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Regional Foreign Direct Investment and Wage Spillovers: Plant Level Evidence from the U.K Electronics Industry[*]

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I. Introduction

The impact of foreign direct investment (FDI) on host economies has been of interest for many years, and many of the perceived benefits or detrimental effects of FDI in this context can be traced back to Dunning (1958). Of particular interest, with the increased scale and scope of FDI and the perceived rate of increase in the speed of "globalisation" has been the extent to which this had contributed to increased inequality, both between and within locations. The impacts of globalisation on host country labour markets have become increasingly important to both academics and policy makers, as the attraction of internationally mobile capital has become a (if not the) major function of regional development agencies across Europe and North America.

Early studies on the labour market impacts of FDI were essentially confined to determining the total employment gain from FDI and relating new employment gains to the size of subsidies provided to attract the investment. However, more recently both policy makers and academics have become concerned with the wider impacts of FDI on host country labour markets, see for example Driffield and Taylor (2000). While it is generally accepted that at least under certain conditions, productivity spillovers do occur from foreign

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to domestic firms within the UK[1], it is less clear that such spillovers benefit those for whom subsidies are designed, unskilled workers and workers in areas of above-average unemployment.

This paper focuses the impact of regional FDI on both skilled and unskilled workers wages within the UK electronics industry. The UK electronics industry is the fifth largest in the world in terms of sales employing over 400,000 people in manufacturing with an additional 100,000 in related services and software[2]. It is an industry with an extremely high level of multinational activity. In 1996 over 25% of the stock of inward investment in the UK from the US, Japan and the rest of the EU were in electrical engineering and electronics, having increased from 19% in 1987. Japanese investment is particularly concentrated in this sector, accounting for over 50% all Japanese investment. Multinational firms undertake a significant proportion of the innovative activity in the sector. Cantwell and Iammarino (2000) indicate that in semiconductors the share of foreign-owned firms in total patents was over 60% for the UK as a whole, and 75% for the South East in particular. High levels of Regional Selective Assistance have gone to firms in this sector. For the period 1991-1994 72% of regional assistance in electrical engineering went to foreign-owned firms in the UK, well above the national average of 40% (Taylor and Wren, 1997).

The purpose of this paper is then to test the impact that inward investment in the UK has on *workers* in domestically owned establishments. Wage spillovers from FDI are found to be not as large, or as prevalent as productivity spillovers, based on previous work. Wage spillovers are largely confined to skilled, rather than unskilled workers, implying that the benefits of FDI are unevenly distributed. There are numerous explanations of this. Firstly, skilled workers are expected to benefit from an increased demand for labour, as the imported technology is complementary with skilled labour. The imported technology is likely therefore

[1] See for example Blomström et al (1999), Girma and Wakelin (2001), Driffield (1999), Driffield (2001).

to increase productivity of this complementary labour, and in turn generate higher wages. Further, Barrell and Pain (1997), show that the technology accompanying FDI is unskilled-labour augmenting, reducing the demand for unskilled labour, and therefore wages of unskilled workers. This follows the arguments of Machin and Van Reenen (1998), who demonstrate that new technology is complementary to skilled labour, and its introduction results in increased demand for skilled workers.

The paper is set out as follows: section 2 discusses previous work on FDI and wage spillovers, while section 3 presents the empirical model that is employed. Data details are given in section 4 and the empirical findings are discussed in section 5. Finally section 6 concludes.

II. Previous work on FDI and factor demand.

There are a number of studies that identify substantial differences in factor demand between foreign and domestic firms. The inference here is that foreign multinationals demonstrate higher levels of labour productivity, and in turn greater demand for high quality labour. Entry by such firms therefore is expected to impact on domestic labour markets via two mechanisms. Firstly, inward investment generates a straightforward labour demand effect, stemming from an exogenous increase in output. This is likely to be particularly important at the region and industry level rather than in the aggregate. While previous evidence suggests that this is likely to favour skilled, rather than unskilled workers, this will of course depend on the nature of the activities undertaken by the inward investors. Secondly, linked to this is the likely impact on domestic firms of the inflow of new technology that is assumed to accompany FDI. There is growing evidence for this in the UK – Driffield (1996) finds that foreign firms will pay wages above the industry average of around 7%, partly due

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[2] Source: National Statistics.

to productivity differences and Girma et al. (2001) report a wage and productivity differentials of 5%. Conyon et al. (2001) find a wage differential of 3.4% wholly attributable to productivity resulting from foreign acquisitions of indigenous firms. This foreign wage differential may therefore also act on the supply of labour to the domestic sector, as workers observe higher wages on offer elsewhere.

