Wage spillovers, inter-regional effects and the impact of inward investment

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ABSTRACT. This paper evaluates the extent of inter-industry and inter-regional wage spillovers across the UK. A large literature exists suggesting that wages elsewhere affect wage determination and levels of satisfaction, but this paper extends the analysis of wage determination to examine the effects of inward investment in the process. Thus far the specific effect of foreign wages on domestic wage determination has not been evaluated. We employ industry and regional level panel data for the UK, and contrast results from three alternative approaches to space-time modelling. Each supports the notion that such wage spillovers do occur, though assumptions made concerning the modelling of spatial interaction are important. Further, such wage spillovers are more widespread for skilled, than for unskilled workers and also lower in areas of high unemployment.

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Keywords: Wage determination; regional spillovers; alternative wage.

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I. Introduction

A substantial body of literature exists which suggests that wages are influenced by spillover effects from wages set elsewhere. For example, a number of authors have considered the extent to which wages set in one region may influence wage determination in neighbouring (contiguous) areas, Manning (1994); Burridge and Gordon (1981); Molho (1982). In a similar vein researchers have also considered the extent to which inter-industry spillovers effect wage determination. For example, Smith (1996) found that within the chemicals industry the existence of a wage leader influences the wage determination of other groups. Moreover, Latreille and Manning (2000) evaluate inter-industry and inter-occupational impacts, again finding that wages elsewhere impact on wage determination.

This work however predates recent developments in inter-regional modelling and spatial econometrics. The purpose of this paper is to add to this literature by considering inter-industry and inter-regional wage spillovers using the concept of contiguity. Further, we extend previous work by considering the importance of simultaneity in the determination of wages of different occupational groups, and make a distinction between the potential differential effects upon skilled and on unskilled wages. Finally, we consider the importance of wage spillovers between the foreign and domestic sectors of UK industry. This is pertinent for two reasons, firstly there is a growing literature, discussed below, that illustrates the apparent premium paid by foreign owned firms. Secondly, foreign owned firms also have higher levels of skill intensity and pay a larger skill premium than domestic firms.

This paper proceeds as follows: The following section provides a brief rationalisation for how such spillovers can be justified. This is followed by section III which discusses the potential role of foreign direct investment in domestic wage determination. Section IV outlines the model of wage determination and spillovers that is developed, while the data are outlined in section V. Finally, the results and conclusions are presented in sections VI and VII.

II. Why do fallback wages matter?

Notions of fairness and the importance of comparison incomes have long been important in the psychology and sociology literature on labour supply. This dates back to Ross (1948) and Adams (1963). For example, Ross (1948) argued:

> *"comparisons play a large and often dominant role as a standard of equity in the determination of wages under collective bargaining."*

More recently such issues have been discussed within the economic analysis of wage determination, see for example Akerlof and Yellen (1990), Rees (1993), and Smith (1996). The underlying mechanism driving the importance of comparison incomes is the concept of a reference level of income against which an individual compares him/ herself, which is also related to issues of individual utility or satisfaction, Clark and Oswald (1996); and Hamermesh (2001).[i] The concept of wage spillovers between industries or regions can be justified theoretically with reference to bargaining theory and migration. In bargaining models, where the aim is to maximise utility over and above some minimum level, neighbouring wages take the form of fallback wages. This provides an obvious link to models based upon migration, Harris and Todaro (1970). If its possible for workers to migrate between different industries and regions, then wage increases in adjacent industries or regions may result in workers migrating to the more attractive (in terms of wages) location.

The importance of external effects in wage determination is discussed in a different context by Yankow (2003) who demonstrates the pecuniary returns to migration. The returns to migration are however neither universal nor equal across occupational groups, suggesting a similar pattern for wage spillovers. Further analysis of the regional distribution of wage rates is provided by Dickie and Gerking (1998), who show that for Canada inter-regional wage differentials are lower for more educated workers. While Dickie and Gerking (1998) do not model the inter-regional effects explicitly, they do however identify regional differences in wage determination, largely using intercept dummies. In a similar vein, Brakman *et al.* (2004) for Germany have shown that real wage equalisation between regions is an unrealistic assumption, and that significant frictions exist in the process of labour market spillovers, limiting the degree of convergence. Interestingly, Dickie and Gerking (1998) identify certain segmentation effects based on distance, and show that relocation costs will limit the size of spillovers. This suggests therefore that any study of contiguity effects in wage determination must consider the limits to this process. This is discussed in more detail in section IV.

This suggests that an important consideration in any study of wage spillovers is labour market segmentation, particularly between regions. For example, 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). Further, there is also evidence that technological change generates an increase in wage inequality through an increase in relative demand for skilled workers, see for example Machin and Van Reenen (1998). New technology is seen as complementary to skilled labour, and skilled labour augmenting, and so disadvantaged the less skilled worker.

The above suggests that notions of comparison wages must be seen within the context of labour market segmentation. For example, while it is well documented that inward investors pay higher wages than their host country counterparts, (for UK evidence see Girma *et al.* 2001), the spillovers effects of these higher wages may not be uniform across regions or occupational groups. The rationale for this and the potential limitations to the process of foreign-to-domestic wage spillovers are discussed in the following section.

III. The role of foreign direct investment in wage comparisons

There are a number of studies that identify substantial differences in factor demand between foreign and domestic firms (Conyon *et al.*, 2002; and Girma *et al.*, 2001). The inference here is that foreign multinationals demonstrate higher levels of labour productivity, and in turn greater demand for high quality labour. Equally, foreign entrants pay higher wages than incumbent domestic firms, and therefore may attract higher quality workers. Entry by such firms therefore is expected to impact on domestic labour markets, not only in terms of labour demand, but in restricting the supply of labour to domestic firms offering lower wages.

Over the period 1984 to 1992 foreign firms on average paid 11% more to unskilled workers than domestic firms, and approximately 9% more to skilled workers (figures from the Office for National Statistics).[ii] Driffield (1999) shows that as a result of these higher wages, increased inward investment acts to bid up wages, and in the short term to reduce employment. However, in this study the labour market effects of FDI have been effectively constrained to intra-industry effects, which also therefore encompass the crowding out of domestic employment through product market competition.

The productivity effects of inward investment may have compounded the direct wage effects. As Barrell and Pain (1997) show, one of the major impacts of inward investment into the UK has been to introduce new technology, while Driffield and Taylor (2005) for example outline some of the major technological differences between the foreign owned and domestic sectors, and their magnitudes. There is a relatively large literature on the importance of productivity spillovers from FDI, see for example Driffield *et al.* (2005). This outlines the importance of inter, and intra-regional effects in industry level productivity spillovers, while Sun (2001) demonstrates for China that the beneficial effects of inward FDI on host regions are not evenly distributed, but concentrated on those regions that are best placed to benefit from the introduction of new technology. Further, Driffield and Taylor (2000) demonstrate that productivity spillovers from FDI are partly facilitated by domestic firms becoming more skill intensive, and as such, one may expect wage spillovers to affect the market for skilled, rather than unskilled workers. Despite this conjecture, the impacts of FDI on labour markets in general, and earnings in particular have surprisingly been far less explored, for a review of this literature see Driffield and Taylor (2000).

The above discussion suggests therefore, that wage spillovers from inward investment will be greater for skilled workers than for unskilled workers, in terms of both inter-regional impacts, and foreign to domestic impacts. 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. Equally, if inward investment merely bids up skilled wages in the domestic sector, then this will increase wage inequality, not only between skilled and unskilled workers, but also across industries and perhaps more importantly across regions. In a similar vein, there is a well developed literature on the determinants of the spatial distribution of FDI, see for example Basile (2004), Coughlin and Segev (2000), Crozet *et al*. (2004) who argue that agglomeration of activity and the level of development of a region has a positive impact on FDI location.

