Spillovers from FDI and skill structures of host-country firms.

Nigel Driffield[1] and Karl Taylor[2*]

[1]Ashley Building, University of Birmingham, Edgbaston, Birmingham. B15 2TT
[2]Department of Economics, University of Leicester, University Road, Leicester. LE1 7RH

ABSTRACT

This paper uses panel data across UK manufacturing from 1983 to 1992, to test whether inward flows of FDI have contributed to increasing trends in the employment of relatively higher skilled individuals. Moreover, the paper isolates the effect on domestic firms, and shows that this effect is a function of the size of the foreign productivity advantage. The results show, that even after controlling for the factors most commonly used to explain relative employment shifts – namely technological change and import intensity, that FDI has a role to play in influencing employment trends.

Keywords: multinationals, spillovers, relative employment

JEL Classification: F21; F23; J23

In recent years both academics and policy makers have expressed concern that increasing globalisation, both in the form of FDI and international trade, is causing dramatic changes in labour demand in the developed world, see for example Wood (1994, 1998) and Anderton and Brenton (1999). Specifically, it has been suggested that demand for unskilled workers in the US and Western Europe has been, and will continue to decline dramatically, as the employers of unskilled workers face significant competition from the NICs and other parts of the developing world.

In addition, concern has also been expressed that the actions of foreign owned firms in western economies have had the effect of increasing the demand for skilled, relative to unskilled labour, generating greater skill – differentials than have hitherto been observed. Such empirical work as has been done in this area, suggests that the increased demand for skilled workers is a combination of two effects. The first, that the entry of MNEs, in possession of a technological advantage over domestic firms, employ more skilled workers, at higher rates of pay, relative to domestic firms. The second effect is essentially a spillover effect, that the new (to the host country) technology which accompanies the FDI, is to a degree assimilated by the domestic sector, which in turn increases the productivity of skilled workers still further in the domestic sector, resulting in increasing demand for skilled workers at the expense of unskilled workers. The purpose of this paper is to isolate the second of these two effects, examining changes in factor input shares that occur in the domestic sector, as a result of increased foreign penetration.

Foreign direct investment by multinational enterprises has grown rapidly in recent years, shown in Figure 1. This growth of foreign owned manufacturing has occurred at a time of increasing employment of the higher skilled relative to the less well skill endowed. Figure 1 shows that relative employment of skilled labour

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increased by 10% from 1983 to 1992, and the share of foreign sales, capital investment and capital stock expenditure rose by 22%, 19%, and 22% respectively over the period. These parallel trends in FDI measures and relative employment suggest that multinational involvement in the UK labour market may have contributed to the demand shift for higher skilled labour.

<<FIGURE 1 HERE>>

The following section discusses in more detail the rationale for spillovers to occur from FDI. Section two introduces the empirical approach to modelling the impact of FDI upon relative employment. Section three describes the data used and the results are presented in section four.

1. Inward investment and skill upgrading

Little work has been done seeking to link skill intensities in domestic firms to FDI. Previous work in the area of the labour market impacts of FDI, has either focused on wage or productivity differentials between the foreign owned sector and the domestic sector (Driffield, 1996), or the more aggregate impacts of inward FDI (Barrell and Pain 1997). Equally, several papers have focused on the impacts upon labour markets of technological change (Krueger, 1993; Autor et al., 1998; Machin and Van Reenen, 1998; Berman and Machin, 2000), and import competition (Wood, 1994, 1998; Anderton and Brenton, 1999). Fosfuri et al. (2001) demonstrate a further impact, based on labour mobility. MNEs, in order to fully utilise their firm-specific assets, may need to invest in training for their employees. If such workers then move to domestic firms, this human capital is also transferred. The potential effects on the UK are discussed in Driffield and Taylor (2000).

There are a number of studies that identify substantial differences in factor demand between foreign and domestic firms. The inference here is that MNEs demonstrate higher levels of labour productivity, and in turn greater demand for high quality labour, linking this to technological differences between inward investors and other firms. The rationale for this is based on studies that suggest substantial differences in factor demand between foreign and domestic firms. Driffield (1996) finds that foreign firms will pay wages above the industry average of around 7%, partly due to productivity differences, Conyon et al. (1999) find a wage differential of 3.4% wholly attributable to productivity, and Girma et al. (1999) find wage and productivity differentials of 5%. There is a growing literature which suggests that over time, domestic firms are able to appropriate productivity spillovers from foreign MNEs, see for example, Blomström (1989), and Driffield (2001), Rodriguez-Clare (1996), Aitken and Harrison (1999). The purpose of this paper therefore is to link these potential spillovers to skill structures in domestic firms. Blomström and Kokko (1996) provide several reasons why technology is expected to transfer from MNEs to domestic firms. This can occur directly, through the licensing of a particular technology, through supplier networks or subcontracting arrangements, or indirectly as knowledge becomes public, and spillovers are assimilated by the domestic sector.

