PRODUCTIVITY AND LABOUR DEMAND EFFECTS OF INWARD AND OUTWARD FDI ON UK INDUSTRY

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Abstract

We relate the technological and factor price determinants of inward and outward FDI to its potential productivity and labour market effects on both host and home economies. This allows us to distinguish clearly between technology sourcing and technology exploiting FDI, and to identify that which is linked to labour cost differentials. We then empirically examine the effects of different types of FDI into and out of the United Kingdom on domestic (i.e. UK) productivity and on the demand for skilled and unskilled labour at the industry level. Inward investment into the UK comes overwhelmingly from sectors and countries which have a technological advantage over the corresponding UK sector. Outward FDI shows a quite different pattern, dominated by investment into foreign sectors which have lower unit labour costs than the UK. We find that different types of FDI have markedly different productivity and labour demand effects, which may in part explain the lack of consensus in the empirical literature on the effects of FDI. Our results also highlight the difficulty for policy makers of simultaneously improving employment and domestic productivity through FDI.

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1. Introduction

There is a large and growing literature on the impact of inward foreign direct investment (FDI) on host economies. Much of this literature is concerned with the productivity or ‘spillover’ effects which may arise as the domestic sector gains from some externality generated by the presence of multinational enterprises. This view fits naturally with the dominant theoretical perspective on the determinants of FDI, which suggests that firms will use FDI as a method of entering foreign markets where they possess some knowledge-based ‘ownership’ advantage which cannot easily be exploited by some other route such as licensing.

Recently, however, there has been increasing theoretical and empirical emphasis on technology *sourcing* rather than technology exploitation as a motivation for FDI. This suggests that an important motivating factor in the internationalisation of production and R&D is not the desire to exploit existing technology within the firm, but to access the technology of leading edge firms within a host economy. Support for this perspective has come from economic evidence on the determinants of FDI (Kogut and Chang, 1991; Neven and Siotis, 1996), and from theoretical work on the existence of multinationals without advantages (Fosfuri and Motta 1999; Siotis 1999).

This literature is important for two reasons. First, it highlights the fact that the research on the impact of inward FDI is largely divorced from that which tries to explain the determinants of FDI at the firm, industry or national level. This is clearly unsatisfactory. Even casual analysis suggests that productivity spillovers will be determined, at least in part, by the nature of technology employed by the multinational and domestic firms, and there is evidence that technology sourcing and technology exploiting FDI have markedly different effects on domestic productivity (Driffield and Love 2002). Second, the existence of technology sourcing as a determinant of international investment flows draws attention to the impact on domestic productivity of *outward* FDI. Some commentators have gone as far as to conclude that FDI flows are predominantly technology sourcing in nature, and that FDI is a ‘Trojan horse’ motivated principally by the desire to take advantage of the technological base of host countries (van Pottelsberghe and Lichtenberg 2001).

While an emphasis on the technological determinants and effects of FDI flows is understandable, it should not blind research to other, possibly more basic, determinants of outward and inward investment flows. For example, the ability of the MNE to respond to factor price differentials across countries is used to explain FDI within theoretical or conceptual models[2], and empirical evidence indicates that factor prices are important determinants of investment flows even between industrialised economies (Pain, 1993; Bajo-Rubio and Sosvilla-Rivero, 1994; Barrell and Pain, 1996). However, such issues are often ignored in studies seeking to analyse the effects of FDI on host or source countries, although the developing literature on the effects of outsourcing (Feenstra and Hanson, 1999) suggests not only that the issue of factor price differentials is topical, but that a fuller picture of the impact of inward and outward FDI needs to take account not only of the productivity effects of such flows, but their impact on the demand for both skilled and unskilled labour.

This paper draws together these disparate strands of literature. We develop a taxonomy which relates the technological and factor price determinants of both inward and outward FDI to its potential productivity and labour market effects on both host and home economies. This allows us to distinguish clearly between technology sourcing and technology exploiting FDI, and to identify that which is linked to factor cost differentials. We then empirically examine the effects of FDI into and out of the United Kingdom on domestic (i.e. UK) productivity and on the demand for skilled and unskilled labour at the industry level, partitioning FDI flows into the types discussed above. As far as we are aware, this is the first study to comprehensively link the different determinants of inward and outward FDI to its effects, in terms of both productivity and labour demand. This also represents an advance on previous work by distinguishing FDI determinants *ex ante*, rather than inferring investment motivation *ex post* from its effects (e.g. van Pottelsberghe and Lichtenberg, 2001; Hejazi and Pauly, 2003).

We find that the impact of inward and outward FDI varies markedly when allowance is made for the motivating influence of technological and factor price differentials between the UK and foreign industries, and conclude that this may be one reason why there is such heterogeneity in

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[2] See, for example, the growing empirical literature linking FDI flows to international labour market conditions, highlighted by the conceptual work of Buckley and Casson (1998, 1999): for example Sethi *et al*. (2003).

the results of empirical studies of the effects of FDI. Our results also highlight the difficulty for policy makers of simultaneously improving employment and domestic productivity through FDI.

2. Alternative Motivations for FDI

In this section we develop a taxonomy of different types of FDI, building on the theoretical and empirical literature, and extending the analysis of Love (2003) and Driffield and Love (2002) on technology sourcing versus technology exploiting as a motivation for FDI. This taxonomy allows for both firm-specific 'ownership' and locational influences on FDI flows[3].

The traditional starting point for considering the determinants of FDI from the perspective of the firm involves the assumed possession of some competitive or 'ownership' advantage, often knowledge-based. The public good nature of these firm-specific assets may make international exploitation of the advantage by contractual means hazardous, thus giving an incentive to engage in FDI (Buckley and Casson, 1976; Dunning, 1988; Horstmann and Markusen, 1996). Recent theoretical work predicts that firms which choose to invest abroad are the most productive in the domestic economy, supporting the ownership advantage idea (Helpman *et al*., 2004).

However, the empirical and theoretical literature has begun to examine the possibility that an important motivating factor for FDI might be the desire not to exploit technology in a foreign country, but to gain access to technology; thus *technology sourcing* may be the motivation for FDI. For example, Fosfuri and Motta (1999) present a formal model of the FDI decision which embodies the possibility of technology sourcing. They are able to show that a technological laggard may choose to enter a foreign market by FDI even where this involves (fixed) set-up costs and where the transport costs of exports are zero. This is because there are positive spillover effects arising from close locational proximity to a technological leader in the foreign country which, because of the externalities associated with technology, decreases the production costs of the investing firm both in its foreign subsidiary operations and in its home production base. Where the beneficial technology spillover effect is sufficiently strong, Fosfuri and Motta show that it may even pay the laggard firm to run its foreign subsidiary at a loss to incorporate

[3] A related discussion of FDI motivation in the context of intra-industry FDI can be found in Driffield and Love (2005).

the benefits of advanced technology in all the markets in which it operates. Similar theoretical results are obtained by Siotis (1999).

Driffield and Love (2003) provide empirical evidence of the domestic-to-foreign 'reverse spillovers' on which the success of technology sourcing depends, and there is support for the technology sourcing motive from elsewhere in the empirical literature. Using R&D intensity differentials between home and host nations, Kogut and Chang (1991) find evidence that US-Japanese R&D differentials has encouraged the entry of Japanese joint ventures into the United States. In a similar vein Neven and Siotis (1996) examined both Japanese and US investment into the EC from 1984 to 1989, and intra EC FDI flows for the same period. Using Kogut and Chang's R&D difference variable to examine the possibility of technological sourcing, Neven and Siotis examine actual FDI flows rather than the propensity for foreign entry, and find evidence that FDI flows from the United States and Japan are associated with sectors in which the EC had a technological advantage, providing support for the technology sourcing argument. Further, the literature on the internationalization of R&D suggests that there is a growing willingness to locate such facilities close to leading centres of research and innovation specifically with a view to absorbing learning spillovers from geographical proximity to such sites (Pearce, 1999; Niosi, 1999). For example, an analysis of foreign R&D direct investment in the United States by Serapio and Dalton (1999) concludes that the nature of such investment is changing, with more emphasis on gaining direct access to American technology and expertise, especially in biotechnology and electronics. They also conclude that foreign firms are increasingly investing in R&D sites in the United States to access technologies that are complementary to those of the investing firms. Pearce (1999) comes to broadly similar conclusions from a survey of multinational corporations' production and laboratory facilities in the UK.

The exclusive focus on technology in explaining flows of FDI ignores the second key element of Dunning's (1979) analysis of FDI, *location advantage.* We therefore extend the analysis of the technology exploitation/sourcing motivation by allowing for the key element of locational influence. The analysis here concerns the benefit conferred on the organisation by its decision to operate in a particular host location. This is generally related to country-specific phenomena, or, within the international economics literature, the factor endowments of a particular country or region. The economics literature consistently shows empirically that factor cost differentials, and in particular unit labour cost differentials, are an important determinant of FDI flows. This is evident even in FDI between advanced industrialised economies (Pain, 1993; Bajo-Rubio and Sosvilla-Rivero, 1994; Barrell and Pain, 1996; Love, 2003). This paper builds on those earlier works by also identifying FDI to and from high and low labour cost locations (at the sectoral level) and then testing for productivity and labour market effects generated *inter alia* merely through moving low value added activities to low cost locations. The possibility that FDI into high and low cost locations (relative to the host country) generates differential productivity and labour demand effects has largely been ignored in the literature.

Table 1: Taxonomy of FDI Types

Type 1 FDI	$RDI_{UK} > RDI_F$ and $ULC_{UK} < ULC_F$
Type 2 FDI	$RDI_{UK} > RDI_F$ and $ULC_{UK} > ULC_F$
Type 3 FDI	$RDI_{UK} < RDI_F$ and $ULC_{UK} < ULC_F$
Type 4 FDI	$RDI_{UK} < RDI_F$ and $ULC_{UK} > ULC_F$

Thus we have a simple categorisation of the different types of FDI, based on technology differences and factor cost differences (Table 1). Crucially, this is at the industry level within countries, not merely at the national level. Technology is measured by R&D intensity (*RDI*) differentials[4], while costs are measured in terms of unit labour costs (*ULC*). For illustrative purposes we differentiate between UK and ‘foreign’ RDI and ULC. From the perspective of *inward* FDI into the UK, Type 1 and 2 FDI both have some technology sourcing element. Type 1 is where the UK economy is more R&D intensive and has lower unit labour costs than the source investor (at the industry level). This implies inward investment which may be motivated by technology sourcing and has the additional advantage of exploiting the host’s locational advantage (lower unit labour costs). Type 2 is ‘pure’ technology sourcing investment, attracted by the host’s higher R&D intensity despite its higher unit labour costs. Types 3 and 4 both have technology exploitation, that is the traditional ownership advantage, as the key determinant.