The existence of foreign-to-domestic wage spillovers, and also the extent to which segmentation between the foreign and domestic sectors exists, can be tested directly. This can be achieved with the use of contiguity matrices, which have been used in the regional science literature to examine issues such as unemployment (for example Aragon *et al.*, 2003), economic growth (for example López-Bazo *et al.*, 2004), and the economics literature for example Latreille and Manning (2000). Our, analysis extends that of Latreille and Manning (2000) to include different spillover terms for wages in the foreign and domestic sectors as well as introducing a regional element to the analysis. Further, comparing wage spillovers in the skilled and unskilled sectors can test the hypothesis of segmentation as a restriction to spillovers. We hypothesize that segmentation will be less important in the market for skilled workers, and as such that foreign-to-domestic wages spillovers will be greater for skilled workers. Also, that wage spillovers for unskilled workers will be limited geographically, as unskilled workers are less mobile.

IV. Theory and empirical models

The theoretical approach is based upon a simple structural model of the labour market, highlighting the role of alternative wages as comparison incomes in labour supply. In order to examine the effect that inward FDI has on the labour market, we focus on wages paid by domestically owned enterprises. To characterise this, we specify a Cobb-Douglas production function for the domestic sector, of the form $Q = AK^{\alpha}L^{\beta}$ where Q is output, K is capital, and labour L is split into skilled and unskilled. The marginal revenue product of labour is defined as $MP_L = \partial Q/\partial L = AK^{\alpha}\beta L^{\beta-1}$.

In equilibrium wages in the domestic sector, y, are given by:

$$y = pAK^{\alpha}\beta L^{\beta-1} \quad (1)$$

where p represents the market price of the good produced. However, it is also necessary to introduce the supply side of the labour market, which is influenced by the wage on offer y, two vectors of alternative wages available $\tilde{\boldsymbol{y}}_1$, $\tilde{\boldsymbol{y}}_2$ and unemployment U,[iii] so:

$$L = f\left(y, \tilde{\boldsymbol{y}}_1, \tilde{\boldsymbol{y}}_2, U\right) \quad (2)$$

The measures of alternative wages consist of wages paid in neighbouring regions and related industries. $\tilde{\boldsymbol{y}}_1$ captures regional level intra-industry effects. Firstly, this includes the inter-occupational term. Following Latreille and Manning (2000) it is necessary to investigate whether skilled wage rates have an impact upon unskilled wage determination and vice versa. Secondly, $\tilde{\boldsymbol{y}}_1$ captures the effect of FDI by including wages paid in the local industry by foreign owned firms. $\tilde{\boldsymbol{y}}_2$ then captures the inter-industry and inter-regional effects in wage determination, including contiguity effects between foreign and domestic wages spillovers, and inter-industry wages paid in both the foreign and domestically owned sectors. The variables that make up $\tilde{\boldsymbol{y}}_1$ and $\tilde{\boldsymbol{y}}_2$ are discussed in depth below. Intra-industry spatial contiguity is modeled using a spatial lag structure outlined in equation (3) below.

To estimate the reduced form model of skilled and unskilled domestic wages we contrast three approaches to time-space econometrics. This involves estimation in both levels and first differences, making differing assumptions concerning the nature of inter-regional effects. We adopt estimation based on a standard spatial fixed effects model, see Baltagi (2002) and Elhorst (2003), and employ the most general reduced form of wage equation, based on Latreille and Manning (2000) and Driffield and Girma (2003). In equilibrium the basic model can be given by:

$$y = \rho W_1 \boldsymbol{y} + \boldsymbol{X}\phi + \gamma_1 W_2 \tilde{\boldsymbol{y}}_1 + \gamma_2 W_3 \tilde{\boldsymbol{y}}_2 + (I - \lambda W_4)\varepsilon \quad (3)$$

where $\boldsymbol{y}$ is the spatially lagged dependent variable, a matrix of industry level wages paid by domestically owned firms in contiguous regions at the industry level, $\boldsymbol{X}$ is a matrix of observations on other independent variables, $\tilde{\boldsymbol{y}}_1$ is a matrix consisting of alternative wages within the same industry and the region, including inter-occupational effects, and wages paid to the same occupational group by the foreign owned sector. $\tilde{\boldsymbol{y}}_2$ is a matrix consisting of alternative wages in contiguous industries or regions as defined below.

The data we employ has three dimensions – industry (*i*), region (*r*) and time (*t*), hence we consider the influence of domestic and foreign wages in adjacent regions and industries using contiguity matrices, which inform us of neighbouring industry and/or regional wages. We also consider the significance of time lags in wage spillover effects, although where spillovers are found these appear to occur within a one year lag. Given the data (see section V below) we are able to split the sample into foreign and domestic sectors with details for each of the 2 digit industries and 11 regions. Hence alternative wages are based upon the following:

- *Contiguous industry domestic wage* – industry level wages paid by UK owned firms in each two digit industry *(i)* operating in the same one digit industry *(j)*, given in $\tilde{\boldsymbol{y}}_2$ (see equation 3 above);
- *Contiguous industry foreign wage* – industry level wages paid by foreign firms in each two digit industry *(i)* operating in the same one digit industry *(j)* , given in $\tilde{\boldsymbol{y}}_2$ (see equation 3 above);

• *Contiguous region domestic wage* – industry level wages paid by domestic firms in adjacent regions. This is the spatially lagged dependent variable, given in $\boldsymbol{y}$ (see equation 3 above);

• *Contiguous region foreign wage* – industry level wages paid by foreign firms in the same industry *(i)* operating in adjacent regions, given in $\tilde{\boldsymbol{y}}_2$ (see equation 3 above);

• *Cross wage term* – wages paid to other occupational groups (skilled or unskilled) within the industry and region, given in $\tilde{\boldsymbol{y}}_1$ (see equation 3 above);

• *Foreign wage* – the wages paid by the foreign owned sector in industry *(i)* and region *(r)*, given in $\tilde{\boldsymbol{y}}_1$ (see equation 3 above).

Hence the alternative wages include inter-industry effects, inter-occupational effects i.e. the cross over wage terms (skilled or unskilled), and the foreign to domestic effect. This also has a spatial component given by γ. In equation (3), above, the matrices W_z are spatial weights where the importance of spatial lags in domestic wage effects are captured by ρ.[iv] We also allow for autoregressive disturbances with effects given by λ. We initially estimate the spatial lag and the spatial error regression model by maximum likelihood, allowing for the spatial nature of our data. In practice we follow Florax and Folmer (1992) and Aragon *et al.* (2003) where firstly we test whether $\lambda = 0$ and then whether $\rho = 0$, with each model allowing for the possibility that $\gamma_1 \neq 0$ and $\gamma_2 \neq 0$.

The model given in equation (3) is based on a relatively standard levels approach but incorporating spatial dependency. In addition, however to the essential problems of spatial lag and spatial error, and the fundamental question of whether findings regarding the importance of alternative wages are robust to alternative treatments of these issues, there are other considerations.

