of any country of direct foreign investment. Successful US investment in the UK economy began in earnest with the introduction of the Singer Sewing Machine manufacturer in Glasgow (Dunning, 1998). By 1907 this was the second largest multiple retailer, by December 1953, US affiliates in Britain employed nearly 250,000 people, almost 3 per cent of the combined UK/US employment total (Jones and Bostock, 1996) and by1962 Ford had the largest labour force, with over 60,000 employed (Jones and Bostock, *op cit*). Foreign ownership was concentrated in the chemical industry, engineering and shipbuilding and motor vehicles, although the US share relative to domestic levels was highest in industrial and scientific instruments and chemicals (Jones and Bostock, *op cit.* p37).

The most dominant overseas investor has continued to be the US. Sharing a common language, culture and a similar political doctrine, the UK was a natural choice of location for penetrating overseas markets in a more direct fashion than had previously been undertaken[4]. For the US, in the latter half of the twentieth century, the UK was second only to Canada as a choice of location for foreign investment. It was a particularly useful stepping stone to the rest of Europe[5] and also allowed greater access to Commonwealth markets in the 1950s and 1960s. Thus it can be seen that inward investment was substantial at the outset, and remains so.

Considering in more detail the attractiveness of the UK, inward investment was a direct result of a number of factors in the first half of the 20th century; firstly, the

[4] Hennart and Park (1993) note that similarities in language and culture reduce costs and risks associated with overseas investment. The different modes of entry and their relative merits are discussed in Chapter 4.

relative openness and developed nature of the British economy made FDI a possibility, but more specifically, institutional issues such as legal and patenting complications which hampered domestic inventions, allied to Britain's rigid industrial structure meant that the domestic economy was resistant to change and mistrustful of monopoly power[6]. Secondly, foreign owned firms were able to capitalise on the fact that there was a lack of incentive to modernise domestic production processes since Britain was well established in basic trades, had an abundance of cheap labour and fuel, which meant that more capital intensive production methods were not viewed as being necessary. At the same time in the macroeconomic environment, both Germany and the US were experiencing rapid industrial growth, fuelled by the discovery of the new power source, electricity.

The more recent years, certainly in the 1980s and 1990s, have seen the very clear emergence of Japan and other Asian countries, particularly in electronics and car manufacturing. In addition to the growth of such 'tiger nations', there has been a very steady growth in European involvement over time as a consequence of increased European integration. By 1996, it was estimated that foreign ownership through acquisitions[7] in the UK exceeded the total value of investment in all other European countries, and was second only to the level of investment seen in the US (KPMG, 1996, cited in Child, Faulkner and Pitkethly, 1997).

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[5] In the same vein as Hennart and Park (1993), the 'nearby factor' meant a much lower level of risk to the investment (Wilkins 1974).
[6] This is referred to as 'personal capitalism' by Jones (1994), in contrast with the big business approach of the US.
[7] The distinction between acquisition and 'new' investment is discussed in Chapter 4 and more fully explored in Chapter 9.

It can be seen therefore that the UK has a long history of FDI, partly a function in the early days of its colonial links (US, South Africa, Australia) and also because of the openness of its economy and development. More recently, the UK has continued to be a popular choice for the location of overseas investors within Europe, attracting around 40 per cent of the total FDI entering the EU (Child *et al*, op cit). The growth of FDI in the UK takes place against a backdrop of increasing global trade and the growth of international markets, in other words, globalisation.

2.3 National trends in FDI

It can therefore be seen that FDI in the UK economy has increased over the past 30 years and whilst this is a global phenomenon, the UK has experienced a considerable proportion of the total activity. One of the main reasons for the growth in foreign presence is a pro-active government role in attracting inward investment (eg. the Invest in Britain Bureau) and financial incentives that have been provided to attract foreign investment to the more deprived regions of the UK (e.g. the Regional Selective Assistance scheme). Dunning (2000) highlighted the importance of language and culture particularly in attracting investment from North America. However, there has been an expansion in the source of inward investment, with less coming from traditional investors such as the US and the ex-British colonies (broadly referred to here the Commonwealth nations), and more from Europe and the rest of the world including Japan and South East Asian interests.

Figures 2.3a, b and c show the underlying trends in employment, output and value added separated into domestic and foreign owned plants. Predictably, the domestic plants dominate UK manufacturing, particularly in terms of employment (Figure 2.3a). From Figure 2.3a, a clear decline in employment over the period can be seen, more so in the case of foreign owned plants. This is the result of increased capital intensity more pronounced in the foreign owned sector than in domestically owned plants. There appear to be two influences on employment over time, firstly employment shares to FDI are increasing, but secondly, in both the domestic and the foreign owned sector, there is evidence of capital substituting for labour over time. This is also reflective of the shift of resources from manufacturing to the service sector.

Gross output trends for the domestic plants over the period indicate that despite the shedding of labour, the manufacturing sector has more or less maintained production levels (figure 2.3b). This leads to the conclusion that there have been productivity gains that partially offset employment decline. Turning to the foreign owned sector, with the exception of 1998 there is a relatively strong increase in output and as a proportion of total UK manufacturing gross output foreign ownership has increased its share, accounting for 14.5 per cent in 1973/74 to around 30 per cent by 1997/98. Trends in GVA are presented in figure 2.3c and this reveals that after removing the effects of differences in the use of intermediate goods in production, there is a much less marked increase in foreign plant performance over time, but a very significant decline in domestic manufacturing which halves from 1974 to 1998[8].

[8] Whilst the ARD is available until 1998, data in this thesis run mostly only to 1995, due to data availability at the time of analysis, particularly capital stock data availability.

Figure 2.3a: Employment in manufacturing, domestically owned, foreign owned and all plants

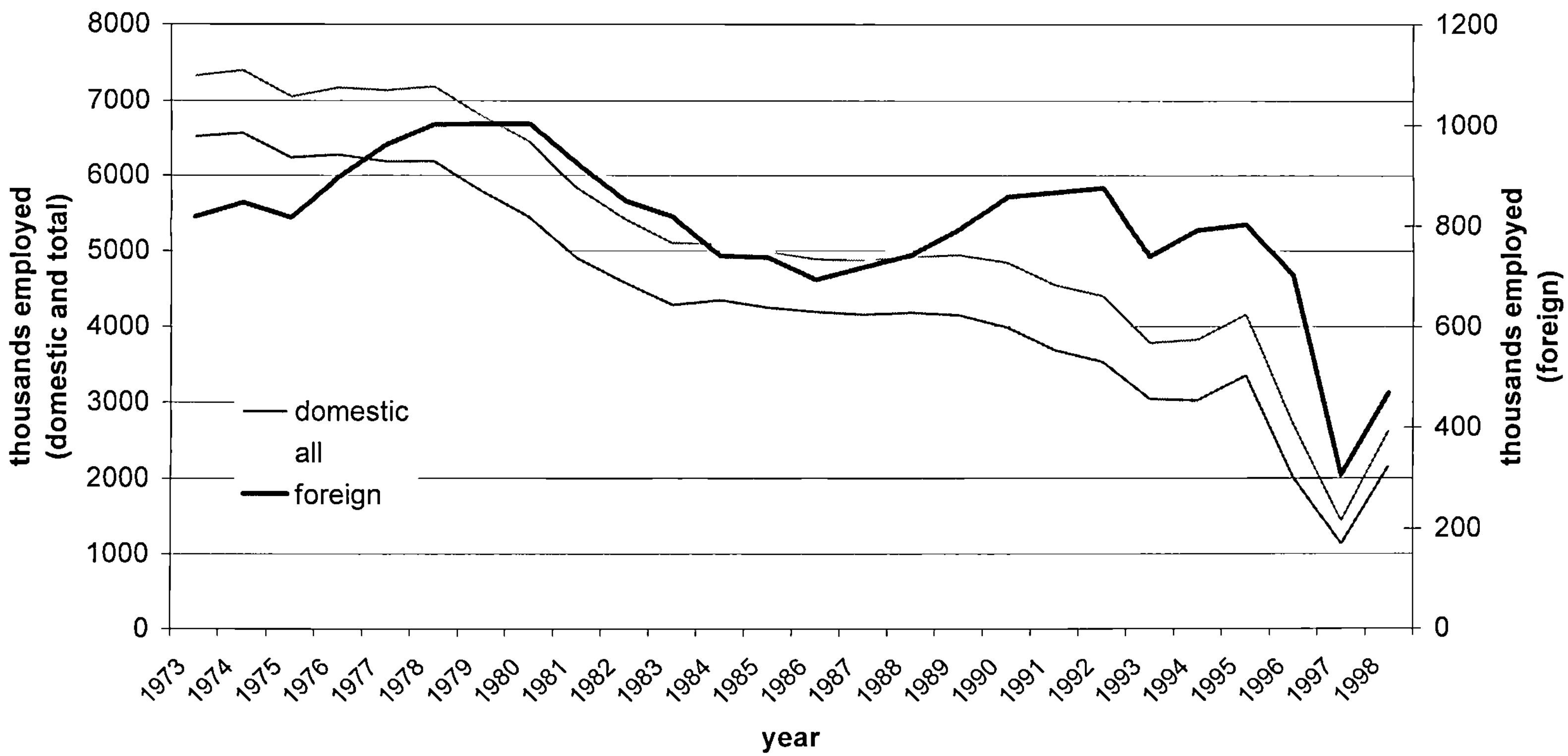


Figure 2.3b: Real gross output in manufacturing, domestically owned, foreign owned and all plants

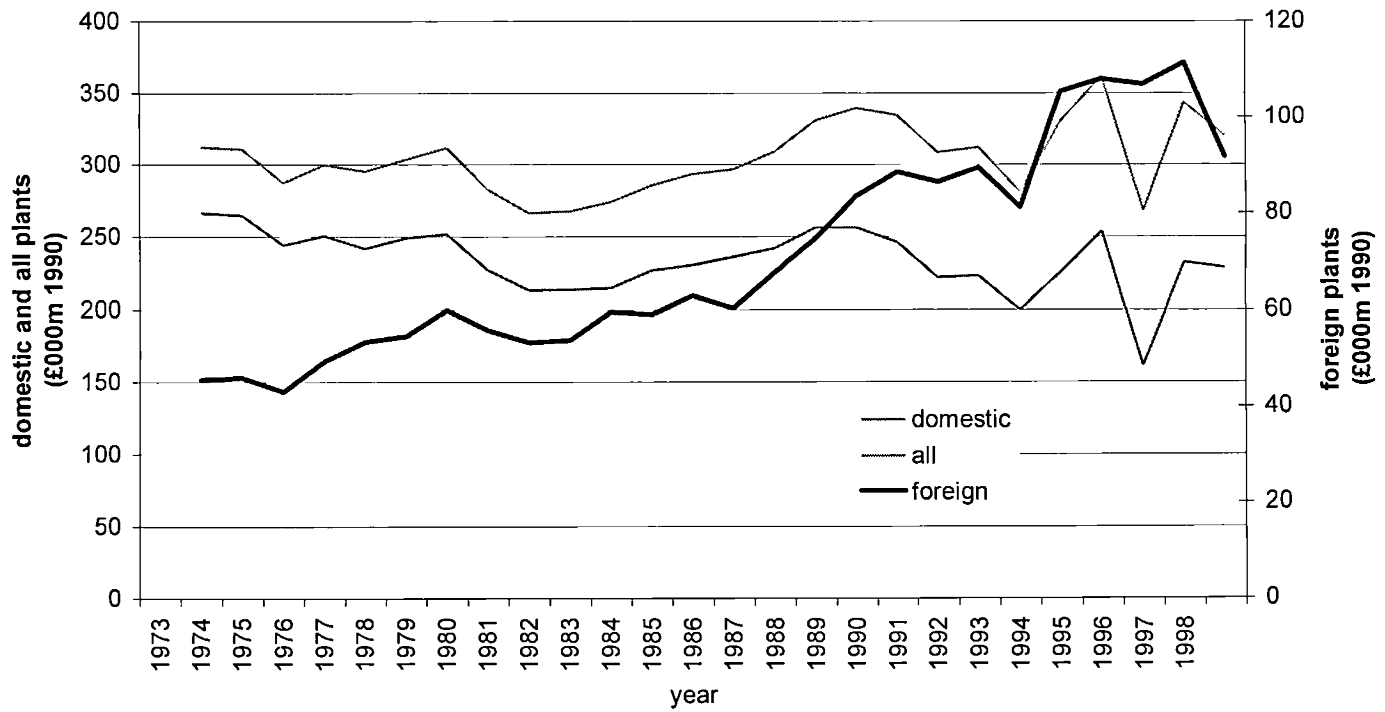
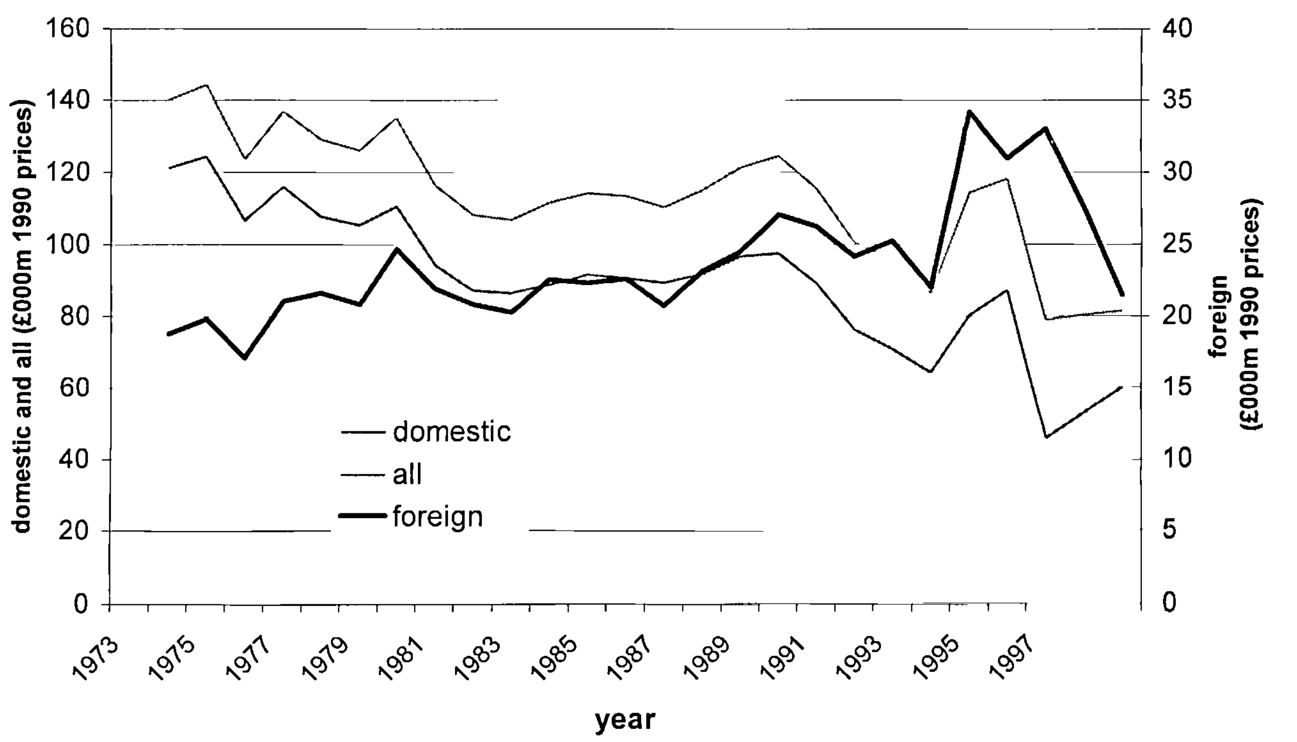


Figure 2.3c: Real gross value added in manufacturing, domestically owned, foreign owned and all plants

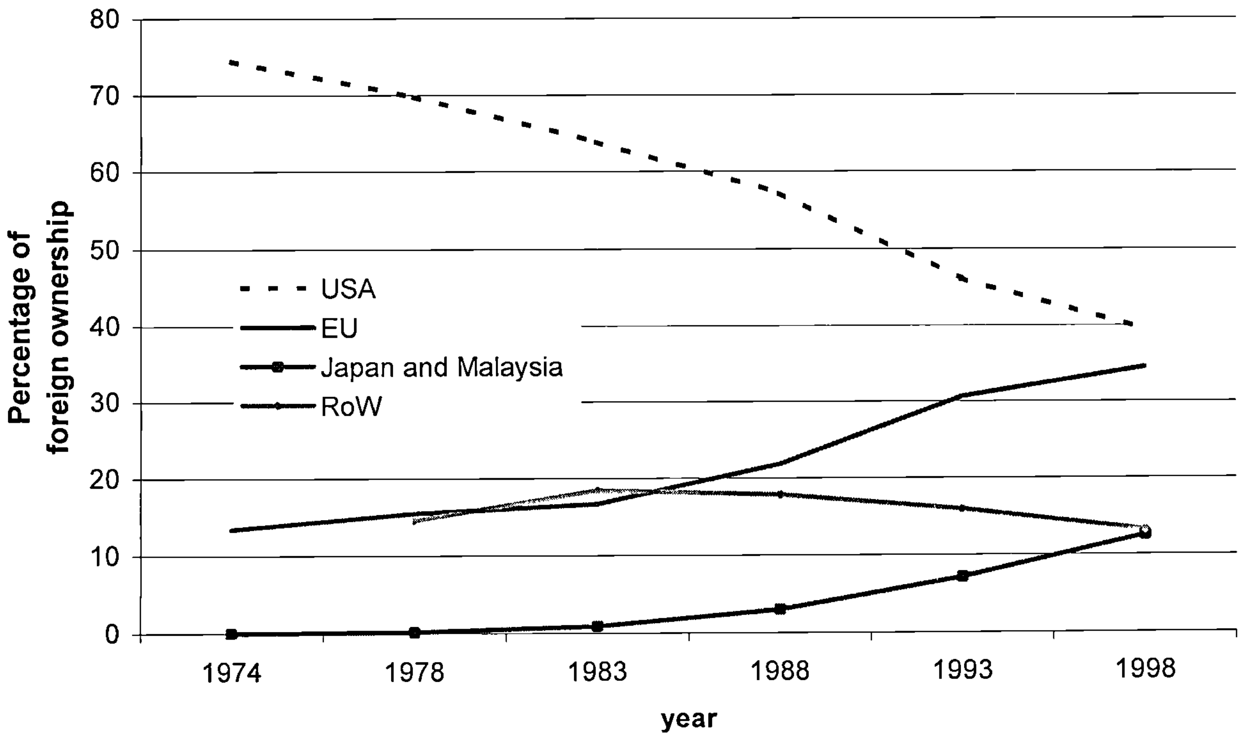


Population weighted, author's own calculations from the ARD

2.3.1 Country of origin

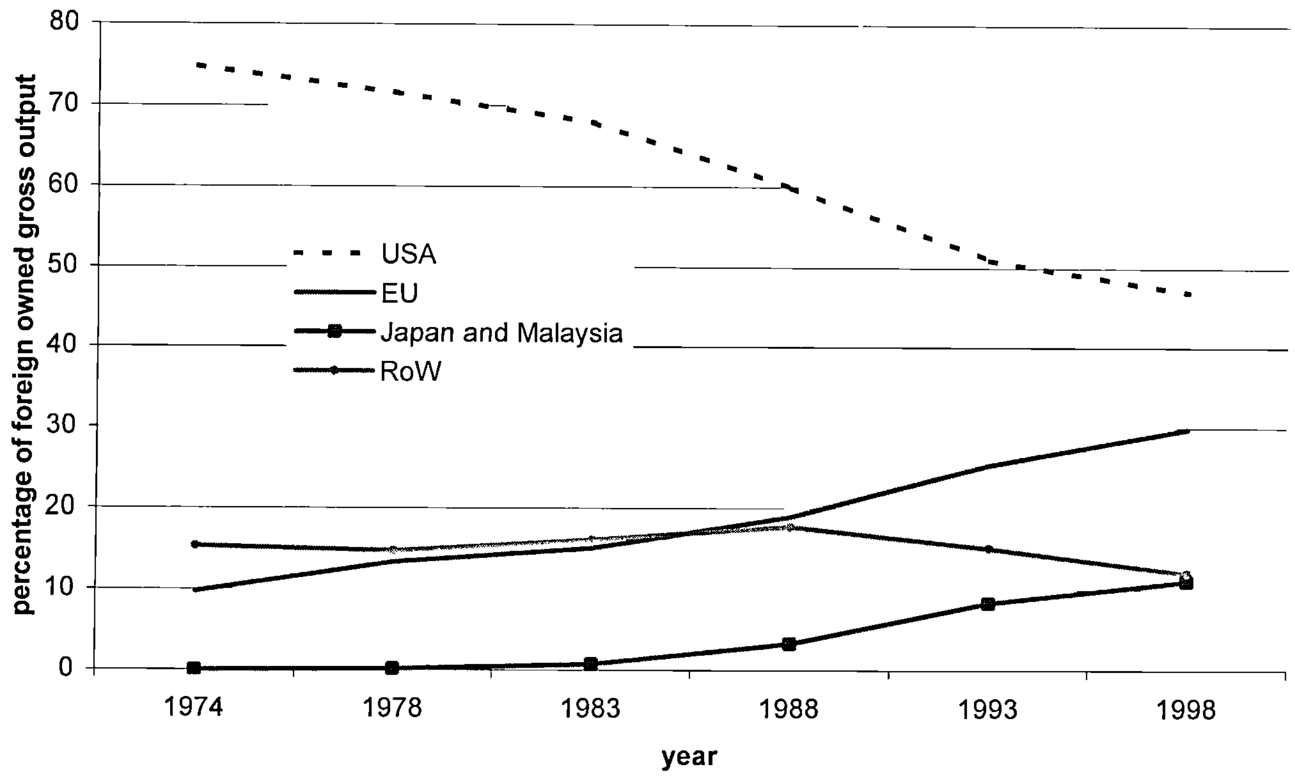
Against this backdrop of declining employment and more or less constant output in manufacturing, foreign ownership has continued to rise in significance not only in terms of absolute value added, but also in terms of diversity in the country of origin of the foreign investor. This was also evident from the discussion of the development of FDI interests in the UK covered in Section 2.2. As previously stated, in 1974, FDI accounted for 14.7 per cent of total gross manufacturing output and came from 15 different countries. By 1998, this had increased to 28.6 per cent of total gross output and came from over 35 different countries. Thus it can be seen that there has been a considerable increase not only in the proportion of foreign investment but also in the source, bringing with it greater cultural diversity. Whilst the US continues to own a significant proportion of plants in the UK, countries such as Japan and other EU member states, especially France and Germany, have increased their role in UK manufacturing. Figures 2.4a, b and c present percentages of foreign ownership by nationality. Figures 2.4 show the trend in employment, output and value added for 4 key groups - the US, the EU, Japan and Malaysia and the rest of the world (RoW) between 1974 and 1998. All years are not included in these graphs, giving a smoothed trend.

Figure 2.4a: Sources of foreign employment



Population weighted, author's own calculations from the ARD

Figure 2.4b: Sources of foreign real gross output 1974-1998

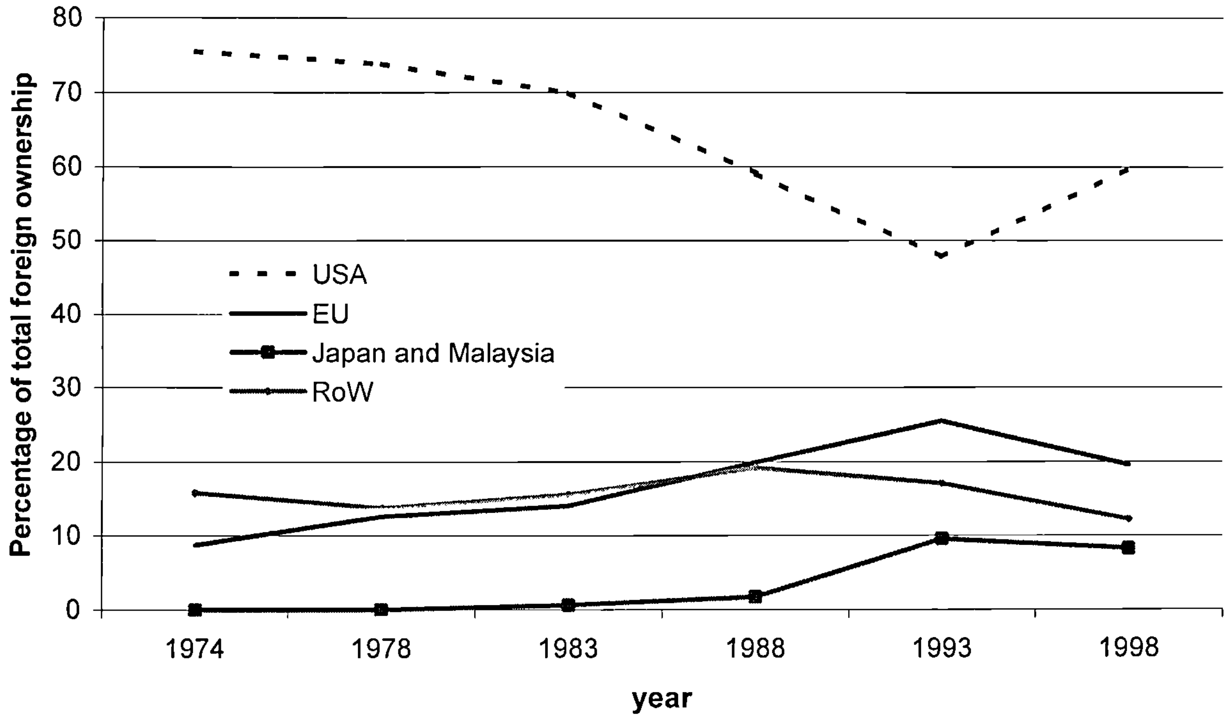


Population weighted, author's own calculations from the ARD

Broadly, these indicators should tell the same story, however their variation provides some indication of the differences between international investments. It can be seen from Figure 2.4a that as a proportion of total foreign employment, the US initially accounts for over 75 per cent of the total of foreign ownership. The EU and the rest of the world account for the remaining 25 per cent, Japan and Malaysia do not really enter the UK manufacturing sector until 1983. By the end of the period, the US is still the principal foreign employer in manufacturing, but EU employment has caught up, accounting for around 34 per cent, compared to a US share of 40 per cent and around 12 per cent for both the rest of the world and Japan and Malaysia combined.

Figure 2.4b shows gross output, and there is a significant rise in the importance of EU output, up to 30 per cent of the foreign contribution to output by 1998 from less than 10 per cent in 1974. Output from US plants has steadily dropped in its importance from around 75 per cent of foreign gross output to less than 50 per cent by 1998. Note that this period has seen a sharp increase in overall foreign investment levels and therefore the US decline is not so much a withdrawal of US interests, but a decline in the relative importance as other nationalities increase their investment levels.

Figure 2.4c: Sources of foreign real value-added 1974-1998



Population weighted, author’s own calculations from the ARD

Finally figure 2.4c shows trends in GVA, which broadly reflect the same trends described for gross output, however, Figure 2.4c provides a more interesting picture in that the US clearly remains the most substantial foreign contributor to gross value added. Since the early 1990s, the US contribution to foreign value added has seen an increase, compared with all other categories, which have seen a decline, the sharpest being the EU. This is in line with expectations that traditional foreign firms are likely to be more intermediate intensive and this can be seen to be the case in the US, particularly.

Therefore, it can be seen that there has been a steady increase in foreign ownership, by whichever measure of presence is used. Foreign ownership has traditionally been dominated by US enterprises, though there has been a notable increase in European investment over the 1980s and 1990s. The following chapter will consider the location of foreign investment in terms of industrial and geographical location; however the following section goes on to explore FDI in greater detail in a selected subset of 20 industrial sectors.

2.4 Trends for selected industries

Most industries have been affected by FDI; indeed, increasingly it has been more concentrated in industries outside manufacturing, such as financial services and business services. Foreign investment has traditionally been attracted to high technology and highly concentrated industries, such as chemicals and pharmaceuticals (Dunning, 1998). The wealth of data contained in the ARD is too extensive to include all industries at the level of disaggregation required to effectively answer all of the questions that this thesis aims to address. For this reason, a cross section of 4 digit industries has been selected following the method outlined below, and empirical analysis concentrates on these.

After ranking the 208[9] 4-digit manufacturing industries available, on the basis of the number of plants owned by foreign owned enterprises (1974-1995), 20 industries spread across the manufacturing sector were selected. The only major constraint on which 4-digit industries to include was that they contained a sufficient number of plants to ensure that there were enough observations for each foreign owned sector in each year to avoid any problems of disclosure that might result in a loss of confidentiality.[10] In total, the 20 industries that have been chosen cover over 24 per cent of all plants that provided financial data to the government and that were foreign-owned during 1974-1995. Indeed, during the 1991-95 period, the 20 industries chosen also accounted for over 39 per cent of all foreign-owned gross output in UK manufacturing. These industries are the focus of the more detailed analyses, included in Chapters 7 and 8. The selection method was designed specifically not to concentrate on one or two industrial areas, such as chemicals or pharmaceuticals, where foreign ownership may be very dominant (arguably, some of these industries may be regarded as international industries), but to obtain a good cross section to represent all foreign interests and involvements[11].

The industries selected on the above criteria are presented in Table 2.2[12] below, which contains information on gross output growth for the selected industries. Output growth is presented for all plants and also separately for foreign owned

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[9] See Appendix B for a full list of all 4-digit manufacturing sectors.
[10] The terms of agreement of using the ARD are briefly discussed in Chapter 1.
[11] The rationale for this stems from the expectation that reasons for FDI may differ, depending on the relative importance of FDI to the sector as a whole.

plants. Growth rates are split into three periods and then compared across the whole period in question 1974-1995. Output growth from 1974-1979 to 1980-1985 shows that there was generally a decline in all manufacturing output, in line with trends already observed in this Chapter. The notable exceptions are once again chemicals, electronic data processing and other electronic equipment, which are most likely to relate to increases in pharmaceuticals and the production of ICT hardware, and as such, part of a global phenomenon. The largest declines in output growth in these selected industries are seen to be concentrated in steel wire, engineers' small tools and mechanical equipment, sectors more associated with heavy, mature industry.

Examining the foreign owned sector only over this period (Table 2.2b), a generally similar pattern of decline can be observed, but the falls are not as great. Concrete, cement and plaster, electronic sub-assemblies, aerospace equipment, and publishing are industries where foreign owned plants do not follow the same trend as the UK total, but manage to experience positive output growth. Arguably, this growth might be at the expense of domestic firms as they face additional competitive pressures.

During 1979-1985, the UK experienced a recession and it can be seen from Tables 2.2 that the period 1986-1995 appears to show more positive all plant growth. This is magnified in the foreign owned plant subsection of these industries, where the only really significant declines in output growth occur in ceramic goods and engineers' small tools. If the overall period 1974-1995 is considered, it can be seen that with the exception of pharmaceutical products, industries that experienced positive output growth were generally bettered by foreign plants within that industry,

[12] Tables 2.2-2.4 are also included in Harris and Robinson (2003)

thus the foreign owned plants contributed significantly to the positive level of growth of the industry. This is particularly noticeable in concrete cement and plaster, electronic data processing, aerospace equipment and semi manufactured plastics. Overall, industries would have undoubtedly experienced greater overall decline in output growth over the whole period were it not for the positive impact of foreign plant growth.

Table 2.3 shows the share of gross output in the 20 industries by source of foreign ownership. This provides an overview of the industries in which various sources of foreign ownership is concentrated. It can be seen that the US had a particularly strong influence in pharmaceuticals, electronic data processing and other electronic equipment motor vehicles and miscellaneous foods, at the end of the 1980s and the first half of the 1990s. However, by the end of the period, whilst the share of US ownership of the gross output in these sectors has fallen from its early 1980s levels, a diversification in US interests can be observed, increasing its coverage across the 20 industries chosen.

Table 2.2a: Real gross output growth (average % p.a.), UK manufacturing (specified industries), 1974-1995

Industry (1980 SIC)	All plants			
	1974/79-1980/85[a]	1980/85-1986/90	1986/90-1991/95	1974/79-1991/95
Steel Wire (2234)	−7.8	−5.6	−2.8	-6.2
Concrete, cement, plaster (2437)	−2.1	0.7	−2.7	−1.4
Ceramic goods (2489)	−3.5	−3.9	−4.9	−4.5
Organic chemicals (2512)	0.9	−1.2	3.7	1.1
Pharmaceutical products (2570)	−0.8	0.8	4.6	1.5
Engineers' small tools (3222)	−10.3	−3.0	−5.9	−7.2
Mechanical equipment (3255)	−9.4	−0.6	0.1	−3.9
Refrigerating machinery (3284)	−7.2	−1.5	4.1	−2.2
Electronic data processing (3302)	1.4	19.3	4.9	9.4
Other electronic equipment (3444)	3.1	−0.4	−2.5	0.2
Electronic sub-assemblies (3453)	−1.2	2.6	1.9	1.1
Motor vehicles and their engines (3510)	1.4	0.0	−3.0	−0.4
Aerospace equipment (3640)	−0.5	−0.8	−1.8	−1.1
Preparation of milk products (4130)	−2.9	−5.4	0.4	−3.1
Cocoa, etc. confectionery (4214)	−2.0	−2.0	−3.1	−2.6
Miscellaneous foods (4239)	−3.4	−3.2	4.3	−1.2
Packaging of paper and pulp (4724)	−6.2	−2.5	−4.7	−4.9
Print/publishing of periodicals (4752)	−5.0	−0.2	3.9	−0.8
Plastics semi-manufactures (4832)	−4.2	2.0	5.5	0.9
Other manufactures n.e.s. (4959)	−9.5	5.4	−4.1	−3.2

Data weighted by population weights.

[a] Growth between average output in each period (converted to annual average equivalent)

Table 2.2b continued: Real gross output growth (average % p.a.), foreign plants in UK manufacturing (specified industries), 1974-1995

Industry (1980 SIC)	Foreign-owned plants			
	1974/79-1980/85[b]	1980/85-1986/90	1986/90-1991/95	1974/79-1991/95
	−0.3	−7.6	4.0	−1.9
Steel Wire (2234)	1.7	5.9	−1.6	2.4
Concrete, cement, plaster (2437)	−3.3	4.1	−6.1	−1.8
Ceramic goods (2489)	5.9	−4.9	3.0	1.3
Organic chemicals (2512)	−0.2	−1.3	4.4	0.8
Pharmaceutical products (2570)	−4.0	−5.3	−5.6	−5.4
Engineers' small tools (3222)	−4.4	2.7	4.7	0.9
Mechanical equipment (3255)	−2.0	3.0	7.1	2.7
Refrigerating machinery (3284)	4.0	23.9	9.7	13.8
Electronic data processing (3302)	0.3	−8.0	6.3	−1.1
Other electronic equipment (3444)	0.3	−0.1	5.9	2.0
Electronic sub-assemblies (3453)	4.6	1.4	−0.0	2.3
Motor vehicles and their engines (3510)	1.2	8.9	19.1	10.1
Aerospace equipment (3640)	−1.4	−10.3	18.5	0.8
Preparation of milk products (4130)	−2.9	−0.2	10.8	2.2
Cocoa, etc. confectionery (4214)	−5.0	−1.0	5.7	−0.5
Miscellaneous foods (4239)	−5.2	−1.7	1.8	−2.1
Packaging of paper and pulp (4724)	6.4	−5.6	1.6	0.7
Print/publishing of periodicals (4752)	0.5	−1.7	15.8	4.5
Plastics semi-manufactures (4832)	−31.5	18.7	−1.2	−8.1
Other manufactures n.e.s. (4959)				

Data weighted by population weights.

[b] Growth between average output in each period (converted to annual average equivalent)

EU interests were concentrated in the same three industries that the US was important to during the early part of the period. By the end of the period, EU interest has also spread more evenly throughout the economy. Indeed the EU coverage is broader than US interests. In contrast to the US and EU approaches to investment in UK manufacturing, the old Commonwealth countries (OC) and South East Asian countries appear to have a more concentrated interest in UK manufacturing. By the early 1990s their interests were particularly strong in the electronics sectors. OC countries appear to have strong interests in concrete cement and plaster, aerospace equipment and printing and publishing.

Table 2.4 provides further descriptive statistics on these 20 industries, the labour productivity levels by broad nationality of owner, the level of capital intensity by nationality of owner and the overall levels of employment. It can be seen from looking at the output per employee that foreign owned plants generally, though not exclusively are more productive. This is particularly noticeable in miscellaneous foods, motor vehicles and also in pharmaceutical products. Examining the level of capital intensity by industry, it can be seen that foreign plants generally have significantly higher levels of capital intensity than domestic plants. This is particularly true in the case of US plants, though to a lesser extent with EU and other nationalities. In terms of employment, there are higher levels of average employment in the US plants and roughly similar levels in EU plants to domestic plants, with a number of exceptions by industry, notably steel wire and cocoa and confectionary (traditional and mature industries). The implications of these findings are that it is likely that foreign owned plants are bigger and this accounts for the various intensities seen.

Table 2.3: Share of (real) gross output of foreign-owned plants, 1974-1995: UK manufacturing (various industries and sub-periods)

Industry SIC (1980)	1974-79				1980-85					1986-90				1991-95		
	EU	US	OC	SE Asia	EU	US	OC	RoW[a]	SE Asia	EU	US	OC	SE Asia	EU	US	OC
Steel Wire (2234)	0.5	3.8	4.5	–	*	6.7	8.3	–	–	5.8	7.4	–	–	14.2	5.5	–
Concrete, cement, plaster (2437)	3.1	*	2.7	–	5.6	0.5	1.1	0.8	–	7.8	–	3.6	–	8.0	–	4.2
Ceramic goods (2489)	1.8	8.5	*	–	4.4	6.0	*	–	–	12.5	6.0	–	*	11.1	5.6	–
Organic chemicals (2512)	7.9	7.9	*	–	10.6	11.5	*	–	–	7.3	9.2	–	–	6.3	10.0	*
Pharmaceutical products (2570)	14.5	31.7	1.4	–	15.5	32.6	1.1	0.7	–	13.6	29.4	0.1	*	16.0	26.5	*
Engineers' small tools (3222)	8.8	6.1	*	–	16.3	7.3	*	–	*	11.8	8.2	*	0.9	11.0	8.9	–
Mechanical equipment (3255)	3.0	16.0	*	1.5	6.9	18.4	0.8	0.2	–	14.7	20.0	*	–	19.2	26.4	*
Refrigerating machinery (3284)	0.7	7.0	1.0	*	3.5	8.1	*	–	*	4.2	12.4	0.7	0.5	6.0	14.1	–
Electronic data processing (3302)	0.2	39.0	–	–	–	46.6	–	–	2.5	4.0	54.0	0.5	20.9	5.6	53.1	0.1
Other electronic equipment (3444)	7.8	40.4	–	–	3.3	36.6	–	*	2.6	1.8	18.5	–	16.4	8.7	13.4	–
Electronic sub-assemblies (3453)	38.6	17.8	–	1.0	22.9	38.7	–	–	4.4	17.2	30.1	*	15.6	21.4	25.8	2.7
Motor vehicles and their engines (3510)	0.1	48.8	–	*	3.6	56.8	–	*	1.5	10.1	54.7	*	8.7	19.5	51.4	–
Aerospace equipment (3640)	*	0.8	0.7	–	0.5	0.6	0.8	–	–	0.7	1.3	1.6	*	2.9	4.1	4.4

Table 2.3: Share of (real) gross output of goreign-owned plants, 1974-1995: UK manufacturing (various industries and sub-periods)

Industry SIC (1980)	1974-79				1980-85					1986-90				1991-95		
	EU	US	OC	SE Asia	EU	US	OC	RoW[a]	SE Asia	EU	US	OC	SE Asia	EU	US	OC
Preparation of milk products (4130)	3.7	3.7	–	–	4.5	3.7	–	–	–	5.4	–	*	–	14.0	*	*
Cocoa, etc. confectionery (4214)	3.8	18.8	–	–	2.9	18.4	–	–	–	13.3	10.9	–	–	24.7	29.3	–
Miscellaneous foods (4239)	6.7	35.6	*	–	7.6	30.2	*	–	–	9.8	34.4	–	0.4	15.8	30.5	*
Packaging of paper and pulp (4724)	6.3	8.9	–	–	12.3	4.1	–	–	–	14.5	*	*	–	23.0	*	*
Print/publishing of periodicals (4752)	0.3	4.7	5.6	3.1	7.3	7.9	5.0	–	2.9	2.8	6.5	3.6	*	2.9	6.2	4.1
Plastics semi-manufactures (4832)	10.5	6.5	*	*	18.5	5.5	*	–	*	12.5	4.5	0.7	1.2	17.9	13.6	*
Other manufactures n.e.s. (4959)	1.2	20.9	*	–	*	*	–	2.6	–	6.2	1.1	–	1.5	2.9	4.4	–

* =data suppressed to avoid disclosure of confidential information; – =no observations in database. Data weighted by population weights. Source: ARD
SE Asian = Japan, Taiwan, Hong Kong, South Korea, and Malaysia; EU= European Union countries (current Member States); OC = Australia, New Zealand, Canada, and South Africa; RoW = all other foreign countries
[a] In other periods, the RoW category comprises a small number of non-zero industries (but which do not allow for disclosure).

Table 2.4: Median labour productivity, capital-to-labour ratio and total employment levels by country of ownership, UK manufacturing

(specified industries, 1974-1995)

Industry SIC (1980)	Gross Output £'000 per employee 1990 prices				Capital[a]-to-labour ratio £'000 per employee 1980 prices				Employment			
	UK	US	EU	Other	UK	US	EU	Other	UK	US	EU	Other
Steel Wire (2234)	46.3	56.0	57.7	114.7	6.5	9.1	6.3	21.8	15	56	48	674
Concrete, cement, plaster (2437)	59.0	35.1	53.6	78.4	15.8	0.9	16.2	33.6	12	9	15	11
Ceramic goods (2489)	22.4	44.1	26.5	*	3.1	6.2	3.7	*	23	48	40	*
Organic chemicals (2512)	175.4	233.9	160.8	*	10.3	71.2	83.7	*	7	18	9	*
Pharmaceutical products (2570)	48.5	74.1	104.1	56.7	9.6	9.6	8.8	13.0	28	19	16	31
Engineers' small tools (3222)	26.4	39.7	34.2	42.4	7.5	13.1	5.9	11.7	19	18	8	17
Mechanical equipment (3255)	35.2	39.0	51.0	37.7	2.8	1.2	2.7	7.4	17	15	15	19
Refrigerating machinery (3284)	46.9	44.5	54.8	37.1	2.8	3.6	4.7	10.9	15	9	11	3
Electronic data processing (3302)	49.7	59.3	101.4	156.4	3.1	5.8	10.4	5.4	17	13	23	10
Other electronic equipment (3444)	25.1	26.7	37.1	70.9	6.1	8.8	6.2	13.0	36	69	47	114
Electronic sub-assemblies (3453)	27.9	87.1	37.3	56.7	4.8	9.2	14.9	8.1	39	13	91	24
Motor vehicles and their engines (3510)	47.0	77.9	117.0	58.4	3.3	10.5	3.8	15.3	16	27	11	47
Aerospace equipment (3640)	35.7	52.3	47.6	43.6	4.9	1.2	4.3	4.6	31	17	10	19

Table 2.4 continued: Median labour productivity, capital-to-labour ratio and total employment levels by country of ownership, UK manufacturing (specified industries, 1974-1995)

Industry SIC (1980)	Gross Output £'000 per employee 1990 prices				Capital[a]-to-labour ratio £'000 per employee 1980 prices				Employment			
	UK	US	EU	Other	UK	US	EU	Other	UK	US	EU	Other
Preparation of milk products (4130)	86.3	136.1	130.1	*	11.9	13.6	3.8	*	16	80	16	*
Cocoa, etc. confectionery (4214)	33.6	75.2	61.2	*	6.4	8.6	19.4	*	25	270	56	*
Miscellaneous foods (4239)	36.7	74.4	113.3	66.4	11.1	12.3	14.2	9.2	13	46	17	73
Packaging of paper and pulp (4724)	51.0	35.8	60.5	*	7.3	11.1	7.0	*	24	24	33	*
Print/publishing of periodicals (4752)	51.9	113.6	68.8	51.1	5.1	5.3	2.3	7.6	13	18	11	14
Plastics semi-manufactures (4832)	54.6	70.6	60.2	91.8	7.1	18.3	10.5	25.3	17	47	17	51
Other manufactures n.e.s. (4959)	28.9	24.5	42.3	59.0	2.5	7.0	3.1	4.1	16	35	31	38

Data weighted by population weights. * data suppressed to avoid disclosure of confidential information. [a] Plant and machinery only. Source: ARD, Harris and Drinkwater (2000)

2.5 Summary

FDI has been a feature of most modern economies and the UK has been both a major source and a major recipient of FDI. The UK has experienced an expansion in overall levels of FDI, defined in terms of employment and output, but also an expansion in the diversity of sources. The period from 1974-1998 was one of overall decline in manufacturing output and a period that saw a decline in the importance of traditional investors from North America and a growth in South East Asian and European investment.

In terms of a number of selected industries, it can be seen that the more traditional manufacturing sectors such as steel wire, engineers' small tools and the packaging of paper and pulp paper saw a decline in shares of gross output, both domestic and foreign. Expanding industries include electronic data processing though this industry has a relatively small foreign presence, and for foreign owned firms there was significant expansion in motor vehicles and aerospace equipment. It has been demonstrated that labour productivity is generally higher for non-domestic plants, the capital to labour ratio is larger and their size in terms of employment is also generally higher. This indicates that foreign owned firms appear to be significantly larger and more capital intensive than domestic plants – this is especially clear when compared to US owned plants.

Dunning (1998) states that the rationale for his 1956 work was to examine the underlying productivity gap between US and UK workers, to try to establish whether the productivity difference was a result of ownership advantages (being US owned) or location advantages (US plants choosing to locate in the UK). From observing labour productivity (gross output per head), foreign owned firms are more productive. However, labour productivity is an incomplete measure since it fails to take into account capital and intermediate intensity and it has been seen that foreign owned firms are more capital intensive. Whilst this is a good indication of some of the benefits that may accrue to the domestic economy, it fails to fully take account of the differences between foreign and domestic plants. Access to the ARD and computed capital stock figures (Harris and Drinkwater 2000) enable the consideration in subsequent chapters of the impact of being foreign owned on plant productivity, domestic plant productivity and acquired plant productivity, using total factor productivity approaches.

Chapter 3:

The location of foreign ownership

3.0 Introduction

The previous chapter provided background information on the development and nature of foreign direct investment in the UK using the ARD. This chapter extends that work to consider in more detail the location of foreign ownership in terms of geography and industry. The aim in this chapter is to provide a context for foreign ownership and background information on the nature and location of different foreign plants, which may provide insight for later findings.

Firstly, this chapter provides an overview of the regional location of foreign plants, exploring any potential concentration of nationalities in any specific regions. Reasons why this might occur are firstly put forward in Section 3.1 and chiefly relate to agglomeration and network economies associated with concentration of location. Following from the consideration of the regional (and sub-regional) dimension of location, Section 3.2 goes on to describe variation in foreign ownership across industries. Certain sectors may be more prone to foreign ownership entry than others potentially because of attributes that the industry might display; in particular, this section explores the relationship between foreign ownership and the level of industrial concentration. The nature of these regional and industrial traits is explored with a view to informing the overall debate within the thesis. The key variables to be analysed in this chapter are gross output and employment, variables that also provide a good indication of size and structure. It is recognised that value added and output per head are also useful measures; however, they do not offer a great deal of additional descriptive power than the two aforementioned measures, and thus, this discussion is largely limited to employment and output.

The forces that attract FDI to particular regions may be difficult to disentangle from the characteristics of an industry in cases where industries have strong regional biases; firms may locate in the South East because of the nature of the industries that tend to be located there, rather than because of regional attributes, *per se*. In order to separate these effects, a multinomial logit model is constructed in Sub-Section 3.3. The results from this model go some way in separating out the effects of region and industry and provide an overall indication of the key determinants of the location of foreign plants.

