Assessing the Regional Impact of Grants on FDI Location: Evidence from UK Regional Policy, 1985-05

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Abstract

The paper implements a methodology for assessing the regional impact of investment grants on FDI location in which both the policy and outcome are measured at the regional level. It takes data for UK regional policy over the period 1985-05, and using a systems Generalised Methods of Moments (GMM) estimator it finds that around £25m in grant changes the regional location of about 6 inward FDI projects per annum (1995 prices). Applying this marginal effect to the policy as a whole it calculates an aggregate impact of 75 projects a year. This effect is highly significant, but small in relation to the scale of UK inward investment, perhaps explaining the weak effect found for regional grants in recent plant-based location studies.

JEL classification: O12, L20, R58.

Keywords: Foreign direct investment; location; grants; regional policy; agglomeration.

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1. Introduction

Foreign direct investment (FDI) reached $1,500bn in the year 2000 from just $13bn in 1970 (United Nations, 2004), making it an important target for regional policymakers throughout the industrialised world. Indeed, countries such as UK and France devote half their regional grant budgets to assist FDI (Wren, 2005; Crozet *et al*, 2004), and the sums involved are substantial, amounting to more than £2 billion ($4bn) in the UK alone since 1985 (2005 prices). However, the recent evidence on the regional grants suggests their location effect is weak. Crozet *et al* (2004) find little or no effect for the regional grants on FDI location in France, while for new plants across UK counties Devereux *et al* (2007) find that a £100,000 increase in regional grant raises the probability of location by just 1%, i.e. from 1% to 1.01%. This contrasts with earlier evidence for Japanese FDI, which finds that fiscal instruments significantly affect the location of these plants in both the US and UK (Head *et al*, 1999; Taylor, 1993).[1]

The mixed results for grants is surprising, as the evidence for the effect of taxation on FDI location across US states is much stronger (Head *et al*, 1999; Hines, 1996; Coughlin *et al* 1991).[2] Further, the *prima facie* evidence for the effect of the grants on FDI location across the British regions is compelling. Prior to regional policy, two-thirds of the UK manufacturing employment in foreign ownership was located in southern England over 1945-65 (Dicken and Lloyd, 1976), but with the incidence of the grants 90 per cent of all new foreign-owned plants

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[1] Head *et al* (1999) find that Japanese investment across US states is deterred by high corporate and unitary taxes and conversely for factor subsidies, although capital is insignificant. Taylor (1993) finds Japanese location across UK counties is strongly influenced by the designation of areas for regional policy grants.
[2] Corporate taxes affect US FDI location across European countries in Devereux and Griffiths (1998), although earlier US studies, such as Glickman and Woodward (1989) and Wheeler and Mody (1992), fail to find an effect for taxation on FDI location.

were locating in the Assisted Areas by 1990, and outside of the south (Jones and Wren, 2009).

A similar change in location is evident for UK-owned plants (Ashcroft and Taylor, 1977) and

for FDI in the West Midlands region after it was first designated for grants in 1984.[3]

In general, location is measured at the plant level, but research in this area is bedevilled

by data problems, such that the grant term is measured in one of several ways. One approach is

to match the grant data directly to plants, but with difficulties, e.g. Devereux *et al* (2007) match

316 of the 2,135 grant offers in their dataset to the new plants, but giving just 17 observations

on assisted foreign-owned plants.[4] The other approach is to measure the treatment spatially in

terms of either the designation of regions for different subsidy rates, possibly zero (Criscuolo *et*

al, 2007; Head *et al*, 1999; Taylor, 1993), or the amount of grant disbursed (Crozet *et al*, 2004;

Wren and Taylor, 1999). These are indirect methods of associating grants with plants and they

pose a dilemma. While smaller areas reduce heterogeneity and are desirable (see Guimaraes *et*

al, 2003), the lack of grant data at this level limits the analysis, such that virtually all the above

studies are for relatively short time horizons and cover periods no later than 1995.[5]