Firstly, previous work in the area also investigates the importance of time lags and persistence in these effects. This requires a reformulation of the basic model to include a lagged dependent variable. In standard wage determination models, see for example Willis (1986), a vector of further characteristics, or "fixed effects" such as age, experience, education, gender and ethnic group would be included. Such data are clearly not available at this level of disaggregation, but these effects can be captured by a lagged dependent variable, which by definition is correlated with these fixed effects. Thus, the model that is estimated becomes a dynamic panel data model (now introducing the subscripts defining the dimension of our data into the analysis):

$$y_{irt} = \alpha y_{irt-1} + \rho W_1 \boldsymbol{y}_{ist} + \boldsymbol{X}_{irt}\phi + \gamma_1 W_2 \tilde{\boldsymbol{y}}_{1irt} + \gamma_2 W_3 \tilde{\boldsymbol{y}}_{2irt} + (I - \lambda W_4)\varepsilon_{irt} \quad (4)$$

$\boldsymbol{y}_{ist}$ captures the spatially lagged dependent variable, region *s* being contiguous to region *r*.

With a model of this type there are a number of endogeneity issues surrounding standard "levels" fixed effects estimators. The development of panel data models to handle these types of problems is relatively well understood, see for example Arrelano and Bond (1988, 1991) and Holtz-Eakin *et al.* (1988). These involve converting the data to first differences and employing a GMM estimator, using past values as instruments for current values.[v] The standard form of this estimator however is not robust to spatial error or autocorrelation. We therefore propose an alternative GMM estimator following Driscoll and Kraay (1998), who develop a spatial GMM estimator. This is essentially a variation on the standard heteroskedasticity and serial correlation consistent covariance matrix estimation developed by Newey and West (1987). This involves obtaining a non-parametric covariance matrix which is robust to general forms of spatial and temporal dependence. One advantage of this approach is that it remains consistent when *N*, the size of the cross section is large relative to *T*. However, the choice of instruments for this estimation is far from straightforward. With a spillover model of this type, there is the concern that contiguous wages are endogenous in wage formation, and must therefore be instrumented. We employ further spatial lags and time lags of wages as instruments of contiguous wages, and time and spatial lags to instrument unemployment. Capital is instrumented using time lags only. This approach is confirmed by the Sargan test statistic. The model that is estimated, taking differences, becomes:

$$\Delta y_{irt} = \alpha \Delta y_{irt-1} + \rho W_1 \Delta \boldsymbol{y}_{ist} + \Delta \boldsymbol{X}_{irt} \phi + \gamma_1 W_2 \Delta \tilde{\boldsymbol{y}}_{1irt} + \gamma_2 W_3 \Delta \tilde{\boldsymbol{y}}_{2irt} + (I - \lambda W_4) v_{irt} \qquad (5)$$

A third consideration in the empirical modelling is that with two types of labour (skilled and unskilled) there is the potential for simultaneity in wage determination between these occupational groups. This is particularly pertinent when considering the impact of cross wages, that is, the effect of skilled wages on unskilled pay, and vice versa. Theoretically this is intuitively appealing, and ties in with the theoretical proposition of Akerlof and Yellen (1990) who stress the interdependence between the two groups. This has largely however been ignored in the previous empirical literature, see for example Latreille and Manning (2000), Lee and Pesaran, (1993). In order to allow for this, we propose a further estimator, which is a version of the estimator employed in Driffield and Girma (2003), where the skilled and unskilled wages equations are estimated simultaneously via iterated three stage least squares (FD-3SLS).[vi] Lagged wages, capital and unemployment are employed as instruments in the first-differenced (i.e. wage growth) equations following Anderson and Hsiao (1981).[vii] In the basic form, this employs the same set of instruments that would be suggested by single equation dynamic panel data procedures. However, we also employ further spatial lags as instruments in the contiguity effects. This imposes another set of orthogonality conditions, based on spatial interaction rather than merely time lags, and the validity of this approach is confirmed by the Sargan tests. Equally, the appropriate length of both spatial lags and time lags must be considered. Given that by construction the lagged dependent variable captures all past values of the internal and external variables, the number of time lags included in the dynamic estimation is limited to two, though this restriction is formally tested.

While capturing the special dependence effects with such an estimator has to be more mechanistic, and relies on ex post testing for spatial effects (those not captured by the use of the contiguity matrices) when considering the efficiency of the estimator, it does have potential advantages. Firstly, this estimator allows for potential simultaneity in the determination of skilled and unskilled wages, as well as for potential spillover effects between groups. Secondly, this estimator allows the importance of contiguity effects to vary across regions. It is likely for example that regions contiguous with the South East of the UK may experience larger contiguity effects than average, while an area such as the South West may exert much smaller spillover effects on its neighbouring regions. In terms of the labour market these differential effects may also be related to differences in unemployment rates across the UK.

<<TABLE 1 HERE>>

It is clear from Table 1 that different regions of the UK exhibit markedly different patterns of unemployment. As such, it is likely that the effects of external wages, and indeed the importance of external wages in wage determination will differ across regions, varying with the levels of unemployment. Further, regions with Assisted Area status have often sought to attract inward FDI in order to reduce structural unemployment.[viii]

The regions with higher unemployment: North West; North; Wales and Scotland were all covered by assisted area status during the period. One common criticism of estimating equations (3, 5) is that the unemployment variable is endogenous. Consequently, in the empirical analysis in addition to employing unemployment as an explanatory variable, we also split the sample by region in terms of assisted and non-assisted area status.[ix] When we do so the unemployment term is dropped.

After describing the data in the next section, we estimate skilled and unskilled domestic wage equations based upon: fixed effect spatial panel data models; non-parametric spatial GMM panel data models; and simultaneous FD3SLS models. The latter two approaches employ instruments to allow for endogeneity, with the final approach also allowing for simultaneity in skilled and unskilled wage determination.

We also experimented with measures of distance based not on geography but on similarity of region, following Boarnet (1998). This involves for example identifying regions that are dominated by similar industries, or constructing a distance matrix based on similarity of earnings or unemployment rates. Using earnings or unemployment rates is problematic, as by definition the contiguity matrix becomes endogenous in the estimation. Measures of distance based on industrial activity in the UK essentially serve to illustrate that the key differences between regions in the UK can be explained in terms of the "core-periphery" distinction that is well understood, and as such spatial weights outperform such measures in the analysis.

V. Data

The UK Office of National Statistics (ONS) provided the data used for the empirical analysis. The data set comprises information for both the foreign-owned and domestically-owned sectors of UK manufacturing, and comprises industry and regional level data for the UK, covering the period 1984-1992. There are 11 standard planning regions, and 19 manufacturing sectors (2-digit level), see Figure 1 and Table 2. While data for Northern Ireland are available, these are omitted from the econometric analysis as Northern Ireland is not contiguous with the rest of the UK. Figure 1 illustrates the Standard Statistical Regions of the UK as defined by the UK Office for National Statistics. These are NUTS2 regional classifications. The choice of this level of aggregation is largely driven by data availability, particularly for FDI data. At any level of aggregation below NUTS2, good data on the foreign owned sector often become disclosive and therefore not available. Equally, the split between skilled and unskilled workers for the foreign owned and domestic sectors separately is only available at this level of aggregation. The definitions of industry and region classifications are given in Table 2, while some summary statistics at this level of disaggregation are provided in Table 3.