3.1 Regional variation in foreign ownership

The UK economy is often discussed as though it behaves collectively (and evenly) as a unit. However, it may also be viewed as a collection of regional economies, all growing at different rates, which may not be convergent but divergent (at the very least, absolute levels of prosperity may widen over time). Firms facing the decision to locate are guided by a number of factors; supplies of raw materials, the quality and nature of the local labour market, communications and transportation links, the location of competitors, suppliers and customers, etc. All of these factors determine the attractiveness of an area for firms, and the types of industries that develop in particular regions. Arguably, each industry has its own geographical dimension, which is likely to vary over time (again dependent on changes within the region, and in the production process and technological developments within the industry/firm). A branch of economics is dedicated to identifying and explaining differences across regions (c.f. Armstrong and Taylor, 2000), but since regional economics is not the primary focus of this thesis, it is only discussed as far as it applies to location differences between domestic and foreign plants. However, it is worth highlighting that the uneven distribution of economic activity is likely to result in social and economic problems in the more remote regions and also problems of congestion and excess demand for factors of production can start to hinder overly successful regions that attract many firms.

The regional location of FDI is one of the key decisions firms make when entering a host nation. Chapter 2 has established that the UK has been especially successful at attracting US and increasingly Japanese investment within Europe, but it will be seen in this chapter that specific areas within the UK have been more successful than others. In this section the theoretical rationale for why this might be the case is outlined and the regional location of FDI over the 1974 to 1995 period is considered.

3.1.1 Regional location decisions

The discussion above has implied that regional factor endowments are the primary source of different growth rates between regions[1]. However, aside from factor endowments, firms may choose to locate in a particular region because other firms are located there and they perceive there to be benefits stemming from such close proximity. Armstrong and Taylor (2000) distinguish clearly between localisation economies and agglomeration economies, defining the former as within industry clustering and the latter operating across industries, mostly (though not exclusively)

[1] Wheeler and Mody (1992) highlight the early work by von Thunen (1826) and Isard (1956) which assumes that industry location patterns are essentially 'pre-ordained by geographical endowments, relative prices and transport costs' (p.59).

within supply chains. These two types of economies are described in greater detail below.

Localisation and agglomeration economies

Since the early work of Marshall (1890) it has been recognised that there are externalities to firms locating in the same geographical area, i.e. there are external economies to the spatial proximity of related activity. Many of these relate to transport and communication economies which explains why distribution and assembly costs can be minimised for certain types of industry. Marshall (*op cit*) highlighted the importance of knowledge, labour markets risk pooling and vertical linkages as major sources of agglomeration economies. These factor market externalities, which have been further developed by others (such as Romer and Arrow), suggest that firms with similar technologies will benefit from co-location.

This type of clustering allows for individual plants to specialise more than they would otherwise, and facilitates R&D and innovation in an industry through technical spillovers, and clustering reduces risks for workers and employers as the employment opportunities for skilled and trained workers are likely to be greatly enhanced by a concentration of similar plants in a geographic area, and it also provides a pool of suitably qualified workers for employers.

In contrast to the clustering for firms within the same industry, Jacobs (1969) suggests that diverse industrial structure may result in external benefits chiefly in the form of technological spillovers. This is more broadly referred to as agglomeration economies. Agglomeration economies arise from the geographical association of a larger number of economic activities (Armstrong and Taylor, 2000), which can jointly benefit from the provision of an input, such as good transportation and communications facilities or a pool of highly skilled labour. Internal economies of scale will be reinforced by external economies in industries which are highly vertically integrated (Venables, 1998). The clustering of firms that buy from one another may result in significant cost reductions, in part by lowering transportation costs, but also as they share information and learn more about each others' requirements and technologies up and down the supply chain. Guimaraes *et al* (2000) also highlight the importance of urban variety and not simply localisation of particularly industries as being a major source of economic growth.

The effects of agglomeration need not be confined to the growth centre, but may spread beyond – the idea of backwash effects is put forward by Armstrong and Taylor (2000). Growth centres are typified by high growth, high capital intensity and technologically advanced industries. Whilst these types of economies are likely to increase regional disparities, excessive growth could cause external diseconomies, such as congestion, pollution, high rents and wages, etc.. This may lead firms to re-locate in lower cost locations, resulting in a trickle down effect.

So far, the consideration of location and agglomeration economies has related to the location of domestic and foreign firms alike; however, there may be good reasons why foreign firms with less cultural know-how than domestic plants, are likely to benefit more from the location and agglomeration economies (Driffield and Munday, 2001). This may in part relate to the nature of a foreign firms' production process, particularly in the case of the Japanese style of management (Head *et al*, 1995). In addition, foreign owned firms are more likely to be innovation driven and capital intensive (Cantwell and Immarino, 2000; Dunning, 1998), and are therefore typical of the type of plants that are most likely to benefit from agglomeration economies. This theory relates closely to the literature on spillovers, reviewed in greater detail in Chapter 5, where domestically owned firms may benefit from close proximity to foreign owned plants in particular[2]. Whilst this is clearly a microeconomic effect, at the macro level, international economics (Krugman, 1991) emphasises the role of external economies in explaining economic growth.

Empirical evidence in support of tangible benefits from industrial agglomeration is found by Head *et al* (1997), who looked at the extent to which Japanese plants had been attracted to specific US states, by considering the proportion of Japanese plants already established in each state. They find that Japanese inward investors were attracted to locations that already had an existing concentration of plants in the same industry. This was also confirmed by the high geographical concentration seen of Japanese investors in the UK. Ford and Strange (1999) explored the location choices of non-European firms locating within Europe. They found that Japanese firms tended to locate in regions within Europe that already had significant Japanese investment.

Audretsch (1998) shows that the number of patents registered by firms located in cities is significantly correlated with the number of research centres, the number of patents per head and the percentage of the population with degrees, thus he finds that education and patents have a high positive correlation. Devereux, Griffith and

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[2] In addition, foreign firms may benefit from locating close to domestically owned plants also; the idea of reverse spillovers is discussed by Driffield and Love (2003) and in greater detail in Chapter 5.

Simpson (2002) explore the role of agglomeration within Great Britain using the ARD. They find that during the 1980s new entry was still attracted to regions with geographic concentrations, some of which had been established for decades, highlighting the pervasiveness of agglomerations.

Guimaraes *et al* (2000) were critical of the majority of empirical studies aiming to detect agglomeration because of the geographic scales over which they were testing and also because of the relatively imprecise nature of their agglomeration variables. Guimaraes *et al (op cit)* use establishment level data to consider the location decisions of Greenfield foreign entrants to Portugal. They test for 4 types of agglomeration; industry specific location economies, concentration of business services, foreign specific and other types of agglomeration, captured by the inclusion of a total manufacturing activity variable. Using a conditional logit model they find that business services are the strongest of all the agglomeration factors tested. Overall, they do find that external economies are significant and positive.

In another study of the US, Wheeler and Mody (1992) argue that international investors may discount the agglomeration benefits preferring to diversify the risk. However, in their detailed empirical analysis of the US they find little evidence to support this.

Thus, in support of the theoretical literature, the empirical literature seems to bear out the fact that FDI is attracted to areas where firms in the same industry are also located. In so doing, they benefit from a stock of skilled labour, and are likely also to benefit from upstream and downstream linkages (Markusen and Venables, 1999;

Matouschek, 2000). Within this literature there is also the suggestion that in a number of industries, once a critical mass of firms is achieved in a location, others will follow (Wheeler and Mody, 1992)[3]. This is, in part, the rationale behind some government assistance schemes, which have a strong regional dimension (e.g. RSA).

The importance of government financial assistance in the location of foreign owned plants is well established in the regional economics literature (Hill and Munday, 1994; Wren and Jones 2003; Driffield, 2001). David (1984) refers to location 'tournaments' that take place to attract international capital such as incentive programmes. Indeed, there is significant evidence that foreign firms are guided by the availability of government assistance schemes that encourage inward investment in manufacturing, such as RSA (Harris and Robinson, 2001b). In addition, communications may have a significant impact on location choices facing firms; e.g. the growth of the East Midlands airport may assist firms in importing inputs and exporting goods and this might motivate a decision to locate in this region. Fothergill and Gudgin (1982) demonstrate that there is a growing long term tendency for firms to locate in less congested areas, which are generally also less costly. These locations however still need to be relatively well located, in terms of communications and transportation, and therefore tend to be on the periphery of large conurbations, rather than in remote rural areas.

With this literature in mind, the location of FDI and the spread of manufacturing across the regions (and sub-regions) is considered; the literature above may provide a rationale for any patterns perceived as the literature would suggest that there is a

[3] The difference between ergodic and non-ergodic regions and their importance is discussed in detail in Wheeler and Mody (1992).

clustering of economic activity. The chapter firstly concentrates on the standard statistical regions (SSRs)[4] when considering both the location and trends in ownership. Figures 3.1a and 3.2a below summarise the distribution of employment and output over each of the 11 regions, for 1974-1995, for foreign and domestic plants in manufacturing. Figures 3.1b and 3.2b show the changes in employment and output from 1974 levels in each of the region.

Figures 3.1a and 3.2a show the dominance of the South East in both employment and output terms, accounting for around 25 per cent of gross output, and around 20 per cent of employment over the whole period. The South East is a densely populated area with good transportation links for export markets, near the coast and having a number of airports. The next most important regions are the North West and the West Midlands, where much of the heavy industry is located (discussed in more detail in Section 3.2). Northern Ireland, Scotland and Wales (and to some extent the North) have expanded their overall percentage share of employment, from around 20 per cent to around 24 per cent, though this is largely due to these regions experiencing a smaller decline than elsewhere in the UK, rather than a real growth in employment. The general decline in employment over time is also noticeable, whilst gross output is more or less maintained over the period, with a clear cyclical pattern. These figures do, in part, reflect population density and therefore trends in shares over time need to be considered in conjuction. These are presented in Figures 3.1b and 3.2b.

[4] The South East, East Anglia, the South West, East and West Midlands, Yorkshire and Humberside, the North West, the North, Wales, Scotland and Northern Ireland.

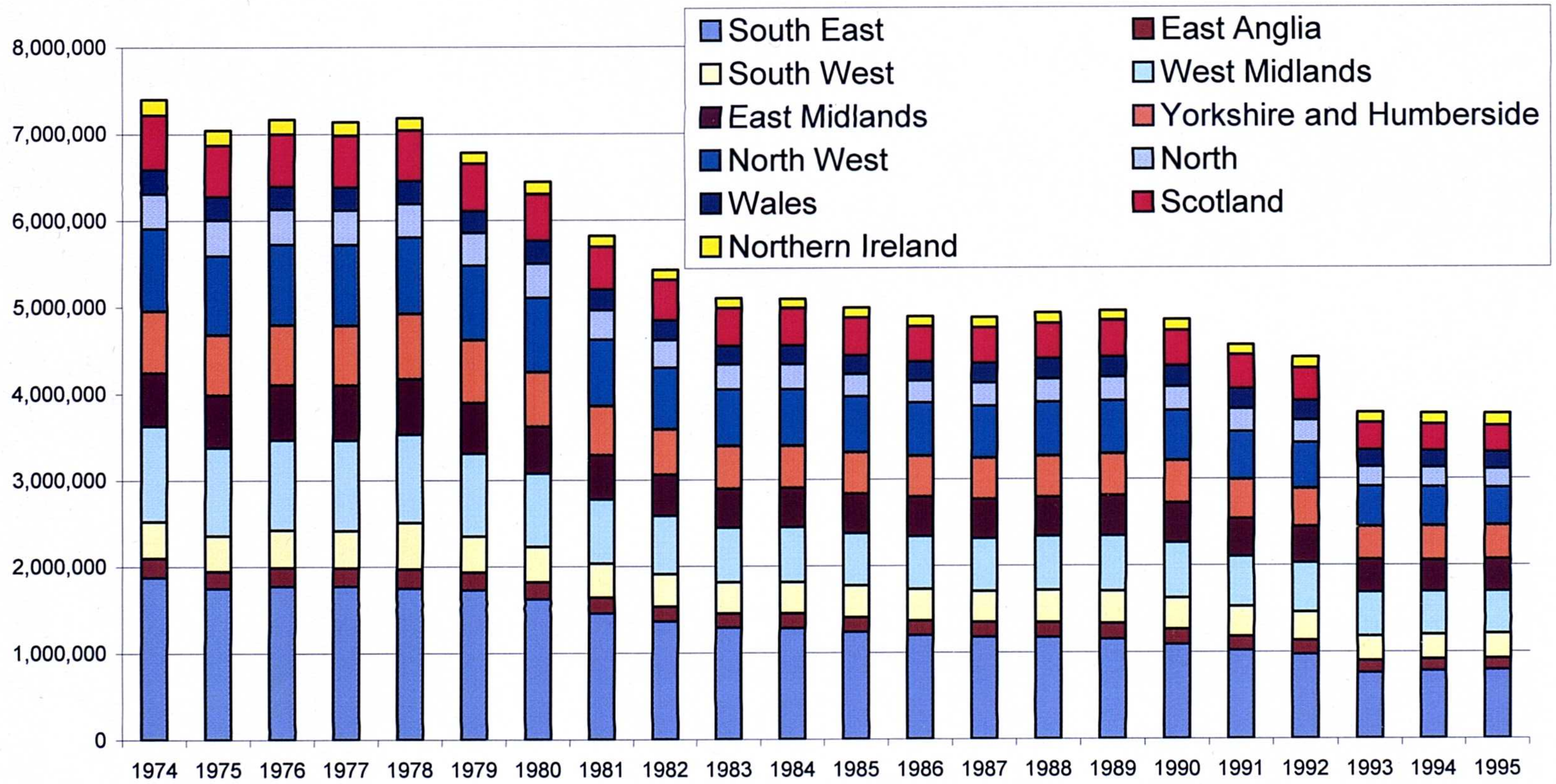
From these line graphs, it can be seen that in terms of absolute employment levels, as seen in Chapter 2, there has been general decline over time, with every region employing less than they did in 1974 by the end of the period. However, the South East, West Midlands and the North West have seen the greatest relative declines from their 1974 positions, areas that were seen to be dominant in figures 3.1a and 3.2a.. This is suggestive of the problems associated with higher pecuniary and non-pecuniary costs in the South East, discussed above. Northern Ireland, Wales and the South West have seen the smallest fall since the beginning of the period, but all experience a fall, nonetheless[5].

Considering Figure 3.2b, it can be seen that output has been maintained in most regions, with the exception of the South East, West Midlands and the North West. Again, Wales, Northern Ireland and the South West have seen significant increases in manufacturing output over the period, each seeing over 40 per cent growth in output on 1974 levels. The results therefore suggest that there has been considerable capital intensification in manufacturing production as demand for labour has fallen considerably and output has been largely maintained. It also indicates that there has been a shift in manufacturing away from traditionally strong manufacturing regions to the more remote locations. This may again be the result of negative externalities referred to above, related to congestion and excess demand, but it may also be influenced by regional support grants that are directed at manufacturing in these regions.

[5] It should be remembered that data for manufacturing only are being discussed here, and thus this may not be the case when the service sector is taken into account. This however, is beyond the scope of this thesis.

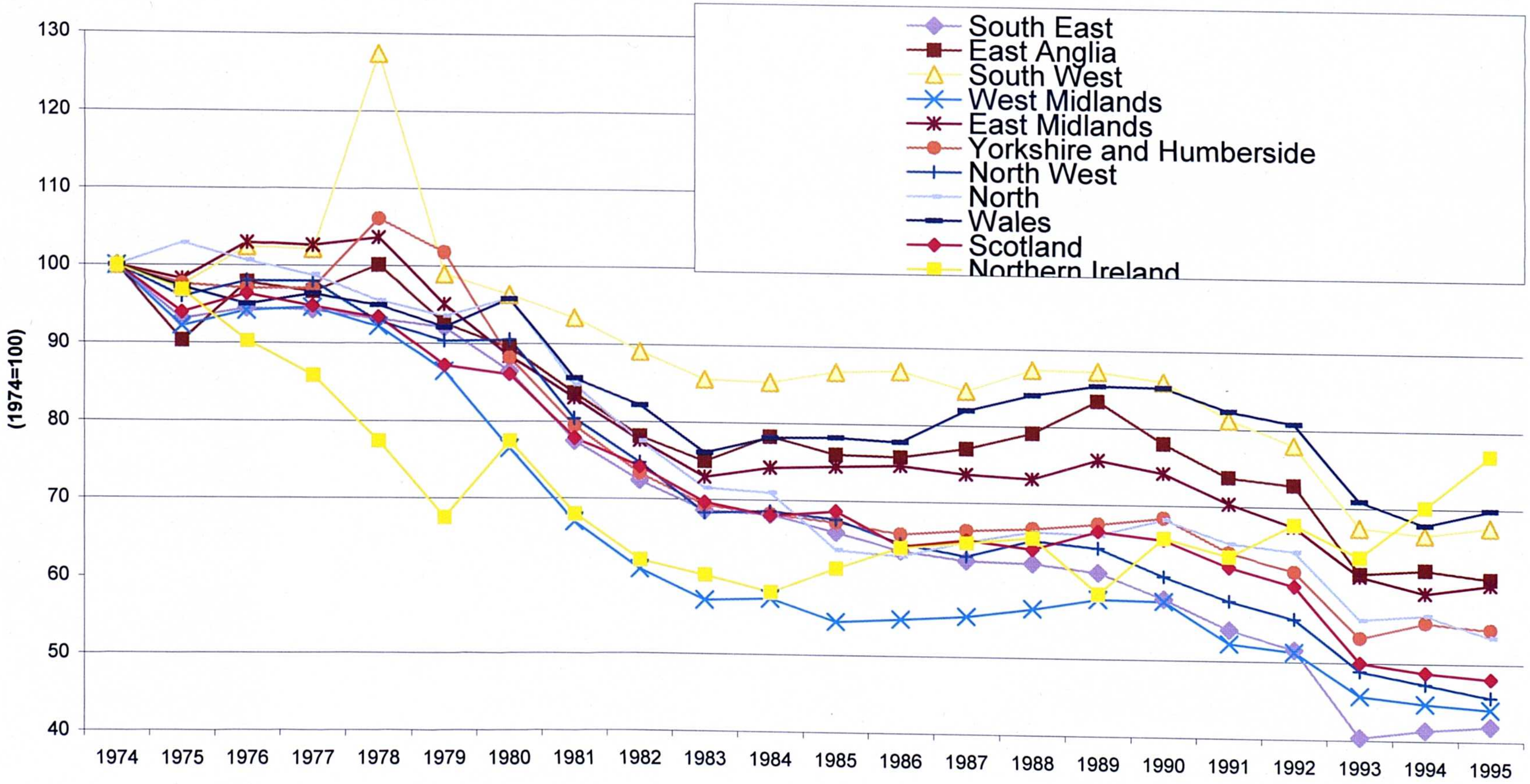
Overall, the ranking of regional distributions of employment and output is evidently stable over time, which is in part an indication of the high degree of aggregation used here, but this also suggests that convergence is generally slow, if indeed any convergence occurs. This is consistent with the findings of Harris and Trainor (1999) who found that convergence in UK manufacturing did not occur between 1968 and 1992.

Figure 3.1a: Manufacturing employment by region, 1974-1995



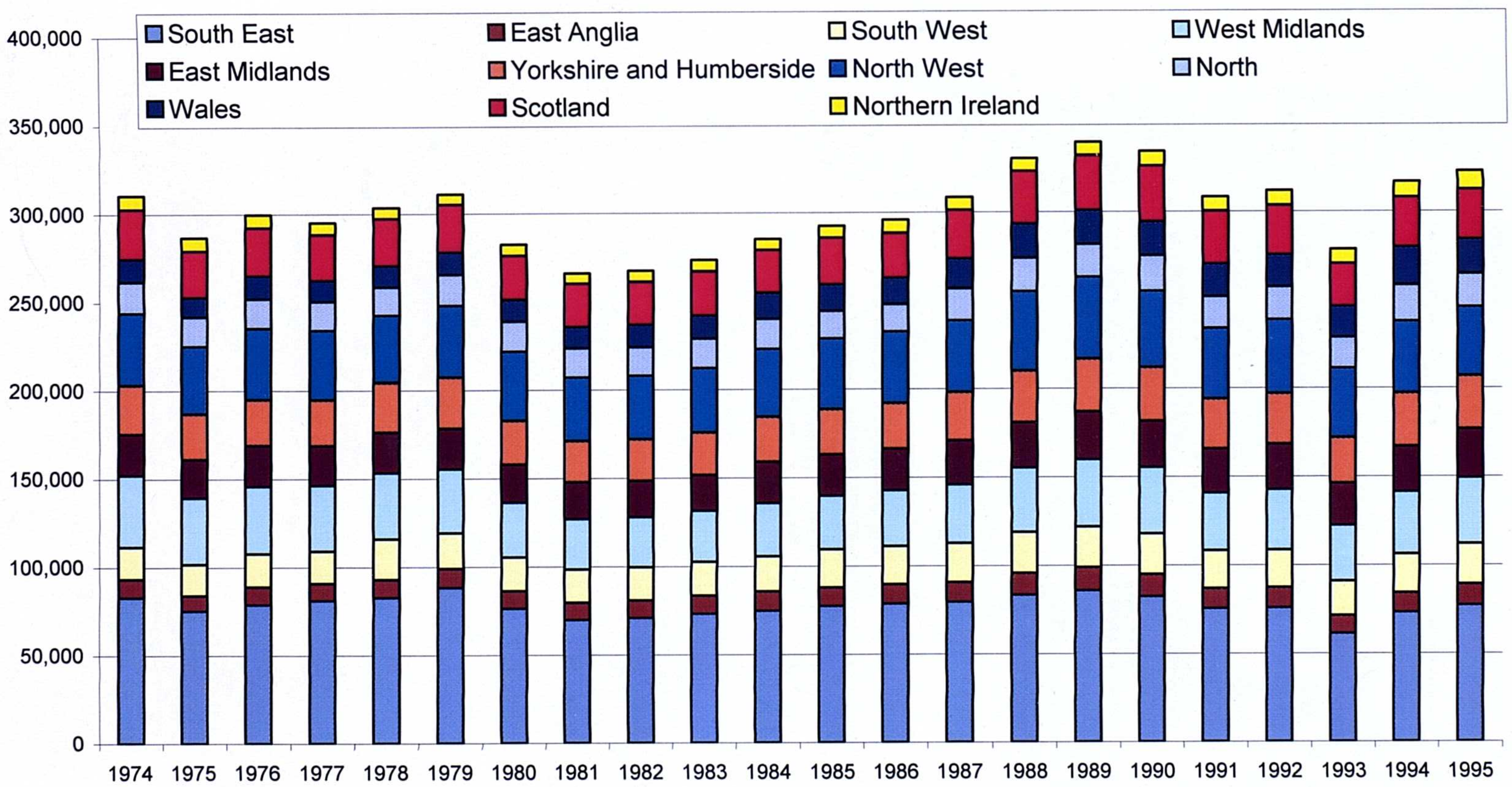
(Source: ARD, author's calculations)

Figure 3.1b: Change in manufacturing employment by region, 1974-1995



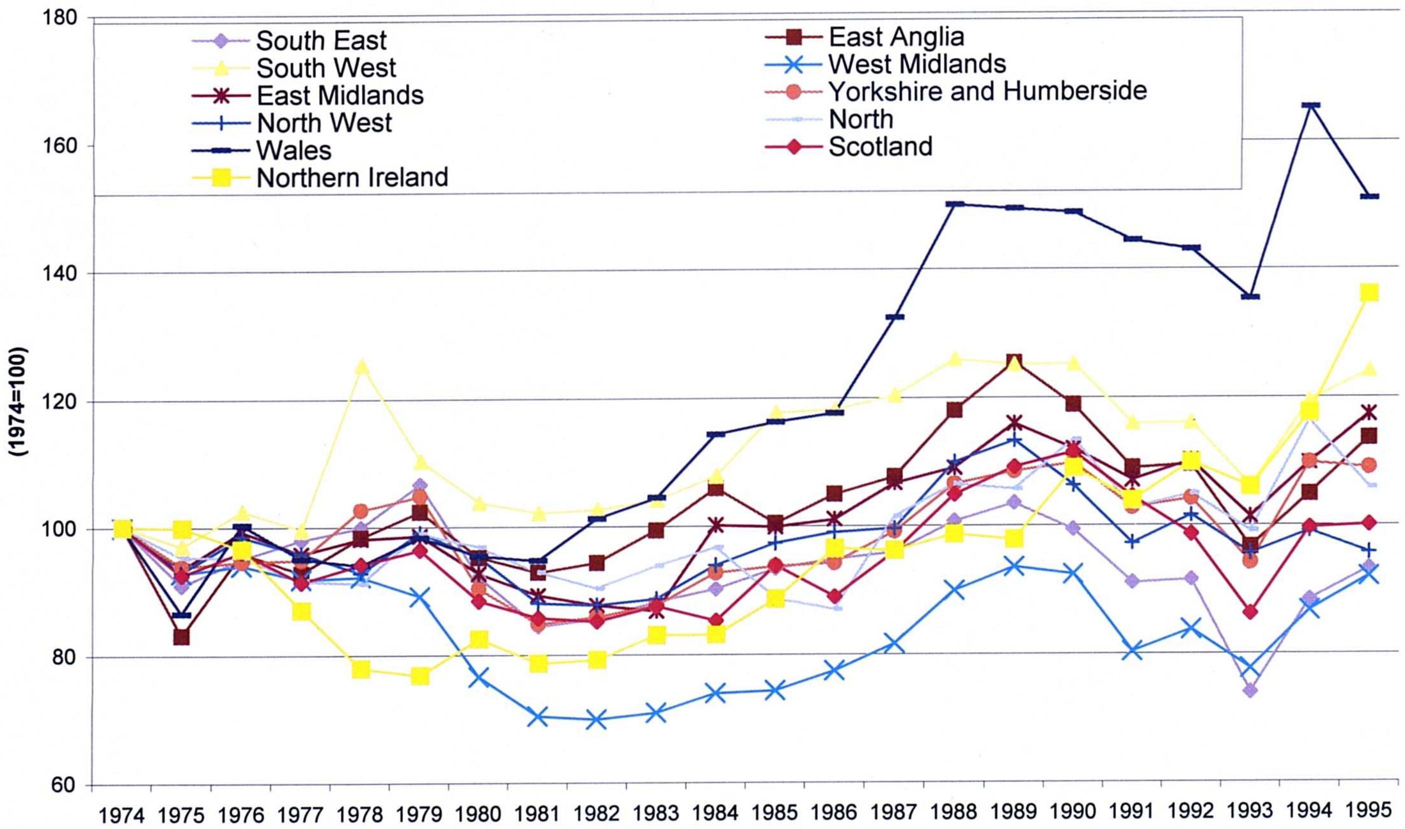
(Source: ARD, author's own calculations)

Figure 3.2a: Real gross output in manufacturing by region, 1974-1995
(£m 1990 prices)



(Source: ARD, author's calculations)

Figure 3.2b: Change in real gross output in manufacturing by region, 1974-1995



(Source: ARD, author's calculations)

3.1.2 Regional location of FDI at the broad level

Turning to the location of FDI; Figures 3.3 and 3.4 show the percentage of each regional employment and output share that is accounted for by foreign plants, respectively, for 1974, 1985 and 1995. The 10 year gaps broadly summarise changes over time. In contrast to the figures presented above, Figures 3.3 and 3.4 show a significant increase in foreign share over time in some regions for employment (and in all regions, except Northern Ireland (see below), in the case of gross output share). Thus, despite the decline in manufacturing, foreign investment has increased in absolute terms. The importance of foreign investment can be seen more clearly in terms of output, accounting for over 25 per cent of output in 8 out of 11 regions by 1995. The importance of foreign ownership in terms of employment is less emphatic, with 8 out of 11 regions having over 15 per cent of employment by 1995, this simply highlights the greater capital intensity in foreign owned plants.

The regions in which foreign ownership of output and employment has been concentrated has changed over time which would suggest some degree of mobility, or "footloose-ness" about their location (Gorg and Strobl, 2003). In terms of the highest share of employment, it can be seen that by 1995 the most important regions for foreign ownership are Wales, the West Midlands and the South East. However, at the beginning of the period, Scotland, Northern Ireland and the South East are dominant. The South East and East Anglia have not lost or gained significant shares over the period, whereas the importance of FDI has grown considerably in Wales, West Midlands and the North, consistent with the shift from more to less congested regions. The West Midlands saw an increase from around 7 per cent of local employment coming from foreign owned firms in the area in 1974, to around 22 per cent by 1995[6]. Overall therefore it appears more as though regions have seen an expansion of foreign interests rather than a shift from one area to another. Only Northern Ireland experienced a slight decline in the percentage of employment from foreign owned plants. This is partly a feature of its already well-established foreign owned sector, which began in the 1950s (considerably earlier than Great Britain). As a consequence, foreign owned firms are likely to be located in the more mature Northern Irish industries and therefore more likely to be in decline now (Harris, 1991).

In terms of gross output, the changes over time and between regions are more pronounced, though the trends are broadly the same. Again, Northern Ireland is the only region that experienced a decline in the foreign owned share of output. Scotland saw the largest foreign share of gross output of almost 37 per cent by 1995. The West Midlands experienced the largest gain in foreign gross output share over the whole period, increasing from 8 per cent to 33 per cent.

Tables 3.1 and 3.2 show the growth in employment and gross output shares of foreign owned plants, 1974-1995, respectively. There is a three fold increase in the share of employment attributable to foreign owned firms in the West Midlands and the North, and in the case of gross output the West Midlands foreign owned plants experience a four-fold increase in output share. Given that Northern Ireland contributes relatively little to employment and gross output totals in UK manufacturing (Figures 3.1 and 3.2), the decline in foreign owned shares does not

[6] Much of this is likely to be the take-over of the motor vehicle industry by foreign investors.

make a big impact at the UK level. However, the South East and West Midlands make up a substantial proportion of total manufacturing employment and output and have seen significant growth in foreign ownership shares. These two aspects taken together account for a large part of the increasing importance of foreign ownership in manufacturing.

Observing these trends at the regional level, whilst providing a useful overview, provides no indication of what foreign firms are looking for when they enter a particular region, since regions themselves are diverse. This broad breakdown provides very few clues as to the determinants of location, and therefore a more detailed breakdown is necessary. Thus, the following sub-section provides information at a more disaggregated level.

Figure 3.3: Percentage of FDI in manufacturing employment by region, 1974, 1985 and 1995

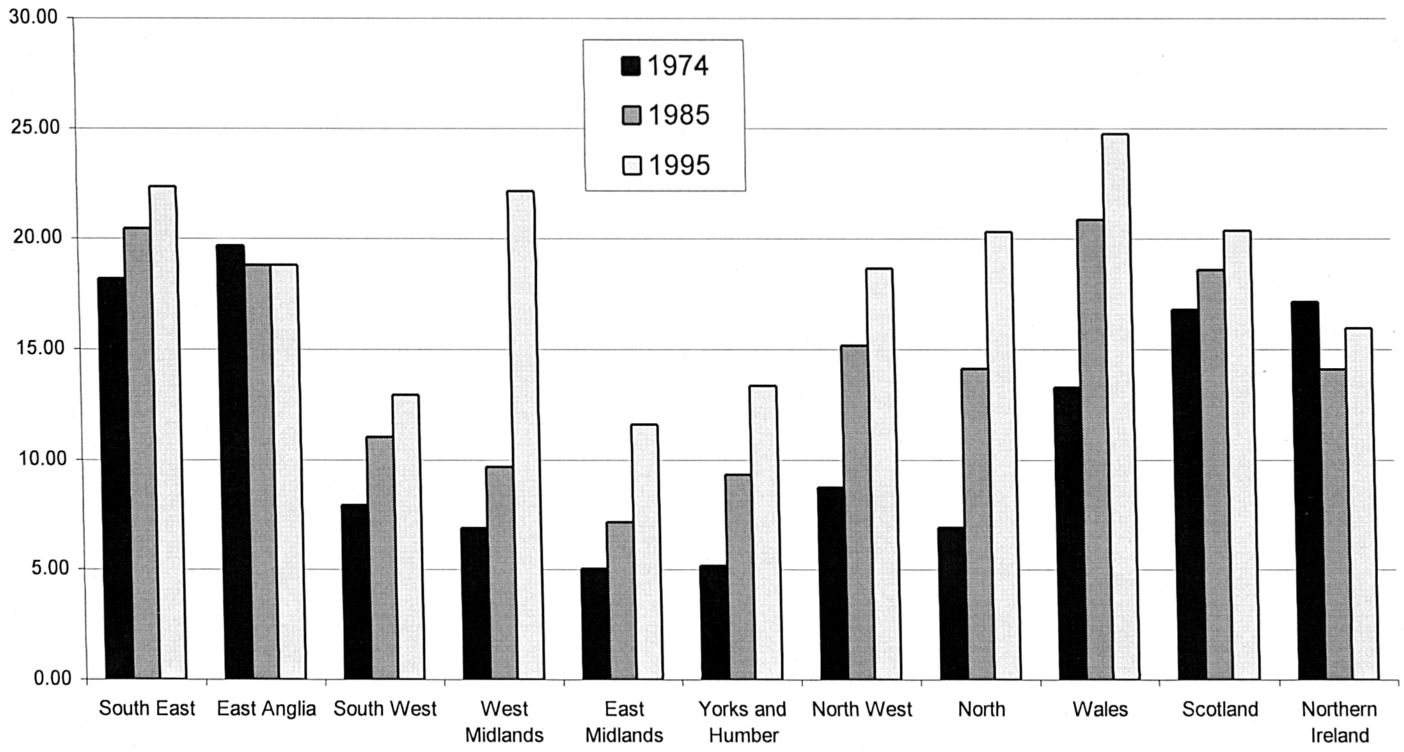


Figure 3.4: Percentage of FDI gross output in manufacturing by region, 1974, 1985 and 1995

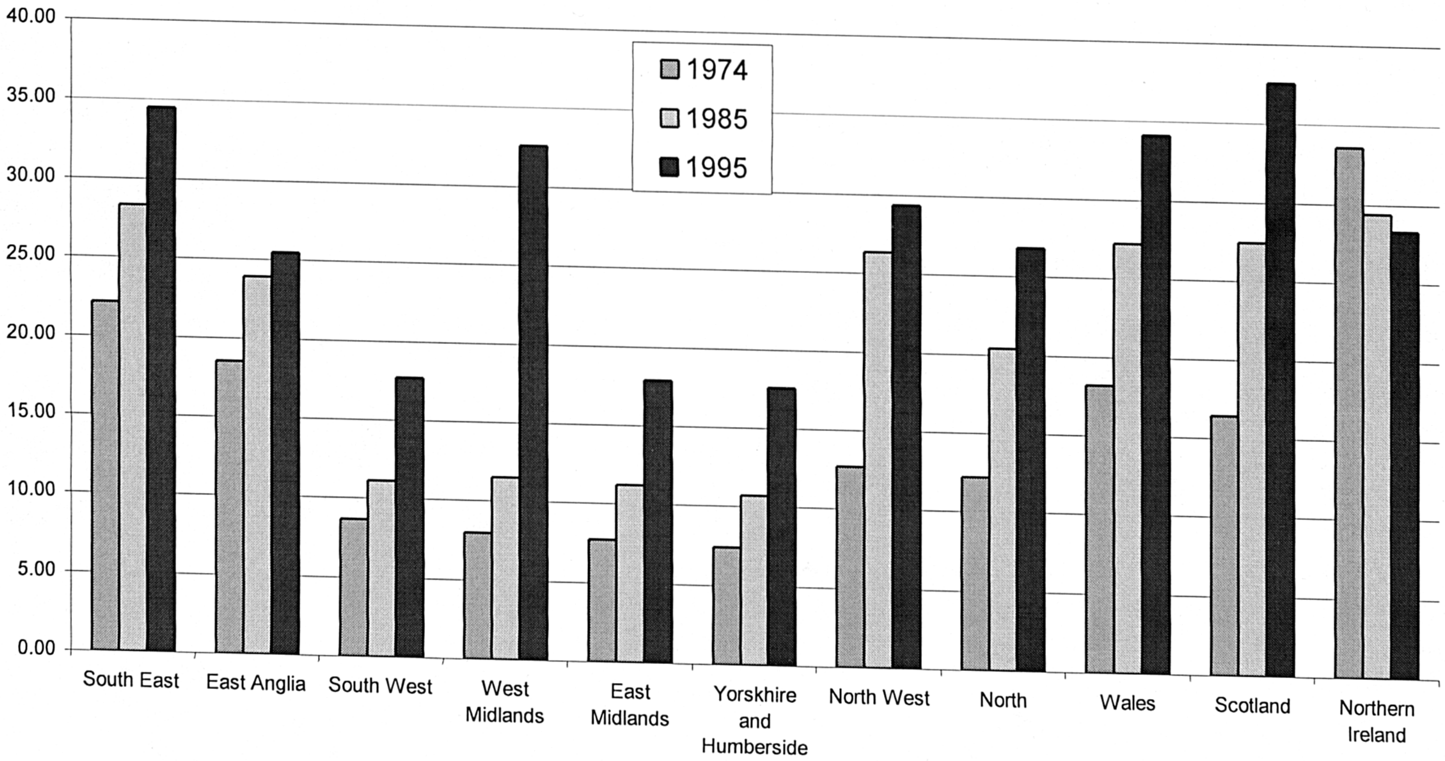


Table 3.1: Change in FDI employment shares in manufacturing by region, 1974-1995 (1974=100)

	South East	East Anglia	South West	West Midlands	East Midlands	Yorkshire and Humberside	North West	North	Wales	Scotland	Northern Ireland
1974	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1975	99.3	103.0	104.6	83.0	112.1	135.1	111.3	106.3	103.2	99.7	100.0
1976	112.5	101.5	105.1	100.4	107.9	157.0	106.5	121.4	117.8	99.2	103.2
1977	120.9	104.9	129.3	95.7	127.9	182.9	123.8	143.6	124.7	94.0	111.6
1978	124.2	116.9	139.7	102.2	121.4	166.1	129.1	169.5	136.7	99.5	122.6
1979	127.0	99.5	144.6	115.2	139.9	178.0	154.8	173.5	140.2	104.2	129.0
1980	121.8	115.7	138.1	141.0	174.6	191.0	176.8	192.0	148.0	106.5	119.4
1981	124.9	105.3	151.8	146.4	178.4	182.1	185.3	194.1	153.7	109.9	117.5
1982	122.5	95.6	152.2	148.2	187.9	178.0	181.3	197.2	151.2	108.9	106.7
1983	128.4	101.5	153.4	148.8	187.4	171.3	194.8	198.3	155.4	102.5	109.9
1984	116.6	92.0	134.8	134.9	143.1	161.5	174.5	178.1	154.1	97.1	96.4
1985	112.6	95.5	139.2	141.3	142.3	180.4	173.3	204.7	157.6	110.8	82.1
1986	106.8	101.8	145.1	135.8	129.8	164.8	167.0	222.8	150.8	101.4	81.7
1987	106.9	99.3	159.6	158.3	142.7	166.5	178.0	222.4	156.4	104.9	81.2
1988	109.1	98.5	157.3	163.5	165.5	176.1	169.8	254.7	163.6	106.5	76.0
1989	115.1	112.2	145.3	165.7	183.8	223.5	183.1	273.5	158.9	118.2	76.7
1990	122.2	113.3	157.6	213.3	202.2	250.6	202.5	287.3	173.3	133.1	121.6
1991	130.7	107.5	175.7	215.7	239.0	272.1	222.2	302.4	192.1	141.9	134.7
1992	134.1	105.4	190.9	266.0	245.9	268.7	241.0	303.5	187.7	145.7	120.9
1993	120.1	106.9	187.6	246.0	251.9	294.7	237.2	321.5	214.1	145.0	128.1
1994	132.6	111.6	193.9	352.4	264.3	296.3	228.7	336.7	213.9	131.6	103.0
1995	123.1	95.6	163.4	323.7	230.8	258.2	213.3	294.8	186.9	121.3	93.1

Table 3.2: Change in FDI share of gross output shares in manufacturing by region, 1974-1995 (1974=100)

	South East	East Anglia	South West	West Midlands	East Midlands	Yorskhire and Humberside	North West	North	Wales	Scotland	Northern Ireland
1974	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1975	97.0	118.5	92.6	102.4	108.1	119.5	105.4	101.0	111.9	102.9	96.1
1976	116.7	112.5	94.0	114.6	101.3	129.9	104.4	112.5	112.8	107.5	102.8
1977	124.5	120.5	121.1	115.2	116.4	149.0	134.9	127.1	109.5	104.1	115.3
1978	122.6	124.7	144.7	116.8	115.2	132.7	133.0	144.7	112.3	105.8	114.9
1979	131.0	108.7	122.3	124.9	137.2	143.8	155.8	140.1	123.2	104.5	114.9
1980	122.6	128.9	117.0	158.6	156.7	144.9	178.7	137.6	135.7	113.0	104.5
1981	127.9	116.3	132.6	156.5	159.9	129.0	186.7	133.2	134.5	116.7	98.6
1982	127.1	124.4	133.6	152.4	175.1	131.8	183.4	130.2	136.7	122.2	91.6
1983	140.8	133.1	145.0	155.2	183.2	127.4	211.1	145.0	140.6	119.4	97.2
1984	131.9	123.3	124.4	136.9	146.4	143.2	202.6	144.4	139.8	134.5	92.0
1985	128.0	129.2	128.4	144.9	144.7	144.5	207.1	167.4	149.6	167.3	87.5
1986	120.8	129.2	140.9	139.4	132.8	127.8	195.0	171.8	146.5	145.3	93.4
1987	127.5	133.0	169.1	182.5	149.9	133.7	210.2	154.5	150.9	163.7	98.6
1988	129.1	129.6	169.4	199.2	170.2	144.5	202.5	189.9	152.8	168.9	96.8
1989	138.7	148.7	165.4	205.1	200.7	181.2	214.4	217.4	164.4	195.0	102.9
1990	144.8	149.3	170.2	255.2	206.5	211.5	231.9	233.7	177.1	206.0	113.3
1991	152.0	145.1	189.8	266.3	222.8	231.4	242.3	276.6	185.8	217.2	117.9
1992	158.1	144.2	217.8	326.6	230.7	221.9	248.5	264.2	179.9	206.2	102.2
1993	145.9	145.7	237.8	319.2	220.7	258.5	235.5	296.8	203.5	217.2	103.9
1994	159.7	147.2	244.1	447.4	252.6	256.2	223.2	258.1	177.0	249.3	81.9
1995	155.8	137.4	204.4	410.2	231.4	237.1	230.9	219.9	187.4	228.9	84.3

3.1.2 Regional location of FDI at the county level

A breakdown at the SSR region level is too broad to be able to discern any detail on the trends in the location of foreign plants and therefore further disaggregation at a sub-regional level is necessary. Postcode level data are available from the ARD, but as well as creating disclosure problems this is too disaggregated to perceive any patterns. A breakdown even at the local authority level also appears to be too fine with over 400 local authorities in the UK. For this reason, a more disaggregated breakdown is conducted at the county level. There are 64 counties in the UK, excluding Northern Ireland (the latter in these data is considered as a whole unit because a more detailed breakdown is not readily available in the ARD). With this in mind, Table 3.3 contains the percentage of manufacturing output of the UK, by county[7] to consider firstly where manufacturing is concentrated.

In terms of counties, there are comparatively high levels of output in the urban areas of Greater Manchester, West Midlands, Greater London and Strathclyde. These 4 counties account for around 32 per cent of total manufacturing gross output at the beginning of the period, though by 1995, they accounted for only 23 per cent. Although this is still a sizeable proportion of output, the decline that has affected manufacturing employment has affected metropolitan areas and also applies to foreign owned firms. Turok and Webster (1998) argue this is part of a discernable 'suburbanisation' trend. Clearly, these metropolitan counties are densely populated urban areas, with good transportation links but are increasingly likely to suffer from all the problems associated with excess demand. In Wales' case it is argued that foreign owned firms locate just across Offa's Dyke, i.e. Clwyd and Gwent to take advantage of generous subsidies (from the WDA – Welsh Development Agency), whilst being relatively close to good transportation links (see Blackaby *et al*, 1996).

From the data presented here (Table 3.3) it can be seen that over time there has not been a dramatic change in the distribution of output between counties, except that the urban areas do appear to have lost ground to more rural locations – Hampshire, Clwyd and Cheshire have shown modest gains in manufacturing share. Therefore, it can be seen that there is a shift out of urban areas into more rural locations, though not to particularly remote regions such as those surrounding 'hubs' (e.g. Cheshire in the case of Greater Manchester, and Oxford for Greater London). This is fully consistent with the idea of suburbanisation, as previously discussed and is perhaps more clearly revealed in Figure 3.5.

Figure 3.5 below provides an overview of the changes in manufacturing growth over time at the county level, based on the figures in Table 3.3.[8] Manufacturing decline can be seen to be concentrated around the conurbations of London, Manchester and Glasgow. Wales sees very little decline overall, with most areas experiencing in excess of 50 per cent growth from 1974 levels to 1995. In Scotland strong growth can be seen in the Scottish Isles, a remote area of Great Britain that starts from a very low base of manufacturing and thus even with this high growth rate the Scottish Isles still only account for 0.04 per cent of all UK manufacturing.

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[7] Northern Ireland is only included at the country level and accounts for 2-3 per cent throughout the whole period. It is not therefore strictly appropriate to compare Northern Ireland with county data.
[8] Some matching between county boundaries in 2001 and the boundaries appropriate for the study period had to be undertaken because of electronic availability of maps.