[4] There are numerous measures of R&D intensity, such as the share of total national R&D, or the share of worldwide industry level R&D. However, as we wish to compare international R&D intensities at the sectoral level, we use R&D as a proportion of value added, in order to remove simple size effects.

Type 3 has the additional locational advantage of lower host unit labour costs, suggesting an 'efficiency seeking' motivation (Dunning, 1998). The final Type (4) is the 'pure' ownership advantage motivation, where source-country R&D intensity is greater than that of the corresponding host sector and FDI occurs despite the host sector having higher unit labour costs[5]. For *outward* FDI from the UK the interpretations of the various types are, of course reversed e.g. Type 3 becomes 'pure' technology sourcing by UK MNEs abroad.

3. The Effects of FDI

Perhaps surprisingly, there has been very little attempt to link the determinants and effects of FDI. This section briefly reviews the empirical evidence on the effects of inward and outward FDI, and highlights variations in the empirical results which may be at least partially explained by developing a clearer link between different types of FDI and their possible effects.

3.1 Productivity effects

The evidence on productivity spillovers from inward FDI is mixed. While there is a body of evidence suggesting that there are (intra-industry) spillover effects running from MNEs to domestic firms, and that these effects can be substantial (Blomström and Kokko 1998), the conclusions of early cross-sectional industry-level studies have been questioned on econometric grounds (Görg and Strobl 2001). More recent micro-level panel data research has led to mixed results, with some showing evidence of positive horizontal spillovers (Haskel *et al*., 2002; Keller and Yeaple, 2003), while others show evidence of a negative effect of FDI on domestic productivity (Aitken and Harrison, 1999). The latter effect is generally ascribed to the existence of 'market stealing' effects arising from MNE entry. A technologically superior MNE may take market share from domestic enterprises, forcing them to produce at lower output levels with increased unit costs (Markusen and Venables, 1999). Where the market stealing effect dominates the productivity spillover effect, the result may be a net reduction in domestic productivity. Note, however, that empirical evidence of market stealing has largely been restricted to the impact of inward investment on developing economies.

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[5] We recognise that labour costs are not the only possible locational advantage, and accept that this simple taxonomy appears to ignore so-called 'resource seeking' FDI. However, the availability of natural resources will be strongly related to efficiency, and so this effect should be captured in Table 1.

In terms of the taxonomy developed above, where the source industry is more technologically advanced than that in the UK (i.e. Types 3 and 4) we would expect to find positive net effects on domestic productivity, as long as any technological spilllover effects are not offset by market stealing effects. By contrast technology sourcing FDI (Types 1 and 2) is unlikely to result in productivity spillovers, and it is also less likely to generate competition effects, and for the same reason; technology laggards are in a relatively poor position to compete in international markets.

However, inward FDI is only half of the story; there are also the domestic productivity effects of outward FDI to consider. In a recent contribution, van Pottelsberghe and Lichtenberg (2001) extend their earlier analysis of international trade as a conduit for R&D spillovers[6] to consider FDI as a technology transfer mechanism. In an analysis of 13 industrialised countries from 1971 to 1990, they find that outward FDI makes a positive contribution to domestic total factor productivity through spillover effects from accessing the foreign R&D capital stock in target countries; by contrast, inward FDI has no such effect. Van Pottelsbergh and Lichtenberg therefore conclude that FDI flows are predominantly technology sourcing in nature, and that FDI is motivated principally by the desire to take advantage of the technological base of host countries.

The analysis of van Pottelsberghe and Lichtenberg (2001) does not distinguish between the different types of FDI motivation *ex ante*, but infers motivation *ex post* from the spillover effects of inward and outward FDI respectively. This is also the case with a recent analysis of the impact of FDI on Canadian gross fixed capital formation (Hejazi and Pauly, 2003). Both of these studies are also carried out at the highly aggregated national level. By contrast, Bitzer and Görg (2005) examine the effects of inward and outward FDI on productivity growth across 10 manufacturing industries and 17 OECD countries over a 28 year period. Their results are almost exactly the reverse of van Pottelsberghe de la Potterie and Lichtenberg (i.e. positive aggregate effects of inward investment, and negative effects of outward FDI), although they also find considerable heterogeneity in the effects across different countries.

[6] Lichtenberg and van Pottelsberghe de la Potterie (1998).

These mixed results again highlight the potential for linking the type of outward FDI to its effects. If van Pottelsberghe and Lichtenberg are correct, and most outward FDI is motivated by technology sourcing, this should be clearly shown in the results for the different types of FDI. However, our taxonomy also allows for the possibility that outward FDI to low cost locations can also lead to productivity growth at home through a 'batting average' effect as low value added activities are moved elsewhere. This is quite a different mechanism by which domestic productivity growth may be achieved, and a major advantage of our approach is that it permits a clear distinction to be made between different methods by which similar results may be obtained. Crucially, our approach allows the motivational influence to be identified *ex ante*, rather than inferred *ex post* from the productivity effects (c.f. van Pottelsberghe and Lichtenberg, 2001) .

3.2 Labour market effects of FDI.

FDI flows have increased at more than double the rate of trade flows in the past twenty years, which have in turn far outstripped output growth. A particular concern expressed by policy makers and commentators in developed countries has been the resulting changes in labour demand. Specifically, the focus recently has turned from simply the impacts on host countries, in particular the effects of technological change (Berman *et al*. 1998), to issues such as outsourcing. Outsourcing of intermediate inputs, in particular the production tasks performed by lower skilled workers, to foreign countries which offer lower wages *vis a vis* the home country is likely to impact on labour demand by reducing the demand for lower skilled labour (Feenstra and Hanson 1999). The technological change argument rests on the notion that technology complements skilled labour and consequently technological advances increase the demand for skilled labour relative to less skilled workers (Machin and Van Reenen, 1998).

In this paper we focus upon one obvious channel by which the demand for jobs may also be influenced – through the activity of multinational enterprises and in particular FDI. Notably, this has not been as fully explored in the literature as other aspects of globalisation, particularly in terms of the effects of outward FDI on the source country[7]. In addition to the role of technology

[7] The literature does not make a clear distinction between outsourcing and outward FDI. Typically outsourcing in the media and by policy makers is often thought of as subcontracting and is typically defined in academic literature in terms of imported intermediates in a given industry (a narrow measure) or by all imported intermediates across industries (a broad measure), see Feenstra and Hanson (1999) and Hijzen *et al*. (2005). For the purposes of this

shocks and outsourcing, concern has also been expressed that the actions of foreign owned firms in western economies have influenced labour demand (see Conyon *et al*., 1999 for effects on overall UK wage rates; Taylor and Driffield, 2005; Blonigen and Slaughter, 2001, for the impact of FDI on wage inequality in the UK and USA respectively). The empirical work which has investigated the role of FDI on labour demand has, to our knowledge, only considered inward FDI and suggests that demand for skilled workers has increased as a result of FDI being a combination of two effects.

Firstly, the entry of MNEs in possession of a technological advantage over domestic firms yields productivity differences between national and foreign firms influencing wages directly. Following on from this, it is then assumed, and indeed confirmed by empirical evidence, that foreign-owned firms have different factor demands for labour in comparison to domestically owned firms, even within the same industry (Conyon *et al*. 1999). There is also the possibility of a further impact upon labour demand. This second effect occurs through a learning process (Barrell and Pain, 1997; Figini and Görg, 1999) whereby technological advantages are transferred to domestic producers (Blomström, 1986; Haddad and Harrison, 1993). To the extent that technology favours skilled workers the demand for skilled labour should increase relative to lower skilled workers[8].

The impacts of outward FDI on labour demand are perhaps somewhat ambiguous. However, given that we are able to split outward FDI into four different types, defined in terms of Table 1, it is possible to envisage that certain types of outward FDI might be detrimental to lower skilled workers. Our taxonomy of outward FDI brings our analysis very close to a topical issue, how subcontracting can harm employment. For example, outward FDI which occurs due to lower unit labour costs (Types 2 and 4 in Table 1) should be to the detriment of workers employed in the UK since demand for these workers will fall *ceterius paribus*, as production processes which employed such workers is moved overseas.

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paper we consider outward FDI, defined as total capital flows out of the UK to foreign countries, consistent with Bitzer and Görg (2005), which can obviously also consist of outsourced intermediate processes.

[8] This reasoning is similar to the impact over time of general purpose technologies upon wage differentials (Aghion and Howitt, 1998).

4. Estimation of the effects of FDI

In this section we introduce the methodology we adopt to consider the impact of inward and outward FDI on productivity and the demand for labour.

4.1 Determining the scale of productivity spillovers

There are essentially two possible approaches to estimating externalities in total factor productivity (*tfp*). The first possibility is to employ a 'two step' method in which one first obtains an estimate of total factor productivity from the following equation:

$$tfp_{it} = \ln Q_{it} - \hat{\beta}_L \ln L_{it} - \hat{\beta}_K \ln K_{it} \qquad (1)$$

where Q, L and K represent output, labour and capital of the firm, and the estimates of the β terms are derived either through estimation or (more commonly) simply from the relative factor shares of the two inputs. The estimate of total factor productivity can then be regressed against the externality terms within a fixed effects model, including a time trend (or alternative measure of exogenous technical progress) and other explanatory variables. This approach can, however, generate biased results. This can arise firstly because, particularly where the β terms are derived through factor shares, the two-step approach does not test for the appropriate specification of the production function. Perhaps more importantly, such an approach does not allow for endogeneity of capital or labour, and this has been shown to perform poorly, especially where capital is proxied capital by some perpetual inventory method. For further discussion see Griliches and Mairesse (1995).

As a result of these issues, we employ a 'one step' estimation approach. The method for identifying technological externalities adopted here follows the seminal paper by Griliches (1992), who postulates an augmented production function including both internal and external factors of production. The presence of such external influences on the firm is the consequence of externalities in production, due to formal or informal linkages between firms. The specification is thus:

$$\ln Q_{it} = \alpha + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \sum_{p=1}^{r} \mu_p X_{it} + \omega_{it} \qquad (2)$$

Where X is the vector of r externality terms, which is linked (usually positively) to total factor productivity, (i) represents the industry and (t) is time. It is assumed that there may be individual and time effects i.e. $\omega_{it} = v_i + v_t + u_{it}$ where u_{it} are the random errors, assumed to be iid $\left(0, \sigma_u^2\right)$[9].