Evidence is emerging that such spillovers are generating increases in technological capability of domestic firms, Markusen (1995). Barrell and Pain (1997) find that in the UK manufacturing sector that a 1% rise in the FDI stock is estimated to raise technical progress by 0.26%. Barrell and Pain (1997) however are unable to distinguish between the aggregate improvement in technical progress, and the impact solely on the domestic sector. Both the productivity and spillover effects are likely to have an impact upon relative employment. Indeed, Hubert and Pain (1999) suggest

that inward investment is virtually solely labour augmenting, and as such, inward investment acts to reduce the demand for unskilled workers, while Aitken et al (1996) suggest that such productivity gains may be translated into increased wages within the domestic sector.

However, there is a further consideration when considering the likely impact of FDI on domestic firms. This concerns the extent to which the domestic sector will be able to assimilate any technological externality. This phenomenon is discussed by Cohen and Levinthal (1989), and Kokko (1994). Blomström et al (1999) for example, demonstrate that the impact of FDI on domestic firms will depend on the size of the technology (productivity) gap that exists between the two sectors[i]. For example, in industries where the gap is negligible, or even where domestic firms are more advanced than MNEs, one would not expect spillovers from foreign to domestic to occur. Equally, where the foreign – domestic gap is very large, then the domestic firms are likely to be unable to assimilate this "new" technology, and as such, spillovers are unlikely to occur. We therefore posit a non-linear relationship between the foreign technological advantage and productivity spillovers.

The average productivity advantage exhibited by the foreign sector for 1983 – 1992 is around 20% (see Davies and Lyons, 1991 for the methodological details of these calculations). As such, we assume that this is the critical value, beyond which spillovers are less likely occur. Equally, we assume that in industries where there is no average foreign productivity advantage, then the capacity for spillovers is limited. Consequently, we envisage the impact of FDI to have a non-linear effect upon relative employment. Defining the relative productivity of foreign labour (FLP) to domestic labour (DLP) as:

$$A = \left(FLP / DLP \right) \tag{1}$$

so based upon the above the relationship between spillovers and A is a non-linear, rather than linear relation.

The following section provides details of the empirical model used to try and identify the quadratic relationship between FDI spillovers across varying relative productivity groups and the impact upon employment.

2. Empirical methodology

Employment skill shares are modelled as a function of capital K, output Y, the relative wage between skill and unskilled labour W_s/W_u and other factors Z following Machin (1996), Anderton and Brenton (1999) and Machin and Van Reenen (1998), so

$$\text{Employment share} \equiv \left(N_s/N_u\right) = f\left(Y, K, W_s/W_u, Z\right) \qquad (2)$$

with skilled labour denoted by s, unskilled by u, and we define Z as a function of technological change, trade intensity and FDI spillovers[ii]

$$Z = g\left(\text{Technology}, \text{Trade}, \text{FDI}\right) \qquad (3)$$

To proxy for technology we use R&D intensity, and import intensity for a measure of foreign competition. The estimating equation is defined in equation 4 (with the additional terms from the relative employment relationship, equation 2, attempting to capture other possible demand shifters) where i is the industry, t is time, N is employment Y is output, K is the capital stock, R&D/Y is our measure of technology intensity and Imports/Y is trade intensity. In practice it is likely that adjustment to the equilibrium for the firm is likely to follow a partial adjustment mechanism, such that

$\left(N_s / N_u\right)_{it-1}$ is expected to be an important determinant of variation in the observed levels. Thus, the equation to be estimated becomes:

$$\left(N_s / N_u\right)_{it} = \Omega + \eta\left(N_s / N_u\right)_{it-1} + \alpha K_{it} + \gamma Y_{it} + \mu\left(W_s / W_n\right)_{it} + \phi\left(R \& D / Y\right)_{it}$$

$$+ \theta\left(Imports / Y\right)_{it} + \sum_{j=1}^{3} \pi_j \left[\lambda_j \times FDI\right]_{ijt} + \beta CR5_{it} + v_{it} \qquad (4)$$

$$v_{it} = \delta_i + \varepsilon_{it} \qquad \varepsilon_{it} \sim IID\left(0, \sigma^2\right)$$

where λ is a vector of 3 slope dummies, determined by the value of A (see below), FDI is the measure of multinational activity in industry i (defined below in Table 1), Ω is a constant, the vector CR5 is a measure of variations in industry concentration[iii], and δ_i is an industry fixed effect representing unobserved heterogeneity.