Table 3.3: Percentage of Manufacturing real gross output by county, 1974-1995

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	**% Change 1974-95**
Avon	1.98	2.13	2.09	2.01	1.86	1.82	1.88	1.92	1.95	1.91	1.93	1.96	1.89	1.91	1.73	1.57	1.67	1.76	1.73	1.61	1.73	1.89	**-1.39**
Bedfordshire	1.36	1.27	1.35	1.55	1.63	1.63	1.25	1.17	1.34	1.60	1.51	1.58	1.42	1.36	1.50	1.56	1.41	1.38	1.60	1.55	1.52	1.47	**11.99**
Berkshire	1.46	1.28	1.27	1.26	1.23	1.38	1.48	1.50	1.47	1.51	1.49	1.49	1.46	1.39	1.39	1.37	1.33	1.50	1.45	1.29	1.30	1.66	**17.54**
Buckinghamshire	0.74	0.77	0.81	0.87	0.82	0.83	0.95	0.90	0.99	1.04	1.01	1.07	1.10	1.13	1.07	1.18	1.23	1.24	1.14	1.10	1.07	1.08	**50.46**
Cambridgeshire	0.89	0.85	0.92	0.93	0.92	0.98	1.19	1.23	1.17	1.24	1.31	1.39	1.39	1.37	1.47	1.50	1.45	1.32	1.35	1.27	1.24	1.32	**53.59**
Cheshire	2.23	2.05	2.19	2.32	2.34	2.46	2.48	2.51	2.65	2.86	2.62	3.15	3.17	2.88	3.23	3.60	2.99	2.84	2.89	3.32	3.41	3.17	**47.14**
Cleveland	1.63	1.58	1.44	1.38	1.56	1.52	1.56	1.71	1.73	1.84	1.77	1.57	1.46	1.79	1.61	1.33	1.57	1.06	1.26	1.17	1.31	1.24	**-21.06**
Cornwall	0.15	0.15	0.18	0.16	0.17	0.39	0.40	0.38	0.37	0.37	0.33	0.45	0.39	0.42	0.47	0.42	0.38	0.44	0.45	0.36	0.36	0.44	**200.86**
Cumberland	0.64	0.77	0.78	0.67	0.62	0.80	1.00	1.05	1.05	1.12	1.05	1.05	1.05	1.14	1.06	0.91	1.03	1.09	0.99	1.09	1.34	1.30	**109.38**
Derbyshre	2.37	2.38	2.15	2.08	2.31	2.14	2.07	2.02	1.97	1.82	1.91	1.87	1.88	1.92	1.89	1.96	1.92	2.02	1.99	1.99	2.10	2.04	**-10.50**
Devon	0.64	0.69	0.64	0.64	0.71	0.89	1.08	1.18	1.19	1.20	1.36	1.24	1.26	1.10	1.15	1.09	1.12	1.17	1.05	1.17	0.97	1.09	**75.14**
Dorset	0.35	0.42	0.44	0.47	0.47	0.53	0.62	0.64	0.61	0.65	0.67	0.84	0.75	0.71	0.67	0.69	0.68	0.62	0.61	0.69	0.70	0.59	**73.50**
Durham	1.14	1.11	0.98	1.04	0.71	0.95	1.10	1.09	1.03	0.97	1.10	0.93	0.96	1.10	1.14	1.24	1.29	1.24	1.10	1.25	1.18	1.13	**2.42**
East Sussex	0.38	0.39	0.43	0.47	0.48	0.37	0.45	0.45	0.47	0.48	0.55	0.52	0.54	0.52	0.50	0.52	0.51	0.48	0.47	0.47	0.38	0.41	**11.30**
Essex	1.64	1.52	1.66	2.07	2.30	2.41	2.50	2.31	2.42	2.39	2.37	2.40	2.23	2.26	2.26	2.38	2.28	2.11	2.08	1.73	1.85	2.01	**27.40**
Gloucestershire	0.97	1.07	1.06	1.05	1.17	1.03	1.00	1.09	1.05	1.01	0.87	0.93	0.99	1.05	1.04	1.03	1.07	0.99	1.09	1.01	1.04	1.12	**18.86**
Hampshire	1.84	1.70	1.79	1.75	1.88	2.15	2.40	2.53	2.61	2.63	2.44	2.55	2.61	2.66	2.67	2.57	2.72	2.91	2.61	2.49	2.98	2.75	**54.33**

Table 3.3 continued…

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	**% Change 1974-95**
Hereford and Worcester	0.90	1.03	1.00	0.92	0.92	1.08	1.04	0.96	0.99	0.91	0.92	0.90	0.96	0.94	0.99	1.08	1.09	1.08	1.11	1.15	1.10	1.23	**41.24**
Hertfordshire	1.75	1.63	1.60	1.92	1.93	1.77	1.99	2.00	2.10	2.09	2.11	2.28	2.21	2.22	2.05	1.75	1.82	1.65	1.72	1.48	1.62	1.47	**-13.30**
Humberside	2.12	2.01	1.90	1.95	2.57	2.41	1.84	1.90	1.95	1.99	1.99	2.03	2.01	2.12	2.13	2.24	2.21	2.42	2.36	2.42	2.41	2.25	**9.88**
Isle of Wight	0.06	0.08	0.08	0.05	0.07	0.09	0.11	0.10	0.10	0.11	0.10	0.11	0.12	0.13	0.12	0.10	0.10	0.12	0.10	0.11	0.08	0.08	**41.14**
Kent	2.35	2.13	2.17	2.21	2.28	2.29	2.06	1.92	1.93	1.97	2.06	2.03	2.03	2.08	2.15	2.17	2.13	1.88	2.04	1.99	2.04	1.93	**-14.87**
Lancashire	2.39	2.41	2.52	2.54	2.45	2.24	2.73	2.63	2.55	2.41	2.78	2.46	2.76	2.65	2.71	2.87	2.89	3.11	3.25	3.40	2.51	2.28	**-0.98**
Leicestershire	1.59	1.61	1.73	1.69	1.68	1.62	1.82	1.85	1.78	1.76	1.89	1.82	1.96	2.09	2.04	2.12	2.11	2.02	2.06	2.14	2.00	2.15	**39.69**
Lincolnshire	0.65	0.68	0.72	0.70	0.65	0.66	0.77	0.89	0.85	0.78	0.92	0.91	0.84	0.78	0.82	0.82	0.82	0.90	0.88	0.83	0.82	0.94	**50.20**
Norfolk	1.32	1.28	1.40	1.37	1.46	1.39	1.21	1.27	1.34	1.43	1.47	1.15	1.21	1.21	1.20	1.27	1.17	1.23	1.28	1.21	1.13	1.19	**-6.19**
North Yorkshire	0.71	0.66	0.77	0.85	0.82	0.98	0.93	0.93	0.97	0.97	1.01	1.01	1.04	1.05	1.06	0.93	1.10	1.12	1.06	0.97	1.12	1.34	**93.91**
Northamptonshire	1.10	1.08	1.08	1.09	1.15	1.11	1.11	1.22	1.15	1.15	1.28	1.37	1.31	1.36	1.26	1.31	1.30	1.41	1.34	1.48	1.38	1.28	**20.13**
Northumberland	0.30	0.27	0.31	0.31	0.30	0.32	0.39	0.38	0.36	0.39	0.37	0.32	0.36	0.42	0.39	0.40	0.40	0.41	0.38	0.44	0.46	0.54	**86.05**
Nottinghamshire	1.87	1.90	2.06	2.10	1.95	1.92	1.97	1.96	1.99	1.98	2.26	2.02	2.04	2.00	1.74	1.82	1.73	1.84	2.02	2.13	1.87	2.14	**18.61**
Oxfordshire	0.38	0.41	0.44	0.55	0.41	0.47	0.83	0.78	0.84	0.88	0.91	1.09	1.02	1.00	1.04	1.01	1.02	1.03	1.13	1.01	1.01	1.09	**199.57**
Salop	0.43	0.44	0.49	0.56	0.57	0.49	0.58	0.62	0.64	0.59	0.62	0.55	0.61	0.59	0.66	0.71	0.80	0.82	0.86	0.94	0.95	1.13	**170.43**
Somerset	0.72	0.72	0.76	0.76	0.78	0.84	0.84	0.88	0.93	0.92	0.86	0.88	0.97	0.92	0.92	0.85	0.88	0.91	0.91	0.90	0.87	0.87	**25.74**
Staffordshire	2.37	2.20	2.57	2.54	2.48	2.37	2.11	2.09	2.16	2.12	2.16	2.10	2.20	2.18	2.14	2.25	2.18	2.08	2.17	2.07	1.95	1.63	**-28.68**
Suffolk	1.03	0.88	1.03	0.98	1.01	1.00	1.12	1.22	1.18	1.17	1.15	1.09	1.14	1.11	1.09	1.12	1.13	1.16	1.09	1.17	1.13	1.20	**20.30**

Table 3.3 continued..

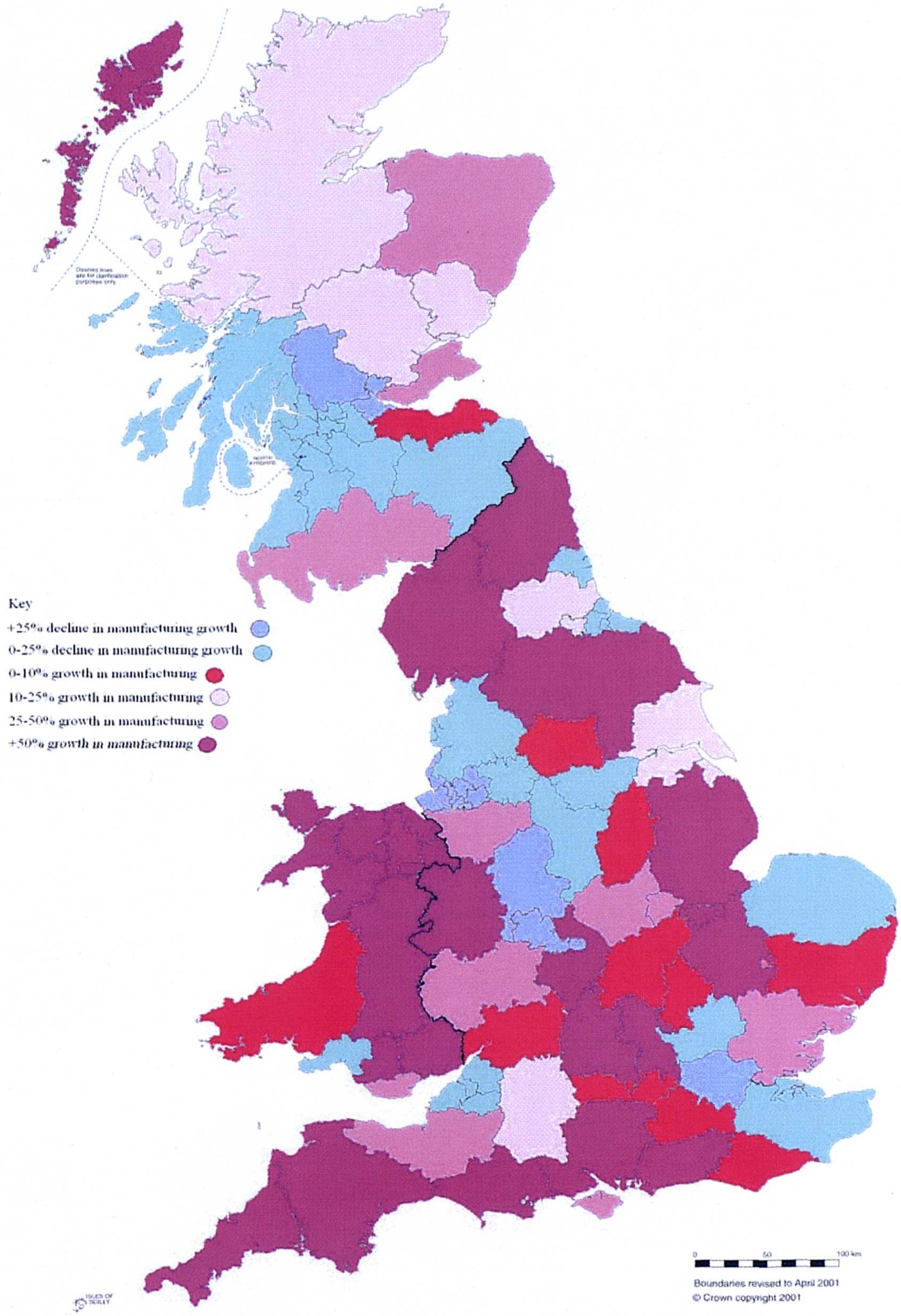
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	% Change 1974-95
Surrey	0.95	1.04	0.92	0.95	0.96	0.82	1.01	1.08	1.02	1.02	1.12	0.98	1.15	1.12	1.08	1.10	1.03	1.06	1.03	0.77	1.08	1.12	**22.03**
Warwickshire	0.57	0.45	0.68	0.70	0.73	0.59	0.68	0.69	0.65	0.64	0.75	0.78	0.84	0.82	0.90	0.94	1.05	1.03	1.02	1.17	0.99	1.07	**93.45**
West Sussex	0.68	0.65	0.68	0.82	0.71	0.78	0.89	0.86	1.01	0.87	0.98	0.89	0.98	0.97	0.87	0.96	0.98	0.98	0.81	0.99	0.98	1.03	**56.32**
Wiltshire	1.06	0.70	1.10	1.10	1.18	0.99	0.92	0.91	0.96	0.94	0.93	1.09	1.08	1.05	1.01	1.12	1.07	1.00	0.99	1.25	1.27	1.06	**3.66**
Greater Manchester	5.72	5.64	5.79	5.79	5.30	5.70	5.58	5.44	5.36	5.25	5.38	5.40	5.17	5.23	5.15	4.81	4.81	4.87	4.91	4.91	4.44	4.63	**-16.21**
Merseyside	2.90	3.08	2.85	2.52	2.58	2.59	2.94	2.94	2.86	2.73	2.67	2.58	2.58	2.43	2.50	2.34	2.27	2.08	2.28	2.41	2.19	2.05	**-26.62**
South Yorkshire	2.37	2.51	2.43	2.44	2.35	2.35	2.17	2.19	2.12	2.14	1.94	1.88	1.93	1.90	1.97	1.95	1.96	1.82	1.85	1.99	2.19	1.85	**-19.26**
Tyne & Wear	2.05	2.22	2.13	2.13	2.07	2.05	2.05	1.88	1.81	1.74	1.70	1.50	1.37	1.38	1.49	1.64	1.70	2.09	2.19	2.34	2.22	1.63	**-17.70**
West Midlands	9.08	9.27	8.08	7.92	7.85	7.09	6.55	6.35	6.14	6.28	6.08	5.98	6.05	6.23	6.35	6.24	6.13	5.61	5.78	6.01	6.18	6.53	**-25.45**
West Yorkshire	3.53	3.66	3.56	3.50	3.57	3.47	3.78	3.65	3.71	3.69	3.97	3.78	3.76	3.75	3.68	3.65	3.72	3.77	3.80	3.90	3.82	3.85	**12.90**
Greater London	12.87	13.47	13.12	13.16	13.13	13.45	11.12	10.73	10.37	10.16	9.53	9.49	9.65	8.89	8.54	8.49	8.08	8.15	8.12	6.97	7.24	7.79	**-37.26**
Clwyd	0.58	0.50	0.56	0.62	0.61	0.48	0.60	0.62	0.75	0.75	1.03	0.90	0.87	1.03	1.09	1.08	1.13	1.23	1.34	1.32	1.25	1.28	**130.96**
Dyfed	0.28	0.24	0.28	0.24	0.23	0.32	0.40	0.43	0.49	0.42	0.34	0.40	0.36	0.34	0.26	0.29	0.29	0.31	0.36	0.28	0.28	0.31	**15.50**
Gwent	0.81	0.74	0.92	0.88	0.89	0.87	0.84	0.90	0.93	1.13	1.05	1.24	1.16	1.25	1.27	1.24	1.21	1.27	1.26	1.44	1.79	1.24	**59.65**
Gwynedd	0.11	0.09	0.12	0.11	0.10	0.12	0.16	0.17	0.17	0.18	0.23	0.16	0.18	0.21	0.21	0.19	0.18	0.18	0.18	0.17	0.24	0.29	**169.19**
Mid Glamorgan	0.66	0.80	0.75	0.74	0.70	0.69	0.92	0.89	0.83	0.82	0.84	0.89	0.93	0.96	1.04	1.07	1.18	1.14	1.14	1.11	1.12	1.15	**79.55**

Table 3.3 continued...

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	**% Change 1974-95**
Powys	0.05	0.05	0.05	0.04	0.06	0.10	0.13	0.15	0.16	0.15	0.25	0.16	0.19	0.16	0.14	0.11	0.11	0.15	0.16	0.15	0.16	0.17	**247.06**
South Glamorgan	0.53	0.55	0.53	0.56	0.54	0.64	0.55	0.58	0.60	0.60	0.52	0.53	0.61	0.64	0.71	0.66	0.67	0.69	0.53	0.78	0.90	0.66	**28.69**
West Glamorgan	1.10	0.93	1.10	0.97	0.90	0.84	0.78	0.87	0.90	0.85	0.85	0.81	0.80	0.92	1.08	1.03	0.97	1.01	0.94	0.99	0.98	0.91	**-14.54**
Borders	0.13	0.14	0.13	0.15	0.14	0.16	0.15	0.16	0.18	0.19	0.18	0.19	0.17	0.19	0.17	0.14	0.15	0.18	0.15	0.19	0.13	0.12	**-4.10**
Central	0.80	0.73	0.76	0.73	0.73	0.78	0.68	0.68	0.62	0.63	0.65	0.65	0.55	0.59	0.60	0.62	0.65	0.65	0.65	0.54	0.36	0.37	**-51.20**
Dumfries and Galloway	0.18	0.16	0.16	0.22	0.23	0.28	0.25	0.27	0.30	0.28	0.30	0.27	0.33	0.37	0.29	0.30	0.26	0.29	0.28	0.30	0.25	0.26	**46.21**
Fife	0.44	0.50	0.51	0.56	0.53	0.61	0.63	0.67	0.67	0.76	0.62	0.72	0.66	0.59	0.74	0.64	0.60	0.63	0.64	0.66	0.56	0.56	**31.09**
Grampian	0.72	0.73	0.80	0.76	0.83	0.80	0.83	0.94	0.89	0.96	0.91	0.98	0.90	1.01	0.98	0.93	1.00	0.99	1.05	1.04	0.89	0.91	**30.18**
Highlands	0.19	0.21	0.19	0.24	0.22	0.23	0.33	0.33	0.33	0.35	0.20	0.21	0.24	0.27	0.22	0.24	0.22	0.30	0.22	0.19	0.19	0.18	**0.52**
Lothian	1.17	1.31	1.32	1.23	1.36	1.26	1.09	1.11	1.12	1.15	1.03	1.14	1.08	1.09	1.14	1.18	1.10	1.28	1.32	1.29	1.27	1.33	**17.55**
Strathclyde	4.95	4.79	4.75	4.38	4.34	4.08	4.24	4.25	4.21	4.03	3.97	4.27	3.99	4.02	4.18	4.44	4.77	4.68	4.07	3.92	4.66	4.38	**-8.23**
Tayside	0.56	0.59	0.48	0.52	0.48	0.60	0.62	0.69	0.69	0.70	0.59	0.63	0.55	0.63	0.67	0.60	0.70	0.63	0.59	0.63	0.58	0.59	**9.24**
Scottish Islands	0.02	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.04	0.06	0.05	0.08	0.05	0.05	0.04	0.06	0.05	0.03	0.03	0.02	0.03	0.04	**95.08**
Northern Ireland	2.46	2.66	2.44	2.24	1.99	1.87	2.21	2.24	2.28	2.30	2.21	2.30	2.48	2.36	2.26	2.19	2.46	2.56	2.68	2.89	2.82	3.20	**35.08**

(Source: ARD, authors own calculations)

Figure 3.5: Manufacturing growth rates (real gross output) across Great Britain, 1974-1995



(Source: Ordinance Survey, shading based on own calculations from the ARD)

The discussion above relating to the relative growth of sub-regions within the UK provides some context for considering the location of foreign owned plants. As further illustration of county trends Figures 3.6 and 3.7 below show twenty counties with the largest proportion of foreign owned gross output in 1974 and 1995, respectively. Over time, the industry composition of the most foreign owned intensive has changed. These data are derived from Table 3.3, where all county growth rates may be observed.

In Figure 3.6, it can be seen that the county with the greatest proportion of foreign owned output to total output in 1974 was Bedfordshire, followed by Northumberland. Neither counties are exceptionally urbanised, though Bedfordshire is close to Milton Keynes and has both Bedford and Luton as major towns within it. Perhaps the most obvious attraction of Bedfordshire is that it is very close to London and has good transport links (M1) to airports. Northumberland, in contrast, is located in the North East and so may be regarded as more remote. In and of itself, it is relatively rural, although its location is directly to the north of Newcastle upon Tyne, and is therefore again on the periphery of a major urban area.

By 1995, Greater London is no longer one of the twenty locations that have the highest proportion of output accounted for by foreign firms. Greater Manchester and Strathclyde are urban regions that are amongst those which rely most on foreign investment (Figure 3.7). The growth in the importance of FDI for some counties, in particular Mid-Glamorgan, does seem to be somewhat surprising, given that it is not particularly important in terms of manufacturing in general, and it is rather remote. As such, the importance of FDI in these areas are much more likely to be the result of industrial policies designed to attract foreign investment (Driffield and Munday, 1996). In the case of Wales, for example, investment grants have been directed at foreign owned factory jobs, (e.g. soldering), designed to create 'female' employment to replace the traditional 'male' coal and steel jobs that were lost in the 1970s and 1980s. This is indicative of a move to the periphery and is in part likely to have been driven by government assistance when choosing to locate in the UK.

In the case of employment, similar patterns can be observed, though the percentages (Figures 3.8 and 3.9), are generally slightly lower than those for gross output. This is indicative of the higher capital intensity of production and workforce size of foreign firms. In addition, there are a number of counties that do not feature in the output graphs that are more important in terms of employment; these include Devon, Norfolk and West Sussex.

The trends presented in Figures 3.6 to 3.9 are further summarised below in Figure 3.10 which graphically presents the absolute levels of growth in FDI from 1974 to 1995. It can be seen from this that, with the exception of Greater London, Dumfries and Galloway and West Glamorgan, all other counties have seen positive growth in the level of FDI. In the case of West Glamorgan, the decline is less than 5 per cent over the whole of the 22 year period. On closer inspection of the underlying data, it can be seen that the decline in the proportion of FDI (of gross output) in Dumfries and Galloway is the result of an increase in domestic interests in the region, rather than a decline in foreign ownership. However, the decline in the presence over the whole period is around 25 per cent of foreign owned plants in Greater London and although not as marked as the decline in domestic plants, is a significant proportion.

By comparing the map of manufacturing growth (Figure 3.5) with the map of FDI growth in manufacturing it can be seen that, despite decline of the manufacturing sector in a number of conurbations (with the exception of London), all counties have experienced growth and consequently higher absolute levels of FDI by 1995. Areas that have seen a large rise in FDI are concentrated in Wales and also in the Highlands. In the case of the Highlands, as has already been noted, the initial level of FDI was relatively small, and thus the increase (though a sizeable proportion) does not result in an extremely high concentration of foreign activity in manufacturing, increasing from less than one per cent of manufacturing in the Highlands, to around 25 per cent by 1995. In addition, it is worth noting that both areas are considered to be 'assisted areas' and thus eligible for regional assistance, which may have encouraged foreign investment, as already discussed earlier in this Chapter. It can be seen that except in London, the whole of the South of England and the North East have experienced considerable increases in foreign owned gross output.

Figure 3.6: Percentage of real gross output foreign owned in the top twenty counties in 1974.

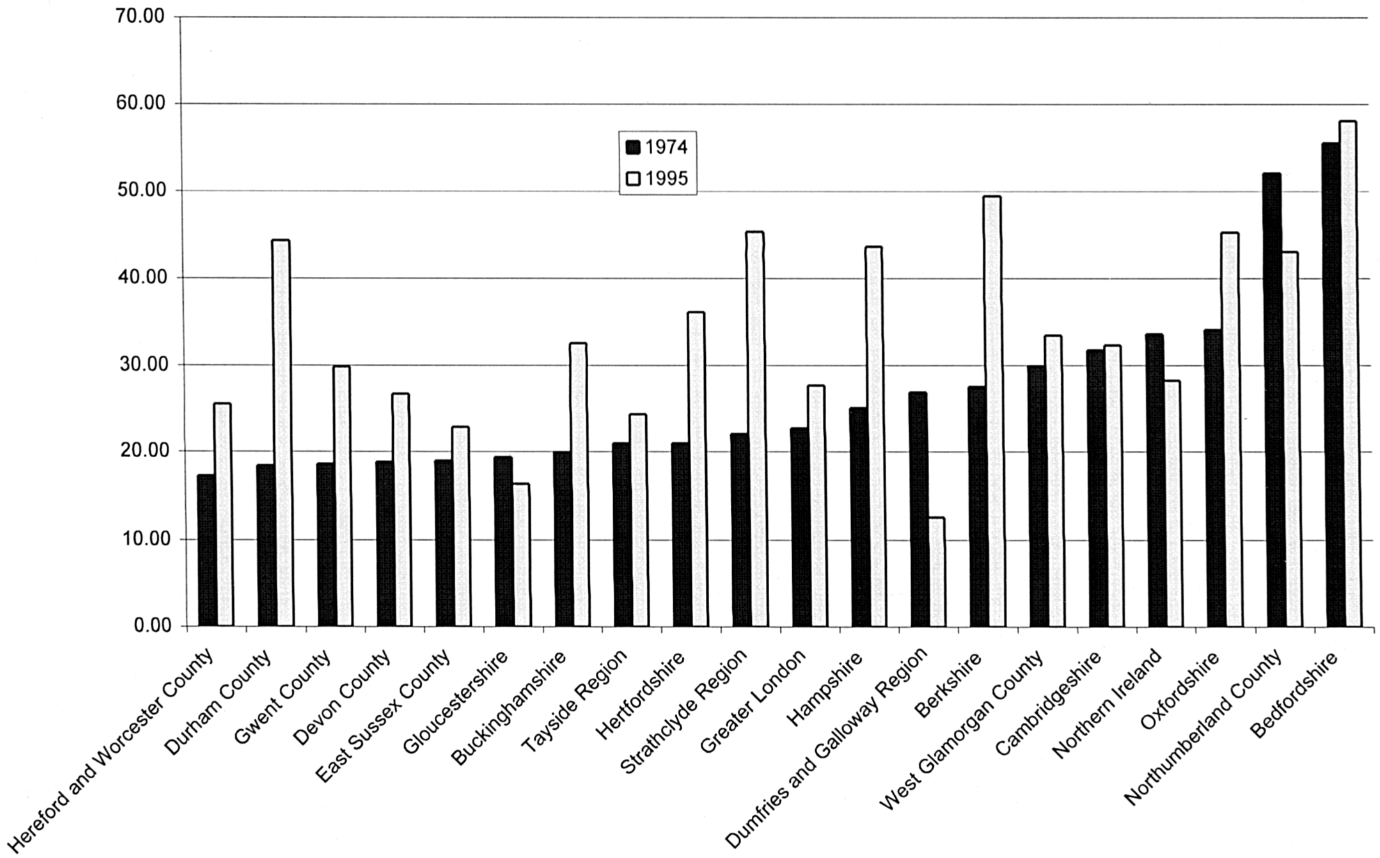


Figure 3.7: Percentage of real gross output foreign owned in manufacturing in the top twenty regions in 1995

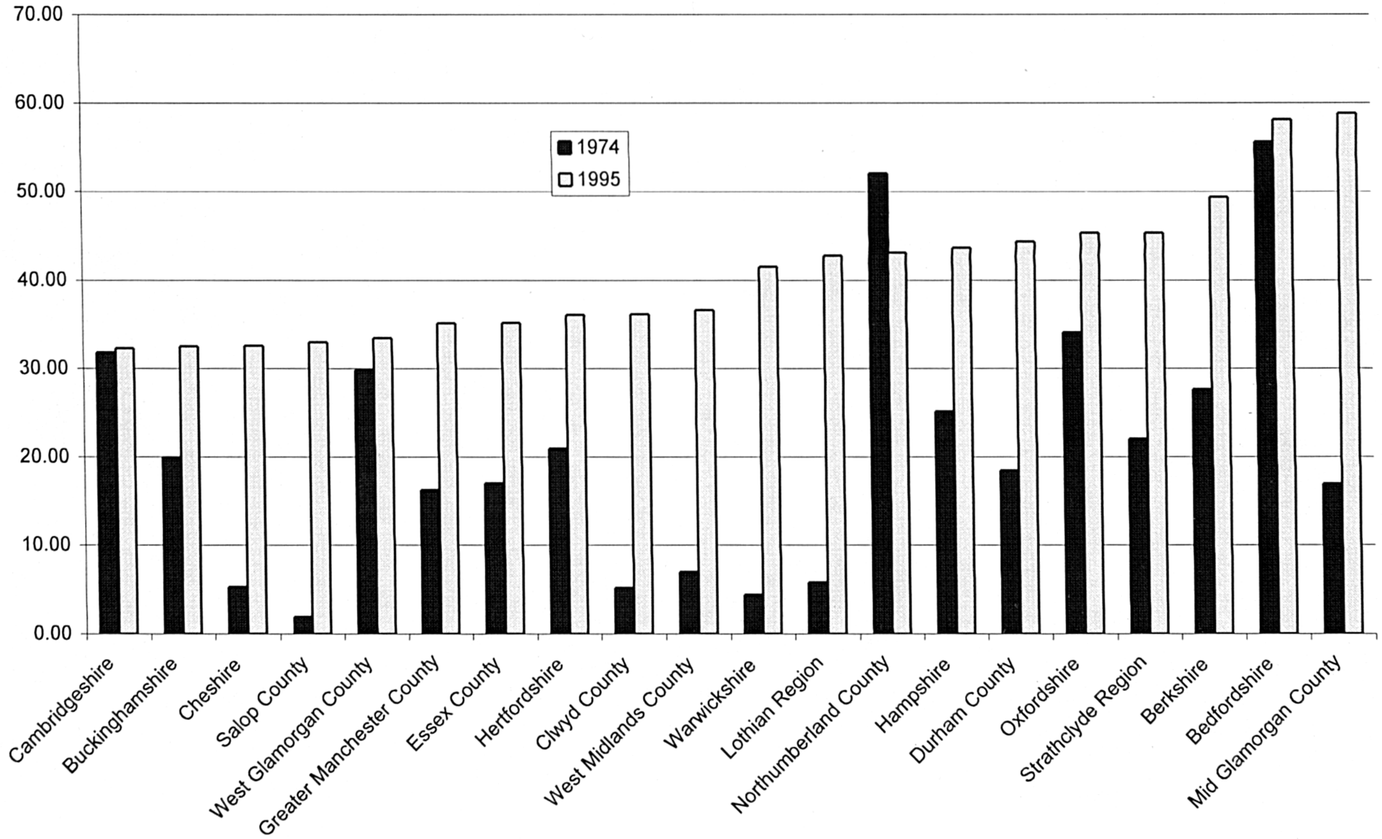


Figure 3.8: Percentage share of employment by foreign owned plants in the top twenty counties, 1974.

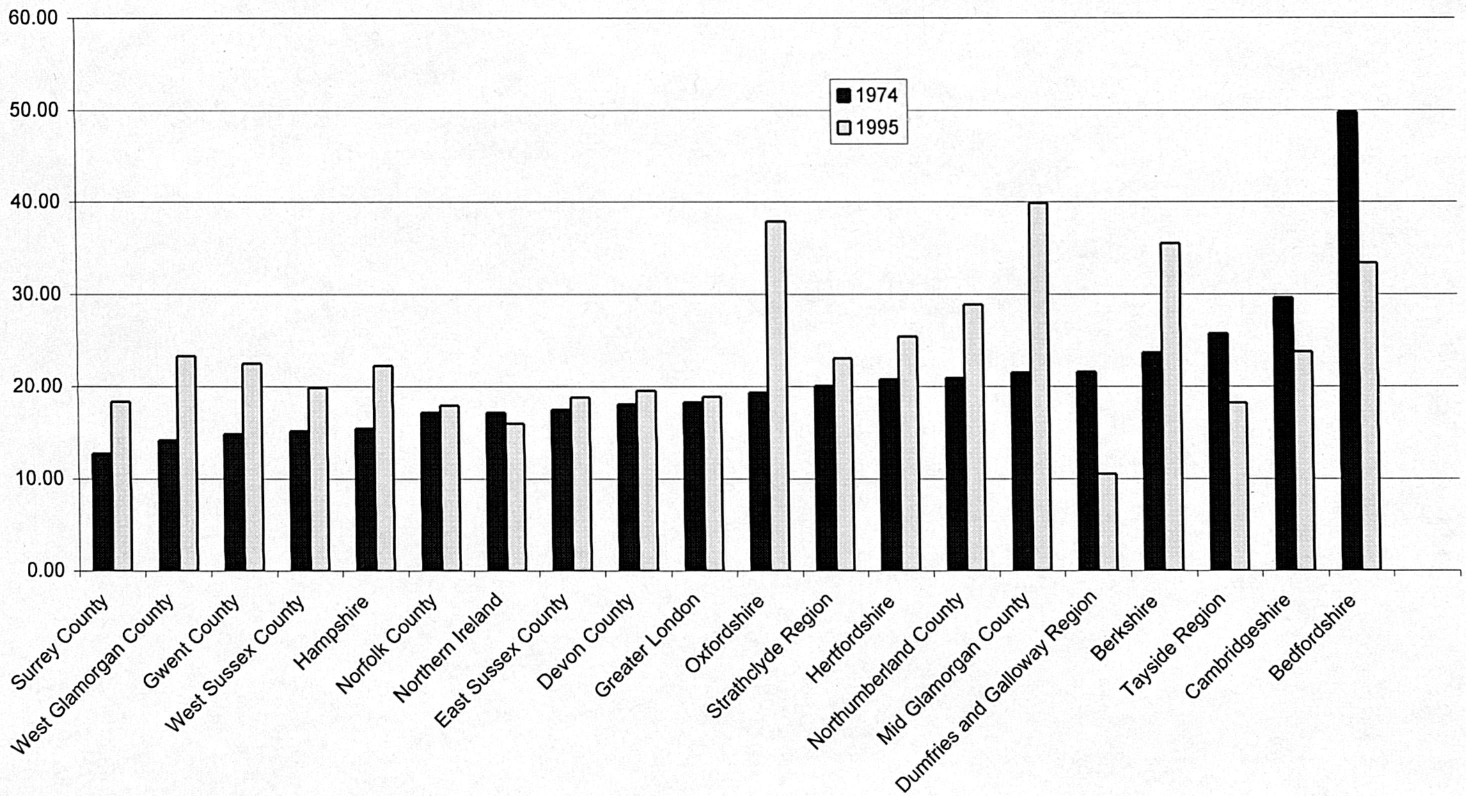


Figure 3.9: Percentage of employment in foreign owned plants in the top twenty counties, 1995

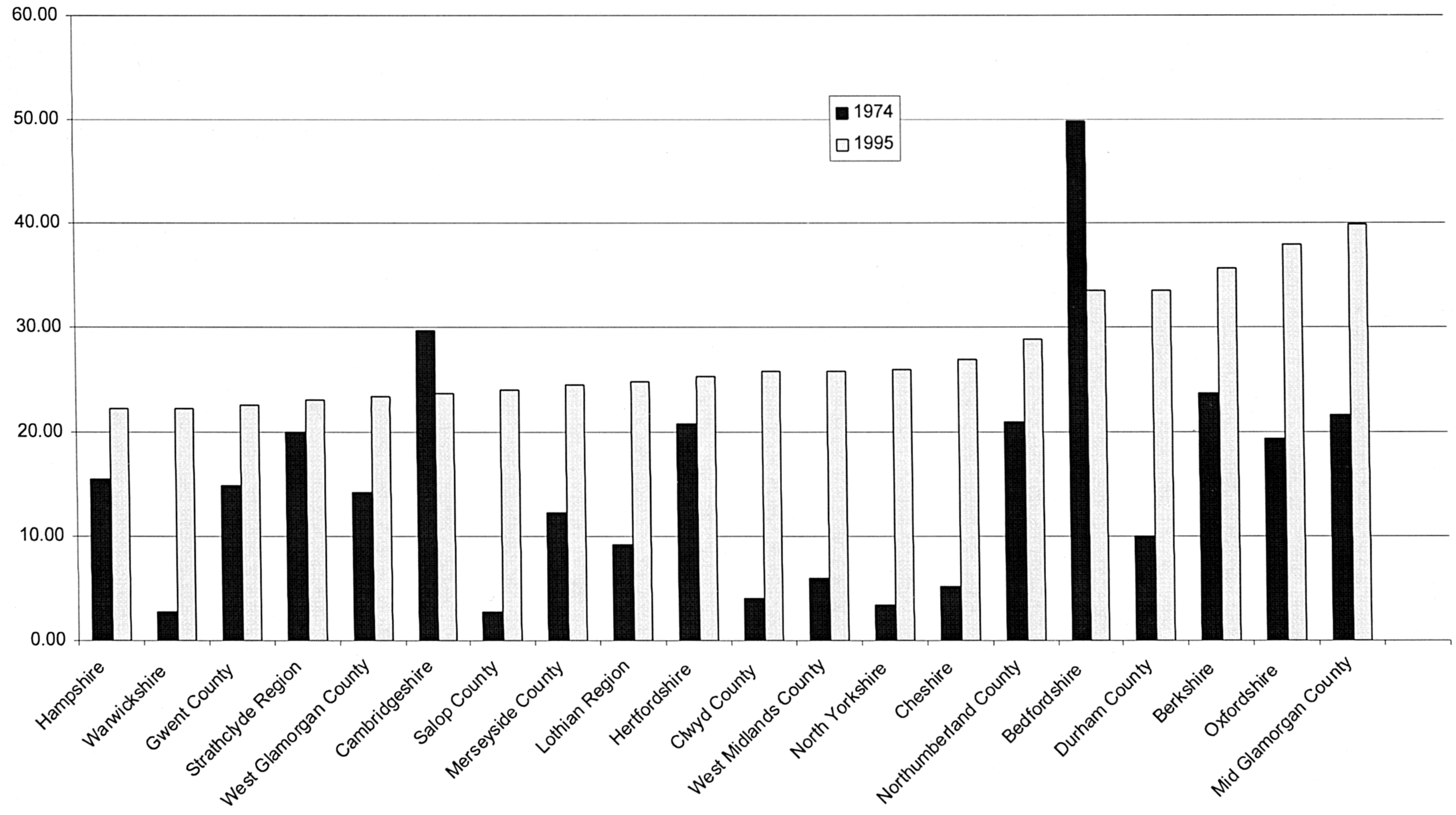
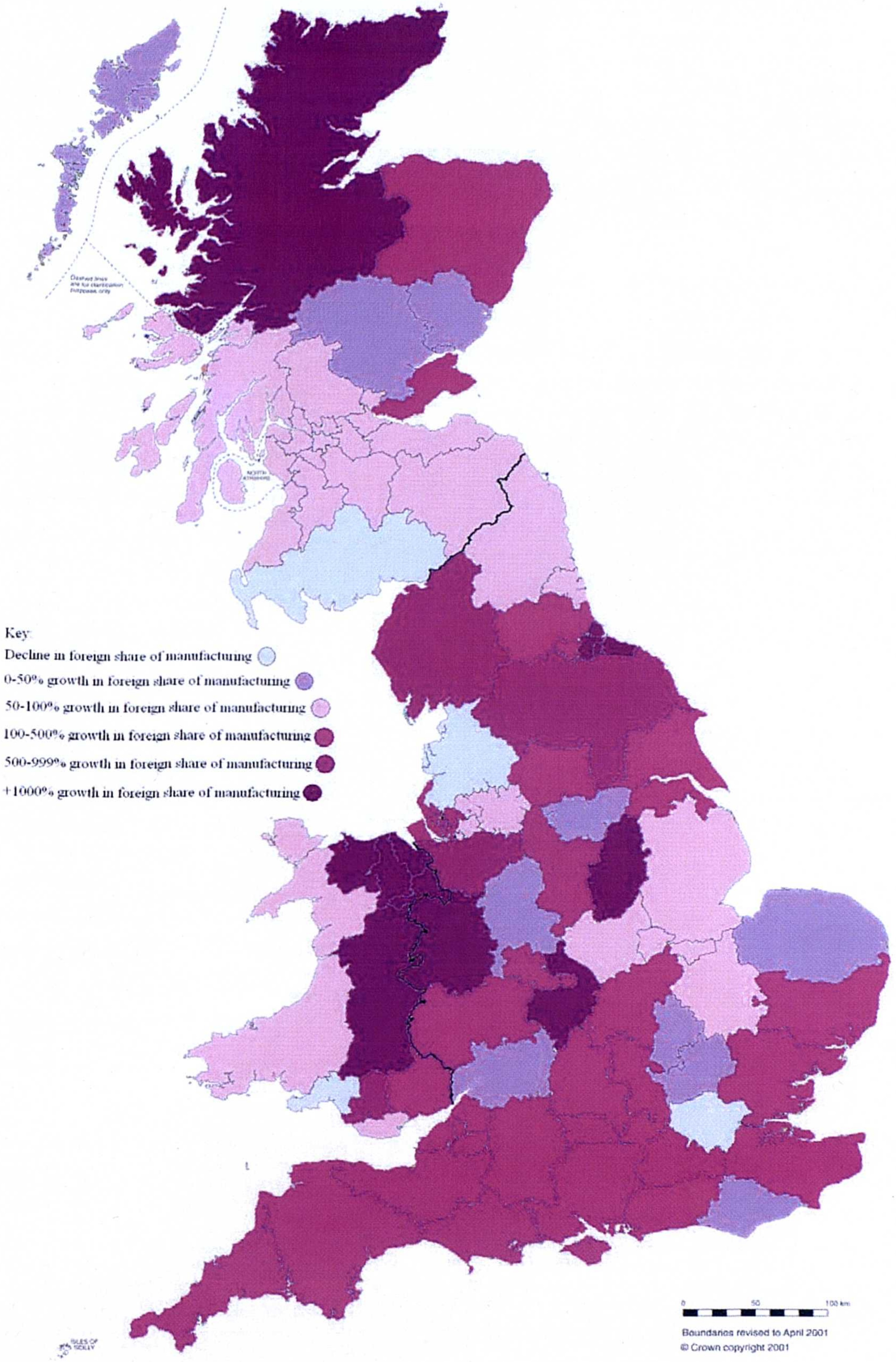


Figure 3.10: Growth in foreign share of real gross output in manufacturing across Great Britain, 1974-1995



(Source: Ordinance Survey, shading based on own calculations from the ARD)

3.1.3 Summary

The literature states that in addition to factor endowments that determine location, co-location is likely to occur because of the presence of positive agglomeration externalities. These are likely to be more pronounced in the case of FDI because of a perception of lower risks in areas with similar nationalities and also because of incentives offered to attract their investment.

By looking at the ARD, it can be seen that underlying the broad regional split, there is considerable variation within regions. Substantial growth pockets can be seen in the North West and East Midlands, in Cheshire and Derbyshire, for example, but other regions have 'hot spots' of FDI (output and employment), notably the Home Counties, Oxford and Cambridge areas; these are linked to new technology industries. In addition, significant growth in the importance of FDI in Wales is broadly spread across Gwent, Mid and West Glamorgan on the South, and Clwyd in the Northeast of Wales (adjoining the West Midlands).

Overall therefore, the data presented in this section illustrates that FDI has shifted towards semi-rural areas, adjacent to major conurbations. This suggests that the densely populated areas are less attractive to foreign firms, which may be partly related to there being lower costs to production, but may also be in response to the government incentives in the form of regional policy. Consideration of the concentration of industries across regions should provide further indications as to why these foreign firms choose to locate in these areas, an issue that is explored in the following section.

3.2 Industrial concentration of foreign ownership

Having considered the importance of geographic location, this chapter now goes on to consider whether there are industries in which the propensity to be foreign owned is relatively higher. Firstly, it explores why foreign owned plants may be attracted to industries with particular attributes. In the previous chapter, a brief analysis of the industrial structure of 20 selected industries (to be used in the more detailed analyses elsewhere in this thesis) was undertaken; gross output, growth rates and labour productivity by industry and employment levels were considered. Here more general issues are taken into account as regards FDI and its industrial location.

Traditionally, industrial concentration was viewed as a determining factor of firm behaviour and determined by basic market conditions. The New IO literature has focussed on the causes of concentration since it is now recognised that this is an outcome of the competitive process, endogenous to the system (Davies and Lyons, 1996). The outcome of the competitive process has been the subject of a large number of game theoretic studies, c.f. Sutton (1991). These demonstrate that industry concentration is not as straightforward as the traditional S-C-P paradigm suggests and is primarily though not exclusively dependent on the relationship between price, advertising, R&D and size (Davis and Lyons, 1996).

There is an *a priori* expectation that stems from some of the early industrial economics literature (Caves, 1974; Kindleberger, 1984) that foreign owned firms will be drawn to concentrated industries, since economic theory states that firms will enter industries where industry profits are positive. Rosenbaum and Lamort (1992) find empirically that high concentration encourages entry. Industry concentration is also an indicator of future monopoly rents, and thus a measure of oligopolistic tendency.

In contrast however, concentration may also be considered a barrier to entry and indeed Geroski (1999) has shown that conditions of entry are just as important for FDI as they are for domestic investment and thus concentration is one of many aspects determining entry. Empirical research exploring the relationship between industry concentration and foreign ownership is not as abundant as the regional literature, and research for the UK appears to be more supportive on there being a negative correlation with concentration. Driffield (2001b) demonstrated that FDI entry reduces concentration levels and Driffield and Munday (2000) find that high levels of domestic concentration deter foreign entry. Consistent with these findings, using the 5-firm concentration ratio in UK manufacturing, Driffield (2002) also finds that domestic industrial concentration deters the entry of foreign owned firms in UK manufacturing. These empirical results are consistent with foreign firms being attracted to high-tech, newly developing industries, bringing their latest technology to exploit new markets (Dunning, 1998). It appears therefore as though the question of whether foreign owned firms are more attracted to concentrated industries is an empirical issue; traditional oligopolistic industries offer above-normal profits to attract foreign entrants, however, such markets are characterised by high entry barriers which are likely to deter foreign entry.

This section considers concentration in manufacturing and how far it relates to the location of foreign owned plants, using the ARD. In this section, Herfindahl indices are calculated for all four-digit industries in UK manufacturing. Given that there are over 200 industries, the most concentrated 4-digit industries are largely focused upon in this section. The Herfindahl Index is calculated as the weighted sum of the squared market shares of all firms in the market; in this case, market share is defined in terms of gross output. Thus, for any industry *i*;

$$H = \sum_i (S_i)^2 \tag{3.1}$$

Where *S* is firm share of industry gross output. The closer this index is to one, the more concentrated the industry. The index was calculated for 4 digit industries by aggregating plant level data, contained in the ARD, to the firm level using the enterprise group reference number. Data were weighted to reflect the population. The concentration of an industry, as discussed above, will have implications for firm behaviour and may give further indications as to why foreign firms choose to locate where they do. In addition, the concentration ratios are calculated for three decades, the 1970s, 1980s and the 1990s separately, to observe if any changes have occurred to industrial structure over the period.

Firstly though, to provide an overview of industrial structure in UK manufacturing information from Table 2.1 (p.39) is relevant. It was observed that mechanical engineering (32) accounted for around 10 per cent of manufacturing output, as did the chemical industry (25). The latter experienced some growth in output share whilst mechanical engineering has lost ground. Electronic and electrical engineering (34) has grown from around 6 per cent at the beginning of the period to around 12 per cent by 1995. This, combined with the more modest growth in office machinery and data processing (from around 0.4 per cent to 4.8 per cent by 1995) may be linked to growth in ICT. More traditional industries such as food and drink have declined in terms of output share, from 14 per cent to around 7 per cent. Paper products and printing have seen a marginal increase from 7.5 per cent to 9.4 per cent, this is most likely to be a function of other industries shrinking (given the overall decline of manufacturing), rather than a dramatic increase in output, *per se*. This section now goes on to consider those trends in greater detail at the 4-digit SIC level.

3.2.1 The concentration of industries in UK manufacturing

The Herfindahl indices were calculated (as described above) using enterprise level data by industry for 1974-1979, 1980-1989 and 1990-1995. The industries with the very highest levels of concentration in 1995 are presented below in Table 3.4[9].

There is no clear overall pattern to the most concentrated industries since they cover the breadth of manufacturing, from salt extraction to cork and basketwork. However it appears as though there are a number of notable groups discernable in the list; there are a couple of relatively specialised industries such as spinning and weaving and cork and basketwork, in addition there are a number of food and drink related industries, largely characterised by products in the latter part of their life cycles. Finally, there are a handful of high technology industries such as chemicals, photographic equipment, pesticides and plastics that are amongst the most concentrated.

[9] 25 industries are presented in table 3.4 and 3.5. These represent over a tenth of the 208 industries.

Table 3.4: Herfindahl index for selected 4 digit industries

(most concentrated in the 1990s)

SIC80 code	Industry	1970s	1980s	1990s
2563	Chemical treatment of oils and fats	0.417	0.540	0.836
3533	Motor cycles and parts	0.326	0.269	0.536
4200	Sugar and sugar by-products	0.509	0.499	0.510
2330	Salt extraction and refining	0.427	0.417	0.495
3212	Wheeled tractors	0.446	0.434	0.469
3162	Cutlery, spoons, forks, and similar tableware; razors	0.133	0.206	0.429
2396	Extraction of other minerals not elsewhere specified	0.378	0.436	0.395
4664	Articles of cork and basketwork, wickerwork and Other plaiting materials	0.379	0.560	0.367
2591	Photographic materials and chemicals	0.533	0.292	0.351
2515	Synthetic rubber	0.232	0.315	0.345
4180	Starch	0.346	0.326	0.313
3733	Photographic and cinematorgraphic equipment	0.354	0.352	0.309
2569	Adhesive film, cloth and foil	0.234	0.265	0.299
4213	Ice cream	0.268	0.176	0.290
4290	Tobacco industry	0.286	0.215	0.286
3634	Pedal cycles and parts	0.219	0.374	0.276
2568	Formulated pesticides	0.247	0.284	0.268
4831	Plastic coated textile fabric	0.153	0.201	0.265
2600	Production of man-made fibres	0.172	0.158	0.263
4115	Margarine and compound cooking fats	0.299	0.288	0.236
4833	Plastics floor-coverings	0.145	0.220	0.235
4340	Spinning and weaving of flax, hemp and ramie	0.062	0.097	0.234
4811	Rubber tyres and inner tubes	0.224	0.204	0.230
2581	Soap and synthetic detergents	0.185	0.170	0.229
2478	Glass containers	0.184	0.176	0.222

The picture presented here is one of concentration in the more traditional and mature industries of UK manufacturing, but what is of prime interest in this chapter is the relationship between concentration and FDI. Therefore, Table 3.5 contains the share of gross output accounted for by foreign owned plants in those most concentrated industries, contained in table 3.4.