This framework has been used to test for spillovers from FDI in the conventional sense, that is, the extent to which capital investment by foreign owned firms is linked to total factor productivity in the domestic sector. For recent examples of this literature and methodology, see Haskel *et al.* (2002), Harris (2002), Harris and Robinson (2002), Driffield (2001) and the earlier literature summarized in Görg and Strobl (2001).

As Oulton (1997) and Driffield (2001) outline, many studies of externalities suffer from specification error. For example, Oulton (1996) and Basu and Fernald (1995) suggest that if the vector of externalities in a specification such as equation (2) contains output variables, then a change in aggregate demand, impacting simultaneously on internal and external output, may generate spurious 'evidence' of externalities or spillovers where none exist. This arises as a result of the error term in (2) being related to aggregate output growth. The problem of spurious externality effects can largely be alleviated by a more precise specification of the externality term.

On both theoretical and econometric grounds, the vector of spillovers used here is lagged (inward or outward) FDI. The theoretical justification for this, derived from the theory of the firm, is that technological advance (or technology new to a particular location), or the international transfer of firm-specific assets, is embodied in new capital investment rather than in output, employment, or local R&D expenditure[10]. Econometrically, the use of lagged external investment produces a tightly defined source of potential spillovers, so it is unlikely that the

[9] This is the standard 'fixed effects' model, which is well understood, and is explained for example in Baltagi (2002). This allows for an industry specific component, and a time specific component. The econometric treatment of this is discussed in the text.

[10] This argument is the basis for the importance of inward capital investment (rather than employment or output) on a host economy, see for example Dunning (1958), Hood and Young (1979). Blomström (1986) stresses that it is ownership of *assets* that counts in FDI, not employment, while Hejazi and Safarian (1999) point out that employment or output measures may understate the level of FDI, because of the greater capital intensity of MNEs compared to indigenous enterprises.

'spillover' variable will be related to the error term in (2)[11]. One possible test for the appropriateness of our specification is to replace the investment term with the comparable value for contemporaneous output. If this produces no significant result, then one can be confident that any results generated using lagged investment are not the result of a spurious correlation. This is discussed at length in Driffield (2001) and the appropriate test is carried out in the econometric analysis below[12].

A further consideration in studies of productivity growth and externalities is the importance of learning by doing and the cumulative effects of continuous production. Islam (1995) shows that the appropriate specification within an econometric framework is to relate current total factor productivity to previous levels of output. By definition, this captures the importance of past levels of inputs in the production process. Therefore a dynamic specification is employed in which accumulated experience is captured by a lagged dependent variable, as in (3)[13]. For further discussion of the econometric specification of this problem, see Lee *et al*. (1998) and Pesaran and Smith (1995). Thus, to encompass learning by doing effects, the specification becomes:

$$\ln Q_{it} = \alpha + \gamma \ln Q_{it-1} + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \sum_{p=1}^{r} \mu_p X_{it} + \omega_{it} \qquad (3)$$

Using inward and outward flows of FDI (*IFDI* and *OFDI*) as appropriate measures of externalities yields:

$$\ln Q_{it} = \alpha + \gamma \ln Q_{it-1} + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \sum_{z=1}^{4} \phi_z \left(\ln IFDI_{it-1} \times D_z\right) + \sum_{z=1}^{4} \theta_z \left(\ln OFDI_{it-1} \times D_z\right) + \omega_{it} \qquad (4)$$

where we envisage four possible types of both inward and outward FDI (see above and Table 1), and *z=1…4*. We therefore define the following four binary indicators:

Type 1: $$\begin{array}{l} D_1 = 1 \quad if \quad \left(RDI_{UK} > RDI_F\right) \quad \& \quad \left(ULC_{UK} < ULC_F\right) \\ D_1 = 0 \quad if \quad Otherwise \end{array}$$

[11] See Oulton (1996) for a full discussion of this. Empirically this can be tested for using standard heteroskedasticity or specification tests.

[12] We formally test for this by substituting contemporaneous domestic output for lagged capital growth in estimating equation 3. This specification is rejected in all the results presented below, using standard specification tests.

[13] Q_{it-1} includes all other lagged values of Q, K and L by construction, as Q_{it-1} can be written as a function of $Q_{it-2}, Q_{it-3} \ldots, Q_{it-n}$ thus picking up experience effects. This also effectively allows the effect of past investment to decline over time, whereas accumulated output does not.

Type 2: $\begin{matrix} D_2 = 1 & if & (RDI_{UK} > RDI_F) & \& & (ULC_{UK} > ULC_F) \\ D_2 = 0 & if & Otherwise \end{matrix}$

Type 3: $\begin{matrix} D_3 = 1 & if & (RDI_{UK} < RDI_F) & \& & (ULC_{UK} < ULC_F) \\ D_3 = 0 & if & Otherwise \end{matrix}$

Type 4: $\begin{matrix} D_4 = 1 & if & (RDI_{UK} < RDI_F) & \& & (ULC_{UK} > ULC_F) \\ D_4 = 0 & if & Otherwise \end{matrix}$

D_z are four binary dummy variables defined in terms of Table 1 above, so if $D_z = 1$ then $D_{\tilde{z}} = 0$ where $z \neq \tilde{z}$. The dummy variables are defined using RDI and ULC at period *t-1*. This means that the motivation for FDI is based at *t-1* and outcomes at time *t*, and so the classification of FDI and its effects are non contemporaneous.

4.2 The impact of FDI on labour demand

In addition to the standard 'externalities approach' to determining the impacts of outward and inward FDI, we also focus on the demand for factors of production that occur as a result of FDI. While such issues in the past have been investigated in order to infer impacts of FDI in terms of technological change, (Barrell and Pain, 1997), they are perhaps more important if seen in the wider context of globalisation. Is outward FDI from the UK simply 'job exporting', and is inward FDI associated with increased demand for skilled workers at the expense of unskilled workers? FDI is hypothesised to impact on different factors to different degrees and possibly both adversely and positively. As such, the restriction of employing, say, a series of reduced form equations within a Cobb-Douglas framework is too restrictive. The approach we take here is to employ a structural equation for factor demand, which allows FDI to impact on different factors to differing extents (and indeed in different directions). Thus, we can determine whether FDI acts to increase or reduce the demand for various factors of production, and hence the rents that are paid to those factors. The advantages of this approach are outlined by Barrell and Pain (1997, 1999), who focus on the demand for unskilled labour as an indicator of technological change, though our model will incorporate wider effects than merely new technology replacing unskilled workers. In addition to allowing for heterogeneity in the impact of FDI across different factor markets, this approach is not beset by the problems associated with imposing unitary elasticity of substitution (σ) between factors, which would bias results here. A full discussion of this is provided in Barrell and Pain (1997): however, to summarise, starting with a standard CES production function:

$$Q = \gamma[s(K)^{-\rho} + (1-s)(Le^{\lambda t})^{-\rho}]^{-1/\rho} \quad \text{....(5)}$$

where A>0, and 0<s<1. Returns to scale are given by: $[s \div (1+s)] \times (K \div L)^{\rho+1}$.

The elasticity of substitution is given by $(\rho / 1+\rho)$ and t represents exogenous technological change. Thus, it is possible to derive a demand for labour equation:

$$\ln(L) = \ln(Q) - \frac{1}{1+\rho}\ln(w/p) - \frac{\rho}{1+\rho}\lambda t + \left[\frac{1}{1+\rho}\ln\left\{1 - s/\beta\right\} - \frac{\rho}{1+\rho}\ln(\gamma)\right] \quad \text{... (6)}$$

$$= \ln(Q) - \sigma\ln(w/p) - (1-\sigma)\lambda t + [\sigma\ln\{1 - s/\beta\} - (1-\sigma)\ln(\gamma)] \quad \text{....(7)}$$

It is therefore possible to relate the vector of FDI flows discussed above to changes in labour demand:

$$\lambda t = \delta_1 TIME + \delta_2 \ln IFDI + \delta_3 \ln OFDI \quad \text{.... (8)}$$

Barrell and Pain (1997, 1999) characterise this purely in terms of the effects of introducing new technology, as in a different context many of the study of spillovers from FDI focus merely on technology flows as the basis for observed productivity growth (van Pottelsberghe and Lichtenberg, 2001). It is important, however, to see the effects of FDI on both host and source countries in a wider context, allowing for phenomena such as outsourcing and efficiency seeking FDI, as well as the links between FDI and technological development. Finally, it is anticipated that there will be a good deal of persistence in factor demand, and that there will exist certain fixed effects, such that the final equation to be estimated can be given in the following terms:

$$\ln L_{it}^{h} = \alpha + \beta_1 \ln L_{it-1}^{h} + \gamma' Z_{it} + \sum_{z=1}^{4}\phi_z(\ln IFDI_{it-1} \times D_z) + \sum_{z=1}^{4}\theta_z(\ln OFDI_{it-1} \times D_z) + \psi TIME + \nu_i + \omega_{it} \quad (9)$$

The dummy variables D_z are as defined above. The first three coefficients are expected to be positive, while inward and outward FDI (*IFDI*, *OFDI*) are expected to impact on the demand for different factors in different ways, as outlined above. There are two types of labour, *h*, either skilled or unskilled.

4.3 Estimation

The problems of estimating a model such as that implied by (4) are well understood. The endogeneity of the 'internal' variables and the lagged dependent variable suggests that an instrumental variables approach is required. Given this approach, there are two possible sets of estimation techniques. The first is the well understood Arrelano and Bond (1988, 1991) estimator, which is employed to estimate the labour demand models. However, when estimating production functions with data of the type outlined below, there is a concern with this type of estimation of what is essentially a 'growth' model. The concerns here centre around the use of panels with relatively short time series, and that the estimates may become biased in the presence of significant heterogeneity (Pesaran and Smith, 1995). The class of estimators that address the problem of heterogeneity are designed for panels with a long time series, but narrow cross sections; see for example Lee *et al*. (1998) who discuss the application of the 'mean group' estimator. However, Lee *et al*. (1995) also show that biased estimates may be produced with the mean group estimator for T as large as 30.

We therefore employ the GMM estimator suggested by Blundell and Bond (1998) to estimate (4), which generates heteroscedastic-consistent estimates. This involves taking first differences in order to generate a transformed difference equation, then estimating this simultaneously with the levels equation, with lagged levels used as instruments in the difference equation, and vice versa. All explanatory variables are then instrumented with all available lags, as discussed in Arellano and Bond (1988, 1991). A consideration with data and models such as the one presented here is the extent to which lags (and particularly lags of differences) are valid instruments, particularly when considering lags of 5 years or more. It is therefore crucial to be careful in testing for instrument validity in each of the models, and all available lags are used for all years except 1990-1992, where the number of lags is constrained to 5 years on this basis. The Sargan tests for instrument validity are presented in the results tables.