The proposed relationship between R&D intensity and relative employment is investigated with a lag structure, since the interpretation of a significant contemporaneous relation between R&D intensity and relative employment is ambiguous[iv]. Theoretically, we would expect the following signs $\partial\left(N_s / N_u\right)_{it} / \partial\left(R \& D / Y\right)_{it-1} > 0$ that is technology is skill biased, as are imports, so $\partial\left(N_s / N_u\right)_{it} / \partial\left(Imports/Y\right)_{it} > 0$. The impact of FDI spillovers, where we envisage a technological transfer from foreign to domestic firms, should take the following form $\partial\left(N_s / N_u\right)_{it} / \partial\left(FDI\right)_{it} > 0$, in other words the technology spillover (identified in the UK by Barrell and Pain, 1997) is skill biased.

One of the main issues of interest is to investigate how FDI impacts across sectors with differing relative foreign productivity. This is achieved by splitting the productivity differential between foreign and domestic firms into three groups – high, medium and low, with associated coefficients (see equation 4) of FDI's impact of π_1, π_2, π_3. Determining the critical values of A is essentially an empirical matter. As

mentioned above Davies and Lyons (1991) estimated the average productivity advantage that foreign MNEs possess over the domestic sector to be 20%. In terms of the slope dummies we define the λ_j's as follows:

$$\lambda_1 = \begin{cases} 1 & \text{if } A \leq 1 \\ 0 & \text{otherwise} \end{cases} \qquad \lambda_2 = \begin{cases} 1 & \text{if } A > 1 \text{ and } A \leq 1.2 \\ 0 & \text{otherwise} \end{cases} \qquad \lambda_3 = \begin{cases} 1 & \text{if } A > 1.2 \\ 0 & \text{otherwise} \end{cases}$$

The low relative foreign productivity group is defined by λ_1, the medium group λ_2 (corresponding to the advantage found by Davies and Lyons, 1991), and the high productivity group by λ_3. In the context of the discussion in section two we expect the following $\pi_2 > \pi_1$ and $\pi_2 > \pi_3$, in other words the impact of FDI spillovers onto the domestic labour market are greater when the productivity differential tends towards 20%.

3. Data description

The data used is based at the 3-digit industry level for UK manufacturing sectors (SIC, 1980 sectors 2-4) over the period 1983 to 1992. This provides 101 industries over 10 years giving 1010 observations. All data are converted into natural logarithms and deflated to 1980 prices. Most of the data used in this study are published in The Annual Production Inquiry, formerly Report on the Census of Production, Office of National Statistics, for various years. The ONS provided data relating to the foreign owned sector of manufacturing at the 3-digit level. Our measure of unskilled workers (operatives) includes all manual workers i.e. operatives in power stations, engaged in outside work of erecting, fitting etc., inspectors, maintenance workers and cleaners. Staff engaged in transport (including roundsmen)

and employed in warehouses, stores, shops and canteens are also included in the definition.

<<TABLE 1 HERE>>

The measure of technological change – research and development was taken from Business Monitors MO14, and various ONS Bulletins. Import data are provided in Business Monitors MQ10. Both research and development expenditure and import expenditure are weighted by industry value added to gain a measure of their intensity. Table 1, above, defines the variables used in the empirical analysis. The summary statistics of the variables used in the empirical analysis are given in Table 2 below, where on average FDI accounts for around 15% of industry total investment over the period.

<<TABLE 2 HERE>>

4. Empirical Results

The data described in the previous section are used to assess the impact of technology, trade and FDI spillovers upon relative employment shares. Clearly, given the specification of equation (4), a major consideration here is the endogeneity, not only of the inward FDI variable, but also the other explanatory variables. For this reason, an instrumental variables estimator is proposed, all variables are treated as endogenous, and therefore instrumented with all available further lags. Also, as is well understood, when employing a lagged dependent variable within such a framework, it is necessary to employ differences, in order to remove the fixed effects, that, by construction are correlated with the lagged dependent variable. For these reasons we employ the Generalised Method of Moments, GMM, one step estimators

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following Arellano and Bond (1991). This also alleviates problems of unobserved heterogeneity – the δ_i's in equation 4.