Foreign ownership is not present for those industries with the highest levels of concentration. However, with the exception of these 4 industries, there is a significant foreign presence in concentrated industries overall. In 8 of the 25 industries included in table 3.5 it can be seen that by 1995, foreign presence accounts for over 50 per cent of gross output. This is a sizeable proportion when one considers that foreign ownership in any one region averaged around 25 per cent of employment by 1995 (Figure 3.9).

Table 3.5: Percentage share of real gross output by foreign owned plants in the most concentrated industries

SIC80 code	Industry	1974	1985	1995
2563	Chemical treatment of oils and fats	-	12.26	-
3633	Motor cycles and parts	-	-	-
4200	Sugar and sugar by-products	-	-	-
2330	Salt extraction and refining	-	-	-
3212	Wheeled tractors	70.59	92.08	87.72
3162	Cutlery, spoons, forks, and similar tableware; razors	1.15	62.91	91.15
2396	Extraction of other minerals not elsewhere specified	-	-	39.18
4664	Articles of cork and basketwork, wickerwork and other plaiting materials	21.10	-	-
2591	Photographic materials and chemicals	72.53	94.03	87.59
2515	Synthetic rubber	36.99	88.70	77.97
4180	Starch	10.37	53.43	60.20
3733	Photographic and cinematographic equipment	87.22	61.18	67.37
2569	Adhesive film, cloth and foil	27.87	56.50	94.30
4213	Ice cream	-	-	3.62
4290	Tobacco industry	27.72	38.35	48.43
3634	Pedal cycles and parts	-	-	48.13
2568	Formulated pesticides	27.73	57.21	22.85
4831	Plastic coated textile fabric	26.71	28.68	-
2600	Production of man-made fibres	17.00	12.01	66.60
4115	Margarine and compound cooking fats	0.58	20.65	26.25
4833	Plastics floor-coverings	1.49	25.72	42.02
4340	Spinning and weaving of flax, hemp and ramie	-	-	-
4811	Rubber tyres and inner tubes	50.73	62.51	90.21
2581	Soap and synthetic detergents	43.62	53.42	47.30
2478	Glass containers	-	1.20	1.03

In order to quantify the degree to which foreign owned plants are located in concentrated industries, Table 3.6 shows the correlation coefficients between foreign presence and industrial concentration, by year. In nearly all cases, the coefficient is both positive and significant, to at least the 5 per cent level of significance. 1994 is the only exception, where the correlation falls compared to previous years, but is found not to be significant. The nature of this correlation is relatively constant over time.

Table 3.6: Correlation between the foreign share of gross output and industry concentration[10]

Year	Correlation coefficient	Significance level
1974	0.23*	(0.001)
1975	0.19*	(0.007)
1976	0.17	(0.016)
1977	0.22*	(0.001)
1978	0.19*	(0.007)
1979	0.19*	(0.005)
1980	0.19*	(0.005)
1981	0.15	(0.034)
1982	0.15	(0.028)
1983	0.19*	(0.007)
1984	0.21*	(0.002)
1985	0.16	(0.019)
1986	0.24*	(0.001)
1987	0.21*	(0.002)
1988	0.20*	(0.005)
1989	0.17	(0.016)
1990	0.17*	(0.013)
1991	0.19*	(0.006)
1992	0.17*	(0.012)
1993	0.22*	(0.001)
1994	0.10	(0.146)
1995	0.19*	(0.007)

Number of observations in each year = 207; * significant at the 1% level

[10] A partial correlation was undertaken that took into consideration the impact of employment, to capture a size effect. However, the results did not systematically change the results presented above and they are therefore not reported here.

3.2.2 Summary of industrial concentration and FDI in UK manufacturing

Overall then, it can be seen that foreign owned firms do locate in the more concentrated industries. By looking at 4-digit industry level data it appears as though there are two separate groups of industries discernable in this section – firstly there is a foreign presence in traditional industries, in the latter part of their product life cycles; relatively concentrated industries where cost reduction would be the chief motivation. Secondly, foreign owned firms are also located in high tech, dynamic industries.

3.3 Modelling the characteristics of foreign ownership

Whilst the study above is useful, it is difficult to establish with any certainty the relationship between FDI and regional and industrial location, (or size, or capital intensity, etc.). Indeed, it raises the question whether foreign owned plants locate in, say, the West Midlands because of the type of industry located there with associated network externalities, or because of regional assistance designed to attract foreign owned plants to a particular area, or because of the area *per se*. Some attempt needs to be made to separate out these effects in order to inform the hypotheses formulation process and to provide a clearer understanding of the most important determinants of FDI.

Therefore, in order to more accurately identify and separate the contributions that each individual characteristic makes to the probability of a plant being foreign owned, estimation of a limited dependent variable model should prove useful. Given the nature of the analyses to be undertaken it would be more informative to consider what effects various characteristics have on the probability of being more specifically

US, EU or other foreign owned. Thus, an unordered categorical dependent variable model is appropriate and therefore a multinomial logit model is applied.

The probability of being owned by the US, the EU, other foreign or being a UK multi or single plant is considered to be determined by plant characteristics, such as age, employment size, region and industry. The multinomial logit model allows for the effects of the characteristics to vary across the unordered categories of ownership. Effectively, the multinomal logit model simultaneously estimates binary logits for all comparisons among the dependent categories, though unlike the separate estimation of a series of binary logits, samples vary for each category and thus they would not offer the constraints necessary among the coefficients in the model. The multinomal logit imposes the constraints necessary (Long and Freese, 2001) to make the model internally consistent.

In this instance, 5 groups are defined; UK single plant firms, UK multi-plants, US owned, EU owned, other foreign owned[11]. More formally (and following the notation of Long and Freese; 2001), this may be written:

$$\ln \Omega_{m\,b}(X) = \ln \frac{\Pr(y = m|x)}{\Pr(y = b|x)} = X\beta_{m\,b} \qquad \text{for } m \text{ 1 to } J \qquad (3.2)$$

where X is the various probabilities of ownership, m is the categorical dependent variable, in this instance, type of foreign ownership (with a total of J groups), and b is the base category of the dependent variable, in this instance UK single plants (as opposed to domestic multi-plant enterprises). The log odds of an outcome compared to itself is always 0 and thus the effects of independent variables must also be 0, thus each category of the dependent variable (each j) may be solved following:

$$\Pr(y = m|x) = \frac{\exp(x\beta_{m|b})}{\sum_{j=1}^{J} \exp(x\beta_{j|b})} \qquad (3.3)$$

It should be noted that the predicted probabilities will be the same regardless of the chosen base category (*b*), though the output will appear to change and is thus confusing as a result of different parameterisation (Long and Freese, *op cit.*).

The UK is separated into two groups (single plants and plants that are part of a multiplant organisation) since their behaviour is likely to be quite different. The results of the multinomial logit model are presented in Table 3.7 and provide a clear overview of characteristics associated with being US- or EU-owned, compared to a UK single plant company. Included in the model are a number of controls; firstly, employment is included which acts as a proxy for the size of the plant. The *a priori* expectation is for this to be positive since one would expect foreign owned plants to be bigger than UK single plant enterprises, partly because the UK single plant category will include all new small entries to the market and partly because of FDI needing to achieve a minimum efficient scale to make entry viable (Hymer 1976). The capital to labour ratio represents the level of capital intensity, the *a priori* expectation is that this will also be positive, given that single UK plants are likely to be relatively more labour intensive. The age of the plant is also included. This is calculated only in reference to the start of the ARD, in 1970. That is, the maximum age of any plant in the data set is 25 years. In a situation where entry was dynamic and turnover rapid, it would be consistent to expect UK single plants to be young, with low survival rates. Under such circumstances, age would be positively

[11] Note that whilst it would have been informative to have a separate Southeast Asian category, it was

correlated with the probability of being foreign owned. However, where UK single plant enterprise turnover is low and survival rates are high in comparison with foreign owned enterprises, age may be negative. Also, the fact that many foreign firms entered UK manufacturing in the 1980s provides further justification for expecting age to be negatively related to foreign ownership. The density variable is calculated as population by square kilometre on the basis of the local authority areas[12]. Therefore, the higher the value, the more densely populated the area. There will be a negative relationship between FDI and density if foreign plants tend to locate in more remote, rural areas and a positive coefficient on density if foreign plants show a preference for more densely populated areas. The density-squared term is also included in the regression in order to take account of the fact that it is unlikely that plants will wish to locate in extremely densely or sparsely populated areas; therefore regardless of whether density has a positive or negative impact, the *a priori* expectation is that this tendency will be at a decreasing rate.

Dummy variables are included in this model in relation to industry, at the 2 digit level, with the base category being metal manufacturing. In addition, in relation to the earlier study, regional dummies were also included. Given the findings in earlier sections of this chapter, it would be reasonable to expect that the South East location would be positively correlated with FDI status, however there is no *a priori* expectation regarding industries, given the spread of foreign interests in UK manufacturing. However, the results in section 3.2 indicate that at the county level there are significant variations within regions, principally between urban and rural areas. It was not however possible to include a more disaggregated measure of

not included since this grouping was too small to show sufficient variation for modelling, especially given the number of independent variables included in the model.

location, hence the inclusion of the density term to capture variation in attributes within a region. In addition, there is a time dummy included to pick up additional FDI effects from 1986-1993, when FDI expanded more rapidly.

Table 3.7: Multinomial logit estimates of the determinants of the probability of foreign ownership, UK manufacturing, 1974-1995 (standard errors in parentheses).

	UK multiplant	US	EU	Other
Constant	2.271*	-0.622*	-2.130	-1.723*
	(0.0169)	(0.028)	(0.0421)	(0.038)
Employment	0.103*	0.124*	0.121*	0.116*
	(0.000)	(0.000)	(0.000)	(0.000)
Capital to labour ratio	0.500*	0.488*	0.496*	0.396*
	(0.0083)	(0.008)	(0.008)	(0.102)
Intermediates to labour ratio	0.454*	0.917*	0.923*	1.097*
	(0. 007)	(0.0927)	(0.009)	(0.009)
Age of plant	-0.059*	-0.046	-0.052*	-0.067*
	(0.000)	(0.0005)	(0.001)	(0.001)
Density	0 .001*	0.006*	0.015*	0.021*
	(0.000)	(0.000)	(0.001)	(0.001)
Density Squared (*100)	-0.001*	-0.006*	-0.014*	-0.020*
	(0.000)	(0.000)	(0.000)	(0.000)
<u>Industry dummies</u>	(Base industry metal manufacturing)			
Extraction of minerals not elsewhere specified	2.063*	-1.967*	0.694*	-0.785*
	(0.0422)	(0.163)	(0.093)	(0.153)
Manufacture of non-metallic mineral products	1.694*	-0.806*	1.072*	2.148*
	(0.0187)	(0.0343)	(0.043)	(0.036)
Chemical industry	0.535*	1.346*	2.092*	0.456*
	(0.0194)	(0.0289)	(0.042)	(0.040)
Production of man made fibres	-0.641*	-1.044*	-0.507*	-1.898*
	(0.0163)	(0.0302)	(0.045)	(0.050)
Manufacture of metal goods not elsewhere specified	-0.413*	0.433*	0.644*	-0.697*
	(0.0159)	(0.026)	(0.0406)	(0.037)

[12] Data were available from various years of Regional Trends (ONS).

Table 3.7 continued...

	UK multiplant	US	EU	Other
Manufacture of office machinery	-0.255*	1.128*	1.396*	1.505*
and data processing	(0 .0330)	(0.0425)	(0.058)	(0.050)
equipment				
Electrical and electronic	0.193*	0.623*	1.739*	-0.048
engineering	(0.0174)	(0.0282)	(0.041)	(0.040)
Manufacture of motor vehicles and	0.699*	0.925*	0.603*	-0.823*
parts	(0.020)	(0.0312)	(0.050)	(0.063)
Manufacture of other transport	-0.252*	-0.832*	-0.114†	0.107†
equipment	(0.0222)	(0.0456)	(0.0614)	(0.050)
Instrument engineering	-0.005	0.449*	0.623*	-0.780*
	(0.0206)	(0.033)	(0.050)	(0.062)
Food, drink and tobacco	0.0345†	-1.681*	-0.489*	-2.610*
manufacture industries	(0.0169)	(0.0356)	(0.046)	(0.063)
Sugar and sugar by-products	0.619*	-0.466*	0.712*	0.111*
	(0.0193)	(0.033)	(0.045)	(0.040)
Textile industry	-0.064*	-1.492*	-0.515*	-1.677*
	(0 .0179)	(0.0418)	(0.054)	(0.066)
Manufacture of leather and leather	-0.761*	-3.50*	-1.178*	-2.915*
goods	(0.0263)	(0.169)	(0.103)	(0.185)
Footwear and clothing industries	-0.134*	-1.419*	-1.334*	-2.059*
	(0.0168)	(0.035)	(0.057)	(0.062)
Timber and wooden furniture	-0.489*	-3.109*	-1.143*	-2.267*
industries	(0.0167)	(0.054)	(0.0513)	(0.058)
Manufacture of paper and paper	0.265*	-0.566*	0.152*	0.883*
products; printing and	(0.0161)	(0.029)	(0.043)	(0.035)
publishing				
Processing of rubber and plastics	0.016	-0.035	1.336*	-0.651*
	(0 .0176)	(0.0302)	(0.042)	(0.046)
Other manufacturing industries	-0.478*	-1.018*	-0.743*	-2.315*
	(0.0197)	(0.0413)	(0.063)	(0.097)
Regional dummies	(Base region South East)			
East Anglia	0.011	-0.135*	0.544*	-0.064†
	(0.0125)	(0.023)	(0.023)	(0.031)
South west	0.251*	-0.043*	0.235*	0.162*
	(0.0093)	(0.017)	(0.020)	(0.021)
West Midlands	-0.189*	-0.727*	-0.135*	-0.392*
	(0 .0074)	(0.015)	(0.017)	(0.020)

Table 3.7 continued...

	UK multiplant	US	EU	Other
East Midlands	-0.062*	-0.433*	-0.354*	-0.473*
	(0.008)	(0.017)	(0.022)	(0.025)
Yorkshire and Humberside	-0.022*	-0.445*	-0.297*	-0.238*
	(0.0079)	(0.016)	(0.0200)	(0.022)
North west	-0.058*	-0.158*	0.039†	0.002
	(0.008)	(0.013)	(0.017)	(0.019)
North	0.216*	0.161*	0.124*	1.059*
	(0.0115)	(0.019)	(0.025)	(0.021)
Wales	-0.004	0.039†	0.243*	0.704*
	(0.011)	(0.020)	(0.024)	(0.023)
Scotland	0.216*	0.237*	0.582*	0.953*
	(0.009)	(0.0146)	(0.017)	(0.018)
Northern Ireland	-1.187	-0.940*	0.186*	-1.438*
	(0.012)	(0.0276)	(0.024)	(0.045)
Time dummy variable				
d8693	-0.076*	0.004	0.232*	0.098*
	(0.0043)	(0 .008)	(0.009)	(0.010)

The results of the multinomial logit estimation are presented in Table 3.7. It can be seen that because of the considerable size of the dataset, almost all coefficients are significant at the 1 per cent level (starred). Those that were significant at the 5 per cent level are also indicated (cross). The beta coefficients as reported in Table 3.7 are probabilities of a particular outcome occurring compared to the base category. However, the interpretation of the raw coefficient is not straightforward since they are bound up in the relative probabilities in relation to the chosen base category (Greene, 2003). Therefore, though these are presented above, Table 3.8 contains the computed elasticities from these coefficients, and discussion will focus on these[13]. Whilst the marginal effect is equal to the differential of y with respect to x, the

[13] These are generated within STATA

elasticities are calculated by $\delta \ln y / \delta \ln x$, in log form. As the elasticities are derived from the coefficients, they are therefore significant at approximately the same level indicated in Table 3.7[14]; however it is important to note that there are changes in signs from the coefficient to the corresponding elasticity, since for any specified variable (x), the differential of that variable with respect to the outcome (y) need not have the same sign as its beta coefficient (Greene 1993; 2003). In the marginal effects calculation, and consequently the elasticities, every sub-vector of betas (for each outcome) enters every marginal effect, through the probabilities and through weighting.

Table 3.8: Elasticities from the estimated multinomial logit model on the determinants of the probability foreign ownership

Variable	UK multiplant	US	EU	Other	UK single plant
Employment	0.021	0.051	0.047	0.039	-0.137
Capital to labour ratio	0.017	0.014	0.016	-0.007	-0.097
Intermediates to labour ratio	0.012	0.177	0.179	0.241	-0.150
Age of plant	-0.163	0.070	-0.039	-0.310	0.918
Density	-0.10	0.089	0.245	0.366	-0.028
Density Squared (*100)	0.003	-0.003	-0.096	-0.140	0.014
Industry dummies (metal manufacturing base)					
Extraction of minerals not elsewhere specified	0.003	-0.022	-0.006	-0.015	-0.010
Manufacture of non-metallic mineral products	0.028	-0.188	-0.025	0.068	-0.118
Chemical industry	0.001	0.048	0.090	-0.003	-0.030
Production of man made fibres	-0.005	-0.035	0.005	-0.099	0.043

[14] Greene (1993) notes that 'the literature contains relatively few studies in which the marginal effects and *their* standard errors are presented' since their estimation is exceedingly complex.

Table 3.8 continued...

Variable	UK multiplant	US	EU	Other	UK single plant
Manufacture of metal goods not elsewhere specified	-0.013	0.093	0.119	-0.049	0.038
Manufacture of office machinery and data processing equipment	-0.001	0.009	0.010	0.011	0.001
Electrical and electronic engineering	-0.001	0.031	0.113	-0.019	-0.016
Manufacture of motor vehicles and parts	0.003	0.010	0.000	-0.043	-0.018
Manufacture of other transport equipment	-0.000	-0.011	0.002	0.006	0.004
Instrument engineering	-0.000	0.008	0.012	-0.015	-0.000
Food, drink and tobacco manufacture industries	0.007	-0.110	-0.029	-0.174	0.004
Sugar and sugar by-products	0.006	-0.047	0.011	-0.019	-0.024
Textile industry	0.004	-0.077	-0.022	-0.087	0.007
Manufacture of leather and leather goods	0.000	-0.018	-0.003	-0.014	0.005
Footwear and clothing industries	0.005	0.090	-0.083	-0.137	0.015
Timber and wooden furniture industries	0.002	-0.132	-0.031	-0.089	0.028
Manufacture of paper and paper products; printing and publishing	0.006	-0.082	-0.006	0.072	-0.022
Processing of rubber and plastics	-0.001	-0.003	0.062	-0.033	-0.002
Other manufacturing industries	-0.000	-0.009	-0.005	-0.031	0.008
<u>Regional dummies (SE base)</u>					
East Anglia	-0.000	-0.005	0.018	-0.003	-0.001
South west	0.003	-0.018	0.002	-0.003	-0.015
West Midlands	-0.001	-0.065	0.005	-0.025	0.021
East Midlands	0.001	-0.033	-0.026	-0.037	0.007
Yorkshire and Humberside	0.002	-0.041	-0.026	-0.020	0.004
North west	-0.001	-0.013	0.002	0.006	0.006
North	0.001	-0.001	-0.003	0.040	-0.009
Wales	-0.001	0.001	0.010	0.029	-0.000
Scotland	0.001	0.003	0.034	0.067	-0.018
Northern Ireland	-0.006	0.001	0.033	-0.013	0.028
<u>Time dummy variable</u>					
D8693	-0.007	0.019	0.095	0.050	0.018

It can be seen from Table 3.8 that the elasticity associated with total employment (the size coefficient in the model) is 0.021 in the case of UK multiplant, which indicates that for a 10 per cent increase in employment there will be an increase in the probability that a plant will be a domestically owned multiplant by 0.21 per cent. The differential between employment levels across the subgroups is in fact likely to be considerably larger than 10 per cent. It can be seen looking across the table to other subgroups that the employment elasticity is larger for all foreign forms of ownership, and largest in the case of the US. The elasticity associated with the domestic single plant organisations is negative, thus, if there was a 10 per cent increase in employment this would decrease the probability of the plant being a UK single plant enterprise by 13.7 per cent. Therefore, the elasticities associated with total employment indicate that foreign plants, and in particular, US plants have a higher probability of being large than single domestic plants.

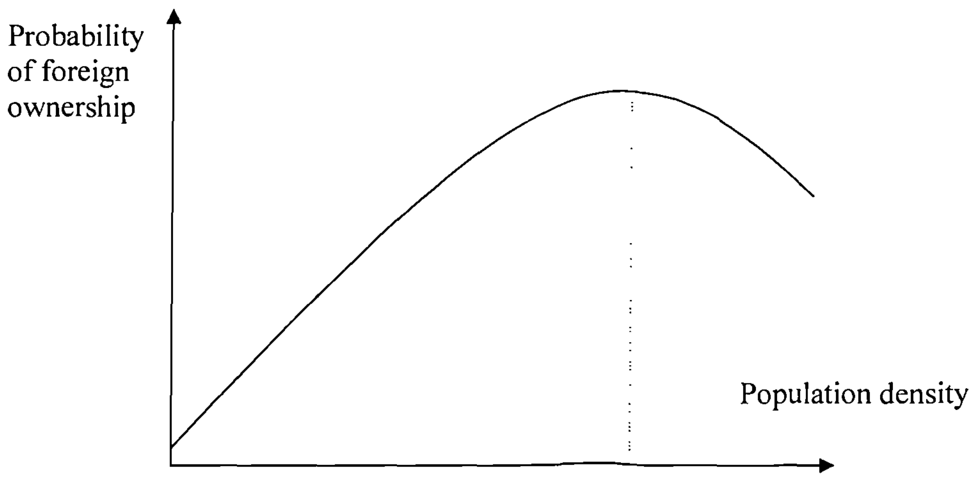
The elasticities associated with the capital-to-labour ratio are positive for the UK multiplant, the US and the EU outcomes of ownership, indicating that these are more capital intensive than other foreign owned plants and single plant UK enterprises. In the case of the UK multiplant, a 10 per cent increase in the capital-to-labour ratio, for example, would lead to an increase in the probability of a plant being a UK multiplant by 0.17 per cent. It is interesting to note that in the case of other foreign owned plants, an increase in the capital-to-labour ratio reduces the probability of foreign ownership, suggesting that these plants are significantly different to the EU and US plants.

When the intermediates to labour ratio is considered, it can be seen that the elasticities are largest for foreign owned plants, especially in the other foreign owned category. In the UK, whilst the elasticity is positive, it is a relatively small impact, thus, a 10 per cent increase in the intermediates to labour ratio would result in a 0.12 per cent increase in the probability of being a UK multiplant, compared to a 2.4 per cent increase in the probability of being an 'other' foreign owned plant. In the case of UK single plants, an increase in this ratio decreases the probability of a plant falling into this category, in line with expectations.

In the case of the age elasticities, the results are more mixed. It can be seen from Table 3.8 that the elasticities are positive in the case of the US and UK single plants, which suggests that an increase in age will result in an increase in the probability of falling into these categories. However, in the case of the UK multiplant and EU and other foreign owned plants, an increase in age results in a decrease in the probability of belonging to these groups. This result suggests that UK single plants and US plants are older than the other three groups, on average, which in the case of UK single plants seems strange, given the level of churning that is known to exist (Harris and Robinson, 2001b). This may, in part, be explained by the sampling procedures in the ARD at the smaller end of the plant distribution. In the case of the US plants, whilst this result is unexpected, it has been seen elsewhere in this thesis that the US plants were the first to enter UK manufacturing to any great extent and this may be a feature of their endurance.

Considering the population density and density squared terms together, it can be seen that foreign owned plants have more of a tendency to locate in more densely populated areas compared to domestic plants. i.e. the elasticities are positive, suggesting that an increase in population density is associated with an increase in the probability that the plant will fall into one of the three foreign owned categories. However, the density squared term indicates that whilst plants from these subgroups are more likely to locate in urban areas, the probability declines as the area becomes more and more urban – thus this supports the findings earlier in this chapter that plants choose to locate on the periphery of large conurbations; thus the probability of being foreign owned is positively related to density but this tails off as congestion starts to have a negative impact – this is illustrated in Figure 3.11 below.

Figure 3.11: A schematic of the relationship between population density and the probability of foreign ownership



In terms of likelihood of particular ownership types locating in specific industries, it can be seen from the results in Table 3.8 that in general, the more traditional industries (such as food, drink and tobacco, timber and wood and miscellaneous manufacturing) do not have positive elasticities in relation to foreign ownership. In the case of high tech industries, the US and EU have a positive elasticity associated with these, which is indicative of an increase in probability of belonging to one of these subgroups, if located in these industries. The other category of foreign owned plants seem to be less spread across industries, and appear to behave less like US and EU plants. Domestic plants, be they single or multiplant enterprises, are generally less influenced by the industry since the coefficients are relatively small, compared to the foreign owned plants. The strongest (positive) elasticity for the UK multiplants was in the manufacturing of non-metallic mineral products, and in the case of the UK single plants, in the production of man-made fibres.

In the case of the impacts on regions on the probability of being foreign owned, positive elasticities are associated with Scotland and Wales for the foreign owned plants. The North West region elasticity was positive in the case of the EU and other foreign owned plants, but not for the US. It appears as though, in the case of the US, there are fewer regions it is associated with, given the negative elasticities to most regional locations. Domestic plants again have relatively smaller elasticities, however, there is a strong positive elasticity associated with location in Northern Ireland and single plant status. The elasticity attached to the time period dummy for the 1986 to 1993 period shows a positive sign for foreign owned plants, in line with expectations, though this is strongest in the case of the EU.

These results therefore confirm that there are considerable differences between different sources of foreign ownership in terms of where they locate, both regionally and industrially, but overall it can be seen that foreign plants are generally larger, more capital and intermediate intensive and generally more likely to be located in high technology industries.

3.4 Chapter summary

This chapter has attempted to provide a detailed description of where foreign firms chose to locate in the period 1974-1995, by analysing gross output and employment. It can be seen that there is considerable heterogeneity in foreign location in manufacturing, so much so that it is difficult to usefully summarise the findings purely from simple descriptive statistics. For this reason, a multinomial logit model has been used to try to net-out a number of inter-related effects. Whilst considerable care needs to be employed in interpretation, the elasticities are indicative of the effect, positive or negative, that certain characteristics have on the probability of being in a specific ownership category.

Two broad patterns appear to emerge from the descriptive statistics. Firstly, from a regional perspective, many foreign firms are (increasingly) attracted not to urban areas, but to the peripheral areas around major conurbations, such as Greater London or Manchester. From the industrial perspective, we see that whilst a significant proportion of foreign firms are located in concentrated 'old' manufacturing, a large, and in some cases increasing, proportion of foreign investment is attracted to young and dynamic industries, located in electronic and electrical engineering, office machinery and equipment.

The multinomial logit model attempts to disentangle some of these effects and has the added dimension of considering a number of foreign groupings, within the foreign owned class (US, EU, other), in order to see if there are significant differences with regard to the nation that is investing. This model reveals that in terms of appearance, the foreign firms do not differ a great deal, but there are differences in choices of location, both regionally and industrially, by broad nationality classifications. It may also be noted that UK multiplant organisations behave more similarly to foreign plants than they do single domestically owned plants.

Section Summary and Statement of Hypotheses

The first 3 Chapters of this thesis have outlined the data to be used, the state of play in UK manufacturing over the past 25 years, and the nature of FDI in the UK, in terms of location, both regional and industrial. It can be seen that the ARD contains detailed plant level information, including information on the nationality of principal owner. Thus, levels of employment, gross output and value added over time have been compared and contrasted, by ownership category. In addition, it has also been possible to consider the location of foreign owned plants, both in terms of region and industry. This leads to a number of testable hypotheses about foreign ownership in the UK. Firstly, given the findings from a detailed exploration of a selection of 20 industries in Chapter 2, foreign firms are generally larger, more capital and intermediate good intensive and have higher labour productivity. The latter in particular leads to the general assumption that *foreign owned plants are more productive than domestically owned plants*. The literature concerning this is explored more fully in Chapter 4, but this is the first hypothesis of the thesis, which will be tested using the ARD.

Secondly, following on from the first hypothesis and implicit from government support (largely in the form of RSA) of FDI is the assumption that foreign owned plants bring something to the domestic economy, over and above the simple batting average effect (Barrell and Pain, 1997) because of their higher labour productivity. It is consistently argued that foreign owned firms also raise the standard of other, domestic plants by allowing new access to new technology and best practice techniques and a number of other 'spillover' effects. Given this, the second hypothesis to be tested in this thesis is *whether there is evidence of productivity* *spillovers from FDI to domestic plants*. The literature concerning this is explored in greater detail in Chapter 5.

Finally, considering at the nature of the plant that becomes foreign owned, the way in which foreign firms enter the UK manufacturing sector is thought to have some bearing on the way in which the firm subsequently performs. There are two modes of direct foreign investment available to foreign firms; via the setting up of a new plant, or by acquiring an existing plant from a domestic (or other foreign) firm. Each of these methods have costs and benefits associated with them, these are first discussed in Chapter 4. For this reason, the third hypothesis to be tested in this thesis is *whether or not foreign acquisitions have higher or lower levels of productivity than similar domestic plants*.

This thesis now goes on to consider the literature in light of these questions.

Section II

Literature, theoretical developments and model formulation

Chapter 4:
The theory of foreign direct investment

4.0 Introduction

This chapter reviews the theoretical literature in relation to the motivation behind FDI and the rationale of host nations seeking to encourage it. Industrial, micro and macro economics all have an input into the theory of FDI since the analysis of FDI operates at several different levels. Whilst it is recognised that there are interrelationships between these different theories, it is not an intention of this thesis to analyse all aspects of FDI, however an overview of a number of theories is provided in the first section of this Chapter. These theories are concerned with various of facets of firm behaviour, the conditions that motivate a firm to become a multinational or have multinational aspirations; for example, the characteristics that a firm needs to possess in order to successfully become a multinational. This chapter goes on to consider, once firms have made the decision to become multinational, what are the problems and additional costs they face? Also, what modes of entry are available to them and what are the advantages and disadvantages of each type of entry?

There are a number of reasons why firms may decide to invest abroad; these include to make strategic alliances, to gain access to foreign technologies, to expand their market (usually in an area in which they have a comparative advantage), and to exploit monopoly power and make extra-ordinary profits. These reasons have most effectively been summarised in Dunning (1998) and his OLI (Ownership, Location and Internalisation) paradigm. However, Dunning himself describes his paradigm as a bringing together of various existing theories rather than a theory in its own right. Hymer's thesis, developed in the early 1960s, was one of the first explorations of why foreign firms invest abroad (Hymer, 1976). Hymer argued that firm specific assets unique to individual foreign owned firms ensure that profitability is substantial enough to offset all the additional costs they must face entering a foreign market.

4.1 Theory of FDI advantage

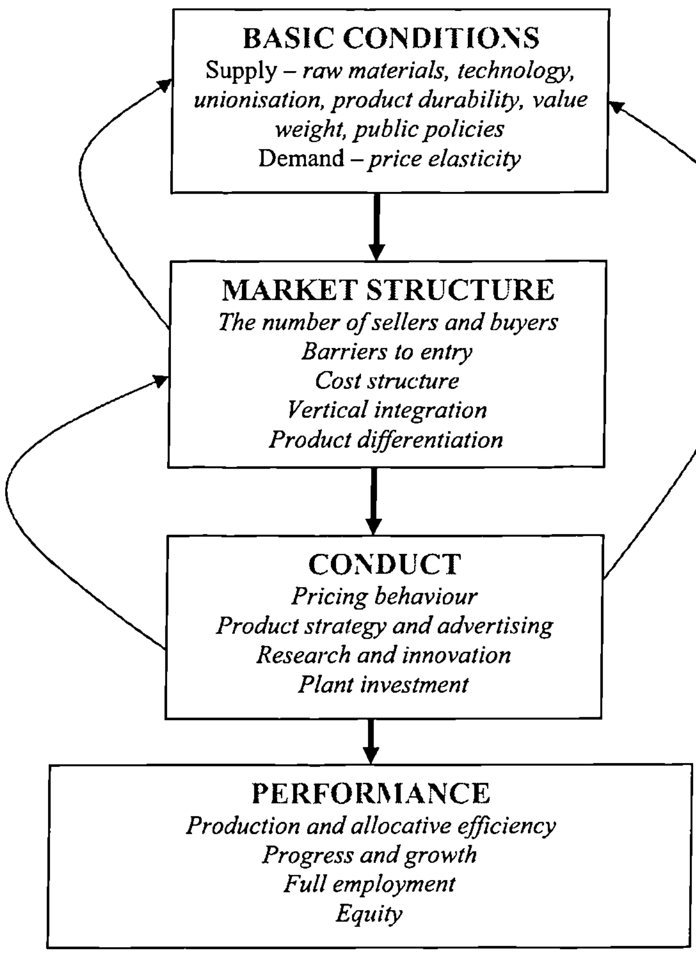
Before going on to explore the theory surrounding FDI and its advantages, it is worth contextualising the theoretical framework employed in the industrial organisational literature, to explain the approach underlying many of the assumptions.

4.1.1 Industrial Organisation, international trade and FDI – a summary

Cantwell *et al* (1986) have agued that theories of international production draw on up to six separate branches of economic theory. These are international capital movements, trade, location, industrial organisation, innovation and the theory of the firm. This thesis concentrates on the latter four of these, largely leaving aside issues of international financial flows and trade, since it focuses only on the role that foreign firms play in the UK. The aim in this section is to provide some background to the review of the FDI literature that follows.

Overall, economic theory offers a framework in which to consider firm behaviour, and consequently, the potential for economic growth and development. Industrial organisation (IO) is defined as a means of organising 'how productive activities are brought into harmony with society's demands for goods and services through some organisation mechanism' (Scherer 1980) – in this case, the free market. The early work of Bain (1959) is heavily referred to at the start of many discussions on IO, and this section will do the same. Bain is largely recognised as one of the first to develop the structure-conduct-performance paradigm, which underpins much of the market analysis others have used in subsequent work. Figure 4.1 outlines the well-discussed model.

Figure 4.1: Bain's model of industrial organisation



Source: Adapted from Scherer (1980; Figure 1.1, p.4)

It can be seen from Figure 4.1 that the primary direction of effects is that basic conditions such as factor endowments and technology, will determine the market structure, i.e. the number of firms within an industry, barriers to entry, etc. The structure of the market will determine the nature and the extent of competitive pressures on the firms, and thus on the way in which the firms within the market behave, in terms of price setting, research and development, product strategies, etc. This will ultimately determine the performance of firms and the growth in the economy as a whole, and quality of life improvements achieved through full employment, for example.

More recent work in industrial organisation has focused on the endogeneity within the system and thus the simple model outlined in Figure 4.1 has been significantly developed (see for example, the work of Sutton, 1991). These 'feedback' effects, whereby market structure and conduct also influence the basic conditions within an economy, through innovation, for example, offer a more sophisticated model of industrial organisation. Technology may enable more efficient production of goods and services, affecting the cost conditions facing the firm. In addition, the conduct of firms within a market is likely to have an impact on the structure of the market, as firms exit, enter and integrate.

This framework offers a structure for analysis, though necessarily it simplifies the complexities of the interactions between economic agents and factors of production. In this thesis, the IO model provides the context in which FDI takes place; and broadly speaking, its entry is determined by a country's basic conditions as well as existing domestic and foreign market structures. The major focus of this thesis is whether (and how) performance (defined as total factor productivity) differs according to ownership characteristics.

Additional theories that offer important considerations in relation to the nature and development of FDI are included in the trade and development literature. The role of foreign direct investors may be considered within the context of comparative advantage and the theories of international competition. For example, the traditional two-country, two-good Ricardian model of comparative advantage depends on differences across countries relating to productivity in the production of each good, whereby countries may benefit from specialisation in production, which in turn may lead to mutually beneficial trade (Krugman and Obstfeld, 1994). Whether or not firms choose to trade, franchise or enter the market directly (through FDI) is discussed in some detail below. Also important in this aspect of decision making is the role that transportation costs play in making it cheaper to produce the same good in more than one location.

Thus it can be seen that whilst the focus of this thesis stems from the industrial economics literature, and specifically from the work of Dunning and Hymer, other aspects relating to trade and development are interrelated and affect FDI. This Chapter now goes on to consider the motivation for overseas investment, the barriers it faces, and, in subsequent chapters, the benefits to host countries and domestic firms. The specific hypotheses were set out at the end of Section I (p.126).

4.1.2 Theories of international production

There are a number of competing and complementary theories of international production. As Cantwell points out, 'international production may be of a resource based, import-substituting, export platform or globally integrated kind, each of which raises distinctive considerations' (Cantwell, 2000, p11). With this in mind, it is a contention of this thesis that the reasons why firms enter a foreign market are important determinants in subsequent behaviour. In addition, Cantwell (*op cit*) highlights the different levels at which analysis of FDI may take place – macro, meso and micro economic. In the rest of this section theories of why and how firms enter foreign markets are reviewed.

Multinational enterprises have several options when looking to expand productive capacity beyond their domestic market. Exporting may not be the most cost effective or profitable approach, given the presence of tariffs and transportation costs. Similarly, licensing or franchising arrangements with domestic firms (Hennart 1991) are likely to involve significant costs, not least because of the potential loss of control over firm specific advantages. Thus acquiring capacity in the host nation is likely to be preferred when firm specific advantages are strong enough to overcome the various spatial 'barriers to entry' (Markusen, 1995). Such advantages include economies of scale and scope, brand names, management know-how and other advantages that may be exploited at several locations without incurring additional costs (Pfaffermayer, 1999; Caves, 1996).

There have been many reviews of the sources of advantage resulting from multinational production. Recently Dunning (2000) has provided an extensive review of the current relevance of his eclectic (OLI) paradigm based on advantages related to ownership, location and internalisation. In addition, Pfaffermayr and Bellak (2000), Siripaisalpipat and Hoshino (2000) and Aitken and Harrison (1999) summarise the various persuasive arguments as to why most empirical work in this area starts by assuming that foreign-owned plants will have higher productivity (and profitability, wages and skilled labour, and growth) (see also Casson 2000).

The thrust of these arguments is based on the now established assumption (Hymer 1976) that MNE's possess non-tangible productive assets (such as specialist know-how about production, superior management and marketing capabilities, export contacts and coordinated, quality-orientated relationships with suppliers and customers – networks, and the like) that they are able to exploit to give them a competitive advantage. These are internalised within the firm – since there are risks to maintaining control via licensing or other types of joint ventures[1] – *and* transferred at low (or zero) additional cost to foreign (branch) plants.[2] Thus, plants that belong to a MNE are part of a network that links them to new innovations and the ability to exploit multiplant economies of scale and are expected to do 'better' than domestically-owned plants that lack access to such competitive assets.[3]

Decisions regarding host nations are likely to be governed by existing markets and the degree of maturity, industrial and product complementarity between host and investor, technology and cultural aspects such as language, domestic institutions and infrastructure. Once the choice of whether to invest in the host market has been made, foreign firms can purchase a new (greenfield) site or acquire an existing (brownfield) one. The decision of how to enter the foreign market will depend on

[1] In addition to such risks, there are other "... transaction and coordination costs of using external arm's length markets in the exchange of intermediate products, information, technology, marketing techniques, etc." (Dunning, 2000, p. 179) that if they exceed internalisation costs will mean it pays the firm to engage in FDI.
[2] Pfaffermayr, (1999) shows that if there are multiplant economies of scale and significant (rising) costs to exporting, then MNE's will have an incentive to invest more in overseas branch plants.
[3] Note, Globerman, Ries and Vertinsky (1994) argue that foreign-owned plants do better not because they are foreign-owned *per se* but because they benefit from participation in a multinational network. That is, there are important spillovers between plants within a multiplant MNE. This also suggests that different types of networks – perhaps linked to different countries – will have different advantages.

the nature of the firm-specific advantage(s) and on market conditions. Hennart and Park (1993) argue that, if the multinational enterprises specific advantage is firmly associated with the management of its labour force, then the mode of entry will favour a greenfield site, since this may be less risky in terms of organisational control than an acquisition (especially if it allows the multinational enterprise to bring in its own managerial practices and avoid trade unions). In contrast, brownfield acquisitions are favoured if the entrant has little previous experience of producing in the host country or if they are entering a market to manufacturing a product not produced at home.

Aitken and Harrison (1999) point out that we may find foreign-owned plants to be superior (to domestic plants) because they may reduce the productivity of domestically owned plants (particularly in the short run). Increased competition in imperfectly competitive markets with increasing returns to scale (particularly through setting up 'greenfield' operations but also through expanding production in existing or newly-acquired plants) will raise the average costs of domestic competitors if they lose market share, thus reducing their productivity levels.[4]

A number of factors explain a preference for the acquisitions of brownfield sites; the new model of asset seeking FDI (Wesson, 1999) states that foreign owned firms hope to create advantages for themselves through acquiring and internalising valuable assets in the host nation. Buckley and Casson (1998) also use the internalisation approach to FDI and compare a wide range of alternative strategies for foreign market entry. They find that acquisition is favoured over greenfield

[4] Note, the FDI will have an incentive to produce more to exploit economies of scale in such markets, and Aitken and Harrison (*op. cit.*) show (in their Figure 1) that positive spillovers from FDI are unlikely to compensate for the adverse impact of increased competition.

production when there are high costs of learning about the foreign market (including the net loss of local production expertise that the FDI faces if greenfield entry is used), and when there are high costs of competition in the host market because greenfield investment increases local capacity and intensifies competition. In contrast, brownfield entry incurs costs through having to establish internal trust post-acquisition in the new organisation, and through the cost of adapting the production facility of the acquired plant. Such costs are likely to be incurred in the immediate post-acquisition phase.

Thus it is implicit that if brownfield sites are chosen, multinational enterprises will be relatively risk averse and establish capacity by acquiring plants with superior productivity levels and technology characteristics more closer to their own (for example, capital and intermediate input intensive). Otherwise, multinational face excessive costs adapting and modifying different technology, gaining expertise and experience in the host market, and building up trust. As Wesson (1999) notes,

> 'in order for asset-seeking FDI to be profitable, it must be the case that... local assets have greater value when combined with some asset already possessed by the investing firm than they do in the hands of local rivals. If not, local firms would be able to exploit the value of the local assets more efficiently than a foreign investor' (p.2-3).

Whilst multinationals may acquire better plants, it is likely that (post-acquisition) multinationals may have problems assimilating acquired plants into their organisations. As such, it is quite probable that productivity will suffer in the short run leading to the overall prediction that multinational takeovers and acquisitions are of high calibre plants but that there may be a decline in performance in the immediate post-acquisition period (cf. Ravenscraft and Scherer, 1989; section 4). In any event, this discussion suggests that the motivation behind acquisition in the case of FDI may be quite different from that of domestic firms' acquisition activity. Given this, one might expect there to be distinct differences in the plants acquired by domestic companies and multinationals, particularly in terms of the (total factor) productivity of these plants, which need to be separated in any empirical work in order to establish the true relationship between plant acquisition and performance.

Considering the competing theories of managerial discipline versus operational efficiency, industry differences are also likely to affect the motivation behind acquisitions, both by foreign owned and domestic sector. The product life-cycle theory of Vernon (1966) suggests that industries in a more mature state, exhibiting slow growth rates and lower levels of competition are more likely to follow the neoclassical models of acquisition. It is thus probable that under-performing plants will be bought so that such factors as improvements in technology and management practices may improve productivity (and hence profitability) of the acquired plants, and in this way help to reduce the costs of the post-acquisition organisation. In younger industries, where growth and competition are high, the operating efficiency argument suggests that plants with higher productivity are more likely to be acquired as they offer better prospects for growth in such markets (in part, because they reduce competition and thus consolidate the acquiring firm's hold on technology and its market share).

Domestically-owned plants may be productively inferior because they do not adopt 'best-practice' technology. Oulton (1998) suggests that UK-owned (especially smaller) enterprises may face a higher cost of capital if constrained to borrow from the UK financial system, and this reduces their ability to invest in superior technology. He also argues that UK companies may also be more risk-averse and may lack the necessary knowledge of what constitutes 'best-practice'. This suggests that learning processes and path dependence are important (cf. Dosi, *et. al.*, 1988, and Teece, *et. al.* 1997). Those domestically-owned plants that are more productive may also be at greater risk of being acquired by MNEs, thus reducing average productivity levels in the remaining stock. McGuckin and Nguyen (1995) provide evidence of this in the US, Moden (1998) confirms a similar situation exists in Sweden. Chapter 9 of this thesis explores the importance of foreign acquisition and its impact on productivity further.

In summary, perhaps it is not surprising that many studies of productivity differences between FDI affiliates and domestic plants assume that the former will be superior and have higher productivity levels. However, arguments can be found in the literature as to why foreign-owned plants may lack any significant and sustained advantages, or may even have lower TFP. These are now discussed below.

4.2 Reasons for lower productivity levels in FDI affiliates

Despite the theoretical arguments in support of foreign owned plants being more productive, empirical evidence to date is somewhat ambiguous. This is generally attributed to problems in the short run, disequilibria positions. Foreign-owned plants may have lower efficiency levels because of a time-lag in assimilating new plants (either 'greenfield' or acquired) into the FDI network.[5] This may also be linked to cultural differences in the host market, which can lead to longer-term problems and productivity shortfalls. Dunning (1988, p. 232) noted that in his seminal work on US manufacturing affiliates operating in the UK in the 1950's he found that foreign owned plants often recorded lower labour productivity differentials than those of their parent plants. Dunning's subsequent work on Japanese FDI in the UK provided similar results. In his 1988 book he cites the lack of experience of management and labour attitudes as a major source of such differentials. In the original work (re-issued in Dunning, 1998), he makes reference to (a relatively small number of) US-owned plants that were acquired rather than established as 'greenfield' entrants, noting that

> "... cases of US-financed firms failing because of managerial inability to appreciate differences in the attitude of British and American labour towards incentives, and employment practices or of UK consumers to American marketing and advertising techniques, are far from being isolated. More than one subsidiary has gone as far as to claim that it only really prospered since the management had become British" (Dunning, 1998, p. 87).

Caves (1996) argues that when an MNE founds or acquires subsidiaries abroad it incurs a fixed cost of learning how things are done in that country.

> "Home-office personnel sent to run and develop the subsidiary will (for a time, at least) be less effective than at home. Foreign nationals can be hired to run the shop, but then a different fixed cost must be incurred to teach them the firm's way of doing things. Either choice leaves the potential MNE facing a virtual disadvantage in the foreign market with respect to its local competitors, who access that social and cultural milieu as a spill-over without explicit cost" (p.58).

[5] Of course, MNE's may acquire 'lemons' rather than high productivity plants (or indeed set out to buy plants to 'turn them around' – see Chapter 9 for a fuller discussion of the motivations for acquisition – but fail to improve those plants acquired).

Of course, the internalisation transaction-cost advantages of the MNE help them to overcome such intrinsic disadvantages, although Buckley (1997) argues that organisational externalities, associated (information, coordination, and motivation) costs and therefore problems of governance will be more severe in MNE's than in uni-national companies. Such costs should decline over time but there are likely to be exceptions (relating especially to idiosyncratic markets, large foreign markets, and markets with large cultural and operational barriers). Gomes and Ramaswamy (1999) go further and argue that the costs of "...coordination and control, administrative systems to manage culturally distinct markets and diverse human resources" increase significantly as the MNE expands further into overseas markets, such that they expect (and provide some empirical support for the notion) that the relationship between multinationality and performance is non-linear (becoming negative above some optimum size). Caves (1996) also noted that foreign investments are 'clearly risky ventures' and that continued expansion of past and new investments can lead to failure. Chapter 2 has already established that there has been something of a shift in investment patterns away from those culturally closest to the UK (i.e. Australia, US) and a move towards those geographically closer (European) and the South East Asian investors.