The purpose of this paper is to apply a methodology for determining the aggregate-level

impact of regional grants on FDI location that measures both the grant and policy effect at the

regional level. This is for the Government Office regions of Great Britain over 1985-05, which

is the geographical unit at which regional development is pursued, and for which grant data are

available over a long time period. It covers the sharp increase in FDI (Jones and Wren, 2006),

and it is the first assessment of this important aspect of policy over such a time horizon. While

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[3] Ashcroft and Taylor (1977) find that regional policy caused 500 UK plants to relocate over the 1960s. Hill and Munday (1992) chart the steady shift of FDI to the peripheral regions.
[4] Matching was made on the postcode and four-digit industry. It is for new plants, although not all grant offers relate to these. Matching was possible for 53% of grant cases in Devereux *et al* (2003, Table A1). There are 1,376 foreign-owned plants in Devereux *et al* (2007, Table 4), of which 36% are in Assisted Areas, for which 3.5% were matched, giving 17 observations.
[5] Crozet *et al* cover the years 1985-87, 1991 and 1994 for French regional grants (1989-91 for EU grants), Devereux *et al* the period 1986-92, Taylor 1984-91, and Wren and Taylor 1971-94. Head *et al* have data for 1980-92, but for large US states. Cruscuolo *et al* conduct a matching exercise for 1985-2004, with the grant either in binary form (assisted or non-assisted) or as the maximum grant rate ceiling when measured on a spatial basis.

the grants are virtually unchanged, the Assisted Areas in which the grants are available have been revised, and this is controlled for. A dynamic spatial panel data model is regressed using a Generalized Method of Moments estimator, and this makes it possible to instrument for the endogeneity of the grant term, but which is frequently overlooked in evaluative work.

The paper finds that the regional investment grants have had a significant effect on FDI location across British regions. At the mean an extra £23.6m of grant increases a region's FDI share by one percentage point (1995 prices). This is invariant to the changes in Assisted Areas, but it represents just 5.6 projects. However, the mean employment size of 150 jobs, which puts it in the ballpark of other job creation estimates, offering support for the methodology. All the same, the grant effect is small in relation to the scale of inward FDI and two factors appear to have weakened its impact. It has not kept pace with the UK increase in FDI, and the revisions to the Assisted Areas have weakened the bias in favour of the north

The next section gives a brief account of regional policy, including information on the grants and on the regional distribution of FDI. Section 3 sets out the model, focusing on issues relevant to the measurement of the grant effect. Section 4 describes the data and variables. The regression analysis is carried out in Section 5 and conclusions are drawn in Section 6.

2. Regional Policy and FDU Location

To promote regional development the Government has designated certain geographical parts of Great Britain for industrial grant support for the past fifty years or so.[6] Inward FDI has formed an important component of this policy, taking about half the regional aid budget since the mid-1980s. The principal instrument is the Regional Selective Assistance scheme, a discretionary

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[6] Direct financial assistance to industry is presumed prejudicial to competition by the EU, but exemptions allow grants in defined areas for the purpose of economic development, where the standard of living is abnormally low or there is serious underemployment (Article 87.3.a) or it facilitates certain activities without adversely affecting trade conditions (Article 87.3.c).

grant that seeks to "encourage sound projects which will improve employment opportunities in the Assisted Areas" (House of Commons, 1985).[7] It was introduced in 1972 and little changed since 1984.[8] It has criteria relating to project viability; 'proof of need'; benefit to the regional and national economy; and a job link. Under the European Union (EU) state aid rules, projects must involve fixed capital investment (plant, machinery or buildings), such that 90 per cent of the grant has gone to manufacturing, although non-local services are eligible (NAO, 2003).