There is significant evidence that wage spillovers in general do occur, see for example Manning (1994). Moreover, Latreille and Manning (2000) evaluate inter-industry and inter-occupational impacts, again finding that wages elsewhere impact on wage determination. It is therefore anticipated that entry by foreign firms, paying on average higher wages, will generate spillovers causing wages in the domestic sector to be bid up. Reasons for this are discussed in detail in Driffield (1996). However wage spillovers may be limited, either by activity, region, or occupational group. It is well established that a good deal of segmentation exists in the UK labour market, see for example McNabb and Whitfield (1998). In addition, it is well understood that unskilled workers are less mobile than skilled ones, and so inter-regional effects are likely to be smaller for unskilled workers than for skilled workers (McCormick, 1997). Linked to the segmentation literature is the evidence that technological change generates an increase in wage inequality, see for example Machin and Van Reenen (1998), by increasing the relative demand for skilled workers. Further, Barrell and Pain (1997) and Girma et al (2001) demonstrate that productivity spillovers from FDI are partly facilitated by domestic firms becoming more skill intensive. This discussion suggests that wage spillovers will be greater for skilled workers than for unskilled workers, in terms of both inter-regional impacts, and foreign to domestic impacts. In addition Blomström *et al* (1999) show that spillovers from FDI accrue only where domestic firms are in a position to assimilate the potential externality, through a certain level of technical competence. As such therefore, one would expect such gains to occur in the more technologically advanced regions of the UK, with the same being said for labour market effects. Further discussion of these possibilities is found in Driffield and Taylor (2000). This is an important issue for policy makers, as concern has been expressed that both skill shortages and labour market tightening have been exacerbated in certain parts of the country by inward investment.

III. Empirical model of wages spillovers from the regional FDI

Our modelling approach is based upon a simple structural model of the labour market highlighting the role of alternative domestic and foreign wages as comparison incomes impacting on labour supply. The literature concerning the labour market impact of FDI suggests that there are two important effects. Firstly, there is the direct effect that inward investment is expected to have on wages through labour market impacts. There may also be an additional secondary effect, as productivity spillovers from FDI increase productivity and increase labour demand within the domestic sector. In addition, it is well documented that foreign firms pay higher wages than domestic firms, and this may act to reduce the supply of labour at a given wage rate, and thus act to increase wages.

To characterise these effects we assume a Cobb-Douglas production function for the domestic sector, of the form $Q = AK^{\alpha} L^{\beta} F^{\eta}$,where Q is output, K is capital and labour L is split into skilled and unskilled. In addition the level of foreign capital, F is also included as a measure of foreign activity. A denotes total factor productivity (TFP). Writing the marginal revenue product of labour as $MP_L = \partial Q / \partial L \; = AK^{\alpha} \beta L^{\beta-1} F^{\eta}$, at equilibrium wages are given by:

$$W = pAK^{\alpha} \beta L^{\beta-1} F^{\eta} \qquad (1)$$

where p represents the market price of the good produced.

However, it is also necessary to introduce the supply side of the labour market $L = L(W, \overline{W})$, where W represents the wage on offer, and $\overline{W}$ represents the vector of alternative wages available. This will include wages available to skilled and unskilled workers, wages available in other industries, and wages available in other regions. In addition, for the reasons discussed about, wages paid by foreign and domestic firms may have different impacts. Our data, discussed below, has an industry, region, and time component, so the vector of external wage rates $\overline{W}$ encompasses the following terms:

Same industry and region domestic (foreign) wage $W_1^d\,(W_1^f)$ defined as the average wage of all other domestic (foreign) plants inside the same region and the same four-digit industry:

- *Same industry and outside region domestic (foreign) wage* $W_2^d\,(W_2^f)$: defined as the distance-weighed average wage of domestic (foreign) plants outside the same region and but inside four-digit industry:
- *Same region but outside own industry domestic (foreign) wage* $W_3^d\,(W_3^f)$: defined as the average wage of domestic (foreign) plants in the same region and the same two-digit industry , excluding the plant's own four-digit sector:

As such therefore, the reduced form wage equation can be written as:

$$\ln(W) = \phi_0 + \phi_1 \ln(TFP) + \phi_2 \ln(K) + \phi_3 \ln(F) + \sum_{k=l,d} \Sigma_{j=1}^{3} \phi_{kj} \ln(W_j^k) + \varepsilon \qquad (2)$$

We also postulate that regions with high levels of unemployment, and low skill levels, may respond differently from other regions. We capture this by distinguishing between assisted and non-assisted area status. Regions with assisted area (AA) status characteristically suffer from a lack of skilled workforce, and so we interact all outside wages variables with an AA with dummy in order to explore whether the forces that generate inter-regional wage spillovers act to differing extents across assisted and non-assisted areas.