Reasons why FDI affiliates may be less productive includes the nature and type of activity undertaken in the foreign-owned plant (which can also be related to product-life cycle effects). Doms and Jensen (1998) provide the usual arguments (discussed above) as to why FDI affiliates should be 'better' but also acknowledge that foreign firms might keep most of their high value-added operations (such as R&D and newer products) at home, concentrating lower value-added assembly operations in the host nation. Thus, the use of lower-skilled workers (who are paid lower wages) and older technology will contribute to potentially lower (labour) productivity. This is consistent with the limited empirical evidence on Japanese 'greenfield' investments in the US (e.g., Blonigen and Slaughter, 1999; and Okamoto, 1999). There is also a well-established literature in regional economics (and economic geography) that deals with the branch plant economy showing that multinational and multiplant firms often operate low value-added assembly plants in (government assisted) peripheral regions (Harris, 1991). This is especially true when the market is oligopolistic and where products are in the mature stage of their life-cycle (Markusen, 1984; Harris, 1987). MNE's operating in such markets may be at a comparable stage in terms of the life-cycle of the proprietary assets they use; i.e., reflecting the depreciation and obsolescence of such assets (cf. Boddewyn, 1983).

Given this, it can be seen that whilst theoretically there more persuasive arguments supporting the fact that foreign owned plants have higher levels of productivity, there are situations where this may not always be the case. The section below now goes on to consider empirical evidence of the productivity performance of foreign owned plants.

4.3 Previous empirical evidence

Much of the empirical analysis of the impact of FDI has concentrated on establishing the strength of indirect impacts. This has been partly driven by the growth in spillover literature in relation to clustering resulting from agglomeration economies (Chapter 3), R&D and innovation (the work of Grilliches, for example), in both of which foreign owned plants are thought to have a significant role. Data limitations have also in part determined the direction research has taken and there has been little emphasis on whether foreign owned plants are demonstrably 'better' than domestically owned plants. The literature that does relate to the direct effects is reviewed in this reviewed in this Section.

Globerman *et al* (1994) considered the relative economic performance of foreign affiliates in 21 Canadian industries and found that, having controlled for capital intensity and size, there was no significant difference in labour productivity. In comparison, Aitken and Harrison (1999) measured the direct impact of FDI in Venezuela and, controlling for differences in the labour force, materials, capital and industry differences, they found a 10.5 per cent productivity advantage for foreign owned plants. More recently, Konings (2000) adopted a similar approach to that of Aitken and Harrison (*op. cit.*) to explore the impact of FDI on domestic firms in Poland, Bulgaria and Romania. Using a panel of 5,000 firms 1993-97, he found no statistically significant effect of foreign ownership on productivity for Bulgaria while for Romania the result is similar though more complex. However, the results for Poland show the foreign owned sector is relatively more productive and Konings attributes this to Poland being further down the path of transition than other eastern European countries.

Okamoto (1999) looked at the impact of foreign (specifically Japanese) ownership in the US automotive parts industry. Data was principally from the LRD[6] and Okamoto found that in 1992 while output per employee was larger for Japanese owned and joint venture establishments, the results from estimating a production function

[6] The US longitudinal respondents database; the US equivalent of the ARD.

showed that foreign owned plants were less productive (in terms of total factor productivity) than domestically owned (US) plants. This he in part attributes to the lower productivity of capital in foreign and joint ventures.

In their study of manufacturing establishments in the US, Doms and Jensen (1998) test for differences in total factor productivity between domestic and foreign ownership. Using data from the Census of Manufacturing and the Bureau of Economic Analysis FDI Survey, Doms and Jensen (*op cit*) use two measures of total factor productivity; firstly, TFP calculated from the residual of a value-added Cobb-Douglas production function, which indicates that foreign owned plants are 3.7 per cent more productive. Following Baily *et al* (1992), the authors also estimated TFP calculated using a growth accounting method and this showed that foreign affiliates were overall 2.3 per cent more productive.

Turning to studies specifically of FDI in UK manufacturing, there have been only a few; however, the studies that have been carried out have mostly found foreign owned plants to be more productive than their domestic counterparts. Davies and Lyons (1991) estimated the productivity difference between foreign affiliates and domestic firms to be around 20 per cent, in favour of the foreign investor. In a paper principally looking at the indirect employment effects of FDI in the UK, Driffield (1999) cites an average productivity gap of at least 14 per cent between the foreign owned sector and domestic plants.

In terms of micro-data studies, in an early use of the ARD considering the motor vehicles sector, Collins and Harris (1999) found that foreign owned plants were between 21 and 26 per cent more productive than domestic plants. Oulton (1998) looked specifically at the UK economy for 1995, testing to see if labour productivity differed between companies because of differences in input intensity or access to technology. He points out that such differences within any industry may be integrally linked to the differing characteristics of foreign owned companies. In measuring labour productivity, Oulton controlled only for industrial composition and found that US owned manufacturing companies were 26 per cent more productive (and other foreign owned companies were 14 per cent more productive) than UK companies. Interestingly, this differential is even more pronounced in non-manufacturing sectors (34 and 31 per cent higher, respectively). These differentials are attributed to easier access to cheaper capital markets, higher levels of capital intensity and a greater awareness of best practice techniques for foreign owned companies.

Finally, Griffith and Simpson (2000) provide an investigation of productivity differences between domestic and foreign owned manufacturing plants in the UK. Also using the ARD they consider both labour and total factor productivity for the period 1980-96. Their results imply that foreign owned establishments have considerably higher labour productivity (this varies from subset to subset between 30 and 50 per cent higher) than domestically owned plants. However, when they estimate total factor productivity relationships they find foreign owned plants have a much lower TFP than domestically owned plants (between around 10 and 56 per cent lower).

4.4 Chapter summary

This Chapter has outlined the potential (productivity) benefits for foreign firms wishing to enter another economy. These revolve essentially around the work of Hymer (1976) and Dunning (1958; 1998), looking at firm specific assets and form the basis for the general assumption that foreign owned plants within a domestic environment are more productive than their domestic counterparts. As such it can be seen to be grounded in the resource based model of the firm (Teece, 1996). This chapter reviewed some of the empirical evidence of this, and also highlighted the instances where this assumption might not hold, particularly in relation to cultural and institutional barriers to assimilation of brownfield plants. However it does seem clear that the productivity benefits that are largely assumed to stem from the presence of foreign owned firms in domestic economies have not been universally proven by the empirical analysis and therefore warrants further investigation.

A hypothesis that this thesis aims to test is that foreign owned firms are *always* more productive than domestic plants, regardless of the industry and nationality of ownership. Certainly the evidence reviewed above indicates that further analysis could shed light on the matter. The approach to be used in testing this hypothesis is formerly described in Chapter 6; however, firstly the theoretical arguments that underlie the other hypotheses to be tested are considered.

Chapter 5:

The indirect effects of foreign direct investment

5.0 Introduction

The literature relating to the motivation for foreign direct investment and the impact that it has directly on productivity levels has been reviewed in Chapter 4. The reasons explaining the benefits to FDI and why they are likely to be more productive than domestic plants were also discussed. In this chapter, the indirect effects of FDI are considered; these are essentially the improvements in domestic firm productivity that stem from the presence of foreign owned plants.

The concept of spillovers is often considered a motivation for policy initiatives to encourage FDI (Wren and Jones, 2003). The purpose in this chapter is to clarify the disparate literature relating to spillovers, which ranges from the discipline of economic geography, covering issues such as technological change and agglomeration to industrial economics, to the literature on international economics. Firstly, a discussion of the definition of spillovers is provided; how spillovers may be measured and to whom the benefits are likely to accrue is then considered. Therefore the literature reviewed in this chapter follows on from the discussion in Chapter 3 of location decisions and externalities as well as issues discussed in Chapter 4.

5.1 Theory of spillovers

Much of the literature on spillovers is derived from the work on R&D spillovers. Griliches (1992) reviews the concept of spillovers from research and development (R&D) and therefore spillovers are considered in a more generic sense, from (the R&D of) any firm to (the R&D of) any other firm and within the context of contributing to aggregate GDP growth. This links to the issue of innovation and its diffusion. Griliches argues that new growth economics emphasises the role of significant externalities (including spillovers) and other sources of increasing social returns for the future of growth. "True spillovers" he argues "are ideas borrowed by research teams in industry *i* from research results from industry *j*", which he points out are not especially related to input purchase. Clearly a number of issues raised at the generic level are relevant for the special case of FDI but there are reasons for assuming that spillovers from FDI are likely to be greater than from domestic plant to domestic plant, given the presence of firm specific advantages (discussed in Chapter 4) and these are addressed below.

When entry of foreign firms to a market takes place, there are thought to be direct productivity effects, through the increase of the demand for labour and the injection of capital, which has benefits wider than the productivity improvements in one industrial sector, to the economy as a whole. These benefits were discussed in some detail in the previous chapter, but may be generally referred to as 'the batting average effect' (Barrell and Pain, 1997). In addition to this direct effect there are potential benefits that spill over from MNCs more indirectly, to domestic firms and the local population. Put formally, firm-specific advantages are not fully internalised, thus there are uncompensated benefits that leak from the MNC into local industry, to its upstream and downstream customers and suppliers and to the region in which it is based. Such 'spillovers' (both in terms of transfers of technology, especially to suppliers, and in terms of upgrading skills in the local labour market as workers transfer between firms) clearly can benefit domestic plants[1] especially in industries that have high levels of spatial concentration (i.e., through a clustering effect – see Cantwell et al, 2001) and were touched upon in relation to regional agglomeration effects in Chapter 3.

Within the FDI literature, McDougall (1960) was the first to include spillovers when trying to measure the full welfare effects of FDI (cited in Blomstrom and Kokko, 1998). Since then, many studies have been undertaken, in many countries at the aggregate level, at the industry and in case studies at the company level. The majority of literature on spillovers from FDI is empirical, though attempts have been made to provide a more rigorous theoretical definition and framework (*c.f.* Kugler, 2001). Fundamentally though, spillovers seem to suffer from a definition problem. The term 'spillovers' has been used in much of the literature as a cover-all term, to pick up the *perceived* residual benefits (externalities) from FDI which accrue to indigenous firms and for which foreign firms are *uncompensated*, raising the overall level of productivity. As such there is the danger that the measurement of spillovers is the result of mis-measurement of the production function.

A review of the spillover literature by Blomstrom *et al* (2000) attempts to identify the determinants and provides a thorough overview of the issues and ambiguities. Spillovers are generally regarded as positive but can be negative, especially in the

[1] For example, Barrell and Pain (1997) showed that FDI had a significant spillover impact on technical progress in UK manufacturing.

short run as the competition effect crowds out domestic plants and as they lose market share to the new (more efficient) entrant (Aitken and Harrison, 1999); whether this happens or not will be largely determined by the market structure prevailing.

Spillovers[2] are traditionally expected to accrue to the industry the multinational enters, whereby local firms are motivated by competition to improve their productivity (intra-industry spillovers). This may also be due to the belief that firm's with similar outputs and activities are most likely to access the MNCs (firm-specific) technology and make use of it. Kugler (2001) and others have argued that generic rather than industry-specific know-how is more likely to spillover, particularly as best-practice foreign plants acquire, supply to and demand from domestic plants, up- and down- stream in supply chains.

It can be seen that the labour market is a key transmission mechanism. Spillovers are said to arise from foreign-owned firms paying higher wages (*inter alia*, in return for higher productivity). This is due to labour turnover, technology driven training, not only in the production process but also at the management level. Over time as a result of FDI, domestic firms will acquire information on the latest technology, employ (FDI) trained staff who can imitate, implement and operate it and adopt organisational techniques that improve their performance (e.g. the introduction of TQM occurred primarily from Japanese firms). Driffield (1999) however, provides some evidence to show that this can lead to above-average wage levels and consequently a reduction in domestic employment. Driffield and Taylor (2001) have

[2] Much of the literature discusses 'knowledge' or 'technology' or 'R&D' spillovers, all spillovers are assumed to be productivity spillovers but arise from various sources.

also argued that the relative employment position may be made worse by the entry of MNCs since they increase the demand for skilled labour to the detriment of unskilled workers which clearly has distributional consequences. In this way, FDI might be regarded as being skill biased.

In addition to the labour market effect, there is a substantial body of literature that considers the agglomeration effect of spillovers. As discussed in Chapter 3, the role of agglomeration economies may be a significant determinant of location. Cantwell (1991) states that agglomeration economies will accrue not only to domestic but also to foreign firms since agglomeration economies are more likely to be particularly strong in high technology industries. Audretsch and Feldman (1996) suggest that spillovers are location specific and likely to decline the further away the domestic firm is from the MNC. Girma and Wakelin (2001) highlight the fact that labour mobility (certainly in the UK) is generally low, thus restricting the diffusion process through the churning of labour to the local region. They also point out that the demonstration effect, whereby local firms may be able to imitate MNC production is very regional in nature. Finally, they state that forward and backward linkages are likely to be local to minimise transportation costs, therefore any spillovers to these sectors are likely to diminish over distance.

Much of the literature focuses on the dispersion of benefits *after* the MNC has located. Kugler (2001) points out that in making an international location decision, *ceteris paribus*, multinational companies are likely to choose to locate where dissipation of monopoly rents from its firm-specific asset are at a minimum. That is, in locations where there is little chance of imitation, paying efficiency wage rates such that the rate at which technology leaks is slow enough to ensure that sunk costs of entry are covered. Kugler (*op cit.*) goes on to suggest that there is much greater potential for spillovers in the forward and backward linkages, in suppliers and customer relations than within the (highly competitive) industry in which the MNC operates. He attributes this to a desire within the MNC to improve the quality of its inputs and to court its customers. He argues that these inter-industry spillovers are also more likely to be generic rather than industry specific.

Market structure has also been recognised as being an important influence on the level of spillovers, not only in terms of the market the foreign affiliate is entering and operating in, but also in terms of upstream and downstream markets (Markusen and Venables, 1999; Matouschek 2000). Matouschek (*op cit.*) argues that spillovers will manifest themselves as local downstream firms improve the quality of their inputs to foreign and domestic owned firms alike. These spillovers will only emerge if the MNC chooses an appropriate supplier arrangement to encourage competition in the downstream sector. Kokko (1994) argues that spillovers are less likely to occur in highly differentiated product markets. However, this is complicated by the causality uncertainty that exists in relation to concentration and multinational presence (discussed in Chapter 3). Blomstrom and Kokko (1998) argue that it appears as though MNCs are drawn to concentrated industries but do not cause them, however their chief criticism is that much of the literature focuses on entry rather than (longer term) presence. Therefore, the nature and the level of spillovers are likely to be highly industry specific and therefore warrant detailed study, at least at the industry level.

Blomstrom *et al* (2000) consider spillovers within a supply and demand framework initially implicitly developed by Cantwell (1991). In it, they consider the costs of foreign owned firms 'supplying' technology being inversely proportional to the level of spillovers to be expected. They consider the cost of adoption by the host country firms and suggest that these are also inversely proportional to the level of spillovers. So, when technology is costly to protect then foreign owned firms are more likely to make it available and when its costly to acquire, host firms are less likely to seek it. This links to the recent literature on the 'absorptive capacity' of domestic firms within the resource based model. Blomstrom *et al* (2000), Kugler (2001) and Kinoshita (2001), also acknowledge the importance of the characteristics of the domestic firm, the greater the 'technology gap', the less chance that domestic firms have the ability to adopt the new technologies and techniques. Others have argued, the greater the gap, the greater the positive spillover could potentially be (Kathuria, 2001)[3].

It is interesting to note also that studies on developed countries generally find a positive relationship between foreign presence and productivity but the results for less developed countries is more mixed. Blomstrom *et al* (2000) highlight that this may be a problem with the absorption of technology – a *capabilities gap* between the foreign and the indigenous firms. Thus spillovers should be more easily captured when there is a high degree of complementarity between the host and the foreign firm. In addition to this reasoning, recent work by Driffield and Love (2003) points to technological sourcing as a major rationale for entry into a foreign market, particularly in the case of FDI taking place between industrialised nations. By this,

[3] However, Kathuria qualifies this by stating that firms need to possess R&D capabilities.

they mean that firms wishing to gain access to leading-edge technology within host country firms. They find evidence supporting the idea that spillovers work in the opposite direction in the case of the UK – from host to foreign plant, in some cases.

From the literature discussed above, it can be seen that the sources of spillovers are numerous, and measuring mechanisms not easily identifiable. In an attempt to improve on existing definitions, Table 5.1 summarises the sources of spillovers, their transmission mechanisms, and, acknowledging that not all spillovers have a positive impact, the possible impact that they may have on productivity levels. This is not exhaustively representative of all possible sources of spillovers, but it provides a clear overview of some of the key mechanisms in relation to foreign owned firms. In particular, it can be seen from Table 5.1 that three broad areas of transmission mechanisms are identified; intra industry spillovers, within the same product markets; inter industry spillovers, up and down the same supply chain and agglomeration spillovers, which operate on a geographic level.

Table 5.1: Typology of Spillovers

Transmission mechanism	Effect	Likely Impact
Intra-industry		
Demonstration effects	Imitation of FDI products and processes; licensing of new technology	+ive
(c.f. Girma and Wakelin, 2001)	Difficulties in absorption of new technology due to lack of technological complementarities	-ive
Competition effects	Reduction in costs/inefficiency in order to respond to entry (threat)	+ive
(c.f.Aitken and Harrison 1999)	FDI market share pushes domestic firms up their average cost curves	-ive
Labour Market	Hiring of FDI-trained staff with improved human capital.	+ive
(c.f.Driffield and Taylor, 2001)	Domestic firms mismatch between current capabilities and human capital of FDI-trained staff	-ive
Inter-industry		
Forward linkages	Technology transfer and/or new management practices (HRM/JIT) to upgrade quality/lower cost of products demanded by upstream FDI	+ive
(c.f. Markusen and Venables, 1999; Kugler, 2001)	Difficulties in absorption of new technology/practices; less efficient domestic firms are 'crowded-out'.	-ive
Backward linkages	Purchase of improved intermediate products; technological upgrading of own products	+ive
(c.f.Markusen and Venables, 1999; Kugler, 2001)	Difficulties in absorption of new technology/products; rising costs of domestic suppliers (due to FDI competition) are passed-on	-ive

Transmission mechanism	Effect	Likely Impact
Agglomeration		
Labour Market	Pool of FDI-trained workers available to local labour markets; increase in entrepreneurial activity (new firm formations)	+ive
(c.f. Driffield,1999)	'poaching' of better staff to FDI (higher pay and career development offered); upward pressure on wage costs	-ive
Infrastructure	Access to greater range of business services (especially R&D which is attracted to service FDI); intra/inter-industry effects stronger in cluster (diminish over space); minimisation of transport costs	+ive
(c.f.Audretsch and Feldman, 1996; Taylor and Wren, 1997)	Higher costs (e.g. premises); congestion; 'crowding out' due to FDI competition for local resources	-ive

A criticism that may be levelled at the literature on spillovers is that it falls short of offering a robust theoretical framework for empirical research. It appears that spillovers may be knowledge or technologically based, they may occur through the labour market via skill enhancement, at the regional level and/or within the same industry or beyond through backward and forward linkages. They probably increase over time, probably vary, depending on the nationality of the MNC and their magnitude is likely to depend on the 'absorptive capacity' of domestic plants and so is likely to vary across regions and industries. In addition, there is no indication that one sort of spillover will be any more important than any other will. Ultimately, in measuring spillovers, estimation aims to capture the diffusion of the frontier technology, which operates through foreign direct investment. Despite these problems in pinpointing what is captured when measuring spillovers, there is general agreement that they exist and result in higher total factor productivity for domestic plants, however, capturing this effect in a production function framework is difficult.

5.2 Empirical evidence of spillovers

Spillovers have attracted much attention in the academic literature on FDI because they are often cited as a rationale for a pro-active inward investment policy (Taylor and Wren, 1997; Girma and Wakelin, 2001). Spillovers, along with all the direct effects of FDI are seen as being particularly important within a regional context, where Taylor and Wren (1997) have estimated that over 40 per cent of RSA funding was invested in foreign owned plants. Based on the arguments presented in Section 5.1, the *a priori* assumption is that spillovers generate positive effects over and above the direct effects of employment and capital investment. Empirical evidence however, is not as conclusive as the discussions surrounding spillovers would suggest. Much of the ambiguity is attributed to different approaches and measurement problems but it seems apparent from the literature that positive spillovers are by no means a certainty.

A body of empirical work on spillovers has focussed on the aggregate impact on labour productivity. This is primarily due to data limitations prohibiting plant level TFP measurement, though recently the availability of micro datasets such as the LRD and the ARD has resulted in studies that have sought to identify spillover impacts on the *total factor* productivity. There are broadly three methodological approaches to spillover measurement. Firstly, there is the case study approach. This allows for in-depth comprehensive coverage with relatively accurate firm specific estimates of the importance of MNCs to changes in productivity of local firms. Whilst still very difficult to pinpoint, the most obvious draw-back to this approach is that such spillovers will not necessarily translate to other situations or industries, thus a useful but very situation-specific (either region or industry or firm) lesson is learnt. Secondly, research has focussed on changes to aggregate productivity as a result of spillovers from inward investment, using an aggregate approach (eg Driffield, 2001). The principal problem with such an approach is that it is difficult to separate the spillover effects from the effects of the characteristics that multinationals possess. The third method involves estimating plant or firm level (total factor) productivity over time. The drawbacks of this approach are the sheer data requirements, and also problems of endogeneity and missing variables, although econometric techniques may be employed to correct for endogeneity problems (see Chapter 6). This sub-section will concentrate on providing evidence of the last two approaches.

5.2.1. Intra-industry spillovers

Much of the empirical work has focussed on intra-industry spillovers, benefits that accrue to domestic plants within the same industry as the MNC. This would include the labour market effect of increasing the skills in the workforce available to local firms and aiding the diffusion of knowledge, for example. Egger and Pfaffermayr (2001) look at the impact of FDI on labour productivity in Austria. They find 'a significant overall (neutral) impact of FDI'. Kathuria (2001) examined 26 sectors of Indian manufacturing, 1975 and 1988 using a stochastic frontier production approach to test for spillovers. Kathuria (*op cit.*) finds that for 'scientific firms' that engage in R&D activity, there are significant positive spillovers. Aitken and Harrison (1999) consider the case of Venezuela and how far its domestic firms have benefited from the presence of foreign firms. Using a plant level panel data set covering 1976-1989, they find that whilst with small plants (less than 50 employees), positive technology spillovers to seem to occur, in the sector as a whole the spillover effect is significant but negative. This suggests there is significant variability amongst those who can absorb spillovers and they seem to be the smallest firms.

Kinoshita (2001) looks at the manufacturing sector in the Czech Republic using a growth accounting framework over the period 1995-1998. In this paper, Kinoshita considers the extent of technology spillovers and finds evidence of catch-up over the period between the domestic and foreign firms productivity levels. This he attributes to technology spillovers, particularly in the electrical machinery and radio and TV industrial sector. Blomstrom and Sjholm (1999) look at technology transfer in Indonesia, and find that technology spillovers to productivity do not seem to be influenced by the level of foreign direct investment and spillovers accrue to domestic plants that do not export. They conclude therefore that the spillovers stem more from the competition effect rather than ownership sharing. Girma et al (2001) use data for UK plants for 1990-1995 find labour productivity to be 10 per cent higher and TFP around 5 per cent higher.

It is also argued that firms with low technology gaps can benefit from FDI presence regardless of other characteristics of the sector. Testing for intra-industry spillovers, Girma et al (*op cit.*) find none, concluding that financial support for foreign owned firms on the basis of spillovers may be misguided. Driffield and Taylor (2001) use a panel of UK manufacturing 1983-1992 in order to test if spillovers from FDI have had a negative impact on the skills structure by shifting demand for labour away from unskilled to skilled labour. They also find evidence supporting the Blomstrom *et al* (2000) assertion that spillovers are greatest when the technology gap is smaller. Their approach specifically considers the impact of FDI spillovers on labour demand, and not on productivity.

5.2.2 Inter industry spillovers

Studies have also considered the potential for inter-industry spillovers as a determinant of net entry into economies. Gorg and Strobl (2001) consider the effect foreign presence has on the entry rate of indigenous firms in Ireland, taking into account the positive linkage effects developed by Markusen and Venables (1999). They find that MNC presence has a strongly positive effect on the entry of firms into the Irish economy, although they model *net entry*, thus it can only be considered indicative evidence of spillovers. However, they present persuasive arguments in support of the positive effect FDI has on firm entry, indicating backward and forward linkage spillover potential.

Kugler (2001) Considers the Colombian manufacturing sector and using plant level panel data from 1974-1998 finds intra-industry spillovers are only significant and positive within the machinery and equipment sector. His main finding, however, is that the inter-industry spillovers are much more prevalent than those traditionally looked for within the industry. He argues persuasively that competitive pressures between firms within industries mean that the real potential for spillovers lies in the upstream and downstream linkages within the product chain.

5.2.3 *Localisation of spillovers*

There is a wide body of literature on agglomeration in economic geography, some of which has been discussed in Chapter 3. Spillovers are less likely to be the result of input-output linkages as highlighted above (which may be regional) but are more likely due to the external economies associated with infrastructure and labour market effects. As such, it is more likely that agglomeration spillovers will be the result of the more general level of FDI in a local area rather than industry specific levels. Barrell and Pain (1997) look for an agglomeration impact from FDI within Europe and find that a 1 per cent rise in the real stock of inward investment raises national technical progress by 0.18 per cent. Their approach however does make it difficult to say with certainty that this is purely the result of spillovers.

Girma and Wakelin (2001) adopt a semi-parametric approach to measuring agglomeration spillovers using the ARD for the UK electronics industry. In their paper, they find spillovers from Japanese MNCs in particular to represent a significant short run positive impact on productivity (A 10 per cent increase in Japanese FDI leads to a 2.5 per cent increase in productivity) but this return to spillovers is lower for plants located in assisted areas. This indicates that the regional differences are significant in the UK which suggests that policies encouraging MNCs to locate in assisted areas is not always the way to derive maximum spillover benefit.

5.2.4 *Evidence of spillovers in UK manufacturing*

Whilst some of these articles have been reviewed above it is perhaps useful to focus on the findings for the UK specifically. Girma and Wakelin (2001) for example do find a positive impact of Japanese investment in the electronics industry in the UK. Driffield and Taylor (2001) in their study of skills composition, also note evidence of positive spillovers from FDI. Girma, et al (2001) in their study of labour productivity also find some evidence of a positive spillover. Barrell and Pain (1997) estimated that FDI accounted for 30 per cent of the increase in productivity between 1985 and 1995.

Recently, Driffield and Love (2003) have found there to be evidence of spillovers in the opposite direction (i.e. from host firms to foreign entrants), supporting the technology sourcing theory for FDI. Specifically related to the work in this thesis, Haskel, *et al* (2001) used the ARD data to consider the impact of FDI on domestic plant productivity for the purposes of determining whether the financial support policies applied are generally justified. They consider foreign ownership in the UK over 11 regions and 22 2-digit industries. Whilst they do find spillovers to be positive and significant (a 10 per cent increase in foreign ownership leads to 0.5 per cent increase in domestic plants TFP), they demonstrate that the benefits from FDI may not always outweigh the substantial costs. The econometric approach adopted does not perhaps adequately deal with problems of missing variables or endogeneity and arguably, there may be problems with the level of breakdown for the measurement of regional spillovers. However, their study provides some cause for concern regarding the overall impact of spillovers in the UK context for the period considered here.

Driffield (2000), using an aggregated approach elsewhere estimates the impact of FDI at the inter- and intra- regional level and the inter and intra industry effect for

UK manufacturing 1984-1992. Using several different measures of foreign investment, he finds that there are productivity spillovers from FDI but very small ones, which only occur at the local level. In addition, his results indicate that there are negative spillovers at the industry level, in line with the results for Venezuela in Aitken and Harrison (1999).

It can be seen therefore that whilst an abundance of empirical research has been undertaken to determine the size and potential for spillovers from FDI, the results are not conclusive. In part this may be explained by differences in measurement techniques and variables and in part by different experiences in different countries, but the experience of the UK is no less diverse.

5.3 Conclusions

From the review of the literature above, it can be argued that there are two fundamental issues presented in the current literature; firstly it is apparent that testing for spillovers preceded the development of a strong theoretical rationale for their existence. Despite this, the common sense appeal of the argument in favour of positive spillovers from the presence of FDI is strong. Not only is it strong, but the perceived importance of spillovers has in the past been strong enough to persuade governments to invest significant amounts of public money in attracting FDI purely on the promise of spillovers to local firms and industry. However, looking to recent empirical studies there is less than categorical support for their existence, and this is true in the UK as much as anywhere else. Given this, there are clearly empirical uncertainties that provide reasons for the following hypotheses to be explored further.

5.4 Hypotheses to be tested

Given the current state in the literature, and having identified a number of shortfalls or areas for further research, the following hypotheses build on those put forward in Chapter 3:

- Productivity spillovers from FDI to domestic plants exist within industries in UK manufacturing;
- Inter-industry spillovers exist, are generally positive and larger than intra industry spillovers, and finally
- There is a strong regional dimension to spillovers in UK manufacturing.

Chapter 6:

Productivity analysis and dynamic panel data models

6.0 Introduction

In the previous two chapters theoretical and empirical considerations in relation to the direct and indirect impacts of FDI on productivity have been outlined. In this chapter the methodological approach adopted in the subsequent empirical section is reviewed. Firstly, there is a discussion of the benefits of panel data over time series and cross sectional data and on its usefulness in productivity analysis. The theoretical basis for the production function is discussed as well as the restrictions that theory and methodologies impose. The general modelling approach adopted is then presented. In short, this chapter provides the methodological framework of analysis for the testing of the hypotheses presented in earlier chapters.

6.1 Dynamic Panel Data

The specific benefits relating to the ARD, in terms its richness for analysing firm/plant behaviour over time in UK manufacturing have been discussed at some length in Chapter 1. This section concentrates on the benefits of panel data more generally, from the perspective of explaining econometrically specified relationships. Panel data differs from cross-sectional and time series data in that it pools observations on the same cross sectional units over several time periods and thus combines both dimensions (see Baltagi, 2001, for a full discussion). One of the advantages of these data is that they provide much more information on the nature and form of relationships over time, which is essentially what economic analyses try to capture.

The use of panel data makes it possible to test theoretical issues in far more detail than either time series or cross-section data allow. With panel data it is possible to control for heterogeneity across plants and across time, which provides variability in the data, reducing problems of collinearity and increasing the degrees of freedom, which improves the results of the estimation. The real advantage of panel data is contained in its ability to explain dynamic processes through time, and indeed adjustment processes to economic or political changes. It enables the consideration of changes that occur to a *single individual unit* over time, thus allowing for other things to be held constant, and can control for unobservable effects. This is particularly useful when research is focused on long run economic relationships. Indeed, the data enable the construction of more sophisticated models of behaviour than either time series or cross sections allow.

There are however a number of problems and complications, not least in the data collection process, but also problems in relation measurement errors and issues relating to selectivity within the sample. In the case of the ARD and its use in this study, the issue of selectively is dealt with through weighting the data[1]. A particular problem for the ARD and other panels is continuity over time due to the attrition of plants and firms, which can lead to distortion in any analysis carried out for an unbalanced panel over time (there is the danger that the 'snapshot' captures mostly

[1] The weighting procedure employed is detailed in Chapter 1 and the necessity for weighting is discussed in more detail in subsection 6.4.2.

winners if only a balanced panel were used). In other datasets, there may be complications relating to non-response or interview biases, though in the case of the ARD, the compulsory nature of the questionnaire and fairly factual design and data requests mean that there is less scope for misinterpretation of questions and requirements than is the case in more qualitative and subjectively structured questionnaires.

A whole body of literature discusses at some length the nuances of variants of panel data analysis (Pesaran and Smith, 1995; Pesaran *et al*, 1999), and the different approaches that may be applied to variations in N (number of plants/firms/individuals) or T (time period of the dataset). In addition, though panel data has all the advantages of the combined power of cross section and time series data, it also has many of the problems associated with both. Notably it is important to take account of the time series properties in panels that cover long periods, and hence to test for cointegration (Pedroni, 1999). These issues insofar as they relate to this thesis are discussed in more detail in section 6.3. The following sections, however, provide a discussion of productivity analysis, the merits of panel data in its estimation and the most appropriate method of analysis for the ARD.

6.2 Productivity analysis

Productivity is of interest at all levels of economic analysis; macroeconomists are interested in productivity as an indicator of (divergences in) economic growth; for example, economists may use productivity differences between countries as a yardstick of international performance (O'Mahony and Robinson, 2003). At the national level, comparisons are made across sectors and between aggregate market sectors such as the service and manufacturing sectors (O'Mahony and Robinson, *op cit*); and at the microeconomic level (as in this case), there is considerable interest in the differences between plants that are more or less productive. It also enables researchers to explore a range of issues more indirectly related to the production process; for example, researchers may want to test for the presence of economies of scale in production (Griliches and Ringstad, 1971), or whether productivity differences are related to the quality of the labour input (Griliches, 1964). For these reasons, productivity analysis is one of the fundamental topics in applied economics.

However, as Hulten (2001) points out, at the macroeconomic level, productivity is not a deeply theoretical concept, but is rather an implicit part of the circular flow of income model. Productivity, in its simplest form, may be defined as the ratio of output to a fixed level of input(s). Over time, countries, industries and plants would expect or hope to see improvements in the amount of outputs for a given level of inputs, chiefly as a result of technical progress or improvements in efficiency. Frequently, productivity is referred to in the context of labour productivity, particularly for policy purposes. Labour productivity is calculated as the output, or value added per unit of labour (per head, for example). This provides an index across plants, countries or time that can be compared to provide a proxy for technical progress. However, labour productivity, while useful, is only a partial measure of efficiency and technical change and sub-section 6.4 explains in more detail why this is the case and why the more holistic total factor productivity measure is to be preferred as a means of capturing technical change.

Productivity differences (be they labour or total factor) at the plant level are of interest here for three reasons (and linked to the hypotheses to be tested):

1. If we observe differences between plants that are foreign owned as compared with domestically owned, can we say that foreign owned plants are 'better' in a productive capacity sense?
2. Whether we observe these differences or not, on the basis of these findings, can we say that the national economy (in the form of domestically owned production units) benefits from their presence?
3. If differences are observed, is it a result of plant specific characteristics or a function of ownership specific characteristics?

In this way, productivity analysis can offer considerable insight into the impact of foreign ownership in UK manufacturing.

6.2.1 The production function

Within a theoretical framework, productivity is derived from the production function. The production function specifies the precise nature of the relationship between inputs and output; i.e. how inputs need to be combined and in what quantities, for outputs to be produced. Typically, these are described in relation to combinations of two inputs – capital (K) and labour (L) combining to produce output (Q). Whilst there are a number of specifications that vary in their assumptions of elasticities of substitution between the inputs, the most common empirically estimated functional forms are the Cobb-Douglas (discussed in greater detail below), constant elasticity of substitution (the CES) and the transcendental logarithmic (translog). The CES and the translog are the more flexible functional forms, however they contain a large number of parameters, which makes them difficult to estimate when using more sophisticated econometric techniques, particularly in relation to the method used here. Therefore, many applied industrial economics studies use on the more restrictive Cobb Douglas function, which takes the form:

$$Q = cL^{\alpha}K^{\beta} \qquad (6.1)$$

which can be represented in logs as

$$\ln(Q) = \ln(c) + \alpha \ln(L) + \beta \ln(K) \qquad (6.2)$$

Thus the Cobb-Douglas production function has the useful property that it is linear when estimated in log form. Therefore, the coefficients α and β represent the output elasticities and when summed, provide an indication of the returns to scale.

Cobb and Douglas (1928) initially developed the framework with a view to analysing marginal productivity and labour market competitiveness in the 1920s within a macroeconomic environment. However, it has since been applied more successfully to the microeconomic environment. The first successful estimation of a production function was carried out in the 1940s using micro economic data of the agricultural sector (Tintner, 1944, cited in Griliches and Mairesse, 1998).

There are, however, two main problems with this approach; simultaneity (or endogeneity) and particularly in the case of micro-data, heterogeneity. The problem of simultaneity stems from the fact that input and output decisions within the same period are not wholly independent from one another (moreover, input decisions regarding capital, labour and intermediate goods are likely to be interdependent). This may most simply be dealt with using a simultaneous equation system approach. However, this does not allow for the correction of the second problem of heterogeneity amongst the individual units in the panel.

Problems of heterogeneity are concentrated in the error term. In the case of aggregate estimates of production functions where data are time series only, this is not directly a problem[2]; however in the case of panel data, with a large number of individual units in each cross section, individual effects as well as time effects are located in the error term, along with pure (white noise) error. In other words, there are two sets of subscripts on the error term, both t – time effects and i – individual effects. This is shown in equation 6.3.

$$U_{it} = \eta_i + t_t + e_{it} \qquad (6.3)$$

where the error term (U_{it}) is composed of unobservable individual (plant) effects (η_i), an effect which influences all plants in the time period (t_t) and the remaining error term (assumed to be normally distributed with a zero mean), e_{it}. The individual plant effects are assumed to be time invariant since they relate to individual characteristics that do not change over time. Unless this unobservable plant heterogeneity is taken into account, estimation will result in biases. One possible method for dealing with the heterogeneity is to estimate the equation in first differences. In this way, the equation only captures the marginal change over time, netting out all fixed effects. There is also a problem if e_{it} is serially correlated, such that:

$$e_{it} = \eta_i + t_t + \rho e_{it-1} + u_{it} \qquad (6.4)$$

where u_{it} is uncorrelated with any other part of the model, and $|\rho| < 1$. Under such conditions, the production function may be transformed into a dynamic form again, involving first-order lags of the variables and a well-behaved error term (see also Griffith, 1999, equations 6-8).

[2] However, aggregated production functions are criticised because the level of aggregation in and of itself results in inaccurate estimations, assuming a single production process for all goods. Therefore, micro data are to be preferred, where available.

However, in the context of micro data, using a fixed or random effects model does not allow for correction of the simultaneity biases, referred to earlier. To allow for the potential of endogeneity (simultaneity) within the production function, the Generalised Method of Moments (GMM) approach may be adopted. The initial GMM estimator was developed by Arellano and Bond (1991) and was a two-step instrumental variable (IV) procedure based on exploiting moment conditions within the specified relationship. Arellano and Bover (1995) developed a unifying GMM framework for efficient IV estimators for dynamic panel models. More recently, Blundell and Bond (1998) have extended the earlier work by Arellano and Bond and developed a GMM systems estimator. They show that the coefficient on the lagged dependent variable is likely to be biased upwards, which scales the estimated coefficients on the instrumental variable towards zero, and thus the instrumental variable estimator performs poorly. They attribute this poor performance to the problem of weak instruments. By exploiting the additional condition of mild stationarity, the GMM estimator may be extended to a system.

The GMM systems estimator combines instruments in levels for equations in differences with instruments in differences for equations in levels (Arellano, 2003 p.111). Blundell, Bond and Windmeijer (2000) argue that by exploiting the additional moment conditions and including both lagged levels and lagged first-differenced instruments leads to significant reductions in finite sample bias. This estimator is therefore generally recognised as the most efficient mechanism available for estimating specified relationships using panel data with large N and reasonably large T[3].

[3] Alternative procedures have been developed for panel data where the time dimension is large, but the number of observations is relatively small (Shin, Pesaran and Smith, 1998).

6.2.2 Estimating Total Factor Productivity (TFP)

Turning now to the formulation used in the analyses in subsequent chapters, using the ARD, plant-level TFP for plant *i* in period *t* can be measured using a standard production function approach. Taking a simple Cobb-Douglas specification (as in 6.2) and using a logarithmic specification:

$$y_{it} = \alpha_0 + \alpha_E e_{it} + \alpha_M m_{it} + \alpha_K k_{it} + \alpha_T t + \varepsilon_{it} \qquad (6.5)$$

where *y* refers to the logarithm of real gross output (in 1990 prices)[4] in plant *i* in time *t*; *e* refers to the logarithm of average employment in plant *i* in time *t*; *m* refers to the logarithm of real intermediate inputs[5] in plant *i* in time *t*; and *k* refers to the logarithm of plant and machinery capital stock[6] in plant *i* in time *t*. The elasticities of output with respect to inputs (α_E, α_M, and α_K) can be used to calculate measures of TFP as:

$$\ln TFP_{it} = y_{it} - \alpha_E e_{it} - \alpha_M m_{it} - \alpha_K k_{it} \qquad (6.6)$$

Incidentally, as an alternative to econometric estimation, a common approach to obtain estimates of α_E, α_M, and α_K is not to estimate the production function but to use cost shares for each factor input (i.e. the ratio of the cost of each input – such as the total wage bill – to total costs, following the growth accounting type approach; Jorgenson et al, 1987). There are two major difficulties with the cost share approach: (i) data are needed on capital costs (the 'user' cost of capital) and this is not generally available; and (ii) the approach usually implies that the sum of factor input shares in total revenue generated equals 1 (the adding-up condition), which is only consistent with constant returns-to-scale, technology and perfect competition in factor and output market. These restrictive assumptions are in many situations too limiting to

[4] Using 4-digit 1980 SIC price deflators for outputs to obtain real values for gross output.
[5] Using 4-digit 1980 SIC price deflators for inputs in this instance.
[6] Updated from Harris and Drinkwater (2000).

yield meaningful results though have been particularly usefully applied to detecting ICT impacts on productivity (O'Mahony and Robinson, 2003), in situations where econometric approaches have failed[7].

The dynamic counterpart to equation (6.5), augmented to include other factors affecting the production process (discussed in greater detail in each of the empirical chapters), can therefore be estimated using the GMM systems approach available in DPD98 (Arellano and Bond, 1998), since this approach is sufficiently flexible to allow for both endogenous regressors as discussed above, through the use of appropriate instruments, and a first-order autoregressive error term. In addition to DPD98, other statistical packages have also begun to include routines within their standard packages, including PCGive and STATA.

In addition to the standard production function, additional explanatory variables are included to capture the various effects of foreign ownership. Rather than estimating equation 6.5 and then decomposing into what determines TFP using a second regression (a la Black and Lynch, 2001), it is more efficient to estimate directly the factors affecting TFP in the extended production function framework. These additional variables and the exact specifications estimated are discussed in greater detail in the subsequent empirical chapters.

All data are weighted to ensure that the samples are representative of the population of UK manufacturing plants under consideration. Data are weighted because of problem of endogenous sampling (discussed in greater detail in Chapter 1), since

[7] See O'Mahony and Vecchi (2003) for a discussion of why econometric approaches fail to detect improvements in productivity following the introduction of ICT capital in production.

stratification is based upon employment size and this means that the probability of being in the sample is correlated with (at least one of) the variables in the model (particularly in the case of ownership attributes and thus productivity). There is also likely to be correlation with the model's error term (i.e., $E(z|e) \neq 0$, where z is the vector of regressors in the model).[8]

6.3 Labour productivity versus total factor productivity

This sub-section is devoted to formally clarifying the importance of estimating TFP, as the more holistic measure of productivity in comparison with labour productivity. As discussed briefly in Chapter 2, labour productivity as a proxy for technical progress has an intuitive appeal; the data are relatively easy to obtain, and relatively consistent series may be collected across countries, industrial sectors and plants. It is therefore a versatile indicator of performance. For this reason, many productivity analyses, some using the ARD, have focussed on labour productivity (Griffith, 1999). However, labour productivity is only a partial measure as it fails to take into account changes in the proportions of factor inputs, specifically capital and other intermediate inputs. Thus as firms turn more to capital to increase their productivity (substituting one input for another) employment decreases, but output may stay the same.

From the labour productivity measure alone it is impossible to tell whether firms have necessarily improved their productivity or simply changed their input mix. Harris (2003) puts this more formally, by subtracting the log of employment from a simple Cobb-Douglas function (specified in log form in equation 6.5). From equation

[8] Since the unweighted estimator is consistent when the sampling is exogenous, and the weighted estimator is consistent with or without exogenous sampling, a Hausman (1978) test can be used to test for exogeneity of the sampling procedure. This is discussed in section 6.4.2.

6.7 it can be seen that an increase in labour productivity is negatively associated with a rise in employment, and positively associated with increases in other inputs – capital and intermediate goods:

$$\Delta y_{it} - \Delta e_{it} = (\alpha_E - 1)\Delta e_t + \alpha_M \Delta m_{it} + \alpha_K \Delta k_{it} + \Delta TFP_{it} \qquad (6.7)$$

Thus, if there is an increase in capital deepening, or outsourcing, then labour productivity will increase as relatively less labour is used. Given this, a more appropriate measure of productivity should take into account both capital and labour inputs (and also intermediate goods, where available) and for this reason, TFP is a better measure of technical change and improvements in efficiency. This is particularly important in the case of foreign owned plants since they are found to have higher capital and intermediate input use (as seen in Chapter 2). Under such circumstances, estimation of labour productivity for foreign owned plants is likely to result in an upward bias of productivity, when compared to the productivity of domestic plants.

6.4 Test statistics

Having estimated a GMM system, a number of tests need to be undertaken to ensure that the models are valid in a statistical sense. This section provides a review of a number of tests that are used to evaluate the models developed in subsequent chapters.

6.4.1 Testing for cointegration in panel data

Having dealt with the problem of heterogeneity and endogeneity with the GMM systems approach, another problem that will affect the validity of the models is non-stationarity. Cointegration has been a major feature of time series econometrics since the 1980s (Harris, 1996; Harris and Sollis, 2003). The problems of time series data being non-stationary lead to bias in the estimates and diagnostics unless a cointegrating vector is identified (and may also lead to spurious regressions).

Given that panel data comprises both time series and cross sections, it is not immune from the problems of non-stationarity, and the longer the time series covered by the panel, the more of a problem non-stationarity is likely to be. It is therefore important to test for the presence of cointegration. Indeed, Baltagi (2001) points out that Binder et al (2000) have shown that conventional GMM estimators based on standard orthonogality conditions break down if the underlying time series contain unit roots (Baltagi, 2001, p.245). Testing for unit roots has only recently become standard in the panel data literature, following the work of Levin and Lin (1992). A number of tests have been developed (and for a comprehensive review of alternative tests see Harris and Sollis, 2003; Baltagi, 2001); this section however is limited to describing only the Pedroni tests since these are used in the empirical chapters of this thesis. An advantage of panel data in this instance is that it improves the power of conventional tests in predicting the presence of cointegration because of the information contained in the cross sectional dimension.

Testing for whether there is cointegration has been limited to a single equation framework mostly. Pedroni (1999) adopts a single equations approach where the null hypothesis is that there is no cointegration. He develops an ADF (augmented Dickey Fuller) type test in line with other tests (Kao, 1999, for example) but it does not impose homogeneity conditions. Pedroni uses the following model

$$y_{it} = \alpha_i + \delta_t t + \beta_{1i} x_{it} + \beta_{2i} x_{2it} + \ldots + e_{it} \qquad (6.8)$$

$$\hat{e}_{it} = \rho_i \hat{e}_{it-1} + v_{it} \tag{6.9}$$

Where y is the dependent variable, x_1 and x_2 are standard regressors in a panel. Equation (6.9) takes the residuals from equation (6.8) and regresses them on their lagged values.

This approach allows for short and long run heterogeneity in that the dynamic and fixed effects can differ across the individuals in the panel and the cointegration vector. The dynamics are taken into account using a test similar to an ADF type test that allows the number of lags in the model to be estimated directly. The test is distributed under the standard normal distribution. To implement the Pedroni test, the residuals are obtained as in (6.9) and then the appropriate mean and variance adjustment terms are applied (See Pedroni, 1999 for details).

6.4.2 Testing for exogeneity of the sampling procedure

There has been considerable debate regarding the legitimacy of weighting data (c.f. Harris, 2002) when specifying econometric relationships. In the case of the ARD, the sampling is stratified, as discussed in Chapter 1 and given this, there are reasons to conclude that weighting may be necessary. The Hausman test (1978) is used to test whether there is exogeneity in the sampling procedure and thus whether weighting is appropriate. The Hausman test may be specified as in equation 6.10.

$$\chi^2 = \left(\hat{\beta}_w - \hat{\beta}_{uw}\right)' \left[\text{var}\left(\hat{\beta}_w\right) - \text{var}\left(\hat{\beta}_{uw}\right)\right]^{-1} \left(\hat{\beta}_w - \hat{\beta}_{uw}\right) \tag{6.10}$$

This test estimates the specified relationship both weighted and unweighted. The estimates from both equations are combined as in equation (6.10), where β_{uw} represents the unweighted estimates and β_w, the weighted. If χ^2 is significant (following the Chi-squared distribution), then this demonstrates that there are efficiency gains from weighting the data and therefore it is appropriate for the data to be weighted. Harris (2002) has demonstrated that in the case of the ARD, weighting does appear to be generally appropriate, though it is tested in each of the models specified in the empirical chapters of this thesis.