<<TABLE 2 HERE>>

<<FIGURE 1 HERE>>

In terms of spillover effects Figure 1 illustrates the contiguity of the 11 regions. For example, imagine a worker employed in industry *i* who lives in York & Humberside. There are a variety of spillovers that may occur in his/her wage determination. For example, the average wage bill in the domestic sector in York and Humberside is £500 less than that in the North West, see Table 3, and may therefore exert a negative impact on wage aspirations as the two regions are contiguous, see Figure 1. However, if the individual remains in the York & Humberside region, but is able to move from the domestic to foreign sector then this may yield a positive wage effect, since foreign wages are around £1,500 higher. An even greater effect on his/her wages may be the possibility of moving. For example, a move to the North

West, and a job in the foreign owned sector would be expected to increase earnings by £4,100. Akin to this argument the differential between the average wage bill by industry and domestic/foreign sectors is also applicable.

The advantage of such data, in addition to isolating domestic-foreign interactions, is that they allow one to evaluate inter- and intra-regional effects, as well as inter- and intra- industry effects. These are based on the best alternative pay, in the industry and sector, in surrounding regions, or related industries. Skilled wages are, in both the domestic and foreign sector, defined as annual earnings of non-manual workers and conversely unskilled wages are defined by the annual earnings of manual workers. The capital stock in the domestic sector is estimated as the sum of net capital investment of the previous 7 years, depreciated by 10% per annum. The unemployment rate is based upon regional level data and does not vary across industries. To construct the alternative wage we chose the maximum wage available in contiguous industries or regions such that it represents the best alternative wage.

<<TABLE 3 HERE>>

Table 3 shows the sample means for a number of variables. For instance, over the period 1984 to 1992 the unemployment rate across regions averaged 10 percent. The regions with the highest average wage in the foreign and domestic sectors respectively were the North West and North East.[x] Looking at the ratio between the foreign and domestic wage bill the largest differential is seen in the North West, 21 percent.

VI. Empirical Results

In this section we report estimates of both skilled and unskilled wage determination, based upon a spatial fixed effect model (equation 3), and a dynamic panel data model (equation 5) which is estimated as a first difference spatial GMM model and to allow for simultaneous wage determination between the skilled and unskilled estimation by FD3SLS. Finally, we report the wage equations for assisted areas and non-assisted areas separately. All results across the three sets of estimators are shown with t-statistics based upon robust standard errors.

Spatial Fixed Effects

The results from estimating equation (3) for both unskilled and skilled wage determination are shown in Table 4. These illustrate results based on alternative specifications, allowing for a spatial lag ($\rho \neq 0$) and a spatial error ($\lambda \neq 0$). There is no evidence of a spatial lag operator in these data, for either skilled or unskilled workers, since the hypothesis that $\rho = 0$ can not be rejected. Spatial autocorrelation however is clearly present, and shows negative dependence. Time dummies are used across the specifications and are always jointly significant. Throughout, we test the null hypothesis of spatial independence i.e. no spatial autocorrelation using *Moran's I* statistic, Moran (1950).

<<TABLE 4 HERE>>

Turning to the estimates of the coefficients generated by the model, capital and labour are shown to be complementary within this framework. While the capital stock is positively correlated with wages, this effect is significantly greater for unskilled workers. It is likely that increased capital expenditure impacts on unskilled labour productivity to a greater extent than it does on the productivity of skilled labour. Unemployment is significant in both equations and has a negative impact as expected, with a significantly greater impact on unskilled wages, again as one would expect. This is consistent with Blanchflower and Oswald (1994) and Cameron and Muellbauer (2000), but contrasts with Latreille and Manning (2000) who find no significant difference in the impacts of unemployment.

The cross wage terms indicate the existence of such wage effects. These are also suggestive of the importance of skill differentials in wage determination. The inter-occupational effects are positive and significant and suggest that skilled wages are more responsive to cross wage spillovers than unskilled wages. Interestingly, industry level wages paid by inward investors at the regional level has no influence upon unskilled wages, but does have a positive and significant effect on skilled wage determination. This would suggest that wage differentials between the skilled and unskilled will increase with foreign presence thus increasing wage inequality in the domestic sector, see Taylor and Driffield (2005).

Finally, this model generates significant evidence of wage spillover effects. We find confirmation that contiguous regional domestic wages and contiguous industry foreign wages impact on local wage determination. Not surprisingly wage spillover effects are greater for skilled labour. Skilled workers are generally more mobile, and as discussed above the returns to mobility are greater for skilled labour, see for example Dickie and Gering (1998). These results are interesting in that *neighbouring* industry and regional wages matter for wage determination, but the mechanism of foreign effects operates solely via industry comparisons. In contrast, domestic wage comparisons exhibit inter-regional effects. This suggests that while inward investment has an impact on local labour markets, these effects are limited to the area of the investment. There are two potential explanations for this. Firstly, there is significant evidence that productivity spillovers from FDI (and indeed productivity spillovers generally) are limited geographically, Driffield *et al.* (2005), Baranes and Tropeano (2003). Secondly (higher paying) foreign firms outside the region may not be seen as relevant comparators by firms seeking to set wages within a local labour market context.

Spatial GMM and First-difference 3SLS

The results from estimating the dynamic panel data model of equation (5) for both unskilled and skilled wage determination are shown in Table 5 below, which reports results based upon spatial GMM and first difference (FD) 3SLS estimation respectively.[xi] Tests for spatial correlation and serial correlation are also reported, where, as with the levels results spatial dependence is apparent in the data. In the FD3SLS estimator, this effect is captured by the use of contiguous wage variables, instrumented with further spatial lags, following Kelejian and Prucha (2004). As a result, tests for second degree spatial lags were also carried out, though none were detected. All estimates are based upon robust standard errors and include a set of time dummies that all prove significant. For the FD3SLS we present an additional test for spatial autocorrelation, which employs the Lagrange Multiplier (LM_{SEC}) test, which following Anselin and Moreno (2003) is shown to outperform other tests[xii].

<<TABLE 5 HERE>>

After losing observations for first differencing and instrumenting, estimation is based upon 1,330 observations. All alternative wage variables are instrumented with lagged values due to possible endogeneity problems, as is the capital stock, and the unemployment rate. The global validity of the instruments in the simultaneous estimation is confirmed (at 5% level) by the Sargan tests reported in both the skilled and unskilled wage equations 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.

In both the skilled and unskilled domestic wage equations, the spatial GMM and FD3SLS, generate coefficients in line with the levels estimation. Capital and unemployment have positive and negative impacts upon wages respectively. We find the impact of the cross wage term is positive which suggests that the two groups are complements and the effect is larger than under the spatial GMM specification.

Turning to the foreign wage variable, there is evidence that the existence of higher-paying foreign firms exerts upward pressure on wages in domestically owned firms. Noticeably, these effects are evident for both unskilled and skilled wages, whereas for the fixed effects analysis foreign wages only influenced skilled wage determination. However, the impact upon skilled wages is larger and so supports the earlier conclusion that a foreign presence in the same industry and region elevates wage inequality in the domestic sector. There is a growing literature that suggests that there is a gap between wages paid in the foreign sector to those wages in the domestic sector of around 5% to 7% in favour of foreign firms (see Section III).

When considering contiguity terms, as found when using spatial fixed effects, across specifications there is a role for the average domestic wage in adjacent regions to influence wage determination. Focusing upon skilled wages, both domestic and foreign contiguous industry wages have an impact – although the former is always larger. This confirms the earlier evidence that the mechanism of foreign effects operates via industry comparisons, rather than regional comparisons.