In our empirical specification we extend equation (2) in several directions. First, we exploit the panel nature of our data and incorporate individual effects (f_i) into the model to control for unobserved time-invariant heterogeneity factors that affect wages. Such factors include firm-specific human capital attributes, working conditions and managerial ability. The impact of regional or four-digit industry dummies is also subsumed in the fixed effect. Third we include a cross wage elasticity term at plant level to explore if the wage growths of skilled and unskilled workers tend to move in the same direction. In addition a lagged wage variable is included. In standard wage determination models, see for example Stewart (1990), a vector of individual worker characteristics such as age, experience, education, gender and ethnic group would be included. Such data are clearly not available at this level of disaggregation, but by construction, these effects are strongly correlated with the lagged dependent variable**.** Total factor productivity is included in the final equation, not only to capture efficiency effects, but also rent sharing, in the manner postulated by Stewart (1990). Price data are not available here, so price differences are captured, partly by the TFP term, but also by the industry effects. Finally, we use time (f_t) dummies to capture other economy-wide factors affecting wage settlements.

Plant level total factor productivity is estimated using the semiparametric approach developed by Olley and Pakes (1996), which is outlined in Appendix A. The main advantage of this approach over more traditional production function estimation techniques is its ability to controls for both selection and endogeneity in a simultaneous fashion.

The final estimating wage equation for each type worker is:

$$w_{it} = \alpha_1 w_{it-1} + \beta X_{it} + \sum_{j=1}^{3} \sum_{k=d,f} \gamma_{kj} w_j^k + \sum_{j=1}^{3} \sum_{k=d,f} (\gamma_{kj} w_j^k \times A_{it}) + f_i + f_t + \varepsilon_{it} \qquad (3)$$

where w is either the log of skilled or unskilled wages of plant i at time t; the w^k represent the log of the various alternative wages as defined earlier. The regional element of this term may be interpreted as a spatial dependence term, but with less restriction on the coefficients than would normally be implied in the regional science literature, see for example see for example Anselin and Florax (1995), and Le Sage (1999). A_{it} is a dummy indicating whether the plant is located in government Assisted Areas, and the vector X consists of the log plant level capital , cross wage term and total factor productivity.

Equation (3) represents a dynamic panel data model of wages with plant-specific effects. The estimation problems of dynamic models from short panels is well documented in the econometric literature (see Baltagi, 1995 and references therein). The basic difficulty lies in the fact that the presence of fixed effects renders the lagged dependent variable correlated with the equation disturbance term. Standard "within" transformation typically used in static models fails to deliver consistent estimators. A popular way of circumventing this problem is to the remove the fixed effects via first-differencing and then employ a variant of the instrumental variable estimation technique (e.g. GMM). In this paper lagged wages, capital and productivity are employed as instruments in the first-differenced (i.e. wage growth) equations in the spirit of Anderson and Hsiao (1981) and Arellano and Bond (1991).[3]

However, a further issue here is that with 2 types of labour (skilled and unskilled) the estimation of (3) for these groups should allow for simultaneity in wage determination, something that is hitherto ignored in previous studies, see for example Latreille and Manning (2000), Lee and Pesaran, (1993). The first-differenced versions of the skilled and unskilled wages equations are therefore estimated simultaneously via iterated three stage least squares (FD-3SLS) using the same set of instruments described above (that is the instrument set suggested by single equation dynamic panel data procedures). Overidentification test statistics (which are the FD-3SLS objective function evaluated at the solution points and divided by the sample size) are also computed to test the validity of the instrumental variable

[3] Our approach of estimating the system of dynamic panel equations is in the spirit of Holtz-Eakin et al (1988), using lagged values as instruments to generate orthogonality conditions on differenced data, and employing GMM.

candidates. To our knowledge this is the first paper that attempts to estimates a system of simultaneous dynamic wage equations.[4]

IV. Data details

This paper draws on the Annual Respondents Database (ARD) to identify domestic and foreign plants in the UK electronics industry for the period 1980-92. The ARD is provided by the Office for National Statistics in the UK under controlled conditions, and it consists of establishment level data that is used to generate the published the Annual Business Inquiry (formerly the Census of Production). As Oulton (1997), Griffith (1999) and Barnes, Haskel and Ross (2001) provide very useful introductions to the data set, we only include a brief discussion of some of the features of the data that are relevant to the present work.