There remains the possibility that the estimate of the coefficient on the lagged dependent variable has an upward bias if the panel data exhibits significant heterogeneity (Pesaran and Smith, 1995). There is no definitive test for this, but a reasonable test with these data is to allow for slope dummies in the lagged dependent variable, allowing the parameter on the lag to vary across industries or across country of ownership. Standard specification tests reject the inclusion of such variables, suggesting that heterogeneity is not a problem in these data. We also test for 1st and 2nd order serial correlation: (Doornik *et al*. 2002). The appropriate AR1 and AR2 tests are then based on average residual autovariances, which are asymptotically distributed N(0,1). Finally, as a further test of the GMM system estimator, we report the Sargan difference test[14]. In none of our regressions are the additional moment conditions suggested by the GMM systems estimator rejected.

5. Data

The data employed in the estimation represent a panel of 13 countries, 11 manufacturing sectors and 10 years (1987-96). Details of the countries and sectors are shown in the Appendix. The countries include all of the major direct investors in the UK and in the OECD generally, collectively accounting for 76% of the total overseas direct investment stock in the UK, and 87% of the outward FDI flows from the UK during the period 1990-98[15]. The manufacturing sectors are at the two digit level, the lowest level of aggregation compatible with combining Office for National Statistics (ONS) and OECD data for the relevant countries. The data for the domestic sectors and FDI inflows were provided by ONS; data on R&D intensities and unit labour cost were derived from the OECD's ANBERD and STAN databases, for R&D expenditure and value added respectively[16]. Full details of variable definitions and data sources can also be found in the Appendix. All monetary values are converted to real terms using sectoral level producer price index data, and purchasing power parity data where appropriate for international comparison. Crucially, this enables us to analyse FDI flows in terms of unit labour costs and R&D intensity, not at the country level, but at the sectoral level between countries.

Figure 1 demonstrates that, for the countries and sectors in the dataset, inward investment doubled over the 10 years to 1996, while outward FDI increased more than three fold over the

[14] As the set of instruments used for the equations in first differences is a strict subset of that used in the system of first-differenced and levels equations, a more specific test of these additional instruments is a Difference Sargan test which compares the Sargan statistic for the system estimator and the Sargan statistic for the corresponding first-differenced estimator.
[15] Data from Department of Trade and Industry (1999 figures) and OECD Financial Market Trends respectively.
[16] The breadth of the sectors is due to the need to find suitable deflators and PPP currency data at the sectoral level, in order to compare R&D intensity and unit labour costs consistently across countries.

period. This perhaps illustrates some of the concerns expressed by policy makers and trade unions over phenomena such as 'job exporting' and the effect that outward FDI may have on the returns to unskilled labour in the UK.

Figures 1-3 here.

Figure 2 illustrates that, over the time period, most FDI into the UK was in sectors where the UK has a relative disadvantage in terms of R&D (Types 3 and 4), accounting for over 90% of inward investment in the UK at the start of the period. The dominant explanation for inward FDI therefore appears to be the technological advantage of the source sector: this conforms to Dunning's 'ownership advantage' explanation, which has become the predominant explanation for FDI, particularly between industrialised countries. However, it is clear that while this explanation remains important, it has declined in explaining total FDI flows. Inward investment into sectors with R&D intensity below that of the source country, but with higher labour costs (Type 4), declined from around 80% of the total at the start of the period to under 40% by the end. This change is mostly explained by increased investment in sectors where the UK has a R&D advantage over the source country, but no labour cost advantage (Type 2), and conforms to the 'technology sourcing' explanation for FDI. These results may have important policy connotations. Much of the analysis of the social returns (spillovers) from inward investment is predicated on the assumption that inward investment possess some technological advantage over the domestic sector, and that this technology somehow spills over to the domestic sector. Analysis of the data presented here, however, suggests that by the end of the time period over one third of inward investment was in sectors in which the UK possessed an R&D advantage over the source country, and in which technology spillovers are therefore unlikely.

Figure 2 also reveals that a surprisingly low proportion of inward investment into the UK appears to be motivated solely by low labour costs, often referred to as 'efficiency seeking' in the international business literature (Type 3). This proportion doubled in percentage terms over the period, but nevertheless peaked at under 30%, and accounts for an average of under 20% over the period. This is a potentially important finding. Policy makers and commentators often assert that FDI is attracted to the UK due to its more flexible labour market and low labour costs compared with the rest of the EU. Indeed, a common argument against the introduction of the minimum wage was that it would not only deter inward investment, but would drive out existing investors. The data suggest that such concerns are unfounded, and question the effectiveness of policies designed to attract FDI to the UK based on low labour costs.

Turning now to outward FDI (Figure 3), the dominant pattern is one of efficiency seeking. Over the period, over 75% of all outward FDI from the UK was into sectors with lower labour costs than the home sector (Types 2 and 4). This is potentially bad news for unskilled workers in the UK, with this type of FDI often being associated with 'outsourcing' or 'job exporting'. However, it is also clear that the dominance of this standard explanation for outward FDI has declined somewhat over time in the same way as it did in the inward investment case. Efficiency seeking FDI declined in importance with the growth in technology sourcing FDI. The proportion of FDI that was targeted at sectors with higher R&D intensity and higher labour costs than the UK (such that efficiency seeking cannot be the explanation) increased from under 10% of total outward FDI to over 25% during the period (Type 3 FDI). Finally, it is reassuring for this analysis that the FDI flows across these categories are relatively consistent, with only limited year on year variation. The data do, however, suggest that in general by the end of the time period some 25% of both inward and outward FDI was associated with technology sourcing activity (where the host country has higher labour costs and higher R&D intensity than the source country).

There is, of course, the possibility that the analysis presented here is merely a sector level phenomenon. Figures 4-6 demonstrate clearly that some UK sectors are indeed more FDI intensive than others, both in terms of inward and outward FDI. Sectors such as chemicals, food and drink and paper and publishing are generally regarded as sectors with high levels of FDI, and clearly the UK is no exception to this (Figure 4). However, it is also clear that there is significant variation within these sectors in terms of the categories of FDI. For example, Figure 5 illustrates that all sectors have outward FDI in at least two of the four categories, while seven of the eleven sectors have outward FDI in all four categories. Clearly, the figures presented above cannot be seen merely as reflecting sectoral differences in either labour costs or R&D intensity in the UK. Not surprisingly, chemicals shows the widest spread in terms of the four categories, with evidence of both efficiency seeking and technology sourcing, as well as FDI motivated by the desire to exploit technology abroad. This is perhaps well understood within the chemicals industry, with firms having distributions of both R&D and mass production activities. The chemicals sector is also the one with the most prominent evidence of technology sourcing FDI, with over one half of its outward FDI associated with technology sourcing. The food, drink and tobacco sector is the only truly bimodal sector in terms of outward FDI, with 97% of the outward FDI targeted at countries with lower unit labour costs than the UK. This suggests that the food and drink sector is one where outward FDI tends to be in the form of efficiency seeking, with the potential for adverse effects on unskilled employment in the UK. In line with the more aggregate figures discussed above, a high proportion of the outward FDI at the sectoral level is associated with low labour cost locations (Figure 5). The same can be said of printing and publishing, electrical engineering and the miscellaneous sector. Interestingly, with the exception of the chemicals sector, there appear to be few sectors where FDI is linked to technological advantage. There are only small quantities of outward FDI in sectors where R&D intensity is greater in the UK, suggesting that in general outward FDI is not associated with significant technology transfer abroad, but rather with efficiency seeking and technology sourcing.

Figures 4-6 here.

The sectoral pattern of inward investment is, however, quite different (Figure 6). Most sectors experience large proportions of inward FDI from countries with higher R&D intensities, suggesting that inward FDI is associated with the introduction of new technology to the UK. However, it is also noticeable that five of the sectors experience FDI in all four categories, while a further four have inward FDI in at least three. As with outward FDI, the four categories of investment are not simply sector-specific. Printing and publishing and electrical engineering FDI originates mainly from countries with lower R&D intensities, while chemicals and vehicles appear to be the main recipients of efficiency seeking FDI, largely through Japanese and US investment. In general however, there is not a consistent pattern of the UK attracting a huge proportion of FDI motivated by low labour costs, even at the sectoral level.

6. Results

The results from estimating the impact of FDI on productivity (equation 4) are shown in Table 2, and those from estimating the impact of FDI on labour demand (equation 9) in Tables 3 and 4 (for skilled and unskilled workers respectively). As outlined above, there is a good deal of variation in the literature not only in the magnitudes of social returns to inward and outward investment, but also in the direction of effects. The results presented here illustrate the importance of linking the motivation to the impact of both inward and outward FDI. For comparison we present a set of results for each model treating both inward investment and outward FDI as homogenous blocks. The results from this specification are shown in columns 1 and 3 of each table and largely generate insignificant coefficients, which would suggest that the impacts of FDI on the UK are minimal. The only significant impact comes from inward FDI by increasing the demand for skilled labour (Table 3, column 1), consistent with findings in the literature (see Driffield and Taylor, 2000). However, once one allows for the different determinants of FDI, shown in columns 2 (inward) and 4 (outward) in each table, the results become far more informative.

The results for inward FDI illustrate clearly why there has been such a variety of empirical findings on the spillover effects of inward investment on domestic productivity. Table 2 indicates that there is some evidence (p=0.064) of a positive overall effect of inward FDI on domestic productivity growth. However, the picture becomes clearer when allowance is made for the different types of FDI. There is evidence of conventional positive spillovers in the sense that FDI from sectors more technologically advanced than the UK does act to stimulate productivity growth in the UK sector, i.e. ϕ_3, $\phi_4 > 0$. This suggests that UK manufacturing gains from productivity spillovers where the incoming investor has some form of technological advantage, consistent with the previous findings of Driffield and Love (2002). However, it is clear that this positive spillover is significant only where the technological (ownership) advantage of the foreign investor is sufficiently great to offset the disadvantage of higher unit labour costs in the UK, since ϕ_3 is insignificant.

The negative coefficients for *IFDI 1* and *IFDI 2*, ϕ_1 and ϕ_2, indicates that there is some evidence of market stealing by firms who invest in the UK in order to source domestic technology. At first sight this seems an unlikely result: Sembenelli and Siotis (2002) point out that technology sourcing with market stealing is an unlikely combination in reality, because the technological laggard is in a poor position to compete with local or other foreign firms. For this reason they conclude that technology sourcing is likely to leave competitive conditions unchanged. However, the advantage of the present analysis is that it also allows for the impact of factor cost differentials as a determinant of FDI. Our results indicate that technology sourcing FDI has a significantly negative (i.e. market-stealing) effect only where the foreign investor benefits from lower labour costs in the UK, suggesting that the ability to access cheaper labour offsets the technological gap sufficiently to allow the incoming foreign investor to compete with indigenous UK firms. Where the incoming company's technological disadvantage is not offset by access to cheaper UK labour (*IFDI 2*), the relevant coefficient ϕ_2 is negative but insignificant, consistent with the argument of Sembenelli and Siotis (2002).