Comparisons Across Estimators

The results presented in Tables 4 and 5 are also indicative of the difference in the results generated by the alternative estimators. In general, the coefficients of unemployment and capital are greater from the levels estimation than for either of the difference estimators. This is a relatively common result, but may also be indicative of the problem of endogeneity in the levels model. All the results presented here suggest that capital and labour are complementary, and though standard endogeneity tests for capital and unemployment do not indicate a problem, it is clear that the different estimators provide alternative results regarding the magnitudes of the effects of capital investment on wage rates. The implied inter-industry effects are also greater in the fixed effects estimation, though more marked in the foreign effect. The results do suggest that, particularly for skilled workers, wages paid by foreign firms do have a positive impact on domestic wages.

There is far less of a difference however regarding the implied importance of contiguous wages on wage determination. Once spatial error is allowed for, each of the models generate very similar results regarding the importance of industry level contiguous wages, for both skilled and unskilled workers. The FD3SLS does however suggest the importance of contiguity varies across regions.

<<TABLES 6 TO 8 HERE>>

As outlined above, one essential difference between the simultaneous equation estimator and the more standard spatial lag estimator is that it allows the importance of contiguity to vary across regions. Indeed, the results presented in Table 8 suggest that this is important, as there are significant differences in the size of the contiguity parameter across regions. As may be expected, contiguity effects are significant for those regions contiguous to the South East, such as East Anglia and the East Midlands, while the same effect does not work in reverse. Equally, in general contiguity effects appear more significant for skilled workers, and for the "core regions" of the UK, where in general unemployment is lower. The average effect of contiguous industry level wages across all regions is reported in Table 5, whilst the region-specific point estimates are given in Table 8. For the sake of brevity the results for individual regions based on the assisted / non-assisted area split are not reported, though these are in line with Table 8.[xiii] The issue of further spatial lags becomes particularly important in the case of the FD3SLS estimator, as it is possible that the

South East of England exerts upward pressure on earnings beyond its contiguous regions. No such effect however could be detected.

The final difference between the estimators concerns the “cross-wage” effect, the impact of skilled wages on unskilled wages, and vice versa. Perhaps not surprisingly, theses effects are shown to be much greater by the simultaneous estimator, than the single equation estimates. This again is perhaps not to be unexpected, and highlights one of the differences between the results produced here and earlier work, for example Latreille and Manning (2000). Skilled and unskilled labour appear to be treated by firms as complementary, although the impact of skilled wages on unskilled earnings appears to be greater than the reverse. This is intuitively appealing in that skilled workers are only concerned with the wages of those of the same occupational status, not those below, whereas the wage determination of unskilled workers is influenced not only by the wages of similar workers but also those in higher occupational classes presumably due to aspiration effects.

Assisted Area Status – Spatial GMM and FD3SLS

The importance of unemployment in terms of the differential effects on skilled and unskilled wages has been noted across estimators. We now investigate this further by estimating (3) and (5) as above, but for assisted and non-assisted areas separately. The results are shown in Tables 6 and 7 above, where both tables have the same format as Table 5.[xiv] The results so far suggest that contiguous inter-industry and inter-regional domestic wages are more important in skilled wage determination than for unskilled wage determination. The analysis in Tables 6 and 7 confirms that these impacts are generally less important in assisted areas. This again confirms a priori expectations, that unskilled workers, particularly those in areas of high unemployment would be the least mobile, Gordon and Molho (1998), and therefore the least likely to experience wage spillovers.

When considering the impact of inter-industry or inter-regional contiguous FDI, the greatest effects are again found for skilled workers, with wages paid by foreign firms exerting a greater inter-industry and inter-regionally effect on skilled rather than unskilled workers. This again seems a plausible result, and ties in with results reported elsewhere, which show that foreign firms are more skill intensive than domestic firms, Driffield and Taylor (2005). Consequently, it is logical to assume that skilled workers in the domestic sector are more likely to be able to move into the foreign sector, because the foreign sector demands skilled labour. Notions of fairness and comparability therefore feed through into the determination of skilled wages, and to a much lesser extent into unskilled wages. This suggests that wage spillovers in general, and effects from FDI in particular may be acting to increase regional disparity in the UK.

Carrying out the estimation for assisted and non-assisted areas separately, we also find evidence of inter-regional effects, that is $\gamma_2 \neq 0$, with the exception of unskilled wage determination in assisted areas. However, the magnitude of these effects suggests that inter-regional or inter-sectoral wage spillovers are limited. This may tie in with work by Ingram *et al.* (1999) who report that issues of wage comparability are becoming less important over time in the UK, as does Hamermesh (2001) for the USA.

Whilst wage spillovers from foreign to domestic firms are largely confined to intra-industry, intra-region effects, such spillovers exist even within assisted areas. This is a potentially important result, as it suggests that even in areas of high unemployment, inward investment acts to bid up wages in the domestic sector. For skilled workers, this effect is particularly strong; a 10% increase in foreign wages will increase domestic wages by some 2.9% (based upon the FD3SLS estimator).

VII. Conclusions

There is evidence of wage spillovers, for both skilled and unskilled workers, both across regions, industries, and between the foreign and domestic owned sectors. However, for both inter-regional and inter-industry effects, the impact of wages paid by foreign owned firms is limited to skilled workers. As such, there are inter-regional wage spillovers from FDI, but these are restricted to skilled workers. There are several potential explanations of why wage spillovers are greater for skilled workers. For example, it is widely accepted that skilled workers have greater mobility, and often their skills are more transferable between industries. It is also interesting to note that wages paid by foreign firms have a greater impact on domestic skilled wages. This suggests that inward investment encourages inter-regional mobility of skilled workers due to the higher wages on offer. Equally, there is evidence that certain regions and industries in the UK are experiencing significant skill shortages and such sectors, and wage spillovers in such locations are likely to be larger. Again this effect will be limited to skilled workers and areas with low unemployment.

This suggests that while contiguity effects are important in wage determination, the UK exhibits evidence of distinct spatial labour markets, similar to those reported for Canada and Germany by Dickie and Gerking (1998) and Brakman *et al*. (2004) respectively. Equally, there is evidence of labour market segmentation in the UK, both between assisted and non-assisted areas, between occupation groups, and between the foreign and domestically owned sectors. This difference between the results for skilled and unskilled workers is highlighted further by the assisted areas distinction, as there are no significant external effects on wages for unskilled workers in assisted areas. At the same time, such regions have higher proportions of unskilled workers than non-assisted areas.

While inward investment does generate wage increases in the domestic sector, there is also evidence of labour market segmentation. Foreign firms employ more skilled workers, and so inward investment has only a limited impact on surrounding unskilled labour markets. It is also worth noting, that foreign wages impact, even within the region, to a larger extent on domestic skilled wages. This adds credence to the recently expressed concerns that inward investment may act to increase wage inequality between the two groups.

These results have also shown that the importance of wage spillovers varies across regions. While the models are generally robust to the restrictions concerning contiguity impacting uniformly across regions, the individual region effects are clearly heterogeneous, suggesting that work on external wage effects that does not at least allow for differences in the importance of wage spillovers across regions must be treated with caution.