The ARD consists of two files for the relevant period. That known as the 'selected file', contains detailed information on a sample of establishments that are sent inquiry forms. The second file comprises the 'non-selected' (non-sampled) establishments and only basic information such as employment, location, industry grouping and foreign ownership status is recorded. For our study period, data on some 14,000-19,000 establishments across all manufacturing are provided in the selected file for each year, based on a stratified sampling scheme. The scheme tends to vary from year to year, but establishments with more than 100 employees are always sampled. In the electronics industry, selected establishments account for less than one eighth of the total number of establishments, but for more than 80 percent of output and employment. In the ARD, an establishment is defined as the smallest unit that is deemed capable of providing information on the Census questionnaire. Thus a 'parent' establishment reports for more than one plant (or 'local unit' in the parlance of ARD). For selected multi-plant establishments, we only have aggregate values for the constituent plants.

[4] Notice that in the linear context we are working with, the 3SLS estimator can be derived as a GMM estimator

Indicative information on the 'children' is available in the 'non-selected' file. In the sample period considered in this paper 95 percent of the establishments that are present in the electronics industry are single-plant firms[5]. In the actual sample we used for the econometric estimation this figure is around 80 percent. Thus most of the data we used is actually plant level data. Like the majority of researchers who have worked with the ARD (e.g. Disney *et al.* 2000; Griffith, 1999), we use data on multi-plant establishments. We define the electrical and electronic sector as the two two-digit classes 33 and 34 (using the SIC80 revision) spanning 17 four-digit sectors. The main advantage of using this type of data is that it removes a good deal of the heterogeneity that may be present in cross industry studies, particularly when attempting to impose uniform coefficients. In addition, it removes the inherent sample selection problems that accompany treating FDI as an exogenous variable. It is now well understood that sectoral characteristics influence the investment decision by multinationals. For example FDI tends to be concentrated in more productive sectors, which also have above average wage rates. This implies that FDI might be endogenous to the process governing the dynamics of wages. The use of a narrowly defined industry group is likely to mitigate the impact of this potential endogeneity problem

The precise definition of the sub-sectors and the share of foreign ownership in that sector are given in Table 1. Foreign presence is measured both as the share of employment and as the number of establishments. The variation in FOE activity can also be seen on a regional as well as a sectoral level.

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from the orthogonality conditions implied by the set of instrument (see Theorem 5 in Cornwell *et al* , 1992)

[5] As a result we tend to use the terms plant and establishment interchangeably for what are termed establishments in the ARD.

Table 1:

Employment share of MNE activity in the Electronics Industry[6]

Standard Industrial Classification (1980)	1980	1992
Office Machinery and Electronic data processing equipment (330)	0.345	.684
Insulate wires and cables (341)	0.205	.198
Basic electrical equipment (342)	.073	.345
Electrical equipment for industrial use , and batteries and accumulators (343)	.124	.175
Telecommunication equipment, electrical measuring equipment, electronics capital goods, passive electronic components (344)	.231	.266
Other electrical and electronic engineering (345, 346,347)	.311	.442

Table 2 gives the employment share across ten regions for 1980 and 1992.

Table 2:
Pattern of regional FDI (employment share)

Region	**1980**	**1992**
East Anglia	0.215	0.262
East Midlands	0.076	0.156
North West*	0.146	0.228
Northern England*	0.125	0.236
Scotland*	0.163	0.277
South East	0.204	0.298
South West	0.103	0.170
Wales*	0.192	0.297
West Midlands*	0.090	0.213
Yorks. & Humber.	0.089	0.155

Note: Regions denoted by * contain Assisted Areas

A few points are worth noting:

- In 1992 the regions with the highest share of FOE employment are Wales and the South East with around 30% of employment in foreign firms.
- All regions have experienced a rise in the share of foreign employment, with the share more than doubling in both the East and West Midlands (although the former still has one of the lowest shares at 16%).

[6] Industry- wide variables in the econometric analysis are calculated four-digit industry level , encompassing 17 sub-sectors. The summary statistics reported in Table 1 are at a much aggregate level lest we violate the disclosure criteria set by the ONS.

- It is clear from the table that while the foreign employment share has fallen slightly in a few sectors, most sectors have experienced a rise in foreign employment. For instance, electronic data processing equipment experienced a large rise in foreign employment from 30% to almost 70% in 1992 making it the second-highest share of foreign employment. Basic electrical equipment also experienced a five-fold increase.
- In 1980 office machinery had the highest proportion of MNE employment, by 1992, this sector was overtaken by electronic consumer goods with over 80% of employment in foreign firms (rising from just over 20% in 1980). Office machinery and active components both have around 50% foreign employment.