The grants are available in Assisted Areas, which immediately prior to 1980 covered the whole landmass of Scotland, Wales and northern England, but which since then are drawn more tightly around the disadvantaged areas. They include most of the populated parts of these regions, where FDI tends to locate, and at 1992 the coverage was in the range 66-75% for each of the populations of Scotland, Wales and northern England (AEP, 2000). The coverage of the Assisted Areas for Great Britain as a whole has remained remarkably constant over time, at about 35% of the working population, although falling to 31% in 2000.[9] There are two tiers of Assisted Area since 1985, with higher grant rate ceilings in the higher tier.[10] Further, there have been two main revisions to policy, but mainly affecting the Assisted Areas.[11]

The first revision to the Assisted Areas map occurred in August 1993, when small areas in southern England became eligible for grants for the first time. It involved some weakening of policy in the traditionally assisted regions, both in the coverage and the designation of the higher tier of Assisted Area. However, the grant ceilings were unchanged, at 20% in the lower tier and 30% in the higher tier of Assisted Area. The other change was in January 2000, when

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[7] The grant is discussed in Criscuolo *et al* (2007), Devereux *et al* (2007) and Wren (2005).

[8] In 2000 smaller grants in England (up to £75,000) were made available outside the Assisted Areas. In 2004 they were replaced by the Selective Finance for Investment in England scheme, which is similar to RSA. In Scotland and Wales, RSA remained in place throughout.

[9] As a cost-cutting measure the coverage fell from 40% to 28% in 1982, but as an emergency measure increased to 35% in 1984 with the inclusion of the West Midlands region.

[10] These are Development and Intermediate Areas, but Tier 1 and Tier 2 areas since 2000.

[11] The maps can be found in the *Annual Reports on the 1982 Industrial Development Act*. Prior to 1993 travel-to-work areas (TTWAs) were used to construct the Assisted Areas, which are similar in scale to US Metropolitan Statistical Areas and the criterion was economic activity. In 1993 parts of TTWAs were given split designation, while in 2000 the lower tier was based on smaller electoral wards grouped into contiguous units with at least 100,000 population, for which the criteria related to labour market performance and the manufacturing base.

the areas were scaled back nationally and the higher tier was restricted to just four geographical areas (Merseyside, South Yorkshire, Cornwall and the Isles of Scilly, and West Wales and the Valleys). These are EU-determined, but responsibility for the lower tier was with the UK. For large firms the grant ceilings were more or less unchanged, at 35% and 20%, although a range of ceilings were in operation. Some changes were also made to the grant (see above).

The grant budget is set centrally for Great Britain as a whole, but the regions are able to exercise discretion within this framework, and there may be an element of regional competition for FDI and the bidding-up of grants. In England, grant applications are dealt with by regional Industrial Development Boards (IDBs), staffed mainly by local industrialists, with large grants (above £2m in 2000) handled by a central Industrial Development Advisory Board (IDAB) in London, and all cases above £250,000 approved centrally.[12] The firms may apply for a grant in a single region only, but occasionally central Government has to arbitrate between regions. In Scotland and Wales, all applications are assessed by the respective IDABs for each country. A *Memorandum of Understanding* was prepared for these countries to prevent the competitive bidding for projects with England, but it was unsigned. Regional agencies in England may also promote the availability of grants in their region to differing extents.

2.1   The Regional Distribution of Grants and FDI

Descriptive statistics for the ten regions of Great Britain are given in Table 1. Over the period 1985-05 about 80% of the grant has gone to plants located in Scotland, Wales and northern England (North East and North West), which is 84% for foreign-owned plants. However, these four regions have done less well in the share of FDI, combined receiving a total of just 40% of all projects and 50% of manufacturing FDI. The agglomeration of FDI in the South East helps

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[12] IDBs advise the UK Government Regional Offices, but since 2002 they report to Regional Development Agencies that now administer the grants, suggesting greater discretion.

account for this, which has received 28% and 13% of FDI shares respectively. Service FDI has increased over time, and in the number of projects exceeding that of manufacturing by 1995.