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Figure 1: Standard Statistical Regions of the UK

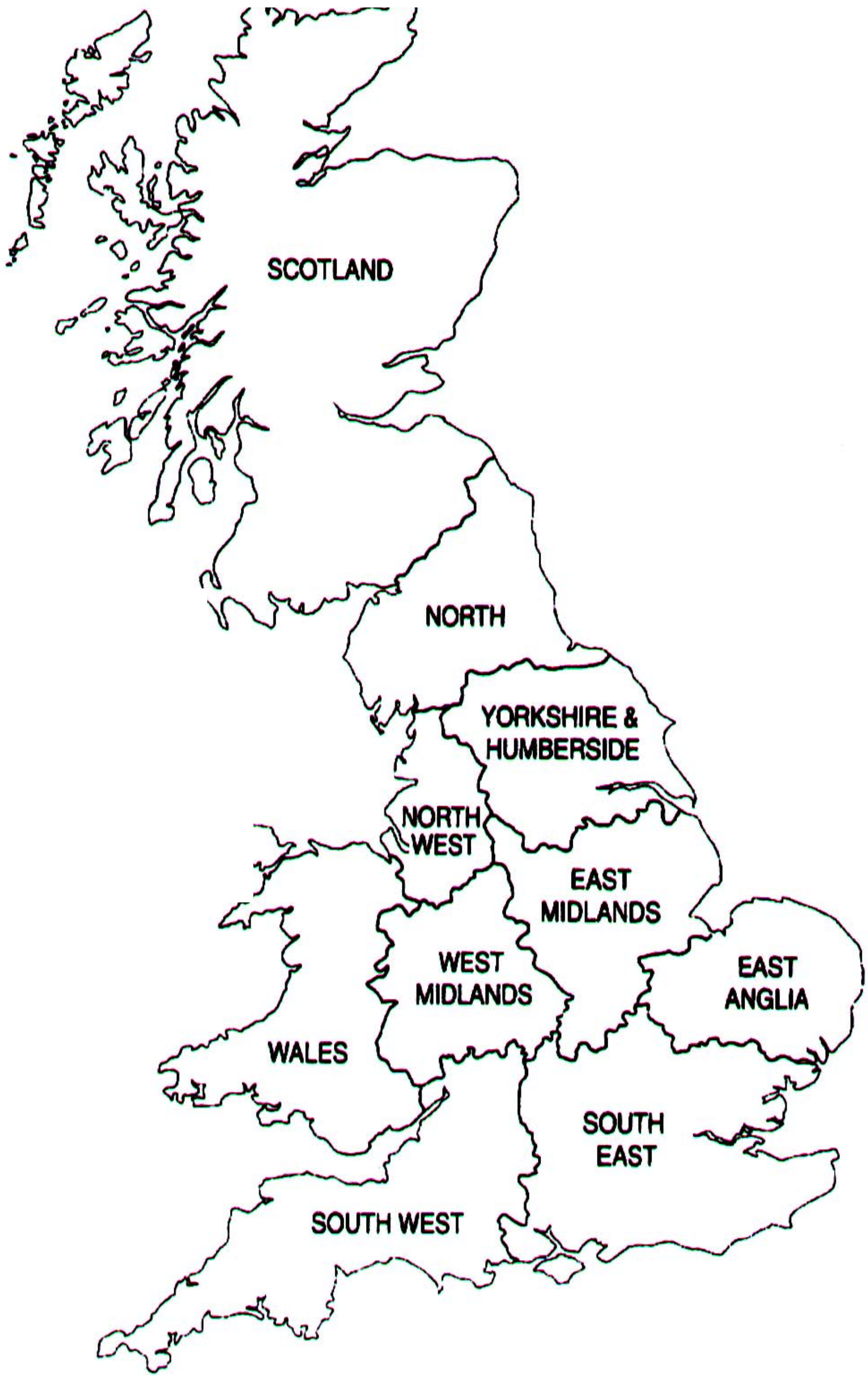

Table 1: Average unemployment rates by region over the period 1984-92

	UNEMPLOYMENT%
South East	6.80
East Anglia	6.40
South West	7.50
West Midlands	10.10
East Midlands	8.00
Yorkshire & Humberside	9.90
North West*	11.10
North of England*	12.50
Wales*	10.50
Scotland*	11.00

* Mostly covered by Assisted Area Status during the period.

Table 2: Definitions of regions and industries.

REGIONS	INDUSTRIES	
	SIC code	Description
South East	22	Metal manufacturing
East Anglia	23	Extraction of minerals not elsewhere specified
South West	24	Manufacture of non-metallic mineral products
West Midlands	25	Chemical industry
East Midlands	26	Production of man-made Fibres
York and Humberside	31	Manufacture of metal goods not elsewhere specified
North West	32	Mechanical engineering
North East	33	Manufacture of office machinery & data processing equipment
Wales	34	Electrical & electronic engineering
Scotland	35	Manufacture of motor vehicles & parts
	36	Manufacture of other transport equipment
	37	Instrument engineering
	41	Food, drink and tobacco
	43	Textile industry
	45	Footwear and clothing industries
	46	Timber & wooden furniture industries
	47	Manufacture of paper & paper products; printing & publishing
	48	Processing of rubber & plastics
	49	Other manufacturing industries

Table 3: Summary statistics of sample means.

Earnings, capital and unemployment			*Average foreign and domestic wages per head and ratio by industry*				
Domestic skilled wage	£17198				Foreign	Domestic	Ratio
Domestic unskilled wage	£13095			sic22	£20,000	£20,300	0.98
Foreign skilled wage	£18761			sic23	-	£15,900-	-
Foreign unskilled wage	£17488			sic24	£17,900	£18,000	0.99
Capital	£1,261,219			sic25	£19,200	£19,000	1.01
Unemployment	10%			sic26	-	£16,300-	-
				sic31	£17,200	£16,100	1.07
Average foreign and domestic wages per head and ratio by region				sic32	£18,400	£18,400	1.00
	Foreign wage	Domestic wage	Ratio	sic33	£20,600	£18,200	1.13
South East	£19,800	£17,100	1.16	sic34	£15,800	£15,600	1.02
East Anglia	£17,200	£16,800	1.02	sic35	£22,600	£20,100	1.12
South West	£16,800	£16,800	1.00	sic36	£17,300	£18,600	0.93
West Midlands	£18,400	£16,400	1.12	sic37	£15,400	£15,500	0.93
East Midlands	£18,000	£15,500	1.16	sic41	£21,000	£15,200	1.38
York and Humberside	£17,800	£16,300	1.09	sic43	£14,300	£13,000	1.10
North West	£20,400	£16,800	1.21	sic45	£10,700	£10,300	1.04
North East	£19,200	£17,400	1.10	sic46	£13,500	£15,400	0.87
Wales	£18,100	£17,300	1.05	sic47	£20,700	£18,800	1.10
Scotland	£18,300	£16,700	1.10	sic48	£19,100	£17,100	1.12

Definitions of industry sic codes are given in Table 2. Average wage per head=total wage bill÷ FTE employment by industry (region)