The estimates of the factor demand equations for inward FDI are also informative (Tables 3 and 4). Overall, the impact of inward FDI on skilled labour demand appears to be slightly positive, with no net effect on unskilled labour demand. Again, however, these aggregate effects hide more than they reveal. There is evidence of the effect identified by Barrel and Pain (1997) in that inward FDI reduces the demand for unskilled workers. Importantly however, this result is not associated with all FDI into the UK, but only where the UK lags behind the source country in terms of technology. By contrast, where investment into the UK is motivated by technology sourcing, and especially where the UK is a lower cost location, demand for unskilled labour is stimulated by inward investment i.e. $\phi_1 > 0$. The effects on skilled labour demand are almost precisely the reverse. Where the investor has some technology advantage, and especially where there is no labour cost advantage in investing in the UK (*IFDI 4*), demand for skilled labour rises with inward investment. But technology sourcing FDI generally reduces the demand for skilled labour in the UK, especially where the UK has lower labour costs. Overall therefore, the effects of inward FDI on domestic productivity and labour demand appear to depend more on technology differentials than on factor cost differentials: acquiring technology through inward investment increases the demand for skilled labour, decreases demand for unskilled labour and produces positive spillovers on domestic productivity

Turning now to outward FDI, in aggregate there appears to be no significant effect of outward FDI on domestic productivity (Table 2 column 3). However, when we distinguish between the different types of FDI the picture becomes clearer. There is some evidence of effective technology sourcing FDI from the UK, in that outward investment into high cost, high R&D intensive locations generates productivity growth in the UK i.e. $\theta_3 > 0$. This finding is to some extent consistent with that of van Pottelsberghe and Lichtenberg (2001), who interpret any positive effect of outward FDI on domestic productivity as the result of technology sourcing. However, in an advance on the findings of previous researchers our results show that outward FDI to low cost locations can also lead to productivity growth at home ($\theta_2 > 0$ and significant). This cannot be seen as technology sourcing as argued by van Pottelsberghe and Lichtenberg (2001) *inter alia*, because in this case UK R&D intensity is greater than that of the relevant sector in the host economy. This is more likely to be the result of domestic productivity growth generated through a ‘batting average’ effect as low value added activities are moved elsewhere.

These results are consistent with the factor demand estimates. In the aggregate figures, as with the productivity effects discussed above, outward FDI appears to have no overall effect on demand for unskilled or skilled labour in the UK (Tables 2 and 3, column 3). However, it becomes clear that these aggregate effects mask markedly different effects of different types of FDI. The effects on skilled and unskilled workers vary depending on the technological differentials between the UK and host sectors. The effect on skilled workers (Table 3) appears to be associated with technology sourcing, in that the negative effect on the demand for skilled workers occurs when foreign industries are more R&D intensive than the UK, regardless of labour cost differentials i.e. $\theta_3 < 0$ and $\theta_4 < 0$, column 4. By contrast, for unskilled workers (Table 4) there is evidence of relocation due to factor costs; the coefficient on *OFDI 4*, θ_4, is highly significant and *OFDI 2* marginally so. These results suggest that the effects on unskilled labour are predominantly a *cost* issue, consistent with outsourcing, while the effects on skilled labour are predominantly a *technology* issue. This is consistent with the offshoring of jobs by

UK firms, but for different reasons; technology sourcing offshores skilled jobs, while seeking lower labour costs abroad offshores unskilled jobs.

Two other points are relevant to the labour demand effects of outward FDI. The first is that where the UK has a technological advantage and where this is reinforced by lower unit labour costs (OFDI 1) outward FDI increases the demand for skilled labour. This may be a result of the increased need for scientific and technical personnel required to develop new products and adapt existing ones to foreign markets (Pearce, 1999; Niosi, 1999) The other issue relates to the size of the estimated elasticities where FDI has a significant effect on labour demand, in the region of 0.12 to 0.19. These are large, and suggest that the overall insignificant impact of FDI on skilled labour masks very substantial gains and losses arising from outward investment of different types.

7. Conclusions

The impacts on both host and source countries of the ever increasing amounts of FDI flows have generated a great deal of academic and policy interest, and no little controversy. The results outlined above suggest that at least part of the reason why there has been such a lack of consensus in the empirical research on the effects of FDI arises from considering FDI as a homogeneous block, and failing to allow for the possibility that investment motivated by different considerations may have markedly different effects.

Inward investment into the UK comes overwhelmingly from sectors and countries which have a technological advantage over the corresponding UK sector, and this is reflected in the effects which inward FDI has. This suggests that in general the standard 'ownership advantage' explanations of FDI are still valid, and so policy initiatives designed to boost technological development through inward investment may be valid. Technology differences matter much more than labour cost differences in terms of the effects of inward FDI: acquiring technology through inward investment increases the demand for skilled labour, decreases demand for unskilled labour and produces positive spillovers on domestic productivity. However, this is far from the complete picture, as our analysis in sections 5 and 6 suggest. The fact that the bulk of inward FDI also comes from sectors which have lower unit labour costs than the UK equivalent, coupled with some evidence of a trend towards technology sourcing FDI into the UK, suggests that the policy preoccupation with a flexible labour market as a major attractor of inward investment may be overstated.

Outward FDI shows a quite different pattern, dominated by investment into foreign sectors which have lower unit labour costs than the UK, but with evidence of an increasing trend towards technology sourcing by UK industry. Like van Pottelsberghe and Lichtenberg (2001), we find that outward FDI can raise domestic productivity in the source economy, However, this is clearly not restricted to a technology sourcing effect; UK productivity also rises when FDI occurs from sectors which have lower unit labour costs but higher R&D intensity than their foreign counterparts, consistent with a 'batting average' effect as low value added activities are moved abroad. Given that this latter form of outward FDI is much more common than 'true' technology sourcing from the UK (Figure 3), and that the coefficients on OFDI 3 and OFDI 2 are virtually identical (Table 2), this suggests that van Pottelsberghe and Lichtenberg's assertion that most outward FDI is motivated by technology sourcing considerations clearly does not hold, at least for the UK. The dominance of outward FDI to low-cost locations also has implications for labour, markedly reducing the demand for unskilled labour

In policy terms, our results indicate that concerns about the impact on jobs of outsourcing may be well placed. The dominant forms of outward FDI unequivocally reduce demand for unskilled labour in the UK, and to some extent also for skilled labour. The only form of outward investment which increases labour demand is the effect on skilled labour where the UK sector has an unambiguous technology advantage; but this form of investment (Type 1) typically accounts for less than 10% of total UK outward FDI. In terms of inward FDI, our results support the possibility that attracting inward investment can improve productivity by attracting foreign technology and can help to solve structural or regional unemployment – but it has to be of the right sort. The form of inward FDI most common in the UK (i.e. relatively technology intensive) certainly improves demand for skilled labour. But it will be of little assistance to regions in which the main problem is lack of demand for relatively unskilled labour: technology intensive FDI unambiguously reduces the demand for unskilled labour and may therefore be an inappropriate policy response in some areas. In addition, if the trend towards more technology-sourcing inward investment continues, it may lessen the likelihood and extent of beneficial productivity spillovers, thus undermining one of the key policy advantages of attracting FDI.

It is important to see the results from the total factor productivity estimates and the labour demand estimates together. The main motivations for policy makers seeking to attract FDI into a developed country are twofold. Firstly, to generate employment, particularly in regions that are still suffering from long term structural unemployment. Secondly, to attract new technology into the country. The results presented here suggest that achieving both of these simultaneously may be difficult. Where FDI introduces new technology, and thus increases total factor productivity in UK firms, this is largely associated with a relative reduction in the demand for unskilled workers. Such inward FDI into the UK will increase skill differentials and hence wage inequality rather than reduce it. At the same time, there is scope for inward investment to generate employment for unskilled workers, but only where this is motivated by low labour costs, and such FDI generates little in the form of spillovers. Thus the main objectives of attracting inward investment to the UK are achievable, but are typically mutually exclusive within the same investment project. Whether policy makers are able to identify this key distinction, and indeed whether it is desirable to pick and choose investment projects in this way, is another matter.

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Figure 1: **Inward and outward FDI flows over time**.