6.4.3 Testing the validity of the instruments

The Sargan test is used to test for overidentifying restrictions, that is, whether there are the appropriate number of instruments in terms of the most suitable number of lags and differences in the GMM system. The null hypothesis is that if the appropriate number of lags and differences has been chosen, for a given matrix of instrumental variable, then the Sargan test is asymptotically distributed as χ^2. Full details of this test are contained in Arellano and Bond (1991) and Doornik, Bond and Arrelano (2002).

6.4.4 Testing for serial correlation

When estimating a GMM model, a key assumption for there to be consistency of estimators is that there is no serial correlation in the error term, e_{it}. Therefore it is necessary to test for first and second order serial correlation. With the error term not serially correlated, "there should be evidence of significant negative first order serial correlation in the differenced residuals and no evidence of second order serial correlation in the differenced residuals" (Doornik, Bond and Arrelano, 2002, p,8). The m1 and m2 tests[9] reported in the following chapters are based on standardised average residual autocovariances, which are asymptotically distributed $N(0,1)$ variables, under the null hypothesis of no serial correlation. These tests are based on estimates of the residuals in first differences and are explained fully in Arellano and Bond (1991, equations 8 and 9 and appendix).

6.5 Conclusions

In this chapter, the usefulness of productivity analysis has been briefly reviewed; the properties of the preferred functional form and problems of estimation are presented. The econometric approach is powerful but problems of simultaneity and heterogeneity require specific modelling procedures, the GMM systems approach (Blundell and Bond, 1999) is best suited to deal with the large heterogeneous panels. This methodology is too sensitive to use on small datasets since instrumenting becomes too unstable. However, the data available in the ARD should permit for stable relationships to be tested.

Productivity analysis is one of the key tools available to an applied economist but its use is not without problems. The problem that TFP presents is that capital stock estimates are needed and are generally not readily available. In the case of the ARD, capital stock estimates have been calculated by Harris and Drinkwater (2000). This chapter has provided a discussion of a number of key statistics used in the subsequent analyses to ensure that relationships estimated are meaningful and robust.

[9] Also referred to as the AR tests.

The functional forms adopted to test for direct and indirect effects of foreign ownership are discussed in the following two chapters, in the next section. The final empirical chapter uses the GMM approach to test for differences in productivity following acquisition by foreign firms.

Section III

Empirical estimations and results

Chapter 7:

Are foreign owned plants better than domestic plants?[1]

7.0 Introduction

In Chapter 4, theoretical arguments were put forward in support of the idea that generally, foreign owned subsidiaries are likely to perform better than domestically owned plants because of firm specific assets. Empirically, the results reviewed in Chapter 4 indicate that there is considerable ambiguity in the findings. In this chapter the econometric estimation of TFP, as outlined in Chapter 6, is presented, testing for higher productivity in foreign owned plants in a subset of manufacturing industries in the UK, for the period 1974-1995. These industries are discussed in greater detail in Chapter 2.

7.1 Data requirements and model specification

In order to test for the presence of a productivity advantage in foreign owned plants, compared with domestic plants, an augmented Cobb-Douglas production function has been estimated, including in addition to the standard format a number of variables to detect an advantage specific to being foreign owned (outlined below). Data were taken from the ARD where gross output, intermediate inputs and employment are all readily available (after deflation of nominal values, where appropriate). The capital stock variable is taken from Harris and Drinkwater (2000).

[1] This chapter is based on a paper co-authored with Richard Harris, University of Newcastle, which has now been published in the *Review of Industrial Organization*, 2003.

This analysis was conducted at the plant level but given the extent of the information contained in the ARD, only the selected industries first outlined in Chapter 2 are included. This simplifies the computation and presentation of the significant findings here, and excludes industries that have little or no foreign investment. For these reasons, 20 of the 208 industries[2] were selected for inclusion in this analysis. These industries were not selected on the grounds that they had extremely high levels of FDI, because this may distort the types of foreign investment that occur (since there is a concern that some industries may be regarded as international industries such as chemicals, for example, and investment that takes place there may be of a different nature to that in miscellaneous manufacturing, for example). Thus the 20 industries were selected as described in Chapter 2.

Table 7.1 summarises the extent of foreign ownership in each of the selected industries. It can be seen that there is considerable diversity as to the extent of foreign ownership. For example, motor vehicles and their engines is included, where foreign ownership accounted for almost 90 per cent of gross output in 1995, and organic chemicals, where foreign ownership accounted for only 5.76 per cent of total gross output.

[2] Therefore, almost 10 per cent of the total number of industries was selected.

Table 7.1: Selected industries, and proportion of foreign owned gross output, 1995

SIC code (1980)	Description	% foreign ownership (gross output)
2234	Steel wire	26.46
2437	Concrete, cement, plaster	10.10
2489	Ceramic goods	16.73
2512	Organic chemicals	5.76
2570	Pharmaceutical productions	45.29
3222	Engineers' small tools	28.06
3255	Mechanical equipment	56.96
3284	Refrigerating machinery	15.53
3302	Electronic data processing	81.47
3444	Other electronic equipment	30.89
3453	Electronic sub-assemblies	58.82
3510	Motor vehicles and their engines	87.22
3640	Aerospace equipment	12.26
4130	Preparation of milk products	23.55
4214	Cocoa, etc. confectionary	62.39
4239	Miscellaneous foods	41.85
4724	Packaging of paper and pulp	23.21
4752	Print/publishing of periodicals	12.82
4832	Plastics semi-manufactures	32.67
4959	Other manufactures, n.e.s.	16.90

Using the productivity approach outlined in Chapter 6 to estimate TFP for both foreign- and domestically-owned plants in the 20 industries, the following standard log-linear Cobb-Douglas production function was estimated:

$$y_{it} = \alpha x_{it} + \beta l_{it} + \gamma k_{it} + \delta t + \kappa AGE_{it} + \theta_1 FO_i + \theta_2 (FO_i \times t_{86-95}) + a_{it} \qquad (7.1)$$

where i and t represent the i-th plant and the t-th year of observation, respectively; y is real gross output; x is real intermediate inputs (i.e., gross output less gross value added); l is the number of employees (no data on hours is available); k is plant and machinery capital stock; AGE is the age of the plant (in years); FO is a vector of dummies each taking on a value 1 when a unit is owned by either a US, an EU, a SE

Asian[3], an Old Commonwealth[4] or other country[5]. Variables in lower case are in logarithms; and t is a time-index that starts in 1974, except for the multiplicative term involving FO where time is indexed to begin in 1986.[6] It is assumed that y, x, l, and k are all potentially endogenous and it is possible that the foreign ownership marker may be as well but it is assumed exogenous in this study to allow estimation without having to use a structural model involving more than one equation.

The parameters to be estimated comprise of the output elasticities α, β, γ, δ, while the foreign-owned dummies and multiplicative $FO \times t$ terms were initially included and then removed if not significant in a general-to-specific approach to estimation. The composite foreign owned/time dummy variable is designed specifically to detect any catch-up or further divergence that may be occurring in relation to foreign ownership. Thus this specification will detect not only whether foreign owned firms are better but whether they are increasingly or decreasingly better than domestically owned plants. If the coefficient is positive, the gap between the foreign group and domestic plants is growing.

As discussed in Chapter 6, it is recognised that the error term comprises of three elements:

$$a_{it} = \eta_i + t_t + e_{it} \tag{7.2}$$

[3] Comprises of Japan, Taiwan, Hong Kong, South Korea, and Malaysia.
[4] Comprises of Australia, New Zealand, Canada and South Africa.
[5] The country dummies vary by industry depending on sample sizes. In the empirical work OTH always refers to all other foreign countries (except US and EU) unless SE Asian or Old Commonwealth are explicitly included.
[6] The year 1986 was chosen after experimentation with different start dates and because FDI picked up substantially after this date (*vis a vis* the period before the mid-1980s).

with η_i affecting all observations for cross-section unit *i*; t_t affects all units for time period *t*; and e_{it} affects only unit *i* during period *t*. If e_{it} is serially correlated such that:

$$e_{it} = \rho e_{it-1} + u_{it} \qquad (7.3)$$

where u_{it} is uncorrelated with any other part of the model, and $|\rho| < 1$, then equation (7.1) can be transformed into a dynamic form involving first-order lags of the variables and a well behaved error term. Given this, equation 7.1 was estimated using the systems GMM approach.

7.2 Results

The full set of results from estimating equation (7.1) for each of the 20 industries are presented in Table 7.2. Table 7.3 presents an alternative specification for three industries (mechanical lifting and handling equipment, motor vehicles and their engines, and miscellaneous foods) where the age of the plant proved to be significant. However, age was not generally found to be statistically significant in the majority of manufacturing industries and therefore has not been reported in the long run estimates that are contained in Table 7.4.

Observing the individual industry equations, it can be seen from the bottom of Table 7.2 that in terms of diagnostics, all the estimated models were satisfactory in terms of autocorrelation (*cf.* the m1 and m2 test statistics) and the appropriateness of the instrument set used (*cf.* the Sargan test results). The Hausman test that the sampling procedure is exogenous (and thus weighting is unnecessary) confirms that this null hypothesis is satisfactorily rejected in all industries except engineers' small tools and thus the need for weighting is statistically sound. Tests of the null that real gross output, intermediate inputs, capital and labour do not form a cointegrating vector (using the panel- and group-ADF tests reported in Pedroni, 1999) were rejected in all cases, and thus the problem of spurious regressions is avoided[7].

[7] Each of these diagnostic tests are discussed in Chapter 6.

Table 7.2: Weighted system estimates of plant-level dynamic Cobb-Douglas production function, 1974-95: various UK manufacturing industries[a]

Dependent variable:	Steel Wire (2234)		Other building products of concrete, cement, plaster (2437)		Ceramic goods (2489)	
	$\hat{\beta}$	t-value	$\hat{\beta}$	t-value	$\hat{\beta}$	t-value
ln real intermediate input (x_{it})	0.8148	42.13	0.683	35.81	0.727	16.47
ln real intermediate input (x_{it-1})	–0.1693	-3.37	-0.218	-6.89	-0.293	-3.94
ln employment (l_{it})	0.1736	8.51	0.321	13.73	0.302	8.09
ln employment (l_{it-1})	–0.0262	-2.57	-0.038	-4.15	-0.099	-4.97
ln P&M capital stock (k_{it})	0.1217	2.76	0.113	2.05	0.141	2.37
ln P&M capital stock (k_{it-1})	–0.0114	-1.94	-0.010	-1.74	-0.026	-2.56
ln real gross output (y_{it-1})	0.1953	3.38	0.277	7.30	0.375	4.30
t	0.0009	0.79	0.006	5.21	0.008	5.54
US	0.0618	3.05	n.s.		n.s.	
EU	n.s.		n.s.		0.089	3.44
Old Commonwealth	–		n.s.		–	
SE Asia	–		–		–	
Other Foreign-owned	0.0562	1.64	n.s.		-0.091	-5.31
US × $t_{86\text{-}95}$	–0.0078	-1.99	n.s.		n.s.	
EU × $t_{86\text{-}95}$	n.s.		n.s.		n.s.	
Old Commonwealth × $t_{86\text{-}95}$	-		-0.009	-4.67	–	
SE Asian × $t_{86\text{-}95}$	–		–		–	
Other FO × $t_{86\text{-}95}$	n.s.		n.s.		n.s.	
Constant	–0.1453	-2.00	-0.653	-7.34	-0.229	-1.20
Sargan test (P-value)	240.272	(0.23)	549.637	0.17	218.081	0.41
m1 (P-value)	–6.698	(0.00)	-7.473	0.00	-4.639	0.00
m2 (P-value)	–1.000	(0.32)	-0.404	0.69	-0.150	0.88
Hausman χ^2 test (P-value)	12.097	(0.02)	8.066	0.09	28.874	0.00
Panel ADF statistic (P-value)	–17.866	(0.00)	-30.073	0.00	-18.478	0.00
Group ADF statistic (P-value)	–27.954	(0.00)	-76.620	0.00	-66.556	0.00
Instruments	Δt–1, t–2		Δt–1, t–2		Δt–2, t–3	
No. of units	277		605		245	
No. of observations	2,715		5702		2919	

Notes: the samples are unbalanced (weighted) panels; all t-values are based on one-step robust standard errors; m1 and m2 are tests for first and second order serial correlation; the GMM estimator has the instruments (for x, l and k) dated as shown. The Hausman (1978) test is for the exogeneity of the sampling procedure. The Panel- and Group-ADF tests are for cointegration of real gross output, real intermediate inputs, employment and the real capital stock based on Pedroni (1999). [a]Note AGE is only included for those industries were the variable is significant (see Table 7.3 for results)

Table 7.2 (continued)

Dependent variable:	Organic chemicals, not pharmaceutical (2512)		Pharmaceutical products (2570)		Engineers' small tools (3222)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
ln real intermediate input (x_{it})	0.839	38.09	0.696	21.32	0.532	16.18
ln real intermediate input (x_{it-1})	-0.280	-7.06	-0.224	-4.81	-0.197	-4.87
ln employment (l_{it})	0.170	8.80	0.301	9.02	0.468	11.83
ln employment (l_{it-1})	-0.071	-4.76	-0.033	-2.38	-0.092	-4.86
ln P&M capital stock (k_{it})	0.093	3.18	0.108	2.75	0.162	2.29
ln P&M capital stock (k_{it-1})	-0.004	-0.53	-0.002	-0.25	-0.062	-2.74
ln real gross output (y_{it-1})	0.352	6.96	0.274	4.90	0.314	6.06
t	0.000	0.05	0.005	2.94	0.009	4.30
US	0.118	4.01	0.113	4.45	0.047	1.73
EU	0.095	4.25	n.s.		n.s.	
Old Commonwealth	0.267	5.08	n.s.		n.s.	
SE Asia	–		n.s.		n.s.	
Other Foreign-owned	–		n.s.		–	
US × $t_{86\text{-}95}$	–		n.s.		0.015	1.72
EU × $t_{86\text{-}95}$	-0.019	-4.30	0.014	3.13	n.s.	
Old Commonwealth × $t_{86\text{-}95}$	n.s.		n.s.		n.s.	
SE Asian × $t_{86\text{-}95}$	–		n.s.		n.s.	
Other FO × $t_{86\text{-}95}$	–		0.059	16.24	–	
Constant	-0.030	-0.47	-0.580	-4.30	-0.899	-4.70
Sargan test (P-value)	149.056	0.89	255.966	0.07	170.359	0.16
m1 (P-value)	-5.875	0.00	-6.240	0.00	-7.755	0.00
m2 (P-value)	0.441	0.66	-0.244	0.81	0.895	0.37
Hausman χ^2 test (P-value)	2081.639	0.00	19.305	0.00	4.087	0.25
Panel ADF statistic (P-value)	-12.559	0.00	-21.317	0.00	-29.328	0.00
Group ADF statistic (P-value)	-44.458	0.00	-67.661	0.00	-138.157	0.00
Instruments	Δt–1, t–2		Δt–1, t–2		Δt–3, t–4	
No. of units	152		289		486	
No. of observations	1667		3369		4275	

Table 7.2 (continued)

Dependent variable:	Mechanical lifting and handling equipment (3255)		Refrigerating machinery and air conditioning (3284)		Electronic data processing equipment (3302)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
ln real intermediate input (x_{it})	0.408	8.34	0.633	29.40	0.649	14.11
ln real intermediate input (x_{it-1})	-0.251	-9.01	-0.110	-3.64	-0.403	-9.47
ln employment (l_{it})	0.517	8.42	0.381	16.21	0.312	8.32
ln employment (l_{it-1})	-0.100	-5.98	-0.024	-3.36	-0.074	-5.16
ln P&M capital stock (k_{it})	0.093	4.63	0.106	2.09	0.126	2.28
ln P&M capital stock (k_{it-1})	-0.009	-4.83	-0.014	-9.76	-0.008	-0.77
ln real gross output (y_{it-1})	0.437	9.52	0.151	4.18	0.503	10.10
t	0.011	8.10	-0.001	-0.62	0.038	9.71
US	n.s.		-0.042	-4.29	0.076	2.95
EU	0.097	3.12	n.s.		n.s.	
Old Commonwealth	0.154	3.43	n.s.		-0.121	-2.49
SE Asia	0.149	5.99	-0.203	-13.58	n.s.	
Other Foreign-owned	–		–		–	
US × t_{86-95}	0.008	2.84	0.004	1.86	n.s.	
EU × t_{86-95}	n.s.		n.s.		n.s.	
Old Commonwealth × t_{86-95}	n.s.		-0.026	-9.18	n.s.	
SE Asian × t_{86-95}	n.s.		0.031	14.11	n.s.	
Other FO × t_{86-95}	n.s.		–		–	
Constant	-1.433	-6.11	-0.790	-7.85	-1.041	-6.30
Sargan test (P-value)	200.112	0.21	402.967	0.11	195.309	0.10
m1 (P-value)	-7.279	0.00	-8.740	0.00	-6.048	0.00
m2 (P-value)	1.948	0.05	-1.320	0.19	-0.683	0.49
Hausman χ^2 test (P-value)	50.846	0.00	41.717	0.00	12.520	0.01
Panel ADF statistic (P-value)	-34.178	0.00	-29.522	0.00	-6.398	0.00
Group ADF statistic (P-value)	-93.216	0.00	-84.743	0.00	-62.703	0.00
Instruments	Δt–7, t–8		Δt–1, t–2		Δt–1, t–2	
No. of units	498		437		210	
No. of observations	4788		3850		1479	

Table 7.2 (continued)

Dependent variable:	Other components for electronic equipment (3444)		Active components and electronic sub-assemblies (3453)		Motor vehicles and their engines (3510)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
ln real intermediate input (x_{it})	0.441	7.46	0.784	17.38	0.447	9.00
ln real intermediate input (x_{it-1})	-0.252	-6.61	-0.510	-9.62	0.122	3.90
ln employment (l_{it})	0.549	9.41	0.158	4.46	0.491	8.22
ln employment (l_{it-1})	-0.039	-3.27	-0.091	-4.50	-0.019	-1.04
ln P&M capital stock (k_{it})	0.130	1.78	0.195	2.74	0.164	3.56
ln P&M capital stock (k_{it-1})	0.038	2.89	-0.048	-1.73	-0.081	-3.24
ln real gross output (y_{it-1})	0.324	7.16	0.625	10.88	-0.060	-1.08
t	0.020	7.60	0.011	4.36	0.012	3.83
US	0.103	4.46	n.s.		0.210	6.97
EU	n.s.		n.s.		0.123	1.79
Old Commonwealth	–		n.s.		n.s.	
SE Asia	–		n.s.		-0.113	-4.58
Other Foreign-owned	-0.248	-2.98	–		n.s.	
US × $t_{86\text{-}95}$	0.015	2.15	n.s.		-0.014	-2.08
EU × $t_{86\text{-}95}$	0.030	2.92	-0.022	-2.97	n.s.	
Old Commonwealth × $t_{86\text{-}95}$	–		n.s.		n.s.	
SE Asian × $t_{86\text{-}95}$	–		n.s.		0.039	2.95
Other FO × $t_{86\text{-}95}$	0.051	3.63	–		n.s.	
Constant	-1.967	-6.94	-0.176	-1.33	-1.192	-5.08
Sargan test (P-value)	326.719	0.45	183.050	0.12	112.744	0.36
m1 (P-value)	-6.333	0.00	-6.245	0.00	-5.189	0.00
m2 (P-value)	0.855	0.39	1.469	0.14	0.065	0.95
Hausman χ^2 test (P-value)	48.628	0.00	8.892	0.03	17.100	0.00
Panel ADF statistic (P-value)	-23.785	0.00	-14.341	0.00	-22.453	0.00
Group ADF statistic (P-value)	-75.241	0.00	-57.748	0.00	-59.334	0.00
Instruments	Δt–1, t–2		Δt–2, t–3		Δt–8, t–9	
No. of units	347		190		225	
No. of observations	3437		1843		2403	

Table 7.2 (continued)

Dependent variable:	Aerospace equipment (3640)		Preparation of milk and milk products (4130)		Cocoa, chocolate and sugar confectionery (4214)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
ln real intermediate input (x_{it})	0.523	19.60	0.855	75.68	0.742	25.52
ln real intermediate input (x_{it-1})	-0.183	-4.96	-0.320	-6.16	-0.470	-12.11
ln employment (l_{it})	0.481	18.40	0.136	11.59	0.244	10.66
ln employment (l_{it-1})	-0.068	-7.26	-0.062	-8.44	-0.107	-8.09
ln P&M capital stock (k_{it})	0.140	3.55	0.109	2.27	0.160	2.47
ln P&M capital stock (k_{it-1})	-0.045	-4.31	0.002	0.67	-0.059	-1.94
ln real gross output (y_{it-1})	0.266	5.98	0.401	7.11	0.584	11.24
t	0.013	8.81	0.004	6.19	0.001	0.59
US	n.s.		-0.056	-4.06	n.s.	
EU	-0.186	-4.02	n.s.		-0.053	-2.4
Old Commonwealth	n.s.		–		–	
SE Asia	n.s.		–		–	
Other Foreign-owned	–		-0.270	-7.49	n.s.	
US × $t_{86\text{-}95}$	-0.038	-2.37	n.s.		n.s.	
EU × $t_{86\text{-}95}$	n.s.		n.s.		0.019	3.85
Old Commonwealth × $t_{86\text{-}95}$	n.s.		–		–	
SE Asian × $t_{86\text{-}95}$	n.s.		–		–	
Other FO × $t_{86\text{-}95}$	–		0.044	10.36	n.s.	
Constant	-1.274	-11.22	0.016	0.49	-0.295	-2.97
Sargan test (P-value)	337.478	0.29	281.999	0.11	183.157	0.11
m1 (P-value)	-6.695	0.00	-9.814	0.00	-6.882	0.00
m2 (P-value)	-0.090	0.93	1.318	0.19	-0.808	0.42
Hausman χ^2 test (P-value)	17.100	0.00	136.098	0.00	58.278	0.00
Panel ADF statistic (P-value)	-28.199	0.00	-26.130	0.00	-11.356	0.00
Group ADF statistic (P-value)	-72.718	0.00	-74.255	0.00	-41.523	0.00
Instruments	Δt–1, t–2		Δt–4, t–6		Δt–1, t–2	
No. of units	347		472		189	
No. of observations	4116		5260		2100	

Table 7.2 (continued)

Dependent variable:	Miscellaneous foods (4239)		Packaging products of paper and pulp (4724)		Printing and publishing of periodicals (4752)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
ln real intermediate input (x_{it})	0.704	33.21	0.731	23.40	0.636	19.79
ln real intermediate input (x_{it-1})	-0.039	-1.04	-0.214	-3.92	-0.369	-9.94
ln employment (l_{it})	0.297	11.16	0.272	7.91	0.392	10.68
ln employment (l_{it-1})	-0.081	-5.86	-0.024	-2.40	-0.115	-8.98
ln P&M capital stock (k_{it})	0.175	5.15	0.102	2.35	0.127	2.20
ln P&M capital stock (k_{it-1})	-0.051	-3.76	-0.004	-0.79	-0.010	-1.98
ln real gross output (y_{it-1})	0.127	2.52	0.258	4.21	0.503	10.81
t	0.002	1.90	0.010	5.63	0.008	4.85
US	0.058	2.95	n.s.		0.165	2.44
EU	n.s.		-0.092	-2.99	n.s.	
Old Commonwealth	–		n.s.		0.097	3.33
SE Asia	–		–		–	
Other Foreign-owned	-0.220	-5.01	–		0.238	4.24
US × $t_{86\text{-}95}$	n.s.		n.s.		n.s.	
EU × $t_{86\text{-}95}$	n.s.		n.s.		-0.007	-1.86
Old Commonwealth × $t_{86\text{-}95}$	–		n.s.		-0.017	-3.15
SE Asian × $t_{86\text{-}95}$	–		–		–	
Other FO × $t_{86\text{-}95}$	n.s.		–		0.028	2.90
Constant	-0.202	-2.03	-0.648	-4.87	-0.803	-5.35
Sargan test (P-value)	313.224	0.15	147.372	0.90	360.911	0.08
m1 (P-value)	-7.355	0.00	-6.217	0.00	-7.615	0.00
m2 (P-value)	1.468	0.14	2.005	0.05	1.603	0.11
Hausman χ^2 test (P-value)	25.010	0.00	146.520	0.00	6134.197	0.00
Panel ADF statistic (P-value)	-41.363	0.00	-13.269	0.00	-26.195	0.00
Group ADF statistic (P-value)	-84.379	0.00	-36.565	0.00	-99.129	0.00
Instruments	Δt–3, t–4		Δt–1, t–2		Δt–1, t–2	
No. of units	357		151		388	
No. of observations	4114		1519		3507	

Table 7.2 (continued)

Dependent variable:	Plastics semi-manufactures (4832)		Other manufactures not elsewhere specified (4959)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
ln real intermediate input (x_{it})	0.781	25.49	0.692	13.22
ln real intermediate input (x_{it-1})	-0.117	-1.57	-0.149	-2.01
ln employment (l_{it})	0.223	6.99	0.328	7.79
ln employment (l_{it-1})	-0.020	-1.22	-0.027	-0.98
ln P&M capital stock (k_{it})	0.103	2.26	0.147	2.01
ln P&M capital stock (k_{it-1})	-0.003	-0.35	0.018	0.49
ln real gross output (y_{it-1})	0.145	1.63	0.183	2.08
t	0.003	1.64	n.s.	
US	n.s.		0.121	1.66
EU	n.s.		n.s.	
Old Commonwealth	–		–	
SE Asia	–		–	
Other Foreign-owned	n.s.		n.s.	
US × $t_{86\text{-}95}$	n.s.		n.s.	
EU × $t_{86\text{-}95}$	-0.018	-3.25	n.s.	
Old Commonwealth × $t_{86\text{-}95}$	–		–	
SE Asian × $t_{86\text{-}95}$	–		–	
Other FO × $t_{86\text{-}95}$	0.012	2.49	0.104	5.49
Constant	-0.343	-2.66	-0.796	-3.75
Sargan test (P-value)	198.976	0.89	118.173	0.13
m1 (P-value)	-4.139	0.00	-5.763	0.00
m2 (P-value)	0.219	0.83	1.654	0.13
Hausman χ^2 test (P-value)	702.129	0.00	22.215	0.00
Panel ADF statistic (P-value)	-25.879	0.00	-16.812	0.00
Group ADF statistic (P-value)	-53.318	0.00	-47.387	0.00
Instruments	Δt–1, t–2		Δt–3, t–4	
No. of units	205		216	
No. of observations	2032		1722	

Table 7.3: Re-specified weighted system estimates of plant-level dynamic Cobb-Douglas production function, 1974-95: various UK manufacturing industries

Dependent variable:	Mechanical lifting and handling equipment (3255)		Motor vehicles and their engines (3510)		Miscellaneous foods (4239)	
	$\hat{\beta}$	t-value	$\hat{\beta}$	t-value	$\hat{\beta}$	t-value
ln real intermediate input (x_{it})	0.3946	8.45	0.4049	7.72	0.6450	29.50
ln real intermediate input (x_{it-1})	−0.2804	-10.20	0.0507	1.49	-0.0675	-1.58
ln employment (l_{it})	0.4899	8.82	0.5397	9.28	0.3516	13.20
ln employment (l_{it-1})	−0.0852	-4.99	-0.0499	-2.43	-0.0873	-5.56
ln P&M capital stock (k_{it})	0.1084	4.76	0.1679	3.82	0.1770	6.38
ln P&M capital stock (k_{it-1})	−0.0265	-3.96	-0.0780	-2.78	-0.0556	-3.57
ln real gross output (y_{it-1})	0.4768	11.00	0.0569	0.82	0.1740	3.02
ln age of plant (AGE_{it})	−0.0716	-2.89	−0.1451	-3.03	-0.1043	-4.92
t	0.0118	8.05	0.0143	4.20	0.0020	1.88
US	n.s.		0.2200	6.26	0.0431	1.90
EU	0.0938	3.09	0.1001	1.54	n.s.	
Old Commonwealth	0.1335	2.67	n.s.		–	
SE Asia	0.1238	2.75	−0.1037	-1.57	–	
Other Foreign-owned	–		n.s.		-0.3389	-12.10
US × t_{86-95}	0.0081	3.37	−0.0191	-2.45	n.s.	
EU × t_{86-95}	n.s.		n.s.		n.s.	
Old Commonwealth × t_{86-95}	n.s.		n.s.		–	
SE Asian × t_{86-95}	n.s.		n.s.		–	
Other FO × t_{86-95}	–		n.s.		n.s.	
Constant	−1.1531	-5.70	-0.9274	-4.19	-0.1812	-1.95
<u>Long-run model</u>						
ln real intermediate input	0.2182	2.49	0.4831	8.82	0.6991	26.91
ln employment	0.7733	7.86	0.5193	8.70	0.3199	10.93
ln P&M capital stock	0.1565	2.88	0.0953	2.74	0.1470	5.24
Time	0.0226	7.13	0.0152	3.94	0.0024	1.93
ln age of plant	−0.1369	-2.73	-0.1539	-3.06	-0.1263	-5.32
US	n.s.		0.2333	6.11	0.0522	1.91
EU	0.1794	3.11	0.1062	1.52	n.s.	
Old Commonwealth	0.2552	2.54	n.s.		-	
SE Asia	0.2367	2.69	-0.1099	-1.08	-	
Other Foreign-owned	–		n.s.		-0.4103	9.57

Table 7.3: continued...

Dependent variable:	Mechanical lifting and handling equipment (3255)		Motor vehicles and their engines (3510)		Miscellaneous foods (4239)
US × t_{86-95}	0.0155	3.62	-0.0203	-2.35	n.s.
EU × t_{86-95}	n.s.		n.s.		n.s.
Old Commonwealth × t_{86-95}	n.s.		n.s.		-
SE Asian × t_{86-95}	n.s.		n.s.		-
Other FO × t_{86-95}	–		n.s.		n.s.

The long-run solutions to the dynamic models estimated are reported in Table 7.4. After estimating the unrestricted versions of equation (7.1), which involved up to five separate dummies for the foreign-owned sector and similar composite foreign-owned time trends, a parsimonious version of the model was tested down, excluding insignificant variables. The long run results are discussed in detail below firstly by country and then by industrial sector.

Table 7.4: Long-run weighted system estimates of Cobb-Douglas production function, 1974-1995: UK manufacturing (various industries)

Industry SIC (1980)	2234	2489	2437	2512	2570	3222	3255	3284	3302	3444
ln intermediate inputs	0.802	0.694	0.643	0.863	0.649	0.488	0.279	0.616	0.495	0.279
ln employment	0.183	0.325	0.392	0.153	0.370	0.547	0.740	0.420	0.479	0.755
ln capital stock (P&M)	0.137	0.184	0.141	0.137	0.147	0.145	0.148	0.109	0.238	0.249
Time	0.001[†]	0.013	0.008	0.000[†]	0.007	0.013	0.020	-0.001[†]	0.076	0.029
US	0.077	n.s.	n.s.	0.183	0.156	0.069*	n.s.	-0.050	0.154	0.152
EU	n.s.	0.143	n.s.	0.146	n.s.	n.s.	0.173	n.s.	n.s.	n.s.
Old Commonwealth	0.070*	–	n.s.	0.412	n.s.	n.s.	0.274	n.s.	-0.244	–
SE Asia	–	–	–	–	n.s.	n.s.	0.265	-0.239	n.s.	-0.366
Other Foreign-owned	–	-0.145[a]	n.s.	–	n.s.	–	n.s.	–	–	–
US × t_{86-95}	-0.010	n.s.	n.s.	–	n.s.	0.021*	0.014	0.005*	n.s.	0.022
EU × t_{86-95}	n.s.	n.s.	n.s.	-0.029	0.020	n.s.	n.s.	n.s.	n.s.	0.044
Old Commonwealth × t_{86-95}	n.s.	–	-0.013	n.s.	n.s.	n.s.	n.s.	-0.031	n.s.	–
SE Asian × t_{86-95}	–	–	–	–	n.s.	n.s.	n.s.	0.036	n.s.	0.075
Other FO × t_{86-95}	–	n.s.	n.s.	–	0.081	–	n.s.	–	–	–

Note that – indicates no foreign presence from the specified country of origin in the particular SIC; n.s. indicates that the coefficient was not significant when included.

Table 7.4: Long-run weighted system estimates of Cobb-Douglas production function, 1974-1995: UK manufacturing (various industries)

Industry SIC (1980)	3453	3510	3640	4130	4214	4239	4724	4752	4832	4959
ln intermediate inputs	0.730	0.537	0.463	0.893	0.654	0.761	0.696	0.536	0.777	0.664
ln employment	0.177	0.445	0.563	0.125	0.329	0.248	0.334	0.557	0.237	0.369
ln capital stock (P&M)	0.392	0.078	0.129	0.186	0.243	0.142	0.131	0.235	0.117	0.202
Time	0.029	0.011	0.017	0.008	0.003[†]	0.002[†]	0.014	0.016	0.004*	n.s.
US	n.s.	0.198	n.s.	-0.094	n.s.	0.066	n.s.	0.332	n.s.	0.148*
EU	n.s.	0.116*	-0.254	n.s.	-0.127	n.s.	-0.125	n.s.	n.s.	n.s.
Old Commonwealth	n.s.	n.s.	n.s.	-0.451	–	–	n.s.	0.195	–	–
SE Asia	n.s.	-0.107	n.s.	–	–	–	–	0.479	–	–
Other Foreign-owned	–	n.s.	–	–	n.s.	-0.252[a]	–	–	n.s.	n.s.
US × $t_{86\text{-}95}$	n.s.	-0.013	-0.052	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
EU × $t_{86\text{-}95}$	-0.058	n.s.	n.s.	n.s.	0.046	n.s.	n.s.	-0.015*	-0.021	n.s.
Old Commonwealth × $t_{86\text{-}95}$	n.s.	n.s.	n.s.	0.073	–	–	n.s.	-0.034	–	–
SE Asian × $t_{86\text{-}95}$	n.s.	0.037	n.s.	–	–	–	–	0.056	–	–
Other FO × $t_{86\text{-}95}$	–	n.s.	–	–	n.s	n.s.	–	–	0.014[a]	0.127[b]

7.2.1 Country analysis

In general, the results reveal that US-owned plants performed better than domestic plants over the period in question, although there were some exceptions (such as in the refrigerating machinery and preparation of milk products sectors) and other instances where there was no significant advantage to the sub-sector (in 8 out of the 20 sectors covered). It is possible that with a significant intra-industry spillover effect, UK plants in these sectors[8] raised their performance as a result of the foreign presence to rule out any significant differential between the domestic and foreign owned plants (Klette et al, 2000). Or indeed, it may be that US presence in these sectors was not sufficiently large, these may have been dominated by European or other nationalities of foreign owners. There is also some evidence, with the composite time trend dummies, that US-owned plants have been losing their advantage over time (*cf.* steel wire, motor vehicles, and aerospace) and that domestic plants have been catching up, observed by the composite dummy-time variable. This is encouraging from the perspective of the host nation, and is indicative of spillovers from FDI.

Overall, there is little evidence of a significant productivity differential *per se* in favour of EU-owned plants. EU-owned plants outperform domestic plants in only four of the industries covered (especially in ceramic goods, organic chemicals, and mechanical equipment), but do significantly worse in aerospace and the cocoa and confectionery industries. Although for the latter the composite time trend shows that EU-owned plants have been catching-up at a rate of some 4.7[9] per cent per annum

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[8] These are concrete, cement and plaster; ceramic goods; mechanical lifting and handling equipment; active components and electronic sub assemblies; aerospace equipment; cocoa, chocolate and sugar confectionary; packaging products of paper and pulp and other manufactures.

[9] Note, since the dependent variable is logged, parameter estimates need to be converted to $\exp(\theta)-1$.

over the 1986-1995 period, which is indicative perhaps of a catch-up trend as plants learn from domestic operators, or indeed, as economic integration in Europe as a whole starts to generate harmonisation. In two other industries (electronic sub-assemblies and printing and publishing of periodicals) EU-owned plants have also declined in terms of their TFP as evidenced by the negative composite time trends reported in the table.

Plants owned by the Old Commonwealth countries did better in organic chemicals, mechanical equipment and printing and publishing of periodicals, but significantly worse in electronic data processing and preparation of milk products (with declining performance over time in the concrete, cement and plaster, and refrigerating equipment industries). Where separate effects could be measured for SE Asian–owned plants, the evidence is mixed[10]: they performed significantly better in mechanical equipment and printing and publishing of periodicals (30 and 61 per cent, respectively, above the benchmark), but worse in refrigerating equipment, other electronic equipment and motor vehicles. The other foreign-owned estimates that could be obtained were for the most part based on amalgamations of a small number of plants from a range of different foreign sub-sectors, and often the results suggest that these plants were relative poor performers – presumably in part due to their heterogeneity. Only in pharmaceuticals was there any convincing evidence that plants owned by enterprises from the rest of the world did any better (with an 8.4 per cent per annum increase over the 1986-1995 period).

[10] Where the samples were too small to separate, South East Asia was included in the Rest of the World.

7.2.2 Sector analysis

Foreign-owned plants were expected to perform better than UK-owned plants, and therefore this section is devoted to industries where foreign-owned plants do relatively poorly. Reasons were given in Chapter 4 for poor performance, including problems with assimilating acquired plants, lags due to the time needed to bring 'greenfield' operations up to best-practice (which also may involve assimilation problems), and the setting up of branch-plant operations, therefore this section concentrates on the underlying characteristics of the plants that do less well.

Firstly, it can be seen that the negative parameter estimates associated with 'other' foreign-owned plants in the ceramic goods[11] and miscellaneous foods industries[12] (and the Old Commonwealth plants in the preparation of milk products industry[13], and SE Asian plants in refrigerating machinery[14]) are based on relatively few plants, and thus their relative importance is small. The US-owned plants in the refrigerating machinery sector that performed poorly were mostly relatively small and young (a median age of 6 years) and over 72 per cent were established as greenfield plants throughout the period under consideration. Thus, it can be seen that they have suffered high rates of closing and new plants opening to maintain capacity and

[11] The poorly performing plants comprise almost equal numbers of some very young but large, greenfield SE Asian plants mostly located in government assisted areas, and Old Commonwealth plants that are relatively old, large, obtained through acquisition and located in government assisted areas (i.e. fairly typical branch-plants).

[12] Again these comprise a mix of Old Commonwealth and SE Asian plants. The former were by far the oldest in terms of their median ages (16 years), and above average in terms of their usage of manual workers employed in large (branch-type) plants. The SE Asian plants were the youngest in operation in the industry (average median age of 5 years), with two-thirds being acquired and one-third greenfield operations. They were only established/bought in the late 1980s/early 1990s and were relatively large and mostly located in government-assisted areas.

[13] These plants were young (median age of 5 years) comprising 50 percent acquired and 50 per cent greenfield operations. They were only started in the late-1980s/early 1990s, and were characterised as being relatively more manual worker orientated, capital intensive, large and located in the assisted areas (i.e. bearing most of the hall-marks of lower value-added branch plants).

[14] These comprised of old (median age of 20 years), large branch plants that were mostly acquired at the end of the 1970s.

presumably have experienced difficulties in terms of meeting the requirements of their parent organisations.

The SE Asian plants operating in the other electronic equipment sector (3444) that significantly under-performed were relatively young, with a median age of 6 (the lowest across all the ownership sub-groups), and 70 per cent were established as greenfield operations from the mid-1980s onwards (the rest being acquired during this same period). In addition, they were more likely to use higher proportions of manual workers, be more capital intensive, relatively large plants, and mostly be located in government assisted areas. As such, they bear many of the hallmarks of the typical branch-plant operation, which produce lower value-added and technologically mature goods (Harris, 1991).

The under-performing SE Asian plants in motor vehicles comprised of two fairly distinct sub-sets. Some 61 per cent of the plants were older, and relatively small, brownfield operations that were acquired during the early 1980s. The remaining 39 per cent of plants were young (median age of 5 years), very large, highly capital intensive and manual worker orientated, set-up as greenfield plants operating in the assisted areas. These most recent branch plants account for most of the output of this SE Asian sub-sector, and thus it can be assumed that the estimated 10 per cent lower level of total factor productivity is the result of initial assimilation problems associated with new greenfield operations (especially since there is evidence of significant catch-up of 3.8 per cent per annum during the 1986-1995 period).

The EU-owned plants in the aerospace sector that did less well were older (a median age of 14 years versus 8 years for all plants in the industry) and over 80 per cent were brownfield operations mostly acquired in the late 1980s and early 1990s (see Chapters 4 and 9 for a further discussion of acquisition). These plants were relatively more manual worker orientated and relatively small (e.g. half the median size of UK-owned plants), and on the basis of these characteristics it seems probable that there have been problems of assimilating these old, well-established plants into the newer, and presumably larger FDI operations of the controlling enterprises.

The US-owned plants that under-performed in the preparation of milk products industry were generally large, older plants than the industry median, mostly located in the old Development Areas of the UK and brought into production before 1970 (hence we cannot distinguish greenfield versus brownfield sites). These branch plants were mostly closed during the early to mid-1980s.

Lastly, the EU-owned plants in the cocoa and confectionery sector that were overall some 13.5 per cent less productive (but which caught-up significantly in the 1986-1995 period) were the oldest plants in the industry (median age of 15 years), over 76 per cent of which were acquired in the late 1980s. They had on average the highest levels of capital-per-worker in the industry, and were relatively large plants. Presumably these (fairly typical) branch plants were acquired in order to be 'turned around', and the controlling enterprises seem to have been fairly successful during the early 1990s with productivity gains of some 4.7 per cent per annum. The issue of acquisition by foreign owned firms is discussed in greater detail in Chapter 9.

Thus, in those sectors where foreign-owned plants did less well, it would appear that much of the explanation is likely to relate to short term assimilation problems and branch plant factors, based on analysis of the underlying characteristics of these plants. However, there are not sufficient data within the ARD to test this hypothesis.

7.3 Chapter summary

It can be seen that these results provide robust, empirical support to theories that state that foreign owned plants generally should be better particularly in the case of US investors. There are a few exceptions, though these are largely explained by the nature of branch plants, and by the likelihood of foreign investors experiencing (essentially cultural) problems of assimilation. Using a time trend that is linked to the upsurge in FDI from 1986, some evidence has been provided of where, in terms of industrial sectors, foreign owned plants are getting better or worse over time, relative to UK manufacturing plants. It was found that there is some evidence of catch-up in a number of industries. It can also be seen that the country which has the most consistently better performance than domestic plants is the US, which is in line with findings of other studies (c.f. Doms and Jensen, 1998; Criscuolo and Martin, 2002), and with *a priori* expectations that the US is at the technological frontier in most industries.

The results presented in this chapter have clear policy relevance in terms of advocating public support for attracting foreign direct investment. In addition there is some indication of some of the hindrances that face FDI, such as problems of cultural mis-match, which result in lower levels of productivity in the short run. This chapter has attempted to measure the direct productivity differences only, thus the impacts on domestic plants in terms of spillovers have not been included here. However, to try to measure spillovers without first establishing whether direct benefits from FDI actually exist might potentially confuse matters in terms of a justification for encouraging FDI since (as stated at the outset) if TFP is not significantly different or indeed is lower in some industries then it is difficult to see how FDI can have a positive impact on overall UK (manufacturing) productivity and thus growth. The problems of measuring spillovers have been discussed in Chapter 5 and they are conceptually and empirically complex. The following chapter now goes on to use a similar approach to the one used here to test for spillover from FDI at the plant level.

Chapter 8:

Indirect benefits from the presence of foreign plants[1]

8.0 Introduction

The previous chapter was concerned with detecting direct benefits from foreign ownership in UK manufacturing in the form of more productive (foreign) plants. This chapter aims to consider what impact, if any, foreign plants have on the productivity levels of domestic plants. Chapter 5 provided a review of the theoretical arguments in favour of productivity gains to domestic plants in the form of spillovers from FDI, and a discussion of existing empirical evidence of their presence. The benefits are thought to take the form of improvements in access to the frontier technology within the industry, improvements up and down the supply chains for intermediate good production and changes in working practices, the latter two being more generic are likely to transfer across industries. In addition there is a strong geographic dimension to their transmission. Productivity spillovers are regarded as a fundamental benefit from FDI and are often cited as a policy rationale for pro-FDI investment policies (*c.f.* http://www.invest.uk.com/).

This chapter outlines the analysis undertaken using the ARD and input-output tables for UK manufacturing to establish potential inter-industries linkages. Broadly, the approach adopted here is in line with the model specified by Aitken and Harrison (1999), however, here it is extended to incorporate the inter industry impacts which,

[1] This chapter is based on a paper co-authored with Professor Richard Harris, University of Newcastle, forthcoming in the *National Institute Economic Review*, 2004.

Kugler (2001) argues, are likely to be more pronounced, given the competitive nature of within industry relationships.

8.1 Data requirements and model specification

Again, the principal source of data (output, employment and capital stocks) is the ARD. Estimates of the capital stocks have been grossed up to obtain the percentage of industry plant and machinery stock located in foreign-owned plants in each year (for each 4-digit SIC industry). Estimates of the proportion of capital stock for each local authority area were also calculated, using foreign-owned plant and machinery capital stock across all industries in each area and each year, to proxy for agglomeration economies associated with the presence of foreign-owned plants.

To test for spillover effects between foreign- and domestically-owned plants in the 20 UK manufacturing industries, the following augmented log-linear Cobb-Douglas production function was estimated for each industry:

$$\ln y^d_{ijt} = \alpha \ln x^d_{ijt} + \beta \ln l^d_{ijt} + \gamma \ln k^d_{ijt} + \delta t + \theta_1 \sum_{i\in j} (k^f_{it} / \sum_{i\in j} k_{it}) + \theta_2 \sum_{i\in r} (k^f_{it} / \sum_{i\in r} k_{it}) + \sum_{m=1,..n} \theta_m \sum_{i\in m, m\neq j} (k^f_{imt} / \sum_{i\in m, m\neq j} k_{imt}) + a_{it} \qquad (8.1)$$

where i and t represent the i-th unit and the t-th year of observation, respectively, in industry j or m or local authority r; d and f denote domestic- and foreign-owned plants, respectively; y is real gross output; x is real intermediate inputs (i.e., gross output less gross value added); l is the number of employees; k is plant and machinery capital stock; and t is a time-index that starts in 1974. The variable associated with θ_1 measures the proportion of the industry's capital stock operated by foreign-owned plants,[2] and therefore is a proxy for intra-industry effects. In contrast, θ_2 is associated with the proportion of the capital stock operated by foreign-owned plants in local authority area *r*,[3] and covers all manufacturing industries. This is included in an effort to capture spatial agglomeration economies, discussed in Chapters 3 and 5. Finally, inter-industry spillovers are represented by the proportion of the capital stock under foreign control in up to *n* industries, where the latter are linked to industry *j* as identified in the 1990 UK Industry Input-Output tables made available by the ONS.[4]

As before, it is assumed that output, intermediate inputs, labour and capital are all potentially endogenous. The intra- and inter-industry measures are assumed exogenous to allow estimation without having to use a structural model involving more than one equation, although these too could potentially be endogenous. In particular, the intra-industry measures are likely to involve some form of endogenous feed-back (especially when FDI is small and growing rapidly). While in general the spillover terms are endogenous, some limited experimentation with lagged instruments was attempted for these variables. Generally, there was little change in the final results, or the model became unstable producing implausible results. The parameters to be estimated comprise the output elasticities α, β, γ, δ, while the θ are associated with spillover variables that were initially included and then removed if they were found to be not significant in a general-to-specific approach to estimation.

[2] Employment shares could also be used but when tested no substantial differences emerged in the results.

[3] This spatial unit was preferred as it is much closer to the notion of a local labour market than is a standard UK region (e.g., the SE of England). A description of county level data, based on the local authority classification is included in Chapter 3.

[4] The relevant 4-digit industries to include (via either forward- or backward linkages) were identified using a cut-off point that the industry must demand/supply at least 5 per cent of gross output in industry *j*.