Table 4: Spatial Fixed Effects Results for Domestic Wage Determination

	SPATIAL FIXED EFFECTS							
	UNSKILLED				SKILLED			
	Spatial lag estimator		Spatial error estimator		Spatial lag estimator		Spatial error estimator	
Capital	0.744	*(6.36)*	0.810	*(6.30)*	0.271	*(3.69)*	0.307	*(3.41)*
Unemployment	-0.254	*(2.20)*	-0.485	*(4.56)*	-0.220	*(2.12)*	-0.079	*(1.62)*
Skilled Wage	0.490	*(9.37)*	0.480	*(8.51)*				
Unskilled Wage					0.590	*(5.50)*	0.564	*(5.18)*
Foreign Wage	0.015	*(1.41)*	0.008	*(0.68)*	0.060	*(3.51)*	0.051	*(3.12)*
Contiguous Region Domestic Wage	0.048	*(2.79)*	0.041	*(2.50)*	0.047	*(1.87)*	0.050	*(2.03)*
Contiguous Region Foreign Wage	0.012	*(0.83)*	0.008	*(0.55)*	0.003	*(0.19)*	0.004	*(0.29)*
Contiguous Industry Domestic Wage	0.022	*(1.03)*	0.023	*(1.03)*	0.018	*(1.13)*	0.019	*(1.17)*
Contiguous Industry Foreign Wage	0.009	*(2.45)*	0.014	*(2.22)*	0.021	*(3.11)*	0.018	*(2.30)*
Observations	1,520							
Time Dummies	*yes*							
Log Likelihood	-2688.971 *p=[0.000]*		-2686.584 *p=[0.000]*		-2829.121 *p=[0.000]*		-2818.373 *p=[0.000]*	
Wald $\gamma_2 = 0: \chi^2(4)$	*p=[0.000]*		*p=[0.000]*		*p=[0.000]*		*p=[0.000]*	
ρ	0.230	*(0.82)*			-0.097	*(0.34)*		
Wald $\rho = 0: \chi^2(1)$	0.679 *p=[0.410]*				0.116 *p=[0.733]*			
λ			-0.708	*(2.30)*			-1.178	*(7.05)*
Wald $\lambda = 0: \chi^2(1)$			5.294 *p=[0.021]*				49.707 *p=[0.000]*	
Spatial Autocorrelation Moran's I	*p=[0.042]*				*p=[0.400]*			

Table 5: First difference estimates of Domestic Wage Determination

	DRISCOLL & KRAAY SPATIAL GMM				FD3SLS			
	UNSKILLED		SKILLED		UNSKILLED		SKILLED	
Capital*(t-1)*	0.167	*(4.96)*	0.075	*(5.14)*	0.312	*(10.50)*	0.101	*(2.82)*
Capital*(t-2)*	0.024	*(2.55)*	0.029	*(2.89)*	0.109	*(9.45)*	0.040	*(0.23)*
Unemployment*(t-1)*	-0.164	*(4.30)*	-0.118	*(2.52)*	-0.361	*(4.01)*	-0.152	*(2.77)*
Unemployment*(t-2)*	-0.022	*(2.84)*	-0.047	*(2.91)*	-0.058	*(2.09)*	-0.034	*(0.63)*
Skilled Wage*(t-1)*	0.112	*(9.84)*			0.401	*(2.17)*		
Skilled Wage*(t-2)*	0.128	*(1.21)*			0.105	*(1.63)*		
Unskilled Wage*(t-1)*			0.191	*(6.73)*			0.419	*(8.43)*
Unskilled Wage*(t-2)*			0.036	*(3.73)*			0.115	*(3.53)*
Foreign Wage*(t-1)*	0.066	*(2.42)*	0.248	*(4.08)*	0.170	*(5.51)*	0.179	*(5.09)*
Contiguous Region Domestic Wage(t-1)	0.021	*(2.40)*	0.111	*(2.45)*	0.082*	*(2.04)*	0.127*	*(2.78)*
Contiguous Region Foreign Wage(t-1)	0.059	*(0.36)*	0.099	*(0.29)*	0.067	*(1.67)*	0.088	*(0.11)*
Contiguous Industry Domestic Wage(t-1)	0.012	*(0.87)*	0.006	*(3.65)*	0.007	*(1.64)*	0.011	*(3.15)*
Contiguous Industry Foreign Wage(t-1)	0.002	*(1.57)*	0.001	*(3.19)*	0.003	*(1.21)*	0.003	*(4.33)*
Observations	1,330							
Time Dummies	*yes*							
Wald $\gamma_2 = 0$: $\chi^2(4)$	*p=[0.000]*		*p=[0.000]*		*p=[0.000]*		*p=[0.000]*	
Sargan p-value	*p=[0.378]*		*p=[0.259]*		*p=[0.303]*		*p=[0.498]*	
Further time lag in contiguous wages $\sim \chi^2(4)$	6.443 *p=[0.168]*		5.248 *p=[0.263]*		4.288 *p=[0.368]*		5.57 *p=[0.233]*	
Serial correlation AR(2) p-value	0.937 *p=[0.333]*		0.577 *p=[0.447]*		0.402 *p=[0.526]*		0.643 *p=[0.423]*	
Spatial Autocorrelation Moran's I ~ normal (p value)	0.790 *p=[0.430]*		1.233 *p=[0.218]*		1.578 *p=[0.114]*		1.243 *p=[0.214]*	
Spatial Autocorrelation $LM_{SEC} \sim \chi^2(1)$	1.974 *p=[0.160]*		1.687 *p=[0.194]*		1.031 *p=[0.309]*		1.587 *p=[0.208]*	
Fit – $\overline{R}^2$ (approximated by $Corr(y, \hat{y})^2$ for GMM)	0.797		0.864		0.754		0.687	

*This estimation allows the effects of spatial contiguity to differ across regions. As such, this is an average of the 10 coefficients. This model rejects the restriction of a uniform contiguity parameter using standard χ^2 tests. The individual coefficients and test statistics are given in Table 8.

Table 6: First difference estimates of Domestic Wage Determination in Assisted Areas

	DRISCOLL & KRAAY SPATIAL GMM				**FD3SLS**			
	UNSKILLED		SKILLED		UNSKILLED		SKILLED	
Capital*(t-1)*	0.167	*(3.05)*	0.089	*(3.81)*	0.238	*(9.56)*	0.156	*(1.94)*
Capital*(t-2)*	0.028	*(1.84)*	0.039	*(2.38)*	0.075	*(6.69)*	0.014	*(0.97)*
Skilled Wage*(t-1)*	0.378	*(4.36)*			-0.319	*(4.35)*		
Skilled Wage*(t-2)*	0.131	*(0.79)*			-0.160	*(2.73)*		
Unskilled Wage*(t-1)*			0.139	*(4.83)*			0.433	*(7.03)*
Unskilled Wage*(t-2)*			0.031	*(2.14)*			0.284	*(3.83)*
Foreign Wage*(t-1)*	0.015	*(2.19)*	0.163	*(4.82)*	0.235	*(3.79)*	0.290	*(4.25)*
Contiguous Region Domestic Wage(t-1)	0.004	*(0.26)*	0.143	*(2.08)*	0.053	*(1.15)*	0.154	*(1.79)*
Contiguous Region Foreign Wage(t-1)	0.002	*(0.17)*	0.124	*(1.23)*	0.003	*(0.81)*	0.131	*(1.71)*
Contiguous Industry Domestic Wage(t-1)	0.010	*(0.43)*	0.007	*(1.29)*	0.004	*(0.38)*	0.002	*(1.18)*
Contiguous Industry Foreign Wage(t-1)	-0.006	*(0.69)*	0.002	*(2.39)*	0.001	*(0.65)*	0.007	*(2.45)*
Observations	798							
Time Dummies	*yes*							
Wald $\gamma_2 = 0$: $\chi^2(4)$	*p=[0.745]*		*p=[0.000]*					
further time lag in contiguous wages ~$\chi^2(4)$	3.655 (0.455)		3.870 (0.424)		2.651 (0.618)		5.479 (0.242)	
Sargan p-value	*p=[0.457]*		*p=[0.199]*		*p=[0.359]*		*p=[0.540]*	
Serial correlation AR(2) p-value	0.858 *p=[0.354]*		0.815 *p=[0.367]*		0.670 *p=[0.413]*		2.191 *p=[0.139]*	
Spatial Autocorrelation Moran's I (p value)	0.806 *p=[*0.420*]*		1.06 *p=[*0.289*]*		1.365 *p=[*0.172*]*		1.299 *p=[*0.294*]*	
Spatial Autocorrelation LM_{SEC} ~ $\chi^2(1)$					0.943 *p=[*0.332*]*		0.991 *p=[*0.319*]*	
Fit – $\bar{R}^2$ (approximated by $\text{Corr}(y, \hat{y})^2$ for GMM)	0.788		0.792		0.657		0.507	