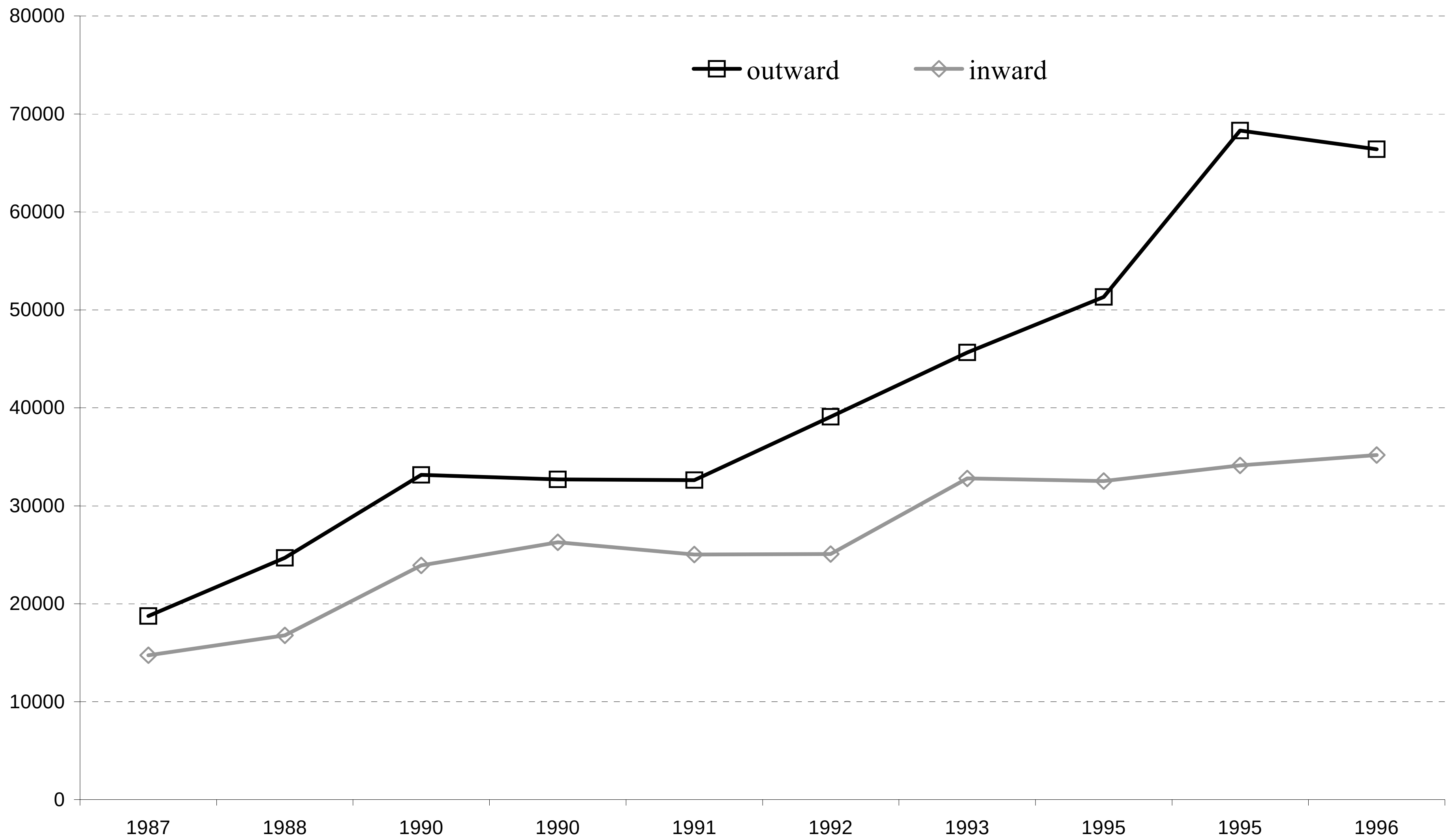

Figure 2: **Patterns of inward FDI over time.**

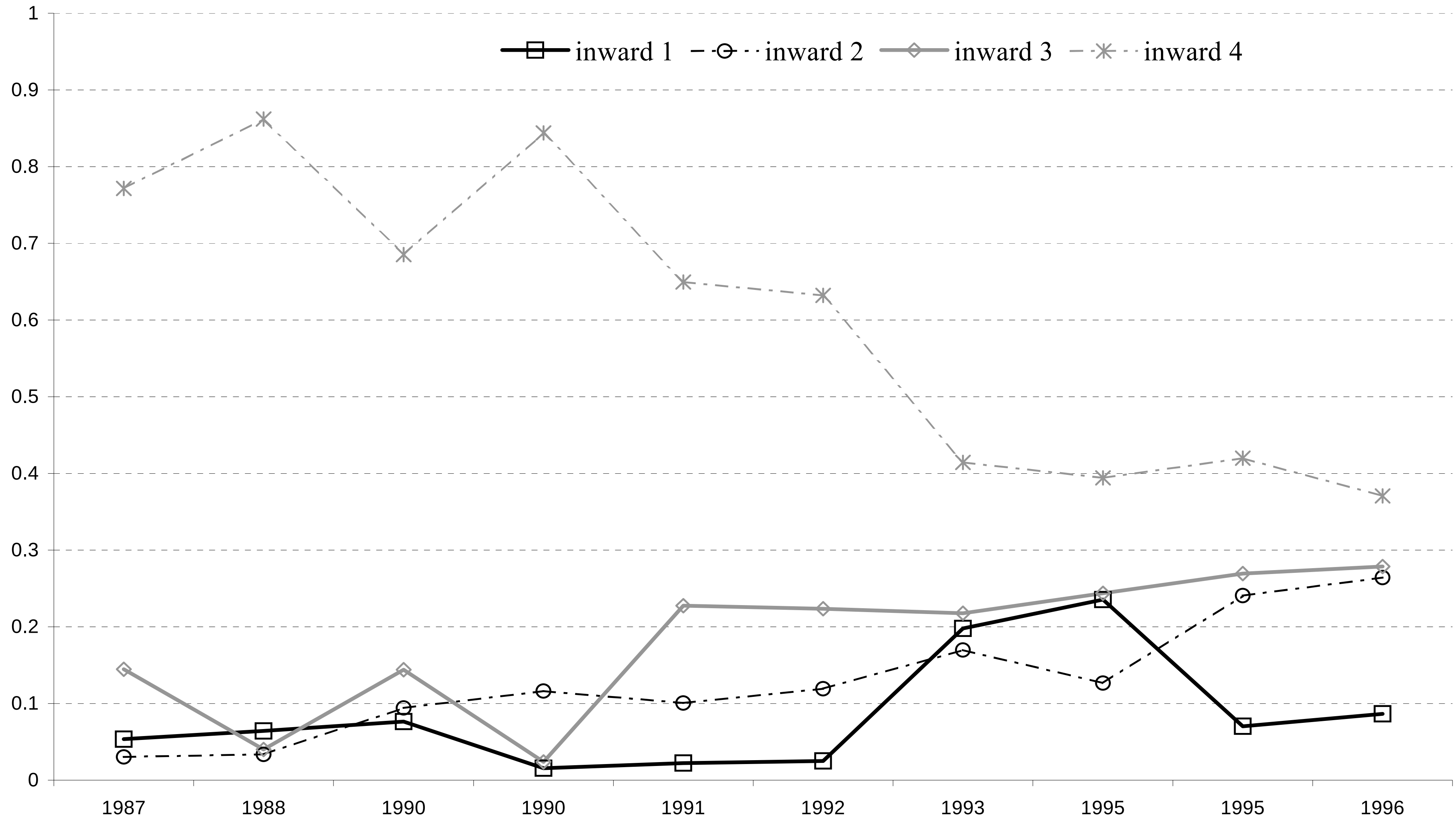

Figure 3: **Patterns of outward FDI over time.**

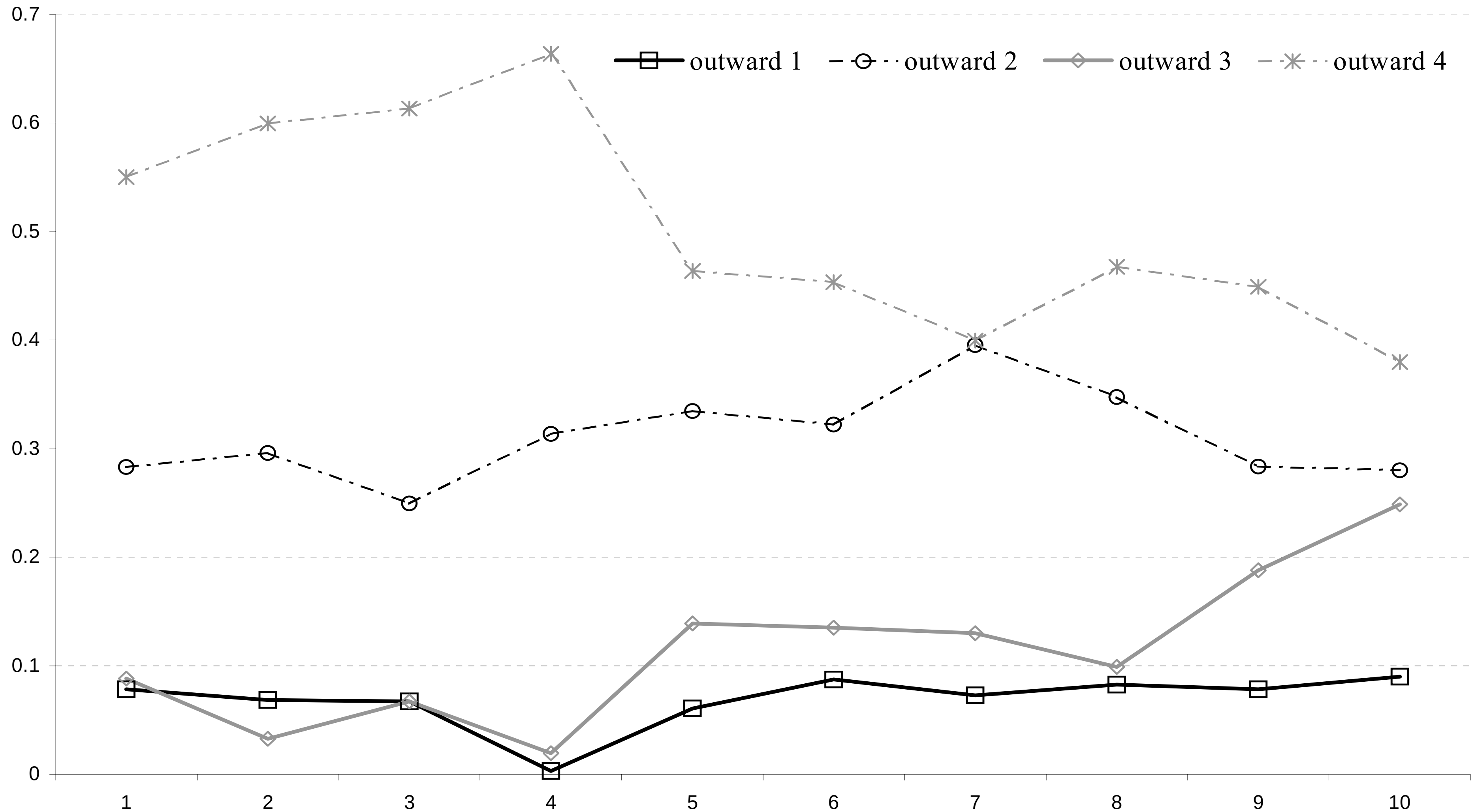

Figure 4: Inward and outward FDI flows as a percentage of UK sales by UK firms.