Equation (8.1) was estimated using the GMM systems approach outlined in Chapter 6 and also used in the estimation process specified in Chapter 7.

8.2 Results

As in the case of testing for direct effects, the full set of results from estimating equation (8.1) for each industry are presented in Table 8.2 at the end of this chapter. In terms of diagnostics, again the Hausman test was used to test if the sampling procedure is exogenous (and thus weighting is unnecessary). The results confirm that this null hypothesis is satisfactorily rejected in all industries except engineers' small tools (as found previously). Furthermore, Pedroni tests for the null hypothesis that real gross output, intermediate inputs, capital and labour do not form a cointegration vector (using the panel- and group-ADF tests reported in Pedroni, 1999) were also calculated. In all cases, this null is rejected and therefore the regression results are not spurious. From the coefficients attached to capital, employment and intermediates in Table 8.2, it can be seen that these results are consistent with those estimated in the previous chapter (Table 7.2) and show slightly increasing returns to scale in all industries.

Given that the chief concern in this chapter is whether there is evidence of spillovers, a summary of the results (based on Table 8.2) is firstly reported in Table 8.1. In over one-third of the industries, there is no statistically significant evidence of an intra-industry effect on domestic plants. For those industries where there was an impact, some are positively affected by foreign-owned plants (concrete and cement, organic chemicals, electronic data processing, electronic sub-assemblies, aerospace, and the preparation of milk products), and in others the competition effect of foreign ownership was presumably stronger leading to an overall negative impact (pharmaceuticals, engineers' small tools, mechanical equipment, various food products, and certain paper and publishing industries). This is perhaps indicative of positive spillovers accruing to plants in the more competitive industries that have less product differentiation, though further testing of this hypothesis would be necessary.

In terms of agglomeration effects (mainly associated with such factors as local labour market external economies of scale – see Table 5.1), from the results obtained here there is no evidence of any spatial spillovers in two-thirds of the industries covered. In the 7 industries with significant effects, three experienced external economies while in four industries a larger local presence of foreign-owned plants resulted in external diseconomies prevailing. In particular, there appears to be no evidence of agglomeration economies in the high-tech electronics industries which suggests either such effects are not present or they are confined to a smaller number of local labour market areas than covered here (as discussed in Chapter 3). Whilst a relatively disaggregated measure of geography (local authority) was applied, there are also grounds to suggest that a more aggregated regional dimension might also provide further insight.

Inter-industry spillovers would seem to be particularly important in some industries that would be regarded as intermediate input producers, such as engineers small tools, and this may reflect both the extent to which such industries have strong forward and backward linkages and the presence of FDI in interrelated industries. However, there is no clear pattern in terms of which industries experienced spillovers, their extent (in terms of the number of industries linked), and the balance between positive and negative spillovers. Indeed, in a number of instances there is a positive link between a forward- or backward-linked industry and one of the 20 industries studied here, while in another estimation of equation (9.1) the impact of the same interrelated industry is negative (*cf.* the impact of SIC2210 – iron & steel – is positive on mechanical lifting and handling equipment and negative for refrigerating machinery, as Table 8.2 shows). What can be concluded, however, is that the evidence presented here (Table 8.1) shows that inter-industry spillovers are just as likely to be negative as positive; there is no clear evidence of an overall beneficial effect on UK manufacturing that results from (supply-side) linkages associated with FDI. This is also consistent with the technology sourcing rationale for FDI explored by Driffield and Love (2003) which argues that foreign owned firms are as likely to be seeking spillover benefits as imparting them.

Table 8.1: Summary of weighted system estimates of spillover effects based on Cobb-Douglas production function, 1974-1995: UK manufacturing (various industries).

Type of Spillover	Steel Wire (SIC2234)	Concrete, cement, plaster (SIC2437)	Ceramic goods (SIC2489)	Organic chemicals (SIC2512)	Pharma-ceutical products (SIC2570)	Engineers' small tools (SIC3222)	Mechanic-al equipment (SIC3255)	Refrigerat-ing machinery (SIC3284)	Electronic data processing (SIC3302)	Other electronic equipment (SIC3444)
Intra-industry	n.s.	+	n.s.	+	–	–	–	n.s.	+	n.s.
Agglomeration	n.s.	–	n.s.	–	+	n.s.	+	n.s.	n.s.	n.s.
Forward (+ive)	3	3	2	7		2	4	2		1
Forward (-ive)	5	2	1	2		3	1	3		
Backward (+ive)	2		2	2	4	10	8	2	1	
Backward (-ive)	1	1	3	4	1	10	2	3	1	2
Type of Spillover	**Electronic sub-assemblies (SIC3453)**	**Motor vehicles and their engines (SIC3510)**	**Aerospace equipment (SIC3640)**	**Preparation of milk products (SIC4130)**	**Cocoa, etc. confection-ery (SIC4214)**	**Miscellan-eous foods (SIC4239)**	**Packaging of paper and pulp (SIC4724)**	**Print/pub-lishing of periodicals (SIC4752)**	**Plastics semi-manufact-ures (SIC4832)**	**Other manufact-ures n.e.s. (SIC4959)**
Intra-industry	+	n.s.	+	+	–	–	–	–	n.s.	n.s.
Agglomeration	n.s.	n.s.	n.s.	+	–	n.s.	n.s.	–	n.s.	n.s.
Forward (+ive)	2			3	1	2	1	3	3	1
Forward (-ive)	2			4		5	1	2	3	3
Backward (+ive)	2	2	2	2	2	4	3	3	5	3
Backward (-ive)	4	1	2	4	2	2	1	2	2	4

See Table 8.2 for full details. + = positive effect; – = negative effect. All parameter estimates are significant at the 5 per cent level (or better)
n.s. not significant at 5 per cent level. Individual numbers represent the number of industries with significant parameter estimates.
Note when the sum of positive and negative forward/backward spillovers sums to greater then the number of industries in Table 8.2, this indicates that some industries had both forward and backward linkages to the industry being investigated.

8.3 Discussion

The literature discussed in Chapter 5 indicated that, it is generally accepted in the literature that spillovers from FDI occur and are beneficial to the host economy. For instance, Blomstrom *et al* (2000) summarise an extensive empirical literature and conclude:

> "...the evidence is convincing in showing the existence of FDI efficiency spillovers in host countries, although there is no strong consensus on the associated magnitudes" (p.28).

Other studies using aggregated and disaggregated UK data have also found positive impacts associated with intra-industry, inter-industry and spatial agglomeration effects, as proxied by the relative importance of FDI in associated industries and regions.

This chapter has used plant-level data for 20 UK manufacturing industries (1974-1995) and has included measures for intra-industry, inter-industry and agglomeration linkages at the local authority level of analysis. The proxies used to capture these effects are comparable to those employed by others – i.e. based on FDI shares (of capital stock)[5]. The results indicate no clear pattern in terms of which industries experienced spillovers, the extent of these (in terms of the number of industries linked), and the balance between positive and negative spillovers. Indeed, inter-industry spillovers are just as likely to be negative as positive and so there is no clear evidence of an overall beneficial effect on UK manufacturing that results from (supply-side) linkages associated with FDI.

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[5] It is acknowledged that employment shares could also have been used, however, it was found that it made very little difference to the findings.

Thus, this chapter concludes that FDI spillovers, where they occur, are not automatically positive, and thus from a policy perspective, the assumption that FDI is beneficial to the host region is open to question. However, it is also apparent that the standard methodology for measuring spillovers effects is also open to criticism. Most importantly, the linkages between FDI plants and domestic plants are difficult to proxy[6] and the methodology currently applied here, and in many other studies, may be regarded as inadequate (or at least involves the use of poor proxies) for explaining the indirect effects of foreign firms on domestic firms. It is possible that in some cases, FDI plants may buy and sell mostly (or even exclusively) from other parts of the multinational company (wherever they may be located). This would clearly limit the opportunities for detecting spillovers.

[6] A point also made by Wheeler and Mody, 1992.

Table 8.2: Weighted system estimates of plant-level dynamic Cobb-Douglas production function, 1974-95: various UK manufacturing industries

Dependent variable: *ln* real gross output y_t	Steel Wire (2234)		Other building products of concrete, cement, plaster (2437)		Ceramic goods (2489)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
ln real gross output (y_{it-1})	0.135	3.04	0.225	7.88	0.334	5.40
ln real intermediate input (x_{it})	0.809	44.40	0.682	33.40	0.754	13.90
ln real intermediate input (x_{it-1})	-0.110	-2.83	-0.154	-6.41	-0.257	-4.94
ln employment (l_{it})	0.172	8.54	0.313	15.40	0.268	6.05
ln employment (l_{it-1})	-0.016	-2.35	-0.045	-6.28	-0.088	-5.37
ln P&M capital stock (k_{it})	0.120	2.28	0.119	2.77	0.163	2.47
ln P&M capital stock (k_{it-1})			-0.018	-3.22	-0.014	-2.35
t			0.014	7.90	0.004	1.24
Constant	-0.244	-3.19	-0.928	-10.30	-0.110	-0.466
Spillover impacts						
Intra-industry			0.010	2.87		
Agglomeration			-0.001	-2.70		
Inter-industry						
SIC2220					-0.029	-6.83
SIC2235	0.021	7.88			0.011	2.72
SIC2247	0.005	4.71				
SIC2310					0.021	2.93
SIC2420			-0.088	-11.20		
SIC2551					-0.004	-2.03
SIC3111			-0.002	-2.30		
SIC3112			-0.007	-4.94		
SIC3137	0.005	2.89				
SIC3138			0.013	4.83		
SIC3161	-0.003	-3.34				
SIC3162	-0.002	-4.78				
SIC3163	-0.002	-5.16				
SIC3284	-0.006	-5.51				

Dependent variable: *ln* real gross output y_t	Steel Wire (2234)		Other building products of concrete, cement, plaster (2437)		Ceramic goods (2489)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
SIC3288	0.004	6.80				
SIC3510			0.004	6.75		
SIC3522					0.002	2.35
SIC3523	-0.007	-3.67				
SIC3530			0.002	3.30		
SIC4728					-0.003	-3.35
SIC4751					-0.003	-2.20
SIC4753					0.022	6.56
Sargan test (P-value)	245.200	[0.958]	522.5	[0.486]	188.700	[0.211]
m1 (P-value)	-4.633	[0.000]	-6.603	[0.000]	-4.851	[0.000]
m2 (P-value)	-1.306	[0.192]	-1.154	[0.248]	0.361	[0.718]
Hausman χ^2 test (P-value)	12.097	[0.021]	8.066	[0.092]	28.874	[0.000]
Panel ADF statistic (P-value)	– 17.866	[0.000]	-30.073	[0.000]	-18.478	[0.000]
Group ADF statistic (P-value)	-27.954	[0.000]	-76.620	[0.000]	-66.556	[0.000]
Instruments	Δt–1, t–2		Δt–1, t–2		Δt–1, t–2	
No. of units	266		579		236	
No. of observations	2526		5267		2655	

Notes: (UK-owned plants only, significant variables only) the samples are unbalanced (weighted) panels estimated in the DPD algorithm in PcGive 10; all t-values are based on two-step robust standard errors; m1 and m2 are tests for first and second order serial correlation; the GMM estimator has the instruments (for x, l and k) dated as shown.

Table 8.2 continued...

Dependent variable:	Organic chemicals, not pharmaceutical (2512)		Pharmaceutical products (2570)		Engineers' small tools (3222)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
ln real gross output (y_{it-1})	0.270	9.41	0.515	14.60	0.234	6.29
ln real intermediate input (x_{it})	0.897	51.8	0.677	13.60	0.456	10.7
ln real intermediate input (x_{it-1})	-0.230	-10.2	-0.405	-15.20	-0.125	-5.05
ln employment (l_{it})	0.105	5.95	0.315	6.14	0.509	10.5
ln employment (l_{it-1})	-0.036	-3.24	-0.094	-6.45	-0.035	-2.69
ln P&M capital stock (k_{it})	0.089	2.66	0.143	2.64	0.121	2.41
ln P&M capital stock (k_{it-1})			-0.018	-2.31		
t			0.016	3.97	0.048	3.36
Constant	-1.322	-7.49	-0.316	-1.05	-0.018	-7.13
Spillover impacts						
Intra-industry	0.008	4.29	-0.015	-4.21	-0.038	-5.49
Agglomeration	-0.001	-1.60	0.001	1.64		
Inter-industry						
SIC2234					0.007	1.79
SIC2235					0.038	3.30
SIC2511	0.007	4.74				
SIC2512	0.008	4.29	0.005	3.85		
SIC2513	-0.004	-5.36				
SIC2514	-0.005	-11.2				
SIC2516	0.048	9.25				
SIC2552	0.009	4.85				
SIC2562	0.005	2.95				
SIC2565	0.015	6.25				
SIC2567	0.009	1.93				
SIC2568	0.005	8.52				
SIC2569	-0.012	-7.59				
SIC2570	0.021	7.72				

Notes continued: The Hausman (1978) test is for the exogeneity of the (stratified) sampling procedure. The Panel- and Group-ADF tests are for cointegration of real gross output, real intermediate inputs, employment and the real capital stock based on Pedroni (1999).

Table 8.2 continued...

Dependent variable: *ln* real gross output y_t	Organic chemicals, not pharmaceutical (2512)		Pharmaceutical products (2570)		Engineers' small tools (3222)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
SIC3111					0.024	4.01
SIC3112					0.018	3.20
SIC3120					0.021	2.17
SIC3137					-0.034	-2.54
SIC3138					-0.074	-7.16
SIC3164	0.004	2.54	0.002	2.91		
SIC3244	-0.040	-5.38				
SIC3245	-0.010	-4.49				
SIC3246	-0.005	-5.58				
SIC3281					-0.010	-1.97
SIC3283					-0.008	-3.07
SIC3284					-0.055	-7.18
SIC3285					0.024	4.88
SIC3286					-0.006	-4.56
SIC3287					-0.004	-1.40
SIC3288					0.015	6.70
SIC3289					0.111	7.81
SIC3510					-0.022	-5.64
SIC3521					0.034	5.86
SIC3522					-0.011	-5.74
SIC3523					-0.033	-4.83
SIC3530					0.016	7.37
SIC4723			-0.011	-3.53		
SIC4725			0.010	3.13		
SIC4836			0.028	5.35		

Dependent variable: *ln* real gross output y_t	Organic chemicals, not pharmaceutical (2512)		Pharmaceutical products (2570)		Engineers' small tools (3222)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
Sargan test (P-value)	108.1	[1.000]	166.9	[0.999]	165.0	[0.295]
m1 (P-value)	-4.961	[0.000]	-6.654	[0.000]	-8.461	[0.000]
m2 (P-value)	-1.609	[0.108]	1.505	[0.132]	0.171	[0.864]
Hausman c^2 test (P-value)	2081.63 9	0.00	19.305	0.00	4.087	0.25
Panel ADF statistic (P-value)	-12.559	0.00	-21.317	0.00	-29.328	0.00
Group ADF statistic (P-value)	-44.458	0.00	-67.661	0.00	- 138.157	0.00
Instruments	Δt−1, t−2		Δt−1, t−2		Δt−3, t−4	
No. of units	127		179		461	
No. of observations	1287		1890		3786	

Table 8.2 continued...

Dependent variable:	Mechanical lifting and handling equipment (3255)		Refrigerating machinery and air conditioning (3284)		Electronic data processing equipment (3302)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
ln real gross output (y_{it-1})	0.197	7.07	0.164	5.75	0.514	9.68
ln real intermediate input (x_{it})	0.632	21.1	0.675	27.9	0.646	11.2
ln real intermediate input (x_{it-1})	-0.141	-6.88	-0.114	-4.61	-0.399	-7.81
ln employment (l_{it})	0.326	9.06	0.350	14.30	0.264	4.54
ln employment (l_{it-1})	-0.024	-4.39	-0.052	-8.35	-0.047	-2.99
ln P&M capital stock (k_{it})	0.131	2.94	0.112	2.51	0.134	2.63
ln P&M capital stock (k_{it-1})			-0.025	-11.50		
t	0.032	7.42			0.028	6.48
Constant	-0.887	-5.63	-0.891	-7.84	-1.196	-4.90
Spillover impacts						
Intra-industry	-0.013	-6.68			0.005	3.48
Agglomeration	0.001	1.85				
Inter-industry						
SIC2210	0.044	5.28	-0.011	-4.85		
SIC2234	0.017	10.4				
SIC2235			0.023	4.72		
SIC3111			-0.010	-4.98		
SIC3112	0.016	5.66				
SIC3120	-0.039	-13.8			-0.016	-2.98
SIC3137			0.037	5.56		
SIC3138	0.016	3.68	-0.008	-3.07	0.048	5.05
SIC3204	0.008	6.85				
SIC3205	0.015	8.83				
SIC3251			0.020	8.72		
SIC3255			-0.018	-6.19		
SIC3281	0.014	7.97				
SIC3283	0.009	4.56				
SIC3288	-0.012	-7.90				

Dependent variable: *ln* real gross output y_t	Mechanical lifting and handling equipment (3255)		Refrigerating machinery and air conditioning (3284)		Electronic data processing equipment (3302)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
SIC3420			-0.006	-5.44		
SIC3610			-0.013	-2.33		
SIC3640			0.048	6.80		
Sargan test (P-value)	313.6	[0.173]	353.600	[0.745]	125.800	[1.000]
m1 (P-value)	-7.482	[0.000]	-4.716	[0.000]	-4.801	[0.000]
m2 (P-value)	2.004	[0.005]	-1.485	[0.137]	-0.426	[0.670]
Hausman χ^2 test (P-value)	50.846	0.00	41.717	0.00	12.520	0.01
Panel ADF statistic (P-value)	-34.178	0.00	-29.522	0.00	-6.398	0.00
Group ADF statistic (P-value)	-93.216	0.00	-84.743	0.00	-62.703	0.00
Instruments	Δt–3, t–4		Δt–1, t–2		Δt–1, t–2	
No. of units	399		392		133	
No. of observations	3268		3310		929	

Table 8.2 continued...

Dependent variable:	Other components for electronic equipment (3444)		Active components and electronic sub-assemblies (3453)		Motor vehicles and their engines (3510)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
ln real gross output (y_{it-1})	0.181	3.63	0.223	5.64		
ln real intermediate input (x_{it})	0.502	9.61	0.549	11.20	0.428	2.70
ln real intermediate input (x_{it-1})	-0.114	-2.47	-0.094	-2.55	0.057	2.47
ln employment (l_{it})	0.458	7.67	0.414	7.45	0.506	3.36
ln employment (l_{it-1})	-0.025	-2.26	-0.072	-3.76		
ln P&M capital stock (k_{it})	0.129	1.90	0.108	3.35	0.193	2.08
ln P&M capital stock (k_{it-1})			-0.013	-4.53	-0.066	-2.19
t	0.026	6.92	0.086	6.95		
Constant	-1.500	-5.48	-1.063	-2.86	-1.224	-2.27
Spillover impacts						
Intra-industry			0.034	5.53		
Agglomeration						
Inter-industry						
SIC2210					0.055	2.17
SIC2246	-0.001	-5.22				
SIC2247			-0.033	-7.43		
SIC2310						
SIC2565			-0.054	-8.02		
SIC2569			-0.016	-4.63		
SIC3112	-0.010	-4.91	0.031	7.22		
SIC3120			0.069	5.40	-0.022	-2.76
SIC3138			-0.024	-3.08	0.015	1.72
SIC3301			0.016	8.03		
SIC3302			0.003	2.98		
SIC3441	0.003	2.75				
SIC3442			-0.014	-4.55		
SIC3443			-0.125	-6.61		

Dependent variable: *ln* real gross output y_t	Other components for electronic equipment (3444)		Active components and electronic sub-assemblies (3453)		Motor vehicles and their engines (3510)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
Sargan test (P-value)	279.5	[0.362]	127.300	[0.987]	70.29	[0.999]
m1 (P-value)	-2.448	[0.014]	-6.024	[0.000]	-3.117	[0.002]
m2 (P-value)	0.367	[0.713]	2.493	[0.013]	-0.540	[0.590]
Hausman χ^2 test (P-value)	48.628	0.00	8.892	0.03	17.100	0.00
Panel ADF statistic (P-value)	-23.785	0.00	-14.341	0.00	-22.453	0.00
Group ADF statistic (P-value)	-75.241	0.00	-57.748	0.00	-59.334	0.00
Instruments	Δt−1, t−2		Δt−2, t−3		Δt−8, t-9	
No. of units	289		142		166	
No. of observations	2621		1193		1501	

Table 8.2 continued...

Dependent variable:	Aerospace equipment (3640)		Preparation of milk and milk products (4130)		Cocoa, chocolate and sugar confectionery (4214)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
ln real gross output (y_{it-1})	0.358	4.73	0.210	3.28	0.265	4.18
ln real intermediate input (x_{it})	0.648	6.25	0.878	80.60	0.663	10.30
ln real intermediate input (x_{it-1})	-0.216	-2.97	-0.172	-3.00	-0.161	-3.08
ln employment (l_{it})	0.313	5.12	0.125	10.30	0.298	5.64
ln employment (l_{it-1})	-0.073	-5.68	-0.031	-3.94	-0.056	-4.41
ln P&M capital stock (k_{it})	0.136	2.30	0.090	2.16	0.158	2.50
ln P&M capital stock (k_{it-1})	-0.060	-2.70			-0.044	-2.44
t	0.017	3.12	0.021	3.97	0.024	7.17
Constant	-1.247	-4.70	-0.593	-4.32	-0.704	-3.19
Spillover impacts						
Intra-industry	0.006	2.41	0.020	5.11	-0.001	-4.94
Agglomeration					-0.001	-1.76
Inter-industry						
SIC3120	-0.009	-2.86				
SIC3164					0.003	3.52
SIC3286	0.002	2.27				
SIC3289	0.017	2.53				
SIC3443	-0.008	-1.69				
SIC4123			-0.009	-6.11		
SIC4126			-0.002	-2.75		
SIC4196			-0.046	-2.93		
SIC4197			-0.008	-8.45	0.005	6.40
SIC4200					-4.388	-5.30
SIC4214			0.007	6.59		
SIC4221			0.011	5.44		
SIC4222			-0.008	-7.19		
SIC4239			0.020	5.89		

Dependent variable: *ln* real gross output y_t	Aerospace equipment (3640)		Preparation of milk and milk products (4130)		Cocoa, chocolate and sugar confectionery (4214)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
SIC4283			-0.011	-7.03		
SIC4723			-0.025	-5.20		
SIC4724			-0.019	-7.77		
SIC4725			0.033	6.44		
SIC4728			-0.004	-3.33		
SIC4834			0.011	5.56		
SIC4835					-0.006	-3.23
SIC4836					0.032	8.32
Sargan test (P-value)	98.57	[1.000]	386.60	[0.092]	166.100	[0.460]
m1 (P-value)	-3.314	[0.001]	-5.085	[0.000]	-4.147	[0.000]
m2 (P-value)	0.772	[0.440]	0.287	[0.774]	-0.843	[0.399]
Hausman χ^2 test (P-value)	17.100	0.00	136.098	0.00	58.278	0.00
Panel ADF statistic (P-value)	-28.199	0.00	-26.130	0.00	-11.356	0.00
Group ADF statistic (P-value)	-72.718	0.00	-74.255	0.00	-41.523	0.00
Instruments	Δt−1, t−2		Δt−2, t−3		Δt−2, t−3	
No. of units	111		465		185	
No. of observations	1043		5132		1813	

Table 8.2 continued...

Dependent variable:	Miscellaneous foods (4239)		Packaging products of paper and pulp (4724)		Printing and publishing of periodicals (4752)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
ln real gross output (y_{it-1})	0.266	6.08			0.374	9.10
ln real gross output (y_{it-2})						
ln real intermediate input (x_{it})	0.784	37.80	0.694	11.5	0.669	23.10
ln real intermediate input (x_{it-1})	-0.188	-5.46			-0.274	-8.47
ln employment (l_{it})	0.245	11.10	0.237	3.71	0.337	10.2
ln employment (l_{it-1})	-0.080	-6.96			-0.088	-8.51
ln P&M capital stock (k_{it})	0.149	1.96	0.103	2.32	0.163	2.36
ln P&M capital stock (k_{it-1})	-0.020	-1.83				
t	0.061	6.30	0.005	1.84	0.026	5.30
Constant	0.443	2.78	-0.631	-2.32	-1.242	-6.24
Spillover impacts						
Intra-industry	-0.021	-9.39	-0.003	-1.71	-0.003	-3.88
Agglomeration					-0.002	-2.95
Inter-industry						
SIC2562					0.002	2.44
SIC2563					-0.004	-2.57
SIC2565					0.005	2.98
SIC2567					-0.005	-3.87
SIC2569					0.011	3.93
SIC3164	0.007	8.44				
SIC3302			-0.003	-3.21		
SIC3510					-0.007	-3.21
SIC3521					0.043	5.79
SIC3523					0.012	2.30
SIC3530					-0.004	-3.67
SIC4121	-0.034	-5.50				
SIC4122	-0.048	-12.50				

Dependent variable: *ln* real gross output y_t	Miscellaneous foods (4239)		Packaging products of paper and pulp (4724)		Printing and publishing of periodicals (4752)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
SIC4126	-0.002	-3.44	0.002	2.24		
SIC4147	0.010	6.53				
SIC4150	0.030	10.50				
SIC4196	-0.181	-9.19				
SIC4197	-0.038	-12.60				
SIC4239					0.019	6.05
SIC4832	-0.040	-13.20	0.008	2.64		
SIC4833	0.012	11.80				
SIC4834	0.031	13.9	-0.009	-6.60		
SIC4835	-0.023	-12.30	0.007	3.04		
SIC4836	0.038	8.48	0.031	7.33		
Sargan test (P-value)	165.200	[0.481]	132.0	[0.972]	326.300	[0.500]
m1 (P-value)	-5.946	[0.000]	-4.614	[0.000]	-7.252	[0.000]
m2 (P-value)	1.442	[0.149]	-0.924	[0.355]	1.983	[0.047]
Hausman χ^2 test (P-value)	25.010	0.00	146.520	0.00	6134.19 7	0.00
Panel ADF statistic (P-value)	-41.363	0.00	-13.269	0.00	-26.195	0.00
Group ADF statistic (P-value)	-84.379	0.00	-36.565	0.00	-99.129	0.00
Instruments	Δt−2, t−3		Δt−2, t−3		Δt−1, t−2	
No. of units	302		143		349	
No. of observations	3125		1440		2960	

Table 8.2 continued...

Dependent variable:	Plastics semi-manufactures (4832)		Other manufactures not elsewhere specified (4959)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
ln real gross output (y_{it-1})	0.386	8.36	0.274	4.32
ln real intermediate input (x_{it})	0.799	35.40	0.715	18.50
ln real intermediate input (x_{it-1})	-0.317	-8.13	-0.208	-3.69
ln employment (l_{it})	0.208	8.55	0.285	5.51
ln employment (l_{it-1})	-0.071	-6.92	-0.041	-1.64
ln P&M capital stock (k_{it})	0.168	2.61	0.102	1.84
ln P&M capital stock (k_{it-1})	-0.013	-1.64		
t	0.065	9.00	0.004	0.68
Constant	-0.753	-5.41	-0.521	-2.17
Spillover impacts				
Intra-industry				
Agglomeration				
Inter-industry				
SIC2514	0.006	8.25		
SIC2515	-0.005	-7.10		
SIC2581	0.010	5.86		
SIC2582	-0.037	-8.95		
SIC3161	-0.023	-8.40	0.007	3.47
SIC3162	0.011	7.84	-0.003	-2.37
SIC3163	0.003	4.06		
SIC3165	0.023	7.61		
SIC3169	0.025	6.82	0.011	2.94
SIC3521	0.018	4.19		
SIC3522	-0.009	-4.67		
SIC3523	0.112	9.14		
SIC3530	-0.008	9.04		
SIC4710			-0.008	-5.00
SIC4721			-0.009	-4.15
SIC4722			0.003	4.98
SIC4724			-0.019	-7.99
SIC4752			-0.003	-2.09
SIC4753			0.046	6.60

Dependent variable:	Plastics semi-manufactures (4832)		Other manufactures not elsewhere specified (4959)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
SIC4754			-0.024	-3.45
SIC4835			-0.004	-2.17
Sargan test (P-value)	178.400	[0.994]	172.500	[0.328]
m1 (P-value)	-5.053	[0.000]	-5.156	[0.000]
m2 (P-value)	0.889	[0.374]	1.937	[0.053]
Hausman χ^2 test (P-value)	702.129	0.00	22.215	0.00
Panel ADF statistic (P-value)	-25.879	0.00	-16.812	0.00
Group ADF statistic (P-value)	-53.318	0.00	-47.387	0.00
Instruments	Δt−1, t−2		Δt−2, t−3	
No. of units	190		210	
No. of observations	1569		1658	

Chapter 9:

Foreign acquisitions in UK manufacturing[1]

9.0 Introduction

The previous two chapters considered the direct and indirect productivity benefits from the presence of foreign owners in manufacturing and find mixed evidence though are generally supportive of the idea that foreign owned plants have higher productivity in the long run. Whilst there is some evidence that in a number of industries foreign owned plants are more productive and that in some industries they do result in improvements to domestic plant productivity levels, there are no clear patterns to these benefits. So why then, are many foreign owned plants considered to be more successful than domestic plants in the UK? It may be that the decision criteria for entry and the mode of entry have a bigger role to play in future performance than previously thought. In this final chapter of the thesis the GMM approach to production function estimation is applied to acquisitions by foreign owned plants in order to explore the nature of foreign firm market entry. Specifically, this chapter looks at the performance of plants before and after acquisition, to see what impact (if any) becoming foreign has on plant level productivity.

9.1 Motivations for changes in ownership

The mode of entry choices available to foreign firms entering the UK were discussed to some extent in Chapter 2. Basically, there are three choices available - franchises,

[1] This chapter is based on joint work with Richard Harris that has been published in the *Review of Economics and Statistics*, 2002.

licensing or direct market entry. For reasons already discussed, the choices available to them are likely to be affected by the nature of the firm-specific advantage or asset they possess. Acquiring capacity within a host nation is preferred when ownership advantages are strong enough to overcome the various spatial barriers to entry (Markusen, 1995; Dunning, 1993). These advantages include economies of scale and scope, brand names, in the case of very differentiated markets, management know-how as well as those that may be exploited at several locations without incurring additional costs (Pfaffermayr, 1999). An alternative explanation for entry to a host market is that of asset-seeking FDI (Wesson, 1999; Dunning 1998), or technology sourcing (Driffield and Love, 2003). This suggests that foreign owned firms hope to create advantages for themselves by acquiring and internalising valuable assets in the host nation. This more aggressive form of foreign acquisition is more likely to result in brownfield acquisition, though this is not without its costs. Brownfield acquisitions are likely to require substantially more efforts at obtaining trust and there are also likely to be costs associated with adapting existing technologies and production techniques to their purposes.

There is also a body of literature devoted to reasons for ownership change within the industrial organisation literature on mergers and acquisitions. This focussed initially on the concern that changes in ownership would affect or be driven by changes in the concentration of market power, which would have implications for economic efficiency. The work of Meade (1968) began much of the discussion, with the assumption that takeovers and mergers were a form of natural selection, resulting in the replacement of poor management as 'bad' plants were taken over by the more efficient surviving firms. This theory predicts that the plants that would be vulnerable to takeover would be the least efficient ones (Jensen, 1988). The assumption following from this theory therefore is that post-acquisition, the plant should improve its performance as it is now subject to more competent management. This is referred to as the managerial discipline hypothesis.

An extension of this approach is taken by Lichtenberg and Siegel (1987; 1990), who argue that changes in plant ownership are driven by lapses in efficiency, so that plants then look for better matches with an enterprise that is better able to improve its performance. Drawing from labour economics, they compare this with the theory of job turnover, where workers search for better job matches. The implication of this model is also that following takeover, performance should improve and there should be improvements in productivity over time as the most efficient plants survive into the long run.

Work in this area carried out in the US suggests that these neoclassical theories of resulting improvements in productivity do not fully explain the causes of changes in ownership, or the consequences. Many empirical analyses of post-acquisition performance have found that there have not been the expected improvements in performance. Ravenscraft and Scherer (1987) and Matsusaka (1993) found that acquired firms were highly profitable before acquisition, but experienced little or no gain following acquisition, and Ravenscraft and Scherer (1989) found no evidence that acquisition improved plant performance.

Alternative theories have been put forward, by McGuckin and Nguyen (1995), who considered the motivation of acquisition to be driven by a desire to acquire operating efficiency rather than through gains via managerial discipline. Using the LRD they found that plants with higher productivity were more likely to change ownership. This operational efficiency theory implies that plants with high productivity levels will be vulnerable to takeovers and whilst it assumes that there will be plant level improvements in productivity post acquisition, this may not be the case in the short run (due to teething problems, for example).

The mode of entry, be it greenfield (the building of a new site) or brownfield (the purchase of an existing site), will depend on the nature of the firm specific advantage and the market conditions. Hennart and Park (1993) argue that if the multinational firms' specific advantage is associated with its management system, then a greenfield site may be less risky in terms of organisational control. In this way, firms do not have to inherit trade unions or existing working practices that may be less efficient than those they wish to follow. Indeed, O'Huallachain and Reid (1997), in their study of Japanese entry to the US, found that this was the chief reason for opting for greenfield entry into the motor vehicle sector.

In contrast, brownfield acquisitions are likely to be favoured if the entering firm has less experience of the host country or if they are entering a host nation to produce a product they have not previously produced at home. Brownfield sites tend to be chosen when multinationals are relatively more risk averse and wish to establish capacity in a host nation by acquiring plants with comparatively superior productivity levels and with technological characteristics that match more closely their own use of technology (technology distance). Otherwise, FDI is likely to involve excessive costs in adapting and modifying existing plant technology. Wesson (1999) states that,

> '..in order for asst-seeking FDI to be profitable, it must be the case that...local assets have greater value when combined with some asset already possessed by the investing firm than they do in the hands of local rivals. If not, local firms would be able to exploit the value of the local assets more efficiently than a foreign investor' (pp.2-3).

Given this, we would expect to see brownfield sites improve following foreign acquisition. There is an expectation, however that foreign multinationals are unlikely to seek to acquire failing plants, particularly within the asset seeking theoretical framework. In addition, it is important to acknowledge that even though better plants may be acquired, there is likely to be short run problems with assimilating their acquisitions.

Therefore, two competing theories of reasons for acquisitions exist that lead to different predictions as to the relative productivity levels of the acquired plant and their subsequent performance, post-acquisition. Multinational corporations are likely to acquire plants for different reasons to domestic acquisitions, in addition, there are also likely to be industry differences, dependent on product life-cycle differences. These concepts are therefore explored further in the sub-sections below.

9.2 Model specification

This model differs in specification from the previous two models, in that firstly in concentrates on the whole of manufacturing (and not the sub-sample of 20 industries that have been considered in the previous two chapters), although it focuses on all plants that changed ownership during 1987-1992. In addition, plant performance in the five years prior to acquisition is also of interest, given that the aim is to consider the impact of ownership change on their performance. Table 9.1 contains details of the sample used. It can be seen that the UK plants dominate still, and in contrast to the stock of capital foreign owned, the EU has the highest number of acquisitions of all foreign acquirers.

Table 9.1: Number of acquired plants, 1987-92 (excluding greenfield purchases)

Year	Foreign owned				UK owned	Total
	EU	US	RoW	Total	Total	
1987	151	20	23	194	1057	1251
1988	42	60	43	145	933	1078
1989	110	63	33	206	1093	1299
1990	87	32	22	141	1624	1765
1991	144	68	30	241	1204	1445
1992	85	66	10	162	789	951
Total	619	309	161	1089	6700	7789

In 1986, over 14 per cent of manufacturing employees worked in plants that changed ownership. In the decade that followed, this figure averaged out to only 8 per cent, per year. After 1987, there was a significant rise in acquisitions by foreign owned enterprises, accounting for around 14 per cent of employees in plants that changed ownership after 1989. Changes after 1985 from foreign to UK ownership accounted for only 4 per cent of employment in those plants that were subject to any ownership change. For the 1982-1986 and the 1993-1995 periods, only the plants that existed during all or some of the 1987-1992 period are included. Plants closing before 1987 or opening after 1992 are dropped from the analysis since they are not comparable with the plants that exist in the period of interest.

All other plants existing between 1987-1992 that were not acquired by the UK or foreign owned sectors during this period are classified into 6 other subgroups for comparisons with those unites that were acquired. Hence, the eight subgroups that span the entire dataset cover (i) those plants that were foreign-owned throughout 1982-1992 (2.7 per cent of the observations in the sample dataset used in the model below); (ii) UK-owned single plant enterprises (14.1 per cent of observations); (iii) those plants that did not change ownership during 1982-1992 (13.4 per cent of observations); (iv) those plants that were acquired by UK-owned enterprises during 1982-1986 (15.1 per cent of observations); (v) those plants that were acquired by foreign-owned enterprises during 1987-1992 (1.5 per cent of observations); (vi) those plants that were acquired by foreign owned enterprises during 1987-1992 (3.4 per cent of observations);[2] (vii) those plants that were acquired by UK-owned enterprises during 1987-1992 (19.1 per cent of observations); and (viii) those plants that did not change ownership during 1982-1992 and were owned by UK multi-plant firms that did not sell plants to the foreign-owned sector during 1982-1992 (30. 7 per cent of observations)[3].

The performances of the sub-groups are compared on the basis of productivity (TFP) levels, in line with the previous empirical chapters, and discussed in greater detail in Chapter 6. A pooled Cobb-Douglas production function was estimated that allowed for each of the 8 sub-groups to have different parameter estimates. In addition, various dummy variables covering the sub-groups of interest (i.e., those plants acquired by the UK- and foreign-owned sectors between 1987-1992) were also

[2] In the subsequent model, this sub-group 6 is sub-divided further by country of ownership (*c.f.* Table 9.1)

[3] Plants that changed ownership more than once and which could have belonged to more than one of the sub-groups 4 to 7 were assigned to sub-group 4 or 5 if they ever met the relevant criteria (with sub-group 4 having preference over sub-group 5, when both criteria were met).

included to test whether country of ownership of the acquiring enterprise matters. The model also allows for differential impacts following acquisition. The following dynamic specification is used, which allows for an autoregressive error term within an unbalanced panel-data model, similar to the previous two models in structure:

$$\ln Y_{it} = \beta_0 + \sum_{j=1}^{4}\pi_{1j}x_{jit} + \sum_{j=1}^{4}\pi_{2j}x_{ji,t-1} + \sum_{l=1}^{7}\sum_{j=1}^{4}\pi_{3j}(D_l x_{jit}) + \sum_{l=1}^{7}\sum_{j=1}^{4}\pi_{4j}(D_l x_{ji,t-1}) + \pi_5 \ln Y_{i,t-1}$$
$$+ \sum_{l=1}^{5}\lambda_l D_l + \sum_{k=1}^{4} \kappa_k ACQ_k + \sum_{k=1}^{4} \kappa_k^{*}(SIZE_k ACQ_k) + \sum_{t=87}^{92}\sum_{m=1}^{2} \gamma_m^t AQYR_m^t$$
$$+ \sum_{n=1}^{10}\varsigma_n REG_n + \sum_{p=1}^{107}\tau_p IND_p + (1-\pi_5)\upsilon_i + (1-\pi_5 L)\vartheta_t + \omega_{it} \qquad (9.1)$$

where the subscripts i and t represent the i-th plant and the t-th year of observation, respectively;

Y represents real gross output (in £ million 1990 prices);

x_1 represents the logarithm of total employment, e ;

x_2 represents the logarithm of plant and machinery capital stock (in £ million 1990 prices), k;

x_3 represents the logarithm of intermediate inputs (in £ million 1990 prices), m;

x_4 represents a time trend to take account of technical progress, t;

D_l is a dummy variable taking on a value of 1 for each sub-group (l = 1, .. 7) with those owned by UK multi-plant firms that did not sell any plants to the foreign-owned sector during 1982-1992 forming the reference group;

ACQ are dummy variables taking on a value of 1 depending on whether plants that were acquired during 1987-92 were EU-, US-, RoW- or UK-owned[4];

[4] Note, aggregating those plants belonging to the sub-groups ACQ_1 to ACQ_3 is equal to the overall sub-group 'acquired by foreign-owned enterprise 1987-92' (sub-group D_6) while ACQ_4 is equivalent to D_7

SIZE is a dummy variable taking on a value of 1 if the plant acquired during 1987-92 employed 500 or more employees (as such it tests the hypothesis that there are different motives for acquiring larger plants);

ACQYR are dummy variables for each of the 6 years 1987-1992 that take on a value of 1 if the plant was acquired in that year, separately for foreign- and UK-owned (m = 1,2);

REG_n is a dummy variable if the plant is located in the standard UK region n (n = 1,..., 10);

IND_p is a dummy variable if the plant belongs to 3-digit SIC p (p = 1,..., 107); and

the composite error term has three elements with υ_i affecting all observations for cross –section plant i, ϑ_t affects all plants for time period t, and ω_{it} affects only plant i during period t[5].

In all, there are 24 non-linear (common factor) restrictions (e.g., $\pi_{21} = -\pi_{11}\pi_5$) implied in equation (9.1) these were tested for, and, where appropriate, imposed. The model was estimated using the GMM systems approach, explained in Chapter 6. Once again, all data were weighted to ensure that the samples are representative of the population of UK manufacturing plants.

9.3 Results

The detailed results obtained from estimating equation 9.1 for all manufacturing industries and for three sub-sectors are presented in Table 9.3; however firstly, Table 9.2 provides details on just the sub-group dummies, as well as the results obtained

[5] In equation (9.1), L is the lag operator.

after imposing various restrictions to collapse the model to a simpler version.[6] Since the parameter estimates for κ_k^* were always insignificant, and since the full model including the ($SIZE_k \times ACQ_k$) variables provided significantly inferior results (in terms of model diagnostics), $\kappa_k^* = 0$ is imposed in the model reported. Thus there is no evidence to support the hypothesis that the motive for acquisitions (in terms of their productivity) during 1987-1992 by either foreign- or UK-owned enterprises differed for larger plants.[7] The various models estimated appear to be well-specified. The common factor restrictions are not rejected, and the Sargan (χ^2) test for over-identifying restrictions is not able to reject the null that the instrument set is valid.

The 'sub-group dummy' estimates presented in table 9.2 show that, with respect to UK owned enterprises not selling plants to the FO sector (the benchmark), plants belonging to FO enterprises were generally more productive throughout the 1982-1995 period, especially those acquired between 1987 and 1992 which were over 24 to 72 per cent more productive across the various manufacturing sub-sectors, though the gains look more modest when considering manufacturing as a whole.[8] Overall, it appears as though FO firms tended to have higher TFP, which supports the broad conclusions of Chapter 7, and have tended to acquire 'good' plants rather than 'bad' plants, and as such there is support for the operating efficiency theory for

[6] F-tests of these restrictions were always able to reject the null, mainly because of the size of the dataset and small differences in the models' parameters generally are significant. However, the restricted-model results are retained and presented in Table 9.3 as these models are accepted (except in the 'Other Manufacturing' sub-group) in terms of the diagnostic tests used, and because there is often little variation in the key parameter estimates obtained for the sub-group dummies (and elsewhere throughout the model).

[7] It might also be useful to have considered differences between plants acquired by FO firms that operated in the UK prior to the acquisition of a new plant in 1987-92, as opposed to plants acquired to establish capacity for the first time during this period. However, too few observations for the 'new foreign-owned' sub-group precludes such an analysis at this stage.

[8] Note, the parameter estimates are converted into exp($\hat{\beta}$)-1, since the dependent variable is in natural logs.

acquisitions. It is also interesting to note that plants that did not change ownership but which belonged to UK enterprises that sold to the foreign-owned sector during 1987-1992 had high levels of productivity, which suggests that being part of a flexible multiplant operation is a good thing for firm level productivity as a whole.

It can be seen that there are some significant differences depending on the industry and country of origin of the acquirer[9]. Plants acquired by firms from the EU and from the rest of the world tended to have slightly lower TFP compared to those plants acquired by US-owned enterprises. Again, this is consistent with the findings presented in Chapter 7. Plants acquired by the foreign-owned sector in engineering and vehicles (the fastest growing manufacturing sector) were overall the most productive. In contrast, plants that were acquired during 1987-1992 by the UK-owned sector (whether from internal UK-to-UK transfers or purchases of foreign-owned plants) were usually more productive than the benchmark sub-group, but by a margin considerably less than that displayed for foreign-owned acquisitions. In particular, plants acquired by UK-owned enterprises during 1987-92 in the 'other manufacturing' sector were some 11 per cent *less* productive when compared to the benchmark sub-group. Thus, these results show that there were both important differences across industrial sub-sectors and this provides support for the argument of managerial discipline for acquisitions in the slowest growing 'other manufacturing' sector, when acquisitions by the UK-owned sector are considered.

In addition to the performance prior to acquisition, the question of whether the inherent higher productivity of acquired plants was maintained post-acquisition is

[9] It was not possible to apply the same degree of disaggregation used in the previous 2 chapters because of problems with sample sizes amongst those plants that changed ownership over the period.

also of interest here. The picture is rather mixed, as evidenced by the results relating to the post-acquisition dummies in Table 9.3. Overall, post-acquisition productivity appears to decline slightly and more particularly for those plants acquired during 1987-1992 by UK-owned enterprises (especially in the metals and chemicals sector).[10] These results are consistent with the operational efficiency theory for acquisitions, but the time period considered and the number of years that plants are observed post-acquisition means that it is not possible to draw any firm conclusions as to whether longer-term productivity improves or declines after a plant is acquired. This can be contrasted with the results obtained by McGuckin and Nguyen (1995) who considered the impact of changes in ownership on US food manufacturing plants. Generally, they were able to track plants during the boom period of the mid- to late-1980's for a longer period of time than that considered here (only a maximum of eight years of post-acquisition performance is available), and found that whilst there was a short-run negative impact,

> "plants that experienced ownership change improved their productivity 5-9 years after being acquired" (p. 273).

Clearly, this could also still be the case in the UK.

[10] If takeovers by UK-owned enterprises were primarily to boost efficiency in the acquiring enterprise, more 'teething problems' might be expected because of greater mismatching post-acquisition. This compares to acquisitions by the foreign-owned sector that were more likely to have occurred in order to expand their capacity in the UK market, and where post-acquisition falls in productivity seem to have been smaller.

Table 9.2: 'Sub-group' dummies of the weighted estimates of dynamic Cobb-Douglas production function

Dependent variable: Gross output, ln y_{it}	All manufacturing (SIC Orders 2-4)		Metals & Chemicals (SIC Order 2)		Engineering & Vehicles (SIC Order 3)		Other Manufacturing (SIC Order 4)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
(a) Unrestricted model								
FO 1982-92 (D_1)	0.208	2.27	0.017	0.19	0.547	2.38	0.576	3.84
UK single plant 1982-92 (D_2)	-0.461	1.99	-0.580	2.53	0.063	0.39	-0.575	4.23
UK enterprise sold to FO sector (D_3)	0.317	2.82	-0.012	0.22	0.372	1.65	0.263	3.25
Changed owner 1982-86 but not to FO (D_4)	0.384	2.97	0.047	0.77	0.108	1.51	0.322	4.41
Changed to FO 1982-86 (D_5)	0.329	2.22	0.182	2.07	0.434	2.73	0.072	1.11
Change to EU 1987-92 (ACQ_1)	0.345	2.83	0.323	3.55	0.479	2.17	0.315	4.32
Change to US 1987-92 (ACQ_2)	0.383	3.10	0.397	4.41	0.509	2.33	0.403	5.45
Change to RoW 1987-92 (ACQ_3)	0.345	2.83	0.217	2.65	0.545	2.43	0.373	4.91
Changed owner 1987-92 but not to FO (ACQ_4)	0.202	1.73	0.184	3.35	0.111	0.50	-0.111	1.88
(b) Restricted model								
FO sector 1982-92 (ACQ_1= ACQ_2= ACQ_3=D_5=D_1)	0.359	3.29	0.241	1.97	0.438	2.324	0.234	3.03
UK single plant 1982-92 (D_2)	-0.441	1.91	-0.531	2.16	0.058	0.89	-0.586	3.22
UK enterprise sold to FO sector (D_3)	0.377	3.52	-0.014	0.24	0.364	1.62	0.218	2.25
Changed owner 1982-92 but not to FO (ACQ_4=D_4)	0.325	3.02	0.120	1.67	0.102	0.52	-0.113	1.46

See Table 9.3 for full details.