The debate concerning spillovers has hypothesised that foreign-owned firms exhibit higher productivity and wages than domestic firms. Higher productivity reflects their superior technology and management skills giving rise to the possibility of spillovers from them to domestic firms. By way of a preliminary analysis, we investigate whether this hypothesis is supported by the data, and Table 3 presents the results for robust regressions estimating the foreign-domestic differentials using a variety of indicators as the dependent variable. We also separate domestic establishments by whether they are located in government assisted areas or not. The base group is made up of domestic establishments in non-assisted areas, and the coefficients on the various dummy variables thus give the margin with respect to these establishments. As Table 3 shows, foreign-owned firms have significantly higher labour productivity, capital intensity, and proportion of skilled workers than domestic plants. The wage differential between domestic establishments is negligible, but plants in assisted areas have lower labour productivity (3.5%), lower capital intensity (45%) and a smaller proportion of skilled workers (5%) compared to their domestic counterparts.

Table 3:
Some differentials (in %) between foreign and domestic establishments

	Skilled Wages	Unskilled Wages	% of skilled workers	Capital intensit y	Labour productivity
Domestic assisted	-0.8	-1.4	-5.0	-45.2	-3.5
	(0.50)	(0.44)	(9.53)**	(4.75)* *	(2.38)*
Foreign	7.6	6.0	3.5	13.6	32.3
	(6.99)**	(2.31)*	(8.42)**	(2.03)*	(27.75)**
Observations	14024	14024	14024	13968	14024
R-squared	0.15	0.06	0.23	0.06	0.38

Note:
(i) Robust t-statistics in parentheses.
(ii) * significant at 5%; ** significant at 1%.
(iii) The reference group in the regressions consists of domestic establishments in non-assisted areas.
(iv) All regression contains time and four-digit sector dummies.
(v) The wages and capital intensity equations the size of establishments is controlled for.

Table 4 gives some summary statistics for the sample of domestic establishments used in our econometric analysis. Our sample is confined to establishments with complete information for at least three consecutive years[7].

Table 4
Descriptive statistics of the domestic establishments in the sample

	Assisted Areas		Non-assisted Areas	
	Mean	Std. Dev.	Mean	Std. Dev.
Real wages in £'000				
Skilled	7.44	107.33	7.49	38.53
Unskilled	4.99	84.39	5.06	27.42
Annual growth rates				
Skilled wages	3.56%	.012	2.91%	.003
Unskilled wages	1.11%	.105	2.01%	.011
Other variables				
% of skilled workers	29.5	.007	40.3	.003
employment	562.31	50.03	539.39	15.24
# of observations	317		3482	

[7] This is to satisfy the minimum requirement for dynamic panel data model estimation.

V. Empirical Results

Table 5 presents the results from the plant level wage equations, employing the simultaneous framework. For comparison, the single equation estimates are provided in table 6. The global validity of the instrumental variables in the simultaneous equations model is confirmed (at 5% level) by the Sargan tests reported towards the bottom of the table. This is further reinforced by the absence of a second-order serial correlation in the first-differenced models under consideration. Focussing initially on the first two columns of Tables 5 and 6, the results suggest that both skilled and unskilled wages exhibit persistence over time as evidenced by the positive coefficients on the lagged dependent variables. However, these results highlight the importance of employing a simultaneous equation estimator, as there are sizable differences in the cross-wage coefficients between the two estimators, these differences being highly significant in the case of unskilled workers. Once one allows for simultaneity, the impact wages in other occupational groups becomes significantly greater than has previously been reported, where single equation studies often fail to find this impact, particularly in terms of the effect of skilled wages on unskilled workers.

Establishment size (measured in terms of capital stock) proves to be a significant determinant of pay, consistent with previous empirical findings of a positive size-wage relationship. Also as expected, wage growth is positively correlated with productivity growth, with skilled wages proving to be more sensitive to productivity movements compared as unskilled wages.

Turning to the spillover terms, both types of wages are strongly correlated with the average four-digit industry domestic pay in the region. A 10% increase in the average skilled (unskilled) wage leads to a 5% (3%) increase in the wages paid at plant level. This is