A distinction is made between Assisted Area (AA) regions and other areas, where in the former case the West Midlands and Yorkshire and Humberside are included with the above four regions. The first of these has received substantial assistance after designation for grants in 1984, while the latter is relatively disadvantaged, receiving support in respect of industrial decline.[13] As Table 1 shows this provides a reasonably sharp distinction between regions. The temporal pattern of FDI going to the AA regions is shown in Figure 1, both for all projects and manufacturing (grants have mainly gone to the latter). It reveals the sharp decline in the share of projects going to the AA regions over time, from 90% in the early 1990s to 40% in 2005, but which is less pronounced for manufacturing, from 90% to 50%. Figure 1 shows that the grant to FDI has fallen in real terms since the mid-1990s, although it is only since 2003 that it has fallen below the level of the late 1980s, following the change to the policy areas in 2000. However, the reduction in the FDI share preceded the decline in the grant, which provides only limited support for a causal relationship between the grants and FDI.

2.2   *Exploratory Spatial Data Analysis*

As a preliminary exercise it is useful to investigate for spatial autocorrelation in the distribution of FDI across regions. This is based on Moran's *I* (Moran, 1950), which is a measure of the coincidence between value similarity and locational similarity (Anselin, 2001). It has the form of an autocorrelation coefficient (Cliff and Ord, 1973), where relatedness is pre-defined by a spatial weights matrix, *W*, which gives the connectivity between regions, i.e. whether FDI in a region is associated with more or less FDI in 'related' regions, which are respectively positive

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[13] Of the non-AA regions, parts of the South East, London and East regions were designated for the first time in 1993, the East Midlands in 1979, while relatively small populated parts of the South West region have been designated since 1966.

and negative spatial autocorrelation. Three weighting regimes are considered for the elements w_{rs} of W, giving alternative views of 'relatedness'. These are as follows:

(a) *Contiguity*: $w_{rs} = 1$ if r and s share a common land boundary, but zero otherwise.

(b) *Distance*: $w_{rs} = d$, where d is the inverse distance between the major economic centres of r and s, which is row standardised.

(c) *Status*: $w_{rs} = 1$ if r and s have the same Assisted Area status, but zero otherwise.

The first of these is an extreme view of geographical 'connectivity', as it assumes only regions that border one another (i.e. 'first-order' contiguity) are related in their attractiveness to FDI. The second is often used in empirical work in some form, e.g. Patacchini and Rice (2007), and it is measured as the physical road distance between the regional economic centres. This seems reasonable as entry is skewed towards the cities (Devereux *et al*, 2007).[14] Unlike the first two, the third is independent of topology and treats the UK landmass as two unconnected islands. These are the six Assisted Area regions and four non-AA regions in Table 1.

The plot of the Moran's *I* statistics for FDI for each year 1985-05 is given in Figure 2. It is for the total number of projects locating in each region in each year. Since larger regions are expected to receive more FDI by virtue of their size, each region is weighted by its share of national employment. The Moran's *I* lies in the range [-1, +1], and is normally distributed, but only asymptotically as the number of regions increases (Cliff and Ord, 1973). In our case, R is small, which means it is not possible to use standard tests.[15] Nevertheless, visual inspection of Figure 2 indicates positive spatial autocorrelation is apparent for the AA status regime *(c)* only, while the index is either negative or broadly zero for the other two regimes. However, even for regime *(c)* the index goes to zero around the year 2000, suggesting that AA status ceased to be important after this time. The exercise was repeated for manufacturing FDI and for the job size

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[14] The economic centres are given in Jones and Wren (2008).
[15] Cliff and Ord (1973) suggest a minimum value for R of 50.

of projects, but similar results were obtained (see Jones and Wren, 2008). Overall, it provides

stronger evidence for a causal relationship between the grants and FDI location.

3. The Model and Methodological Issues

Plant-level location models commence with an index of area attractiveness V_{irt}, such that a firm

i locates in region r ($r = 1, 2, \ldots, R$) at time t if $V_{irt} > V_{ist}$, $\forall\ s \neq r$ and $s \in \{1, 2, \ldots, R\}$. It is

assumed the error term associated with V_{irt} has an Extreme Value Type I distribution, leading

to the conditional logit model proposed by McFadden, of which there are plenty of applications

to FDI location (e.g. Alegria, 2009; Dimitropoulou *et al*, 2006; Guimaraes *et al*, 2004).