Table 9.3: Weighted estimates of dynamic Cobb-Douglas production function

Dependent variable: Gross output, ln y_{it}	All manufacturing (SIC Orders 2-4)		Metals & Chemicals (SIC Order 2)		Engineering & Vehicles (SIC Order 3)		Other Manufacturing (SIC Order 4)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
Employment (e)$_{it}$	0.534	13.78	0.277	18.47	0.450	9.16	0.321	14.69
$e_{it} \times D_1$	-0.238	3.83	0.030	1.25	-0.087	1.32	-0.110	2.89
$e_{it} \times D_2$	0.568	8.36	0.130	2.77	0.518	5.89	0.260	8.13
$e_{it} \times D_3$	-0.269	6.02	0.053	2.94	-0.127	2.10	-0.040	2.00
$e_{it} \times D_4$	-0.162	3.17	0.030	1.50	0.215	3.25	-0.068	3.78
$e_{it} \times D_5$	0.053	1.32	-0.071	2.54	0.207	3.60	0.030	1.15
$e_{it} \times D_6$	-0.203	4.24	0.033	1.32	-0.135	2.04	-0.081	4.26
$e_{it} \times D_7$	-0.078	1.68	-0.013	0.76	0.077	1.07	0.042	2.33
Capital (k)$_{it}$	0.216	6.36	0.236	8.51	0.221	5.24	0.214	4.72
$k_{it} \times D_1$	0.128	6.36	0.034	2.62	0.055	2.37	0.072	5.54
$k_{it} \times D_2$	0.113	4.14	0.069	2.46	0.140	3.84	0.040	3.33
$k_{it} \times D_3$	0.105	10.44	0.051	8.50	-0.060	3.44	0.034	6.80
$k_{it} \times D_4$	0.122	10.22	0.042	5.25	0.070	4.21	0.027	5.40
$k_{it} \times D_5$	0.088	4.55	-0.015	1.36	0.018	0.59	0.039	3.00
$k_{it} \times D_6$	0.061	4.31	0.065	4.33	-0.083	3.83	0.036	4.50
$k_{it} \times D_7$	0.085	7.01	0.027	3.86	-0.030	1.77	0.028	5.60
Intermediate goods(m)$_{it}$	0.521	13.96	0.751	17.77	0.520	12.67	0.707	18.92
$m_{it} \times D_1$	0.121	1.92	-0.047	2.14	0.068	1.03	0.012	0.34
$m_{it} \times D_2$	-0.426	9.07	-0.121	3.90	-0.239	4.15	-0.165	8.25
$m_{it} \times D_3$	0.197	4.63	-0.032	1.88	0.117	2.41	0.013	0.68
$m_{it} \times D_4$	0.016	0.37	-0.075	3.75	-0.226	3.93	0.036	2.12
$m_{it} \times D_5$	-0.158	3.29	0.043	1.48	-0.194	4.22	-0.050	2.17
$m_{it} \times D_6$	0.122	2.53	-0.068	2.96	0.187	3.08	0.018	0.95
$m_{it} \times D_7$	0.024	0.53	0.007	0.09	-0.04	0.70	-0.064	4.00
Time	0.010	6.56	0.018	4.38	0.021	7.62	0.002	2.74
$t \times D_1$	0.006	2.26	0.007	3.50	0.003	0.89	0.000	0.04
$t \times D_2$	0.001	0.75	0.002	1.00	-0.002	0.67	0.014	14.00
$t \times D_3$	0.000	0.27	0.006	6.02	-0.002	0.81	-0.002	1.92
$t \times D_4$	-0.001	1.23	-0.001	1.30	-0.001	0.07	-0.000	0.56
$t \times D_5$	0.000	0.23	0.018	9.28	-0.003	0.95	0.009	4.56
$t \times D_6$	0.002	0.93	-0.006	3.11	-0.001	0.25	0.006	3.90
$t \times D_7$	0.001	0.81	0.005	5.45	0.001	0.68	0.005	2.77
y_{it-1}	0.549	49.00	0.599	34.57	0.537	43.21	0.666	35.46
Post-Acquisition Dummies								
Acquired in 1987, FO ($AQYR_1^{87}$)	-0.014	0.96	0.088	4.19	-0.036	1.78	-0.020	1.67
Acquired in 1988, FO ($AQYR_1^{88}$)	-0.030	2.28	0.019	1.36	0.004	0.19	0.010	0.67
Acquired in 1989, FO ($AQYR_1^{89}$)	0.002	0.18	0.130	6.84	-0.025	1.31	0.006	0.55

Table 9.3 continued...

Dependent variable: Gross output, ln y_{it}	All manufacturing (SIC Orders 2-4)		Metals & Chemicals (SIC Order 2)		Engineering & Vehicles (SIC Order 3)		Other Manufacturing (SIC Order 4)	
	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value	$\hat{\beta}$	*t*-value
Acquired in 1990, FO ($AQYR_1^{90}$)	-0.032	2.57	-0.060	3.16	-0.033	1.41	-0.033	2.54
Acquired in 1991, FO ($AQYR_1^{91}$)	-0.050	3.67	0.071	3.04	-0.040	1.61	-0.076	6.91
Acquired in 1992, FO ($AQYR_1^{92}$)	0.028	2.27	0.136	5.04	0.045	3.23	-0.038	2.11
Acquired in 1987, UK ($AQYR_2^{87}$)	-0.011	1.29	0.015	3.00	-0.009	1.00	-0.051	12.75
Acquired in 1988, UK ($AQYR_2^{88}$)	-0.011	1.74	-0.058	6.44	-0.004	0.44	-0.005	1.25
Acquired in 1989, UK ($AQYR_2^{89}$)	-0.021	2.89	-0.076	9.50	-0.026	2.36	-0.002	0.40
Acquired in 1990, UK ($AQYR_2^{90}$)	-0.023	3.12	-0.113	16.14	-0.012	1.61	-0.023	4.60
Acquired in 1991, UK ($AQYR_2^{91}$)	-0.026	3.69	-0.101	10.10	-0.031	2.42	-0.058	11.60
Acquired in 1992, UK ($AQYR_2^{92}$)	-0.003	0.31	-0.006	0.60	0.003	0.27	-0.033	5.50
No. of sig (3-digit) SIC dummies	93		21		23		47	
No. of sig. region dummies	9		4		8		9	
Constant	-0.508	5.04	-0.555	6.77	-0.770	4.20	-0.571	11.20
Diagnostic tests[a]								
Comfac ~ χ^2(df=24)	36.108	(0.05)	33.127	(0.10)	35.998	(0.05)	34.912	(0.07)
Sargan ~ χ^2 (df=935)	990.8	(0.10)	962.9	(0.26)	974.2	(0.18)	981.8	(0.14)
m1 ~ N(0,1) (df=no. of plants)	-14.16	(0.00)	-7.16	(0.00)	-14.93	(0.00)	-10.11	(0.00)
m2 ~ N(0,1) (df=no. of plants)	1.97	(0.05)	1.90	(0.06)	1.95	(0.05)	2.00	(0.05)
Zero-slopes ~ χ^2 (× 10^5)	341.8	(0.00)	73.3	(0.00)	103.9	(0.00)	149.9	(0.00)
No. of plants	27993		5475		9495		11720	
No. of observations	225954		45174		74533		87955	
Psuedo-R^2	0.99		0.99		0.99		0.99	

Notes: All models are estimated in DPD98; common factor restrictions have been tested and imposed in the results reported here; all *t*-values are based on robust standard errors; all regressions included significant 3-digit SIC and regional dummies (the first SIC in each sub-group and the South East region of England forming the benchmarks); m1 and m2 are tests for first and second order serial correlation; in all models the GMM estimator has instruments back to t – 3 for the model in first differences and Δt–2 for the model in levels; [a] p-values in parenthesis

Finally, and in order to test whether acquired plants are likely to operate with similar technology to that used by plants already belonging to the foreign-owned sector, the various elasticities of output with respect to inputs obtained by differentiating equation 9.1 with respect to each factor input are presented in Table 9.4 and show that in general across the various industry sectors covered, those plants that changed to foreign ownership between 1987 and 1992 typically had much higher capital-to-labour ratios and high intermediate elasticities of output when compared to those plants that changed to UK ownership in the same period (the exception is in the metals and chemicals industry). As such, they were similar to those plants operating in 1987-1992 that had already been acquired by the foreign-owned sector during 1982-1986. Thus there appears to be some evidence that suggests (foreign-owned) companies do look for acquisitions that match more closely with their own use of (capital- and intermediate intensive) technologies, and that this may in part explain why such plants do better (in terms of TFP differences).

Table 9.4: Production function elasticities of output for various sub groups

	Elasticity of Capital	Elasticity of labour	Elasticity of intermediate inputs	Returns to scale
All manufacturing				
FO 1982-92 (D1)	0.344	0.296	0.642	1.282
UK single plant 1982-92 (D2)	0.329	1.102	0.095	1.526
UK enterprise sold to FO sector (D3)	0.321	0.265	0.718	1.304
Changed owner 1982-86 but not to FO (D4)	0.338	0.372	0.537	1.247
Changed to FO 1982-86 (D5)	0.304	0.587	0.363	1.254
Changed to FO 1987-92 (D6)	0.277	0.331	0.643	1.251
Changed owner 1987-92 but not to FO (D7)	0.301	0.456	0.545	1.302
UK enterprise did not sell to FO sector (D8)	0.216	0.534	0.531	1.281
Metals and Chemicals				
FO 1982-92 (D1)	0.270	0.307	0.704	1.281
UK single plant 1982-92 (D2)	0.305	0.407	0.630	1.342

Table 9.4 continued...

	Elasticity of Capital	Elasticity of labour	Elasticity of intermediate inputs	Returns to scale
UK enterprise sold to FO sector (D3)	0.287	0.330	0.719	1.336
Changed owner 1982-86 but not to FO (D4)	0.278	0.307	0.676	1.261
Changed to FO 1982-86 (D5)	0.221	0.206	0.794	1.221
Changed owner 1987-92 but not to FO (D7)	0.263	0.264	0.758	1.285
UK enterprise did not sell to FO sector (D8)	0.263	0.277	0.751	1.264
Engineering and vehicles				
FO 1982-92 (D1)	0.276	0.363	0.588	1.227
UK single plant 1982-92 (D2)	0.361	0.968	0.281	1.610
UK enterprise sold to FO sector (D3)	0.161	0.323	0.637	1.121
Changed owner 1982-86 but not to FO (D4)	0.291	0.665	0.294	1.250
Changed to FO 1982-86 (D5)	0.239	0.657	0.326	1.222
Changed to FO 1987-92 (D6)	0.138	0.315	0.707	1.160
Changed owner 1987-92 but not to FO (D7)	0.191	0.527	0.480	1.198
UK enterprise did not sell to FO sector (D8)	0.221	0.450	0.520	1.191
Other manufacturing				
FO 1982-92 (D1)	0.286	0.211	0.719	1.216
UK single plant 1982-92 (D2)	0.254	0.581	0.542	1.377
UK enterprise sold to FO sector (D3)	0.248	0.281	0.720	1.249
Changed owner 1982-86 but not to FO (D4)	0.241	0.253	0.743	1.237
Changed to FO 1982-86 (D5)	0.253	0.351	0.657	1.261
Changed to FO 1987-92 (D6)	0.250	0.240	0.725	1.215
Changed owner 1987-92 but not to FO (D7)	0.242	0.363	0.643	1.248
UK enterprise did not sell to FO sector (D8)	0.214	0.321	0.707	1.242

9.4 Discussion

The results show that foreign owned enterprises 'cherry-picked' in the sense that they acquired the most productive plants previously operated by UK enterprises. Specifically, plants operating in the UK manufacturing sector that were acquired between 1987 and 1992 were on average over 41% more productive when compared to plants belonging to UK enterprises that did not sell plants to the foreign owned sector, and around twice as productive as plants that changed owner during the same period and were bought by UK-owned enterprises. As such, there is support for the operational efficiency theory for plant acquisitions However, differences across industry sectors were observed that suggest that when plants were acquired by the UK-owned sector in the more 'mature' and slower growing industries, the motives for ownership change may be more in line with the traditional neoclassical 'managerial discipline' approach.

In policy terms the results presented here do not point to any specific spillover benefits from FDI in the sense that foreign-owned enterprises bought inefficient plants to improve their performance. Indeed the remaining UK enterprises (which of course still provided the majority of manufacturing output) were left producing with plants that were generally less efficient and thus productive, and in markets that did not experience (post-FDI) greater competition through the establishment of new 'greenfield' capacity. In contrast, asset-acquiring FDI does offer the longer-term prospect of yielding higher rents since it is worth noting that belonging to the foreign-owned sector generally implies the highest levels of TFP, and UK enterprises that 'trade' plants with this sector also do relatively well (thus bringing productivity benefits to the wider manufacturing sector through inter-firm linkages and through the impact on skills in the labour market). In this way, FDI is apparently setting a standard to which the majority of UK enterprises may want to aspire and against which international productivity comparisons can be made.

Conclusions and policy implications

It can be seen from the preceding analysis that FDI has grown steadily in importance since the 1970s, as the number of nations investing and the proportion of total manufacturing that it accounts for have increased. In many respects, the purpose in this thesis has been to explore the validity of the arguments put forward as to why there has been this increase and to examine whether there are clear productivity benefits to host nations. In this thesis, hypotheses were tested for the UK using the plant level data available in the ARD.

In the first section, detail on the main source of information used is provided, the trends in foreign ownership and manufacturing more generally are explored over time and the location and concentration issues are considered in relation to the industrial structure of UK manufacturing. Section two consists of a literature review of the two main sources of benefits from FDI, directly through being more productive and raising the average level of plant productivity, and indirectly, through spillovers which increase the productivity of domestic plants. Section two also provides an overview of the theoretical approach adopted in this investigation. Section three contains the main empirical findings; firstly testing for direct benefits, secondly indirect benefits and finally whether there were improvements in performance post acquisition by foreign firms.

Overall, foreign owned plants do generally perform better, and in cases where this is not so, the role that the plants play in local economies is essentially that of a branch-plant. In addition, there are short term problems facing new/young foreign owned plants with assimilating existing cultural practices. With reference to the nationality of the foreign owner, it can be seen that US owned plants consistently out-perform domestic plants, though the evidence for other countries of origin is less strong. There is however, considerable heterogeneity by industry, nationality and time.

Turning to consider the indirect impact of foreign owned firms on the performance of domestic plants, evidence of spillovers from the 20 selected industries chosen is very mixed. In the case of intra industry spillovers, there is significant evidence that foreign presence within the industry has a significant impact on domestic plants in only two thirds of industries, and this is not always a positive impact. Agglomeration spillovers are even more elusive, occurring in only 7 out of 20 industries with any significance, and relatively evenly split between positive and negative impacts. This may in part be a function of the industries chosen, inappropriate aggregation levels when dealing with regional spillovers (either too disaggregated or not disaggregated enough), or the imprecise nature of spillovers. Support for the existence of inter industry spillovers appears to be strong, particularly in industries that supply goods for the intermediate stages of production, however, again the evidence is somewhat inconclusive as to which direction these tend to take.

Finally in this thesis, the impact that the entry decision makes to foreign plant productivity was explored. Overall it can be seen that foreign firms were particularly effective at identifying the very best UK plants, acquiring plants that were on average 41 per cent more productive than the average UK plant (that did not change ownership). It was also revealed that domestic firms that traded plants performed better than those that did not, suggesting that plant turnover improves overall firm performance (indicative of the operational efficiency theory discussed in greater detail in Chapter 9).

Therefore, in terms of addressing the hypotheses identified in the introduction (p.15), and using dynamic panel data techniques, the following statements can be made;

- Foreign owned plants are generally more productive than domestically owned plants;
- There is not any clear evidence to support the claim that domestic firms will always benefit from FDI through spillovers and,
- It does appear that foreign owned firms are able to identify the more productive plants in the acquisition process.

From a policy perspective, the UK government particularly encourages overseas investment into the UK. Recent publications of the INVEST UK branch of the Department of Trade and Industry (DTI), a unit specifically set-up to attract inward investors (http://www.invest.uk.com/) demonstrate the emphasis that successive governments have put on the encouragement of FDI. They highlight the dominance of the UK in attracting FDI in Europe, accounting for 40 per cent of all US, Japan and Asian investment in Europe, which they attribute to flexible labour markets, an English-speaking labour force, good transport and communications and low corporation tax. In addition to this wing of the DTI, Regional Selective Assistance (RSA) programmes have in the past deliberately targeted financial support towards overseas investors in order to satisfy the additionality criteria[1] (Harris and Robinson, 2001).

[1] That is, that the investment funded would not have taken place otherwise. In addition, the RSA has in the past also insisted that its funding does not displace existing firms through the additional competition. RSA has recently undergone changes in its remit and rules.

Whilst all of the findings in this thesis relate to the manufacturing sector, it may be that differences are observed in the service sector, which accounts for a significant and growing proportion of the UK economy. However data from the ARD for the service sector is not yet available to the same extent as manufacturing, and given the complications associated with measuring inputs and outputs in the case of the services sector (Griliches, 1992b), this may never be as well developed. Therefore, the complementary use of case study work for both the manufacturing sector and the service sector is likely to prove useful in improving our understanding of the impact of FDI.

With this in mind, the policy relevance of the work contained in this thesis, of comparing the fortunes of domestic investors with foreign owned enterprises, is relatively clear. What can be concluded from the findings is that foreign owned firms, whilst showing some indication that they are generally more productive than domestic firms (particularly in the case of the US investor), a significant proportion of this higher productivity may come not from 'firm specific' advantages or even in the form of spillovers to domestic firm productivity advantages but instead from their ability to cherry-pick good existing UK plants when entering the UK. This is perhaps concerning from a policy perspective.

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Appendix A1:

Copy of Data Access Agreement with ONS

national STaTiSTiCS

AN AGREEMENT made this First day of August 2001 between The Office for National Statistics (ONS) and CATHERINE ROBINSON

WHEREAS pursuant to the Statistics of Trade Act and the Deregulation and Contracting Out Act 1994, confidential information will be disclosed by ONS to the Contractor for purposes described in the Specification.

NB. This contract relates to GB data only.

NOW IT IS AGREED THAT:

Interpretation

1. The headings in this Agreement are for convenience only and shall not affect its interpretation.

2. Reference to the Specification is the specification attached to this Agreement. The Specification is a part of the Agreement.

3. References to the male gender include reference to the female gender. The singular shall include the plural and vice versa.

4. Confidential information means the information described in the Specification.

Timescale and purpose

5. This Agreement shall commence on the date of 1st August 2001 and shall be completed by 30th September 2003 . The Contractor will perform his duties under the Agreement with all due diligence and to the satisfaction of ONS.

Consideration

6. In consideration of the performance of the Contractor's duties, ONS shall pay the Contractor the sum of £1(one pound), the receipt of which the Contractor hereby acknowledges.

Assignment and sub-contracting

7. The Contractor shall not assign, license or transfer this Agreement or any part or share or interest therein or any obligation thereunder.

Termination

8. ONS may terminate this Agreement forthwith at any time on service of written notice to the Contractor.

Confidentiality

9. The information provided to the Contractor is confidential and shall be treated as such by the Contractor. The Contractor shall only use the information for the purposes in the Specification and for no other purpose whatsoever. The obligation on the Contractor in this clause shall continue after the expiry or termination of this Agreement.

10. The Contractor shall be subject to section 9 of the Statistics of Trade Act and paragraphs 8 and 9 of Schedule 15 of the Deregulation and Contracting Out Act 1994.

Intellectual property

11. The Contractor acknowledges that any information, which results from this Agreement is, the absolute property of the Crown.

Variation

12. No part of this Agreement may be changed without the written agreement of both parties to this Agreement.

Entire Agreement

13. This Agreement contains the entire agreement and supersedes all previous agreements, understandings and negotiations between the parties with respect to the subject matter hereof whether oral or written.

Specification

14. The areas of research shall be as follows:

As specified by the Office for National Statistics in order to contribute to the Business Data Linking Project. The data must not be used for any other projects or publications without the express written agreement of ONS. Access to the confidential data given by this contract, ends with the expiry or termination of this contract.

15. All research, data analysis and the production of a paper ready for publication in an ONS publication, or one approved by the ONS, shall be completed by 30th September 2003

16. Any published results shall be non-disclosive and presented in a format agreed **between the ONS and the Contractor. ONS must approve everything before it is published, and has final right of veto.**

17. This is an agreement in English Law

Signed ....**for ONS**

Print Name.................ANDREW ROSS.......................................**for ONS**

Signed ....**for the contractor**

Print Name ......Catherine Robinson.CATHERINE ROBINSON.........**for the contractor**

Appendix A2:
Example copy of the questionnaire
(Production ABI, 1998)

1 **What your Annual Business Inquiry form should cover**

This survey covers the United Kingdom activity of businesses (including foreign owned businesses) <u>except</u> where the coverage is specified as Great Britain or Northern Ireland underneath your address on the front page. The United Kingdom consists of England, Wales, Scotland and Northern Ireland, and excludes the Channel Islands and the Isle of Man. Great Britain consists of England, Wales and Scotland only.

The business unit for the survey is the company, partnership, sole proprietorship, etc. to which the form has been addressed <u>unless</u> specified otherwise on the front page of the form. Figures for subsidiaries of the business addressed should be excluded, <u>unless</u> specified otherwise on the front page.

2 **Period covered by the return**

Your return should cover the **calendar** year **1998**, or the nearest 12 month period for which figures are available. (If no figures are available for the calendar year, the return may cover a business year, ending on any date from 1 April 1998 to 5 April 1999.)

	Day	Month	Year	
Period covered by the return: from				1 1
Period covered by the return: to				1 2

If you traded for only part of the year, please provide figures for the period in which you were trading.

3 **Turnover** *see note 3*

Total amount receivable in respect of invoices raised during the period of the return, plus other receipts recorded on profit and loss / income and expenditure account (including progress payments on work in progress).

Exclude: VAT, sales of fixed assets and output for own final use.

PLEASE GIVE VALUES TO THE NEAREST £ THOUSAND

3.1 (a)	Sales of goods of own production *see note 3.1(a)*	,000	3 0 1
(b)	Value of work done on customers' materials (including value of any additional materials provided by you)	,000	3 0 8
(c)	Value of industrial services such as repairs, maintenance and installation, provided by you	,000	3 0 9
(d)	Value of non-industrial services provided by you (including advertising revenue) *see note 3.1(d)*	,000	3 1 0
(e)	Sales of goods purchased and resold without further processing (merchanted or factored goods)	,000	3 1 1
	Total turnover	,000	3 9 9

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PLEASE GIVE VALUES TO THE NEAREST £ THOUSAND

3.2 Retail turnover *see note 3.2*

Retail turnover relates to receipts from the general public for the sale of goods, including repair and installation.

Of your total turnover shown on the previous page, please give the identifiable amount attributable to sale (including repair and installation) of goods direct to the general public for personal or household use	,000	300

3.3 Value of insurance claims received

Value of insurance claims received	,000	317

4 Expenditure

(excluding deductible VAT, but including non-deductible VAT)

4.1 Employment costs

(a)	Gross wages and salaries (in cash or kind) *see note 4.1(a)*	,000	446
(b)	Redundancy and severance payments to employees	,000	447
(c)	Employer's National Insurance contributions	,000	448
(d)	Contributions to pension funds (including lump sum contributions). Employer's pension contributions should represent actual net amounts rather than notional values. *see note 4.1(d)*	,000	449
	Total employment costs	,000	450

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PLEASE GIVE VALUES TO THE NEAREST £ THOUSAND

4.2 Purchases of goods, materials and services

see note 4.2

(a)	Purchases of energy and water products for own consumption (**including** petrol, diesel, electricity, gas, water etc. but **excluding** waste disposal, sewerage and effluent disposal charges)	,000	401
(b)	Purchases of goods and materials (including stationery and consumables)	,000	402
(c)	Purchases of goods bought for resale without further processing (these purchases relate to turnover in section 3(e))	,000	403
(d)	Value of industrial services purchased (including work sub-contracted out, printing services, repairs and maintenance etc.)	,000	404
(e)	Payments for hiring, leasing or renting plant, machinery and vehicles	,000	405
(f)	Commercial insurance premiums paid	,000	406
(g)	Purchases of road transport services	,000	407
(h)	Purchases of telecommunication services	,000	408
(i)	Purchases of computer and related services (excluding computer hardware and software)	,000	409
(j)	Purchases of advertising and marketing services	,000	410
(k)	Other services purchased not already listed above but excluding employment costs, bad debts and depreciation, all interest payments, amounts charged to capital account and capitalised building repairs *see note 4.2(k)*	,000	411
	Total purchases of goods, materials and services	,000	499

PLEASE GIVE VALUES TO THE NEAREST £ THOUSAND

4.3 Taxes, duties and levies paid *see note 4.3*

Total amounts payable in taxes, duties or levies to government.
Exclude: VAT; taxes already included in the purchases of goods and services; and taxes on profits (e.g. corporation tax and advance corporation tax, income and capital gains tax and petroleum revenue tax).

(a)	Amounts paid in business rates	,000	412
(b)	Other amounts paid for taxes, duties and levies (e.g. excise duties, stamp duties etc.)	,000	413
	Total taxes, duties and levies paid	,000	400

4.4 Subsidies received *see note 4.4*

Total amount received in subsidies from UK government sources and the EC	,000	414

5 Value of stocks held (net of progress payments on long term contracts) (excluding VAT) *see note 5*

The figures for the beginning and the end of the period should be on the same basis in terms of valuation and business units covered.

(a)	Total value of all stocks at the beginning of the period	,000	500
(b)	Total value of all stocks at the end of the period	,000	599

PLEASE GIVE VALUES TO THE NEAREST £ THOUSAND

6 Capital expenditure

(including non-deductible VAT, but excluding deductible VAT)

6.1 Total acquisitions / disposals *see note 6.1*

(a) Cost of acquisitions ,000 600

(b) Proceeds from disposals ,000 699

6.2 Total amount included in acquisitions at 6.1(a) for assets under finance leasing arrangements *see note 6.2* ,000 601

6.3 Value of work of a capital nature carried out by your own staff produced for own use **included in acquisitions at 6.1(a).** Include computer software developed by your own staff to be used for more than one year. ,000 602

Note: If the value at question 6.3 is more than half of total acquisitions, please give an explanation for this in the comments box provided at section 9.

7 Trade in overseas services *see note 7*

Please tick the box if your business has received any overseas receipts for services it has provided or has paid for services from overseas in the past 12 months. 143

8 Time taken to complete sections 2 to 7 (over and above normal accounting operations)

Number of hours hrs 144

plus

Number of minutes mins 145

9 Any relevant comments

Please use this box if you wish to make any comments regarding the information provided on this return.
Please use block capitals.

146

Please give details of the person we should contact with any questions about this return.

Please use block capitals

Name of person to contact if necessary

Position in business

Name of company

Telephone Number   Ext.

Fax Number

E-mail address

Signature..   Date..

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NOTES TO HELP YOU COMPLETE THE FORM

3 Turnover

Turnover consists of total takings or invoiced sales and receipts of the business. Interest and similar income and extra-ordinary income should be excluded as should net proceeds on capital items.
Give the value of all sales made in the year of this return whether or not the goods were produced in the year.
The values given should be the 'net selling' value (i.e. the amount charged to customers whether valued 'ex-works' or 'delivered', less VAT, trade and cash discounts etc. and allowances on returned goods).

Include:

- Provision of goods and services to other parts of your company or organisation which are not covered by this return. These should be valued as if sold to an independent customer;
- Transport, insurance and packaging charges (less amounts for returnable containers) invoiced by your business (even if invoiced separately);
- Progress payments received for work in progress on long term contracts which have not been identified as stocks in the balance sheet.

Exclude:

- Income recorded as extra-ordinary income in your accounts;
- Amounts received from the sale of fixed capital assets;
- Grants from any source;
- Subsidies from UK public authorities and the EC;
- Interest payments received and other similar income;
- For those in the nuclear fuel industry, exclude any receipts received for fossil fuel premiums.

3.1 (a) Sales of goods of own production

Include:

- Sales of goods made by you or for you by others from materials supplied by you;
- Sales of waste products, residues and scrap.

Exclude:

- Output for own final use;
- Transport and delivery costs where possible. Include these in 3.1(d);
- Export rebates received under the EC Common Agricultural Policy.

3.1 (d) Non-industrial services provided by you

Include:

- Services provided to other organisations such as rents for commercial and industrial buildings, amounts charged for hiring out plant, machinery and other goods, the provision of transport, computer processing, technical research and studies;
- Amounts received for the right to use patents, trade marks, copyrights etc., manufacturing rights, technical know-how and advertising revenue;
- Amounts received from royalties.

Exclude:

- Sales of patents, trademarks, copyrights etc.

3.2 Retail turnover

Include:

- Repair and installation work whether or not in combination with sale of goods;
- Retail sale by commission agents.

Exclude:

- Income from other businesses (including repair and maintenance);
- Sales, repair and maintenance of motor vehicles, motorcycles and their parts and accessories, and of fuels for these;
- Sales of food and drink as a catering activity (including take-away food and bar sales);
- Renting and hiring of goods.

AB104 K

4 Expenditure

4.1 Employment costs

4.1 (a) Gross wages and salaries

Wages and salaries are defined as the total compensation in cash or in kind payable to all employees.
State the amount paid before deductions but less any amounts for which you are reimbursed from government sources.

Include:

- All overtime payments, bonuses, commissions;
- Payments to those temporarily absent (for example, on holiday, sick, or on maternity leave);
- The cost to the employer of all benefits in kind, for example, subsidies to staff canteens, sports club membership, nurseries, health insurance, etc.). Redundancy, social security and pension contributions should be recorded under questions 4.1(b), (c) & (d) respectively.

Exclude:

- Payments to working proprietors, partners and executive directors not in receipt of a regular salary, fee or commission;
- Travelling and subsistence expenses;
- Amounts paid to sub-contractors. Include these in 4.2(d);
- Payments to homeworkers on piecework rates;
- Payments for agency workers. Include these in 4.2(k).

4.1 (d) Contributions to pension funds

Employer's pension contributions should represent actual net amounts rather than notional values.

Include:

- Payments into pension funds providing retirement benefits or death benefits for employees, including former employees or their dependants.

Exclude:

- Employer's National Insurance contributions.

4.2 Purchases of goods, materials and services

State the net cost of purchases made during the period whether or not they were used or sold during that period. Valuation should be at full delivered cost. Deductible VAT should be excluded from the cost but non-deductible VAT should be included. In the case of imports the cost should include import and excise duties (less drawback).

4.2 (b) Purchases of goods and materials

Include:

- The cost of raw materials, components, semi-manufactures, workshop and office materials, spares, packaging materials charged to you;
- Imports of goods. If possible, any additional costs such as transport, should be included in 4.2(g) or 4.2(k) as appropriate;
- Transfers of goods to your business from other parts of your company or organisation which are not covered by this return. These should be valued as if purchased from an independent customer;
- The cost of any materials you have supplied for work done by you as a sub-contractor.

Exclude:

- Goods purchased for resale without further processing. Include these in 4.2(c);
- Transport costs on purchases paid to a third party. Include these in 4.2(g) or 4.2(k) as appropriate.

AB104 L

4 Expenditure continued

4.2 (d) Value of industrial services purchased

Include:

- Payments to sub-contractors;
- Amounts payable for printing services provided;
- Amounts payable for repairs, installation and maintenance of plant, machinery and vehicles.

Exclude:

- Cost of repair and installation of office or computing machinery. Include these in 4.2(i);
- Direct payments to outworkers;
- Sewerage charges. Include these in 4.2(k);
- Building repairs, maintenance and cleaning. Include these in 4.2(k).

4.2 (e) Payments for hiring, leasing or renting plant, machinery and vehicles

Exclude:

- Hire purchase repayments and finance leasing payments. See note 6.1;
- Amounts payable for road vehicles hired with drivers. Include these in 4.2(g).

4.2 (f) Commercial insurance premiums paid

Include:

- Premiums for all forms of commercial insurance (fire, motor vehicle, accident, transit within the United Kingdom, loss of profit etc.).

Exclude:

- Premiums for sinking fund policies, premiums for policies providing pensions, superannuation or other retirement benefits, sickness benefits, personal accident benefits, disability benefits or death benefits for employees or their dependants;
- National Insurance contributions;
- Value of insurance claims received. Include these in 3.3.

4.2 (g) Purchases of road transport services

Include:

- The cost of freight transport by road only;
- Road transport used for furniture removal;
- Road transport services purchased for own staff use, for example buses and taxis;
- Amounts payable for vehicles hired with drivers.

Exclude:

- Car hire. Include this in 4.2(e).

4.2 (h) Purchases of telecommunication services

Include:

- Rental charges on telephone services including mobile telephones;
- The cost of telephone calls, facsimiles, Internet services and data transmission.

Exclude:

- The cost of all telephone handsets and modem equipment. Include these in 4.2(b), except if charged to capital account then these should be included in 6.1(a).

4.2 (i) Purchases of computer and related services

Include:

- Consultancy charges on computer software and hardware;
- Cost of repair, maintenance and installation of office and computing machinery.

Exclude:

- Computer hardware, software and programs written by a third party to be used for more than one year. Include these in section 6.

AB104 M

4 Expenditure continued

4.2 (j) Purchases of advertising and marketing services

Include:

- Payments for advertising or marketing campaigns, including payments for television or radio media time, newspaper or billboard space;
- Payments for market research carried out by a third party.

Exclude:

- Market research and public relation activities carried out by your own staff.

4.2 (k) Other services purchased

Include:

- Amounts payable for the services of accountants, auditors, agents, solicitors and surveyors;
- Net payments to Trade Associations and similar bodies;
- Payments for agency workers;
- Postage (including parcel services);
- Payments for the right to use patents, trademarks, copyrights etc., manufacturing rights and technical know-how;
- Royalty payments;
- Amounts payable for technical research and studies;
- Sewerage charges and other costs of effluent and waste disposal;
- Amounts payable for sea, air and rail freight on goods transported, this should include staff travel;
- Building repairs, maintenance and contract cleaning services;
- Bank charges;
- Rent paid on buildings and dwellings;
- Payments to homeworkers on piecework rates;
- For those in the recycling industry, include amounts paid for licensing, inspection and monitoring.

4.3 Taxes duties and levies paid

4.3 (a) Amounts paid in business rates

Business rates are rates payable via local authorities in respect of industrial and commercial property.

Exclude:

- Water rates. Include in 4.2(a);
- Sewerage charges. Include in 4.2(k).

4.3 (b) Other amounts paid for taxes, duties and levies

Include:

- Taxes on production, for example, hydrocarbon oil tax etc.;
- Excise duties (for example, on alcohol, tobacco, petrol, etc.);
- Stamp duties;
- Vehicle excise duty (road fund licences) and operators licences;
- Export levies (for example, under the EC Common Agricultural Policy);
- Insurance premium tax;
- Air passenger tax.

Exclude:

- VAT;
- Corporation tax (including advance corporation tax);
- Capital gains tax;
- Petroleum revenue tax;
- Income tax (including tax on franked investment income);
- Taxes already included in the purchase price of goods and services purchased;
- Net payments to trade associations and similar bodies;
- Windfall taxes.

AB104 N

4 Expenditure continued

4.4 Subsidies received

These are amounts receivable from UK government bodies or the EC to reduce the price of products (goods or services) sold into a market environment.

Include:

- Import and export refunds (for example under the EC Common Agricultural Policy);
- Subsidies on payroll or work force (for example, through welfare to work scheme).

Exclude:

- Grants from non-government or non-EC sources;
- Grants for capital investment;
- Grants to cover historical losses or for the cancellation of debt.

5 Stocks (Inventories)

Stocks should be valued for balance sheet purposes, i.e. the lower of cost or net realisable value. The costing methods used should be acceptable under the Statement of Standard Accounting Practice (SSAP)9, revised September 1988 - Stocks and Long Term Contracts. Where long term contract balances are included in stocks they should be recorded net of progress payments. Where the outcome of the contract is known with reasonable certainty and a proportion of the contact income has been recognised as turnover, progress payments should be disregarded.

Include:

- Materials, stores and fuel, work in progress and goods on hand for sale. (Work in progress consists of goods and services that have been partially processed, fabricated or assembled by the producer but are not usually sold or turned over to others without further processing);
- All stocks owned and either held by you or currently in transit within the United Kingdom;
- The value of any goods let out on hire, only if they were charged to current account when acquired and do not rank as capital items for taxation purposes;
- Products in intermediate stages of completion;
- Long term business contract balances (with progress payments treated in line with SSAP9);
- Duty for dutiable goods held out of bond.

Exclude:

- Stocks you hold that do not belong to you;
- All stocks held abroad or in transit on the seas;
- Duty on stocks held in bond;
- VAT, whether paid on purchases or chargeable on sales;
- Products in intermediate stages of completion that do not belong to you.

6 Capital expenditure

This section should contain details of all expenditure charged to capital account, together with any other amounts treated as capital items for taxation purposes. This should include the value of assets acquired under finance leasing arrangements (see note 6.2).

Do not deduct any amounts received in grants (including lottery grants) and / or allowances from government sources, statutory bodies or local authorities. Do not make any allowances for depreciation. Values should include non-deductible VAT but exclude deductible VAT.

6.1

Include:

- New construction work, including the alteration or extension of existing premises (excluding dwellings);
- Land and existing buildings;
- Plant, machinery and other capital equipment (new and second-hand), including mobile machinery such as cranes;
- New and second-hand vehicles, such as motor cars, other road vehicles, ships, aircraft and rolling stock;
- All work of a capital nature carried out by your own staff (see note 6.3);
- Expenditure on replacing assets destroyed in circumstances (e.g. fire) which have given rise to an insurance claim;
- All expenditure on computer software to be used for more than one year. Such software may be purchased on the market or produced for own use. This includes the purchase or development of large databases and license payments for the use of software. Software produced for own use should be valued at production cost;

AB104 O

6 Capital expenditure

6.1 (continued

Include:)

- Expenditure on assets acquired for hiring, renting and other leasing purposes (but not assets acquired in order to lease to others under finance leasing arrangements);
- All additions, alterations, improvements and renovations which prolong the service life or increase the productivity capacity of capital goods (other than routine maintenance).

Exclude:

- Assets acquired in taking over a business or sold as part of a going concern;
- Assets like goodwill, patents or licence fees;
- The proceeds from an insurance claim against the loss of fixed assets;
- The capital value of any assets acquired by your business but leased out to others under finance leasing arrangements;
- Items of a capital nature acquired for re-sale rather than for use within business;
- Rentals charged for assets leased by you through operational leasing facilities;
- Assets outside the UK;
- New construction work related to dwellings.

6.2

The full value of assets acquired or leased under a finance lease or hire purchase agreement should be included, but assets leased out on these terms should be excluded. A finance lease is a lease that transfers substantially all the risks and rewards of ownership of an asset to the lessee. In this sort of lease, rentals will normally be calculated to allow the lessor to recover the cost of the asset and to make a profit over the period of the lease. This period will normally be equal to the useful life of the asset. **Hire purchase arrangements and the provision of operational leasing facilities are NOT regarded as finance leases.**

6.3

Identify the value charged to capital account for work carried out by your own **staff included in 6.1(a).** This should cover the provision of any capitalised asset or item ranked as capital for taxation purposes, **including computer software.** Relevant labour costs and the cost of purchases consumed in the work should also be included in the relevant parts of section 4.

7 Trade in overseas services

Any transactions with individuals, enterprises or other organisations ordinarily domiciled in a country other than the United Kingdom are regarded as overseas transactions. An overseas subsidiary or parent company is regarded as an overseas resident and hence is relevant if your company trades with it.

Services include:

- Management fees;
- Insurance and financial services;
- Consultancy services (for example, market research, accountancy and research and development);
- Merchanting profits and losses (on goods bought and sold overseas without entering the United Kingdom);
- Advertising and commission as an agent (excluding the value of import/exports on goods);
- Royalties and licence fees

Services exclude:

- Trade in goods;
- Dividend or interest payments;
- Transactions in financial assets or liabilities.

Appendix B:

Standard Industrial Classification 1980

SIC80	Description
Extraction of minerals and ores other than fuels; manufacture of metals, mineral products and chemicals	
2100	extraction and preparation of metalliferous ores
2210	Iron and steel industry
2220	steel tubes
2234	drawing and manufacture of steel wire and steel wire products
2235	other drawing, cold rolling and cold forming of steel
2245	aluminium and aluminium alloys
2246	copper, brass and other copper alloys
2247	other non-ferrous metals and their alloys
2310	extraction of stone, clay, sand and gravel
2330	salt extraction and refining
2396	extraction of other minerals not elsewhere specified
2410	Structural clay products
2420	cement, lime and plaster
2436	ready mixed concrete
2437	other building products of concrete, cement, plaster
2440	asbestos goods
2450	working of stone and other non-metallic minerals not elsewhere specified
2460	abrasive products
2471	flat glass
2478	glass containers
2479	other glass products
2481	refractory goods
2489	ceramic goods
2511	inorganic chemicals except industrial gases

SIC80	Description
2512	basic organic chemicals except specialised pharmaceutical chemicals
2513	fertilisers
2514	synthetic resins and plastic materials
2515	synthetic rubber
2512	dyestuffs and pigments
2551	paints, varnishes and painters' fillings
2552	printing ink
2562	formulated adhesives and sealants
2563	chemical treatment of oil and fats
2564	essential oils and flavouring materials
2565	explosives
2567	miscellaneous chemical products for industrial use
2568	formulated pesticides
2569	adhesive film, cloth and foil
2570	Pharmaceutical products
2581	soap and synthetic detergents
2582	perfumes, cosmetics and toilet preparations
2591	photographic materials and chemicals
2599	chemical products not elsewhere specified
2600	production of man made fibres
Metal goods, engineering and vehicle industries	
3111	ferrous metal foundries
3112	non-ferrous metal foundries
3120	forging, pressing and stamping
3137	bolts, nuts, washers, springs and other non-precision chains
3138	heat and surface treatment of metals, inclusive sintering
3142	metal doors, windows etc.
3161	hand tools and implements
3162	cutlery, spoons, forks and similar tableware; razors
3163	metal storage vessels (mainly non-industrial)
3164	packaging products of metal

SIC80	Description
3165	domestic heating and cooking appliances (non-electrical)
3166	metal furniture and safes
3167	Domestic and similar utensils of metal
3169	finished metal products not elsewhere specified
3204	fabricated constructional steelwork
3205	boilers and process plant fabrications
3211	agricultural machinery
3212	wheeled tractors
3221	metal working machine tools
3222	engineers' small tools
3230	textile machinery
3244	food, drink and tobacco processing machinery; packaging and bottling machinery
3245	chemical industry machinery; furnaces and kilns; gas, water and waste treatment plant
3246	process engineering contractors
3251	mining machinery
3254	construction and earth moving equipment
3255	mechanical lifting and handling equipment
3261	precision chains and other mechanical power transmission equipment
3262	ball, needle and roller bearings
3275	machinery for working wood, rubber, plastics, leather, making paper, glass, bricks and similar materials; laundry and fry cleaning machinery
3276	printing , bookbinding and paper goods machinery
3281	internal combustion engines (except for road vehicles, wheeled tractors primarily for agricultural purposes and aircraft) and other prime movers
3283	compressors and fluid power equipment
3284	refrigerating machinery, space heating, ventilating and air conditioning equipment

SIC80	Description
3285	scales, weighing machinery and portable power tools
3286	other industrial and commercial machinery
3287	pumps
3288	industrial valves
3289	mechanical, marine and precision engineering not elsewhere specified
3290	ordnance, small arms and ammunition
3301	office machinery
3302	electronic data processing equipment
3410	insulated wire and cables
3420	basic electrical equipment
3432	batteries and accumulators
3433	alarms and signalling equipment
3434	electrical equipment for motor vehicles, cycles and aircrafts
3435	electrical equipment for industrial use not elsewhere specified
3441	telegraph and telephone apparatus and equipment
3442	electrical instruments and control systems
3443	radio and electronic capital goods
3444	components other than active components, mainly for electronic equipment
3452	gramophone records and pre recorded tapes
3453	active components and electronic sub assemblies
3454	electronic consumer goods and other electronic equipment not elsewhere specified
3460	domestic type electrical appliances
3470	electric lamps and other electric lighting equipment
3480	electrical equipment installation
3510	motor vehicles and their engines
3521	motor vehicle bodies
3522	trailers and semi-trailers
3523	caravans
3530	motor vehicle parts

SIC80	Description
3610	shipbuilding and repairing
3620	railway and tramway vehicles
3633	motor cycles and parts
3634	pedal cycles and parts
3640	aerospace equipment manufacture and repair
3650	other vehicles
3710	measuring, checking and precision instruments and apparatus
3720	Medical and surgical equipment and orthopaedic appliances
3731	spectacles and unmounted lenses
3732	optical precision instruments
3733	photographic and cinematographic equipment
3740	clocks, watches and other timing devices
Other manufacturing industries	
4115	margarine and compound cooking fats
4116	processing organic oils and fats (other than crude animal fat production)
4121	slaughter houses
4122	bacon curing and meat processing
4123	poultry slaughter and processing
4126	animal by-product processing
4130	preparation of milk and milk products
4147	processing of fruit and vegetables
4150	fish processing
4160	grain milling
4180	Starch
4196	bread and flour confectionery
4197	biscuits and crispbread
4200	sugar and sugar by-products
4213	Ice cream
4214	cocoa, chocolate and sugar confectionery
4221	compound animal feeds
4222	pet foods and non-compound animal feeds

SIC80	Description
4239	miscellaneous foods
4240	spirit distilling and compounding
4261	wines, cider and perry
4270	brewing and malting
4283	soft drinks
4290	tobacco industry
4310	woollen and worsted industry
4321	spinning and doubling on the cotton system
4322	weaving of cotton, silk and man-made fibres
4336	throwing, texturing, etc. of continuous filament yarn
4340	spinning and weaving of flax, hemp and ramie
4350	jute and polypropylene yarns and fabrics
4363	hosiery and other weft knitted goods and fabrics
4364	warp knitted fabrics
4370	textile finishing
4384	pile carpets, carpeting and rugs
4385	other carpets, carpeting, rugs and matting
4395	lace
4396	rope, twine and net
4398	narrow fabrics
4399	other miscellaneous textiles
4410	leather(tanning and dressing) and fellmongery
4420	leather goods
4510	footwear
4531	Weatherproof outerwear
4532	mens and boys tailored outerwear
4533	womens and girls tailored outerwear
4534	work clothing and mens and boys jeans
4535	mens and boys shirts, underwear and nightwear
4536	womens and girls light outerwear, lingerie and infants' wear
4537	hats, caps and millinery
4538	gloves

SIC80	Description
4539	other dress industries
4555	soft furnishings
4556	canvas goods, sacks and other made-up textiles
4557	household textiles
4560	fur goods
4610	sawmilling, planing, etc.of wood
4620	manufacture of semi-finished wood products. Further processing/treatment of wood
4630	builders' carpentry and joinery
4640	wooden containers
4650	other wooden articles (except furniture)
4663	brushes and brooms
4664	Articles of cork and basketwork, wickerwork and other plaiting materials
4671	wooden and upholstered furniture
4672	shop and office fitting
4710	pulp, paper and board
4721	wall coverings
4722	household and personal hygiene products of paper
4723	stationery
4724	packaging products of paper and pulp
4725	packaging products of board
4728	other paper and board products
4751	printing and publishing of newspapers
4752	printing and publishing of periodicals
4753	printing and publishing of books
4754	other printing and publishing
4811	rubber tyres and inner tubes
4812	other rubber products
4820	retreading and specialist repairing of rubber tyres
4831	plastic coated textile fabric
4832	Plastics semi-manufactures

SIC80	Description
4833	Plastics floor-coverings
4834	Plastics building products
4835	Plastics packaging products
4836	Plastics products not elsewhere specified
4910	jewellery and coins
4920	musical instruments
4930	photographic and cinematographic processing laboratories
4941	toys and games
4942	sports goods
4954	miscellaneous stationers' goods
4959	other manufactures not elsewhere specified