The results of estimating equation 4 are shown in Table 3, below, where FDI is defined as the stock of industry capital investment[v] owned by foreign firms. In order to assess the impact of spillovers across industries with different relative foreign/domestic productivity, we interact FDI with a relative productivity term (as discussed above). The positive coefficient associated with the measure of technological change suggests that technology is biased towards higher skill endowed labour, which is consistent with previous research (Machin, 1996; Machin and Van Reenen, 1998). The sign of the trade coefficient is positive, as expected theoretically, but is dominated by technology. The fact that technological change outweighs the impact of trade upon relative employment is what we would expect given the evidence to date (Machin and Van Reenen, 1998; Berman and Machin, 2000) The impact of FDI suggests that there are positive spillovers across high, medium and low relative (foreign to domestic) productivity sectors, with the impact greater when the productivity of foreign and domestic firms is similar – as expected from above i.e. effects are largest when A approaches 1.2 i.e. a 20% gap. Interestingly, when the relative productivity gap is negative A<1 (less than 10%) FDI has a negative spillover effect upon the skill structure.

<<TABLE 3 HERE>>

The "optimal" productivity gap

It is clearly intuitively possible to replace the discontinuous λ terms in equation 4 with a quadratic, and thus calculate the size of the productivity gap which maximises the spillover effect. The results from the estimation of this specification are given in Table 4. These are suggestive that the spillover is maximised when the productivity

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<<TABLE 4 HERE>>

gap is approximately 24%, However, strictly, this specification involves the imposition of what appears to be an invalid restriction, viz that spillovers are increasing in the productivity gap, which is rejected by the results from the estimation involving the discontinous version of equation 4. As such, one cannot have too much faith in Table 4, although a quadratic is implied. We carried out repeated simulations basing the λ_j's upon different breaks in relative productivity A. The results suggest that the estimates in Table 3 are consistent when imposing the break anywhere between 17% and 28%. Anything outside this range can be rejected, based upon 1% differences starting at 15% and repeating the estimation, to try to see where the break in A becomes invalid.

How much does FDI explain?

From the elasticities associated with FDI (given by the coefficients π_1, π_2, π_3 reported in Table 3 above), it is possible to derive the changes in the domestic skill share that occurred over the period 1983 to 1992 as a result of FDI spillovers. The change in the employment share due to inward investment can be given by

$$\partial\left(N_s / N_u\right) = \left(\hat{\pi}_j \times \partial FDI\right) \times \left[\left(N_s / N_u\right) \div FDI\right] \qquad \forall j \qquad (5)$$

where j=1...3. Results are shown in Table 5 and indicate that spillovers account for a

<<TABLE 5 HERE>>

significant percentage of the increase in skilled labour over the period, a maximum of nearly 9% when $1 < A \leq 12$. There is also a clear difference between spillover effects when the relative productivity between foreign and domestic firms is similar rather than away from the optimum. The coefficients on FDI from Table 3 and the analysis

given in Table 5 suggests that the impact of FDI across relative productivity sectors is greatest where the productivity gap is positive, but not too large – around 10-20%.

The results of this paper show that FDI has a positive impact upon relative employment shares even after controlling for the dominant themes in the literature which are thought to have influenced the demand for skilled labour – namely technology and trade[vi].

5. Conclusions

This paper has considered the role of multinational firms operating in the UK upon the demand for higher skilled labour relative to the less well skill endowed over the period 1983 to 1992. In a recent review of the literature Blomström, et al. (1999) found that spillover effects from foreign activity are larger when the gap between foreign and domestic capabilities is not too large. Not only do we find evidence of positive impacts of FDI upon the relative demand for skilled labour, there is also evidence in favour of Blomström et al., (1999) in that FDI has a stronger impact when the foreign to domestic productivity differential is between 10-20%. These findings are robust to including the two most prevalent influences in the literature (technology and trade) in the empirical specification and also to different measures of FDI.

Despite evidence of beneficial spillover effects from FDI in terms of productivity and wages along with the benefits are some undesirable affects upon the labour market in that the less well skill endowed are disadvantaged. Considering wage inequality Taylor and Driffield (2000) and Figini and Gorg (1998) both find that increased inward investment has a detrimental impact upon inequality, even after controlling for trade and technology. Leahy and Montagna (2000) also find that

multinational activity does not always benefit the host country. It is important to have an understanding of the negative impacts of FDI as well as potential benefits for future policy analysis.