Here, it is supposed regional attractiveness takes the form, $V_{irt} = \pi_{rt} + \alpha_{ir}$, where π_{rt} is

the expected profits to be earnt in r at time t and $\alpha_{ir} \equiv \alpha_i + \alpha_r + \alpha_t + \alpha$, comprising firm-

specific (management preferences, productivity, etc); region-specific (e.g. perception of quality

of life, culture, climate and so on); national-specific (common to all regions); and time-specific

effects that influence attractiveness, independent of other effects. Each firm is assumed to be

foreign owned and to have a single project, about which location decisions are independent.

The outcome of these decisions is measured at the regional level, for which it is supposed that

the firm-specific effects -α_i are distributed cumulatively across firms according to the logistic

function. This closely approximates the normal distribution, although it has higher kurtosis.

Let n_{rt} denote the share of region r in the total number of projects at time t and $l(n_{rt}) =$

$\ln (n_{rt} / 1 - n_{rt})$, where l is the logit function and $\Sigma_{r \in R}\ n_{rt} = 1$, then the Appendix shows:

$$l(n_{rt}) \;=\; \pi_{rt} + \alpha + \alpha_t + \alpha_r. \tag{1}$$

The grant affects profits, so that (1) is the basic relationship between policy and the FDI share.

The estimating equation is now derived, and issues surrounding the grant term are discussed. It

begins with spatial linkage effects, which are either intra-regional or inter-regional.

3.1   Spatial Linkage Effects

Intra-regional effects in the form of agglomeration economies have featured prominently in the

recent FDI location work (Jones and Wren, 2006, offer a survey), and may render the classical

location factors insignificant, including grants (Devereux *et al*, 2003; Kim *et al*, 2003; Head *et al*, 1995). These economies arise from proximity to other firms, such as knowledge spillovers,

and are classified either as intra-industry Marshall-Arrow-Romer (MAR) externalities, which

may stem from localisation economies, or Jacobs economies that are external to the firm and

industry, arising from diversity.[16] Econometric work tends to support the MAR externalities

over the Jacobs form (Devereux *et al*, 2007; Henderson, 2003; Rosenthal and Strange, 2003),

which suggests that an important determinant of the regional FDI share is its own lagged value,

$l(n_{rt-1})$. To capture the Jacobs economy a measure of industrial diversity is included, $sd(n_{rt-1})$,

and like the MAR term this is based on previous levels of FDI.

Given this, (1) is specified as an autoregressive-distributed lag model. It is reasonable

as Crozet *et al* (2004) and Head *et al* (1995) both find that recent FDI has a greater influence

on FDI than do domestically-owned plants. A literature on regional agglomeration economies

dates back to Isard (Parr, 2002), while casual empiricism reveals that FDI tends to agglomerate

in the UK regions (see Brand *et al*, 2000). With the inclusion of the above terms the estimating

equation can be written as follows, where α and β are the parameters to be estimated and υ_{rt} is

a serially uncorrelated random error term with the usual classical properties:

$$l(n_{rt}) = \alpha + \beta_1 \, l(n_{rt-1}) + \beta_2 \, sd(n_{rt-1}) + \beta_3 \, l(n_{st}) + \beta_4 \, \pi_{rt-1} + \alpha_t + \alpha_r + \upsilon_{rt}. \qquad (2)$$

The other kind of spatial linkage effect is inter-regional, although as we have seen the regions

do not appear to be linked geographically in their FDI shares, either by contiguity or distance.

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[16] In addition there are urbanisation economies (see Duranton and Puga, 2004).

Positive spatial autocorrelation exists for the policy status, which is captured by the grant, but in addition there may be grant competition between regions for FDI, such that region r has a lower FDI share if other regions s $(s \neq r)$ are more successful in attracting FDI. To pick-up this grant competition effect, the spatial lag term, $l(n_{st})$, is included in (2), where $\beta_3 < 0$.