Table 5
Foreign wage spillovers: simultaneous dynamic panel data estimates

	Specification without FDI variables		*Specification with FDI variables*	
	Skilled Wages	**Unskilled Wages**	**Skilled Wages**	**Unskilled Wages**
Lagged own wages	0.265	0.225	0.279	0.226
	(6.30)***	(3.92)***	(6.63)***	(3.92)***
Cross wages	-0.309	-0.250	-0.278	-0.239
	(2.96)***	(4.32)***	(2.65)***	(4.20)***
Total factor productivity	0.205	0.136	0.200	0.134
	(8.33)***	(6.32)***	(8.12)***	(6.25)***
Capital	0.087	0.057	0.087	0.055
	(4.89)***	(3.72)***	(4.89)***	(3.63)***
Domestic wages				
Four-digit sector own region	0.522	0.319	0.536	0.332
	(10.55)***	(8.27)***	(10.66)***	(8.48)***
Assisted Areas additional effect	0.120	-0.037	0.120	-0.038
	(1.28)	(0.43)	(1.26)	(0.44)
Four-digit sector outside region	-0.003	-0.022	-0.004	-0.026
	(0.05)	(0.54)	(0.07)	(0.62)
Assisted Areas Additional effect	0.917	0.423	0.987	0.441
	(2.94)***	(2.16)*	(3.10)***	(2.23)*
Two-digit sector own region	0.143	0.220	0.201	0.187
	(0.83)	(2.14)*	(1.10)	(1.71)
Assisted Areas additional effect	-0.861	-1.049	-0.878	-1.106
	(1.68)*	(2.28)*	(1.69)*	(2.38)*
Foreign wages				
Four-digit sector own region	0.040	0.012	0.038	0.014
	(1.87)*	(0.60)	(1.77)*	(0.69)
Assisted Areas additional effect	-0.019	-0.067	-0.010	-0.063
	(0.31)	(1.25)	(0.15)	(1.17)
Four-digit sector outside region	-0.036	0.030	-0.035	0.028
	(1.01)	(1.18)	(0.95)	(1.11)
Assisted Areas additional effect	0.073	-0.123	0.053	-0.123
	(0.46)	(1.17)	(0.33)	(1.15)
Two-digit sector own region	0.316	-0.020	0.241	-0.046
	(2.09)**	(0.18)	(1.49)	(0.41)
Assisted Areas additional effect	-0.246	0.820	-0.287	0.858
	(0.57)	(1.85)*	(0.66)	(1.91)*
Foreign penetration				
FDI in Four-digit sector own region			0.075	0.069
			(2.04)*	(2.23)*
FDI in Four-digit sector outside region			-0.062	-0.037
			(1.72)	(1.20)
FDI in two-digit sector own region			0.011	-0.216
			(0.08)	(1.98)**
Year-specific effects	NO	NO	YES	YES
Observations	3783		3783	
Number of plants	894		894	
p-value of overidentification statistic	.340		.321	
Log likelihood	1651.4		1443.8	

Absolute value of t-statistics in parentheses
* significant at 10%; * *significant at 5%; *** significant at 1%

Table 6
Foreign wage spillovers : single equation dynamic panel data estimates

	Specification without FDI variables		*Specification with FDI variables*	
	Skilled Wages	**Unskilled Wages**	**Skilled Wages**	**Unskilled Wages**
Lagged own wages	0.251	0.209	0.249	0.219
	(6.40)***	(5.10)***	(6.35)***	(5.37)***
Cross wages	-0.167	-0.036	-0.168	-0.048
	(4.33)***	(1.15)	(4.37)***	(1.56)
Total factor productivity	0.178	0.106	0.181	0.100
	(5.47)***	(4.52)***	(5.56)***	(4.36)***
Capital	0.067	0.047	0.069	0.044
	(5.07)***	(3.66)***	(5.18)***	(3.42)***
Domestic wages				
Four-digit sector own region	0.474	0.386	0.480	0.374
	(7.16)***	(8.21)***	(7.28)***	(8.22)***
Assisted Areas additional effect	0.169	-0.150	0.176	-0.115
	(1.19)	(1.16)	(1.25)	(0.91)
Four-digit sector outside region	0.042	0.013	0.049	-0.022
	(0.57)	(0.25)	(0.68)	(0.42)
Assisted Areas additional effect	0.819	0.074	0.894	0.094
	(2.41)*	(0.19)	(2.59)***	(0.25)
Two-digit sector own region	0.165	0.420	0.224	0.249
	(0.97)	(4.10)***	(1.22)	(2.47)*
Assisted Areas additional effect	-1.070	-0.501	-1.074	-0.502
	(1.96)**	(0.57)	(1.97)**	(0.58)
Foreign wages				
Four-digit sector own region	0.035	0.026	0.034	0.030
	(1.98)**	(1.26)	(1.97)**	(1.48)
Assisted Areas additional effect	-0.024	-0.047	-0.015	-0.054
	(0.46)	(1.09)	(0.30)	(1.27)
Four-digit sector outside region	-0.073	0.010	-0.072	0.008
	(2.00)**	(0.32)	(1.97)**	(0.28)
Assisted Areas additional effect	0.193	-0.120	0.193	-0.120
	(1.10)	(1.46)	(1.10)	(1.42)
Two-digit sector own region	0.262	0.024	0.222	0.006
	(1.97)**	(0.20)	(1.68)*	(0.06)
Assisted Areas additional effect	-0.103	0.704	-0.187	0.657
	(0.24)	(1.33)	(0.44)	(1.27)
Foreign penetration (FDI)				
Four-digit sector own region			0.031	0.058
			(0.77)	(1.82)*
Four-digit sector outside region			-0.056	-0.031
			(1.40)	(1.28)
Two-digit sector own region			0.059	-0.335
			(0.60)	(3.70)***
Year-specific effects	NO	YES	NO	YES
Observations	3799	3783	3799	3783
Number of plants	898	894	898	894
Sargan p-value	.493	.10	.502	.156
AR(2) test p-value	.720	.626	.756	.501