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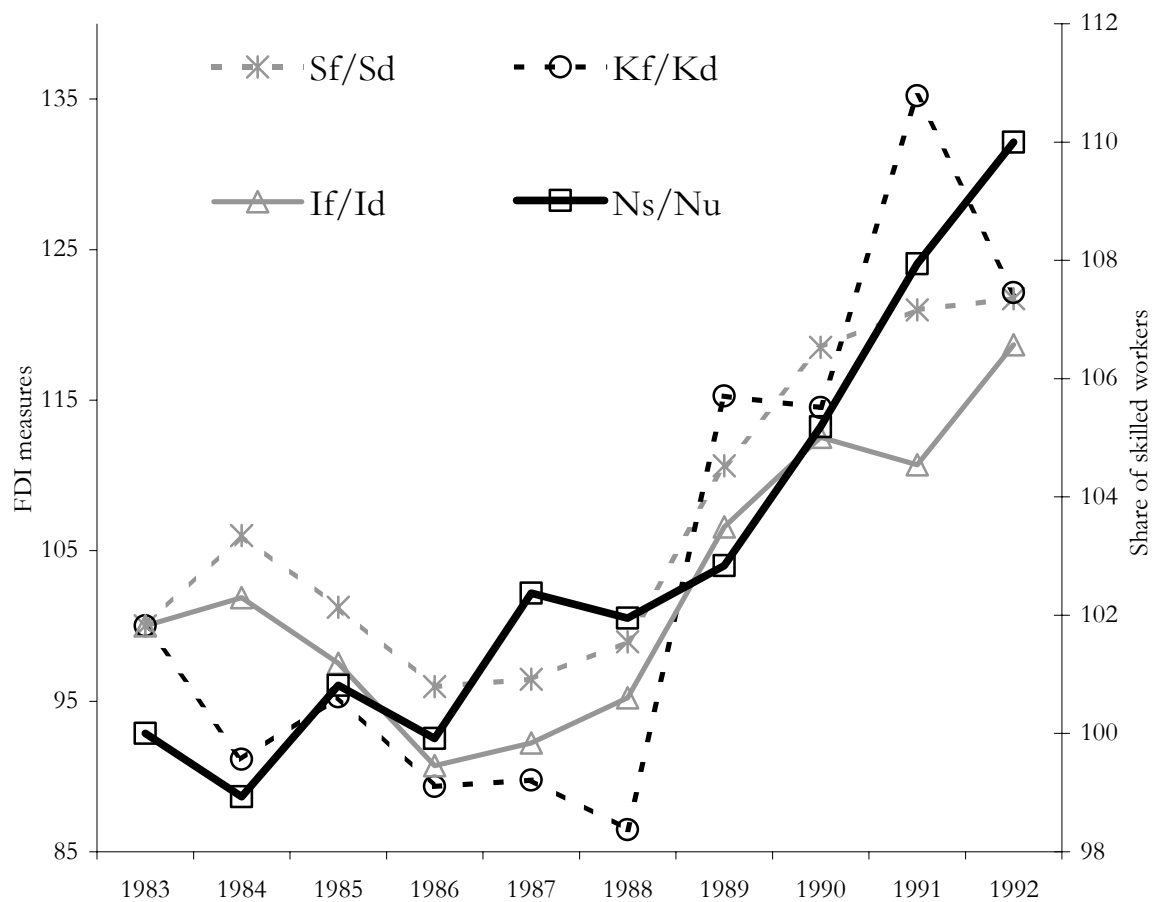Wood, A. (1994) North –South trade employment and inequality: Changing fortunes

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Figure 1 <u>Relative employment and foreign shares in UK manufacturing 1983–1992</u>.

Notes: Relative employment is measured as the ratio of skilled (non-operatives) employment to unskilled (operatives) employment (Ns/Nu). Measures of the impact of FDI are the share of capital stock accounted for by foreign firms (Kf/Kd), share of foreign capital investment (If/Id) and the share of industry sales (Sf/Sd). All variables are indexed so 1983 is equal to 100.

Source: Census of Production, ONS (see section 3).

Table 1 <u>Variable definitions.</u>

Variable	Definition
Y	Gross value added in domestic firms
K	Capital stock of domestic firms estimated as the sum of net capital investment of the previous 7 years, depreciated by 10% per annum.
N_S/N_U	Ratio of the number non-operative employees in domestic firms to the number of operative employees in domestic firms.
W_S/W_U	Ratio of non-operative wages in the domestic sector to the wages of operatives.
R & D	Research and development expenditure at the 3-digit level.
Imports	The value of industry imports.
CR5	The industry five firm concentration ratio by sales.
FLP	Foreign labour productivity.
DLP	Domestic labour productivity.
FDI	The stock of capital owned by foreign owned firms. This is calculated using the standard perpetual inventory method, and depreciated at 10% p.a.