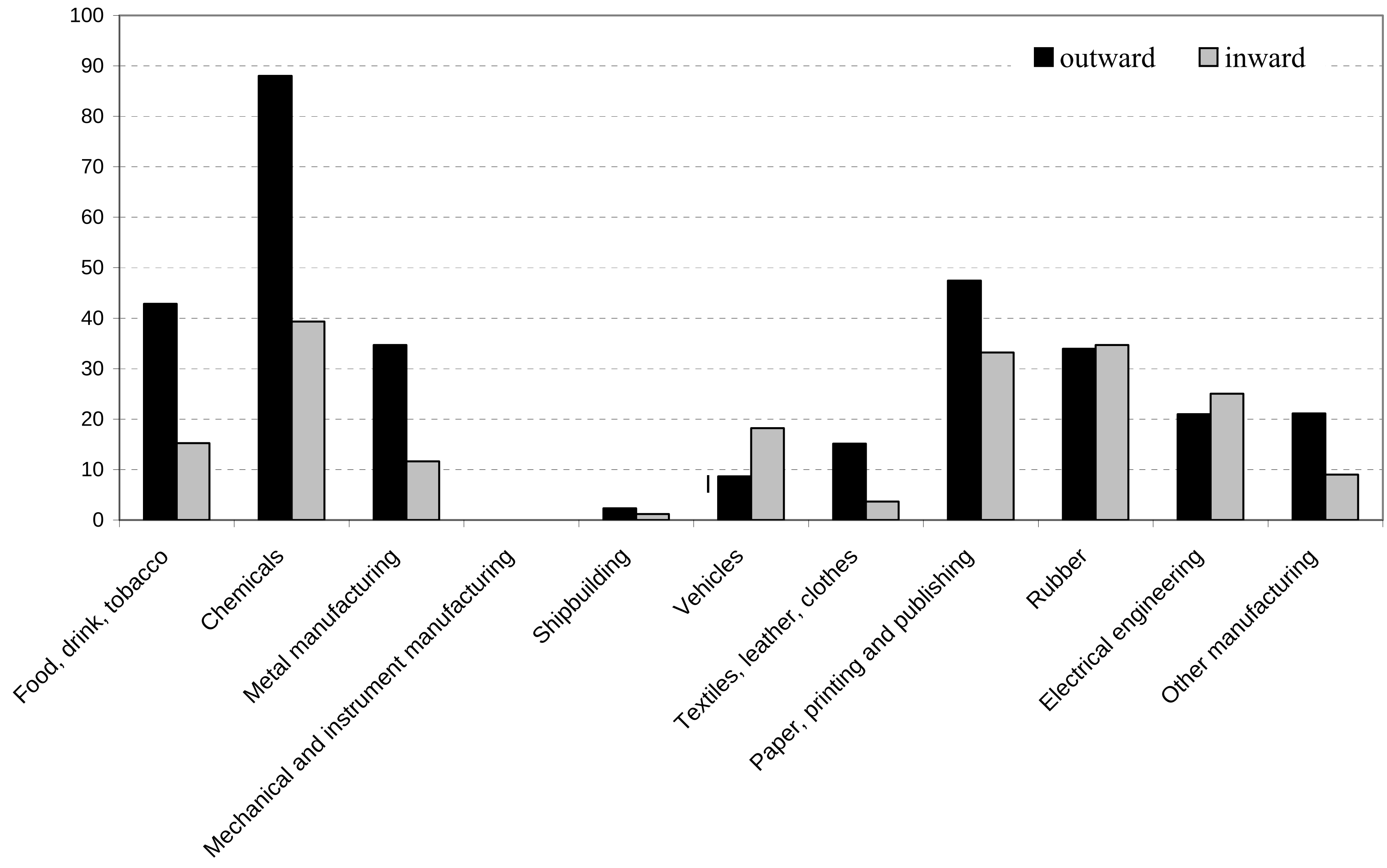

Figure 5: **Outward FDI by sector**.