Absolute value of t-statistics in parentheses
* significant at 10%; * *significant at 5%; *** significant at 1%

substantial outside wage effect, and larger than reported elsewhere. There is also an additional assisted area effect on inter-regional spillovers, which is perhaps not surprising. In areas of high unemployment, wages in neighbouring regions exert strong intra-industry effects. It is well documented that one of the most pressing problems in areas of high unemployment is a shortage of trained people. Thus, workers employed in such locations, particularly in the electronics sector are likely to be difficult to replace. In general however, the intra-regional assisted areas term is negative, again not surprising as wages in these areas are lower than average. It can be noted from Table 5, however, that the corresponding foreign wage does not have discernible effect on the wage of unskilled workers and only a very small impact on skilled wages[8]. There is however a significant inter-industry wage spillover, two-digit industry skilled foreign wage in the region is found to have a significant influence on plant level wages for skilled workers, in the first specification (a 10% growth leading to 3.1% growth). The assisted areas additional effect within the region but inter-industry is marginally significant for unskilled workers. This suggests that where foreign firms (usually in receipt of a subsidy) offer higher levels of unskilled wages, then this can feed through to domestic wage determination.

Turning to columns 3 and 4 of the results tables, where foreign investment penetration is included, the results are largely robust to this specification, with one exception. The inter-industry, within region foreign wage spillover disappears, while foreign penetration at the four-digit level can be seen to have a significant impact on wages. This suggests that the impact of foreign wages occurs largely through labour demand effects, rather than through workers changing (or threatening to change) jobs by moving from foreign to domestic firms. It is interesting to note that the effects of wages outside the region are generally statistically

[8] Elasticity of skilled wages with respect to average foreign wages in the industry region is only .036.

negligible, except in the case of skilled wages in regions with assisted area status. Given that the proportion of skilled workers in assisted areas is significantly lower than the average, this result is consistent with an increase in skilled labour demand elsewhere in the sector biding up wages. Overall, the main conclusion one can draw from Table 5 is that what seems to matter most to plant level wages is the wage dynamics in the domestic rather foreign sector. However to the extent that average sectoral /regional wages are linked to their foreign counterparts, our estimation strategy may underestimate the role of the latter in plant level wage determination.

VI. Conclusion

This paper uses plant level data from the highly "globalised" electronics sector to identify the extent of wage spillovers from regional FDI. There is significant evidence that wage rates are influenced by wages elsewhere within the industry or region. The prevalence of wage spillovers from FDI appears similar to those reported elsewhere for productivity spillovers, although the magnitudes are somewhat smaller. The largest productivity spillovers from inward investment are generally observed intra-industry and intra-region, and while the results for wage spillovers appear to shadow these, the magnitudes for wage spillovers are much smaller. Further, there is an additional "foreign" effect in that the presence of foreign owned firms in the region and industry cause wages of skilled workers to rise. The explanation for this is that inward investment increases the demand for skilled workers, this being supported by the greater skill effect in assisted areas.

Unskilled workers are generally less mobile, both in terms of location and sector, than skilled workers, and this again is illustrated by the smaller spillovers in terms of unskilled wages. Indeed, wage spillovers are larger for skilled workers than for unskilled ones, confirming a degree of segmentation in the labour market, which may well be heightened by

FDI. This suggests that, for a variety of reasons, skilled workers employed in foreign and domestic firms gain more from a foreign presence than do unskilled workers, this foreign differential is maintained, or even exacerbated in areas with assisted area status. This issue however requires further investigation.

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Appendix A
The semiparametric approach to estimating TFP

This study estimates plant level total factor productivity using the semiparametric approach of Olley and Pakes (1996). As stated in the main text, the major advantage of this approach over more traditional production function estimation techniques is its ability to controls for both selection and endogeneity in a simultaneous fashion. Olley and Pakes (1996) suggest conditioning on a plant's probability of survival to deal with the selection issue, and they address the endogeneity problem by employing investment as a proxy (instrument) for productivity shocks. The reason why investment is correlated with unobserved (to the econometrician) productivity is simple. An establishment with a larger productivity shock this year will invest more than an otherwise similar establishment with a smaller realised productivity shock, because it expects to do better in the future.