Table 2 <u>Summary statistics.</u>

Variable	Mean	Standard Deviation	Minimum	Maximum
N_S/N_U	0.488	0.255	0.088	1.916
K	1.958	0.738	0.189	3.966
Y	£4151m	20113	45	305000
W_S/W_U	0.375	0.110	0.154	0.769
R&D/Y	0.543	0.177	0.004	1.741
Imports/Y	0.460	0.625	0.056	1.793
CR5	43.327	23.469	6.800	100
FDI	£101m	£316m	0	£6138m
Observations		1010		

All summary statistics are in non log form.

Table 3 GMM IV estimates of equation 4.

Parameter	Estimate	t-statistic	P-value
$(N_S/N_U)_{it-1}$	0.9945	5.47**	[.000]
K	0.0095	1.13	[.257]
Y	0.0074	2.46**	[.014]
W_S/W_U	-0.1098	-8.98**	[.000]
R&D/Y	0.0486	3.77**	[.001]
Import/Y	0.0046	4.48**	[.000]
FDI($A \leq 1$)	-0.0038	-6.47**	[.000]
FDI ($1<A \leq 1.2$)	0.0047	3.78**	[.001]
FDI ($A >1.2$)	0.0016	1.55*	[.119]
CR5	0.1165	9.94**	[.000]

N = 707 (7 years)

Test of overidentifying restrictions: Sargan [p= .652]

2nd order serial correlation p-value   [p=0.317]

All estimates are based upon data weighted by the industry proportion
of the total manufacturing skill share.
** 5% level of significance, * 10% level of significance

Table 4 GMM IV estimates of the quadratic version of equation 4.

Parameter	Estimate	t-statistic	P-value
$(N_S/N_U)_{it-1}$	0.9945	4.64**	[.000]
K	0.0055	1.51	[.110]
Y	0.0001	0.37	[.710]
W_S/W_U	-0.0879	-5.09**	[.000]
R&D/Y	0.0074	4.10**	[.000]
Import/Y	0.0037	2.85**	[.004]
FDI*A	0.0058	1.04	[.223]
FDI*A^2	-0.0023	2.72**	[.017]
CR5	0.0800	2.35**	[.018]

N = 707 (7 years)

Test of overidentifying restrictions: sargan [p= .306]

2nd order serial correlation p-value   [p=0.289]

All estimates are based upon data weighted by the industry proportion
of the total manufacturing skill share.
** 5% level of significance, * 10% level of significance

Table 5 <u>Estimates of the impact of FDI upon changes in skill</u>
<u>shares 1983 to 1992</u>.

Productivity/FDI definition	FDI investment
FDI(A $\leq$ 1)	−7.22%
FDI (1<A $\leq$ 1.2)	8.93%
FDI (A >1.2)	3.04%

All calculations are based upon equation 5.

ENDNOTES

[i] However, attempts to estimate econometric models based on "catch up" technology gaps have often been fraught with problems concerning specification and endogeneity, for a discussion of this see Lee et al. (1995, 1998).

[ii] Feenstra and Hanson (1995, 1996), Autor, Katz and Krueger (1998), and Blonigen and Slaughter (1999) justify the inclusion of other possible demand shifters by arguing that merely including the factors derived from theory will not capture other influences which could effect a firms demand function.

[iii] There is a large literature linking wage rates to product market power, see for example Stewart (1990). These merely control for the possibility of firms with market power paying higher wages, and therefore attracting a larger proportion of skilled workers.

[iv] This is because it is anticipated that high R&D activities involve the employment of high quality (relatively more skilled) workers (Autor and Katz, 1999). Moreover Machin and Van Reenen (1998) find that lagged R&D expenditures are associated with skill biased technological changes, and so we include the R&D variable as a one year lag in all estimations.

[v] Note we also estimated equation 4 using FDI defined by foreign capital stock shares, and foreign share of industry sales. The results were wholly consistent with those reported herein and are omitted for brevity.

[vi] In an earlier version of this paper we estimated equation 4 by Fixed and Random effects in levels to control for unobserved heterogeneity. The results were largely unaffected – technology had a larger impact than trade, and the non-linear relationship between FDI and skill shares remained.