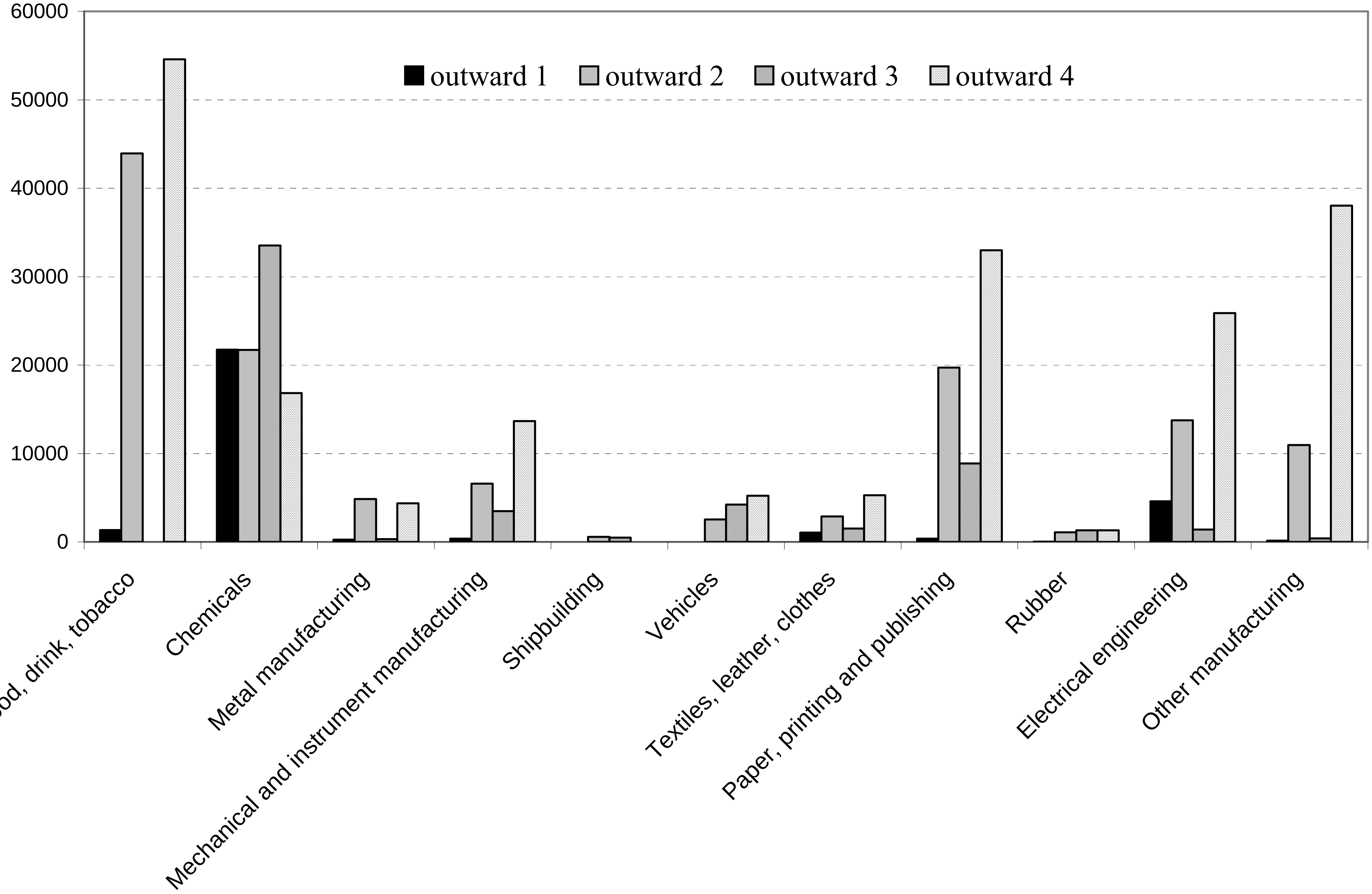

Figure 6: **Inward FDI by sector**

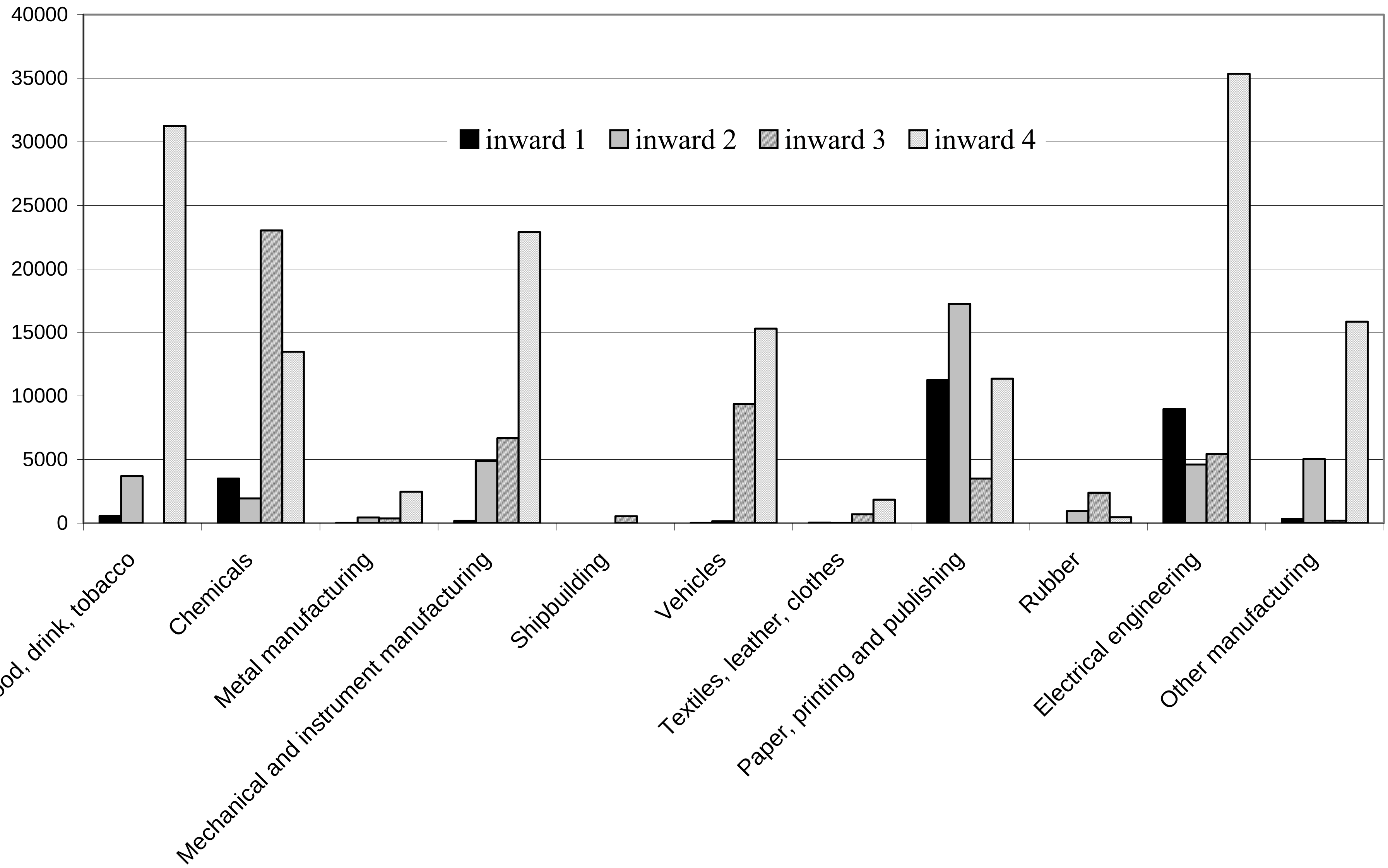

Table 2: Impact of inward and outward FDI on home productivity

	1		2		3		4	
	coefficient	**t value**	**coefficient**	**t value**	**coefficient**	**t value**	**coefficient**	**t value**
Q $_{(t-1)}$	0.01790	*(5.31)*	0.02423	*(3.54)*	0.10523	*(1.48)*	0.04164	*(0.55)*
L skilled	0.65057	*(9.47)*	0.56534	*(6.90)*	0.44011	*(3.63)*	0.35497	*(2.59)*
L unskilled	0.03460	*(9.67)*	0.33225	*(4.38)*	0.34039	*(2.77)*	0.34299	*(2.79)*
K	0.2055	(3.08)	0.1547	(2.81)	0.1863	(2.23)	0.2578	*(3.70)*
Time trend	0.0341	*(2.01)*	0.0374	*(2.32)*	0.0299	*(1.99)*	0.0287	*(1.89)*
IFDI $_{(t-1)}$	0.11628	*(1.88)*						
IFDI 1 (ϕ_1)			-0.02149	*(-3.47)*				
IFDI 2 (ϕ_2)			-0.01223	*(-1.07)*				
IFDI 3 (ϕ_3)			0.01051	*(0.71)*				
IFDI 4 (ϕ_4)			0.02696	*(2.81)*				
OFDI $_{(t-1)}$					0.01137	*(0.65)*		
OFDI 1 (θ_1)							0.0113	*(0.65)*
OFDI 2 (θ_2)							0.02341	*(3.25)*
OFDI 3 (θ_3)							0.02510	*(3.34)*
OFDI 4 (θ_4)							-0.01479	*(-1.03)*
Specification $\sim\chi^2(10)$[17] (p value)	14.521 (0.151)		13.681 (0.188)		11.498 (0.321)		12.547 (0.250)	
Sargan *p value*	*0.256*		*0.261*		*0.271*		*0.240*	
Sargan difference test (p value)	*10.490 (0.399)*		*18.527 (0.421)*		*12.539 (0.251)*		*22.578 (0.207)*	
AR(1), *p value*	*-0.2151 [0.830]*		*0.08547 [0.932]*		*-0.4994 [0.617]*		*-0.5517 [0.581]*	

[17] This is based on testing the Cobb-Douglas specification against a translog specification.

AR(2), *p value*	*-1.619 [0.105]*	*-1.433 [0.152]*	*-1.624 [0.104]*	*-1.995 [0.046] **
OBSERVATIONS	*99*			

Table 3: Impact of inward and outward FDI on skilled labour demand

	1		**2**		**3**		**4**	
	coefficient	**t value**	**coefficient**	**t value**	**coefficient**	**t value**	**coefficient**	**t value**
L $_{(t-1)}$	0.07116	*(4.93)*	0.06665	*(5.69)*	0.07299	*(4.39)*	0.05841	*(3.25)*
Q $_{(t)}$	0.82883	*(4.89)*	0.82668	*(2.35)*	0.83182	*(4.54)*	0.82981	*(4.47)*
L/Q $_{(t-1)}$	0.01918	*(4.21)*	0.02249	*(4.50)*	0.02109	*(8.51)*	0.02298	*(7.30)*
w/p $_{(t-1)}$	-0.76819	*(-2.07)*	-0.62067	*(-2.19)*	-0.74052	*(-3.80)*	-0.64322	*(-4.92)*
TIME	-0.02435	*(-1.65)*	-0.01769	*(-1.18)*	-0.02756	*(-1.89)*	-0.02701	*(-1.70)*
IFDI $_{(t-1)}$	0.01137	*(2.59)*						
IFDI 1 (ϕ_1)			-0.00443	*(-6.67)*				
IFDI 2 (ϕ_2)			0.01131	*(1.29)*				
IFDI 3 (ϕ_3)			0.00023	*(0.51)*				
IFDI 4 (ϕ_4)			0.02130	*(2.00)*				
OFDI $_{(t-1)}$					-0.00491	*(-0.35)*		
OFDI 1 (θ_1)							0.15043	*(1.98)*
OFDI 2 (θ_2)							-0.01902	*(-1.23)*
OFDI 3 (θ_3)							-0.01911	*(-2.72)*
OFDI 4 (θ_4)							-0.12353	*(-2.20)*
Sargan *p value*	*1.147 (0.284)*		*1.339 (0.247)*		*1.068 (0.301)*		*0.519 (0.471)*	
AR(1), *p value*	*0.681 (0.409)*		*0.722 (0.396)*		*0.588 (0.443)*		*0.669 (0.413)*	
AR(2), *p value*	*2.839 (0.092)*		*3.623 (0.057)*		*2.911 (0.088)*		*3.331 (0.068)*	
OBSERVATIONS	*99*							

Table 4: Impact of inward and outward FDI on unskilled labour demand

	1		**2**		**3**		**4**	
	coefficient	**t value**	**coefficient**	**t value**	**coefficient**	**t value**	**coefficient**	**t value**
L $_{(t-1)}$	0.00620	*(2.72)*	0.09722	*(2.38)*	0.00603	*(3.22)*	0.06939	*(2.72)*
Q $_{(t)}$	0.75561	*(2.21)*	0.71335	*(1.90)*	0.69000	*(2.47)*	0.73680	*(2.89)*
L/Q $_{(t-1)}$	0.01511	*(0.32)*	0.01906	*(2.50)*	0.01655	*(2.11)*	0.02561	*(1.89)*
w/p $_{(t-1)}$	-0.70931	*(-0.18)*	-0.58481	*(-2.66)*	-0.69714	*(-2.75)*	-0.54258	*(-2.27)*
TIME	-0.18765	*(-2.19)*	-0.19808	*(-3.64)*	-0.13109	*(-2.07)*	-0.17874	*(-4.19)*
IFDI $_{(t-1)}$	-0.01489	*(-1.19)*						
IFDI 1 (ϕ_1)			0.12892	*(2.32)*				
IFDI 2 (ϕ_2)			0.15913	*(1.75)*				
IFDI 3 (ϕ_3)			-0.09356	*(-1.74)*				
IFDI 4 (ϕ_4)			-0.07949	*(-3.61)*				
OFDI $_{(t-1)}$					-0.27946	*(0.35)*		
OFDI 1 (θ_1)							0.05155	*(0.27)*
OFDI 2 (θ_2)							-0.18938	*(-1.54)*
OFDI 3 (θ_3)							-0.04816	*(-1.23)*
OFDI 4 (θ_4)							-0.19216	*(-2.75)*
Sargan *p value*	*1.343 (0.247)*		*2.257 (0.133)*		*1.031 (0.310)*		*1.650 (0.199)*	
AR(1), *p value*	*(0.221)*		*0.876 (0.349)*		*3.283 (0.070)*		*0.744 (0.388)*	
AR(2), *p value*	*0.744 (0.388)*		*0.597 (0.441)*		*0.887 (0.348)*		*0.899 (0.354)*	
OBSERVATIONS	*99*							

Appendix: Data and Sources

Table A1. Countries and Sectors in Panel

Countries	**Sectors (ISIC 3 codes)**
Australia	Food, Drink and Tobacco (15+16)
Canada	Chemicals (24)
Denmark	Metal Manufacturing (27)
Finland	Mechanical & Instrument Manufacturing (29+33)
France	Transport Equipment exc. Vehicles (35)
Germany	Vehicles (34)
Italy	Textiles, Leather and Clothing (17+18+19)
Japan	Paper, Printing and Publishing (21+22)
Netherlands	Rubber & Plastics (25)
Norway	Electrical Engineering (30+31+32)
Spain	Other Manufacturing (20+26+28+36+37)
Sweden	
USA	

Table A2: Variable definitions and data sources

Variable	Definition	Source
Q_{it}	Value added (sector i year t).	ONS for UK; STAN for source countries.
K_{it}	Capital stock	ONS
ML_{it}	Employment of operatives	ONS
NL_{it}	Employment of non-operatives	ONS
W/p_{it}	Real wage of non operatives	ONS
FDI_{it}	Foreign direct investment	ONS
RD_{it}	R&D expenditure	ANBERD
RDI_{it}	RD/Q	ANBERD/STAN
$FDI\ (1)_{it}$	FDI where $RDI_{UK}>RDI_F$ and $ULC_{UK}< ULC_F$	ONS/ANBERD/STAN
$FDI(2)_{it}$	FDI where $RDI_{UK}>RDI_F$ and $ULC_{UK}> ULC_F$	ONS/ANBERD/STAN
$FDI\ (3)_{it}$	FDI where $RDI_{UK}<RDI_F$ and $ULC_{UK}< ULC_F$	ONS/ANBERD/STAN
$FDI\ (4)_{it}$	FDI where $RDI_{UK}<RDI_F$ and $ULC_{UK}> ULC_F$	ONS/ANBERD/STAN

Sectoral producer price deflators were used throughout, and OECD purchasing power parity deflators were also employed in calculating relative R&D intensities across countries. All estimations carried out in log form.

Table A3. Descriptive statistics

	Firm numbers	Total employment	Unskilled employment	Skilled employment	Average unskilled earnings (£ annual)	Average skilled earnings (£ annual)	Sales (£ million)	Capital stock estimate
minimum	80	20346	7815	12531	6654	6878	209460	34919
maximum	60357	844385	609539	234845	16211	51981	50925104	12069871
average	7742	203441	134289	69152	10125	12356	10820019	2260359
st dev	12426	209036	146712	67334	848	6902	10840752	2482149

Annual FDI data (£ million)

	inward 1	inward 2	inward 3	inward 4	outward 1	outward 2	outward 3	outward 4
minimum	0	0	0	0	0	0	0	0
maximum	606.5	665.0	427.3	531.2	448.8	900.4	981.0	1518.6
average	22.66	35.46	47.47	1365.91	270.62	1168.69	504.58	1801.71
st dev	83.67	89.88	93.38	147.97	77.49	160.65	1394.47	222.81

Table A4 Inward and outward FDI from the UK by country. (£ million, totals for 1987-1996)

Country	Outward FDI from UK	Inward FDI to UK
AUSTRALIA	25841	23767
CANADA	21998	9322
DENMARK	1672	1669
FINLAND	371	1008
FRANCE	30506	9281
ITALY	32914	17005
ITALY	14745	0
JAPAN	6816	8704
NETHERLANDS	63317	21707
NORWAY	731	145
SPAIN	11740	0
SWEDEN	2996	6628
USA	199080	167120