Table 7: First difference estimates of Domestic Wage Determination in Non-Assisted Areas

	DRISCOLL & KRAAY SPATIAL GMM				FD3SLS			
	UNSKILLED		SKILLED		UNSKILLED		SKILLED	
Capital*(t-1)*	0.175	*(4.90)*	0.075	*(4.05)*	0.171	*(4.06)*	0.126	*(2.75)*
Capital*(t-2)*	0.010	*(2.88)*	0.027	*(2.00)*	0.063	*(3.83)*	0.023	*(1.02)*
Skilled Wage*(t-1)*	0.311	*(3.62)*			-0.445	*(3.19)*		
Skilled Wage*(t-2)*	0.131	*(1.33)*			0.111	*(1.54)*		
Unskilled Wage*(t-1)*			0.197	*(4.63)*			0.420	*(6.93)*
Unskilled Wage*(t-2)*			0.054	*(2.41)*			0.032	*(0.45)*
Foreign Wage*(t-1)*	-0.389	*(3.72)*	0.274	*(3.13)*	0.085	*(3.54)*	0.168	*(5.13)*
Contiguous Region Domestic Wage(t-1)	0.042	*(3.36)*	0.168	*(1.51)*	0.103	*(2.58)*	0.115	*(2.75)*
Contiguous Region Foreign Wage(t-1)	0.051	*(2.40)*	0.147	*(1.64)*	0.036	*(2.13)*	0.114	*(1.53)*
Contiguous Industry Domestic Wage(t-1)	0.032	*(3.26)*	0.029	*(2.95)*	0.040	*(3.02)*	0.039	*(2.34)*
Contiguous Industry Foreign Wage(t-1)	0.004	*(3.20)*	0.006	*(3.79)*	0.061	*(2.82)*	0.029	*(3.00)*
Observations	532							
Time Dummies	*yes*							
Wald $\gamma_2 = 0$: $\chi^2(4)$	*p=[0.000]*		*p=[0.000]*					
further time lag in contiguous wages ~$\chi^2(4)$	3.655 (0.455)		4.654 (0.325)		5.687 (0.223)		5.215 (0.266)	
Sargan p-value	*p=[0.341]*		*p=[0.347]*		*p=[0.241]*		*p=[0.591]*	
Serial correlation AR(2) p-value	0.791 *p=[0.374]*		0.647 *p=[0.421]*		0.504 *p=[0.478]*		0.937 *p=[0.333]*	
Spatial Autocorrelation Moran's I	0.916 *p=[0.360]*		1.565 *p=[0.118]*		0.888 *p=[0.374]*		1.288 *p=[0.198]*	
Spatial Autocorrelation $LM_{SEC} \sim \chi^2(1)$	2.568 *p=[0.109]*		2.052 *p=[0.152]*		1.427 *p=[0.232]*		1.626 *p=[0.202]*	
Fit – $\bar{R}^2$ (approximated by $\mathrm{Corr}(y, \hat{y})^2$ for GMM)	0.877		0.868		0.764		0.711	

Table 8: Estimates of Region – Specific contiguity effects (impacts on the region from neighbouring regions)

	UNSKILLED			SKILLED		
	COEFFICIENT	T VALUE – different from zero	T VALUE – different from mean	COEFFICIENT	T VALUE – different from zero	T VALUE – different from mean
South East	0.0086	*(1.02)*	*(8.75)*	0.0245	*(0.84)*	*(3.51)*
East Anglia	0.1475	*(4.55)*	*(2.02)*	0.2227	*(4.87)*	*(2.09)*
South West	0.1235	*(2.87)*	*(0.96)*	0.1356	*(2.51)*	*(0.16)*
West Midlands	0.0952	*(2.14)*	*(0.29)*	0.1053	*(2.09)*	*(0.43)*
East Midlands	0.1244	*(4.98)*	*(1.69)*	0.2048	*(4.52)*	*(1.72)*
Yorkshire & Humberside	0.0577	*(1.07)*	*(0.45)*	0.1083	*(1.01)*	*(0.17)*
North West	0.0944	*(1.74)*	*(0.23)*	0.1156	*(1.98)*	*(0.20)*
North	0.0067	*(1.34)*	*(15.04)*	0.1013	*(1.26)*	*(0.32)*
Wales	0.1224	*(2.63)*	*(0.87)*	0.1563	*(2.18)*	*(0.41)*
Scotland	0.0396	*(1.47)*	*(1.58)*	0.0921	*(1.38)*	*(0.52)*
MEAN	*0.0820*			*0.1266*		
LR Test of uniform coefficients χ^2 (1)			5.02 *p=[0.025]*			6.54 *p=[0.011]*

ENDNOTES

[i] This is also indirectly related to the concept of the reservation wage, i.e. the wage at which the individual would cease to work or find another job.

[ii] In both cases approximately 40% of this differential is due to foreign firms being more highly concentrated in high-wage industries or regions, for details of the methodology used in this disaggregation, see Davies and Lyons (1991).

[iii] The labour force *LF* is defined as the unemployed *UE* plus the employed *E*, $LF=UE+E$, thus the unemployment rate is defined as $U=UE/LF$. The motivation for the inclusion of unemployment rate *U* in the skilled and unskilled wage equations follows Blanchflower and Oswald (1994). Their work suggests that a negative spatial relationship exists, within and across countries, between the level of pay and the local rate of unemployment. This differs from conventional wisdom which implies that there should be a positive relationship between wages and unemployment stemming from compensating-differentials arguments, see Harris and Todaro (1970). As such, although the direction of influence from the unemployment rate may be debatable, the literature implies a relationship exists between unemployment and wage determination.

[iv] Two alternatives for the contiguity matrix are generally offered by the literature, the "rook" specification, where any contiguous region would enter with a "1" in the matrix, and the standard reduced form, where this is normalised such that all columns sum to 1. In practice, the choice of specification makes little difference here, so following convention the standard reduced form is employed.

[v] In practice in the estimation of equation (3) in levels an industry fixed effect is included.

[vi] Notice that in the linear context we are working with, the 3SLS estimator can be derived as a GMM estimator from the orthogonality conditions implied by the set of instrument (see Theorem 5 in Cornwell *et al.*, 1992).

[vii] 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.

[viii] See for example Morgan (1997) for a full discussion of this.

[ix] Assisted Areas are those areas of Great Britain where regional aid may be granted under European Community law. Regional Selective Assistance (RSA) is the main form of such aid in Great Britain. It is a discretionary grant, awarded to secure employment opportunities and increase regional competitiveness and prosperity.

[x] The average wage bill was calculated as: Total wage bill divided by employment, by industry and region.

[xi] 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 variables candidates.

[xii] As the models are estimated in logs, this test employs the "lognormal" errors, see Anselin and Moreno (2003).

[xiii] Interestingly, the importance of contiguity is greatest for skilled workers in non-assisted areas, and smallest for unskilled workers in assisted areas with the highest levels of unemployment.

[xiv] Note that levels fixed effects estimates for the assisted / non-assisted area split are omitted for brevity, but are consistent with those presented and available upon request from the authors.