In the model by Olley and Pakes (1996), each plant begins period *t* with the quasi-fixed input capital, K_t. It then observes its current productivity, say, ω_t, after which it decides whether to stay or exit (χ_t). Conditional on staying and given output price p_t, it then chooses the levels of investment I_t and variables inputs skilled and unskilled labour and intermediate materials (L_t^s, L_t^u, M_t). Using lower cases for log values and indexing establishments by *i,* we write the production function as $y_{it} \equiv f(l_{it}^s, l_{it}^u, m_{it}, k_{it}, \omega_{it}, \varepsilon_{it})$, where y is output, the time-varying productivity shock ω_t is correlated with inputs and ε is a random error term. For estimation purposes we employ a first-order Taylor approximation and we write the production function as:

$$y_{it} = \beta_0 + \beta_s l_{it}^s + \beta_u l_{it}^u + \beta_m m_{it} + \beta_k k_{it} + \omega_{it} + \varepsilon_{it} \qquad \text{(A.1)}$$

Olley & Pakes (1996) show that under certain conditions the investment function of a profit-maximising establishment, $i_{it} \equiv i_t(k_{it}, \omega_{it})$, is strictly increasing in the productivity shock ω_{it}, so that it can be inverted and one can write $\omega_{it} = \omega_t(i_{it}, k_{it})$ for some function ω_t. Equation (A.1) can then be expressed as

$$y_{it} = \beta_s l_{it}^s + \beta_u l_{it}^u + \beta_m m_{it} + \lambda_t(i_{it}, k_{it}) + \varepsilon_{it} \qquad \text{(A.2)}$$

with

$$\lambda_t(i_{it}, k_{it}) = \beta_0 + \beta_k k_t + \theta_t(i_{it}.k_{it}). \qquad \text{(A.3)}$$

. In the first stage, the parameter vector $\beta_v = (\beta_s, \beta_u, \beta_m)'$ of the partially linear equation (A.3) can be consistently estimated via semiparametric regression (Robinson, 1988). The estimate of β_v is then used to purge the contribution of variable inputs in equation (A.1) from the variation in output, i.e.

$$y^*_{it} = y_{it} - x'_{it}\beta_v = \beta_0 + \beta_{kit} + \omega_{it} + \varepsilon_{it} \qquad \text{(A.4)}$$

In order to identify the elasticity of capital β_k, it is assumed that productivity follows a first order Markov process[9], in which case ω_t can be decomposed as $\omega_{it} = E[\omega_{it} \mid \omega_{it-1}] + u_{it}$, where *u* is mean zero innovation term. This allows us to write (A.4) as:

$$y^*_{it} = \beta_k k_{it} + g(\omega_{it-1}) + \varepsilon^*_{it} \qquad \text{(A.5)}$$

where: $g(\omega_{it-1}) = \beta_0 E + [\omega_{it} \mid \omega_{it-1}]$ and $\varepsilon^*_{it} = \varepsilon_{it} + u_{it}$.

Now using the first-stage estimate $\hat{\lambda}_t$ and the identity expressed in equation (A.3), $g(\omega_{it-1})$ can be rewritten as $g(\hat{\lambda}_{it-1} - \beta_k k_{t-1})$.[10] The basic assumption that helps identify β_k is the one which states that capital is slow to adjust to the innovations, so that conditional on ω_{it-1}, k_{it} is independent of ε^*_{it}. To control for selection, the function g(.) can be augmented by the probability of survival function , π_{it-1}. In OP this probability depends on the productivity shock ω_{it-1} and a threshold productivity level ω^*_{it}. If the establishment's actual productivity is below ω^*_{it}, its future profitability is less than its liquidation value, and this triggers its exit from the market. In this paper we generate the survival probabilities via a probit model using a polynomial series expansion in capital and investment to proxy for productivity. The final estimating equation is then:

$$y^*_{it} = \beta_k k_{it} + g(\hat{\lambda}_{it-1} - \beta_k k_{it-1}; \pi_{it-1}) + \varepsilon^*_{it} \qquad \text{(A.6)}$$

In this paper we follow Pavenick (2000) and approximate g(.) by a third order polynomial in $\hat{\lambda}_{it-1} - \beta_k k_{it-1}$ and π_{it-1}.

[9] The method easily handles extensions to higher order Markov processes.
[10] The intercept term β_0 is subsumed into the unknown function g(.)