3.2   The Grant Term

Interest is in the grant term, which is embedded in the profits term, π_{rt-1} in (2). Profits can be written as a function of the expected operating revenue and costs, R and C, and investment cost I. Letting g $(0 \leq g < 1)$ denote the project grant rate (dropping subscripts), this is:

$$\pi = R - C - (1 - g) I. \tag{3}$$

We include terms to control for R and C, as well as for the forward-looking nature of these. Since the role of the grant is to encourage location, it is reasonable that the investment scale is constant across regions. The UK has no regionally differentiated tax incentives, but investment costs will be lower from other non-financial Government support, so that a term is included for this. The other term in (3) is the grant amount, $g\ I$, which is positively related to firm profits. It is also measured at the regional level, and there are a number of issues concerning this.

First, regional grants are discretionary, so that g is variable rather than fixed. In general, higher grant rates are associated with more investments and more grant, but a smaller share of FDI projects *relative* to the grant amount, which suggests smaller regression coefficients. To see this, consider investments of fixed scale I locating in regions, H and L. Suppose a higher grant rate is offered in H, generating a larger number of projects n, so that $g_H > g_L$ and $n_H > n_L$. Then, H has a larger share of investments $n_H / (n_L + n_H) > n_L / (n_L + n_H)$, and offers more grant $g_H\ n_H\ I > g_L\ n_L\ I$, but the ratio of these is smaller in H since $1 / g_H < 1 / g_L$. The data are not

available on the grant rates offered to firms or by region, but we have information on the share of grant going to FDI (the first two columns of Table 1). For a given level of investment and grant amount, regions offering higher grant rates will on average exhaust a greater proportion of their grant budget on FDI and this is used as a proxy for the regional grant rate.

As a second point, the boundaries of the Assisted Areas in which the grants are offered do not perfectly match the regional boundaries, although this is to be expected as the regions are administrative areas rather than policy areas. This is no different to other studies that seek to estimate the effect of national policies on a spatial basis (e.g. Taylor, 1993), but unless there is finely spatially disaggregated grant data it is inevitable given the changes to the policy areas. The purpose of the paper is to measure whether more grant in a region leads to more FDI in the region, so that, on the one hand, it is not problematic, as the grants are discretionary and a firm may be non-assisted regardless of whether it locates in a policy area or not, while even for the firms that are assisted the grant may have no effect on their location. However, on the other hand, if a firm is assisted and it changes location within the region then this effect is potentially unmeasured. Thus, rather than a full evaluation of UK regional policy the aim of the paper is to assess whether the grants have an effect on the distribution of FDI across British regions.

Nevertheless, related to this last point, the regions are designated for grants to differing extents (but always less than 100% of the land area), which may influence the location decision both between and within regions. This is because in return for a grant a firm may be willing to select an alternative location, but only within a limited distance of its preferred location (Potter and Moore, 2000), which suggests that FDI will increase with the coverage of Assisted Areas. In particular, letting p ($0 < p < 1$) denote the firm's expectation of a grant in a region, then its expected profits π^e are $p\,\pi^G + (1 - p)\,\pi^{NG}$ for the grant and no-grant positions ($g \neq 0$ and $g = 0$), and substituting π using (3) gives $\pi^e = R - C - (1 - p\,g)\,I$. This is increasing in p, so that the greater is the coverage of the policy areas the greater is FDI, and a term is included for this. Of

course, the inter-regional effect due to grants should be picked-up by the grant term, so that the area term may capture intra-regional effects, although possibly other effects as well.[17]

Third, there are two tiers of Assisted Area with different grant rate ceilings under which the awarding bodies may exercise discretion. The differences in the grant ceilings are relatively modest (30% against 20%), whereas there are substantial differences in the average grant rates between regions even for the same tier of Assisted Area.[18] PACEC (1993) attribute this to the differences in the grant per job between projects, although foreign-owned plants receive higher awards on average, and it may reflect differences in the distribution of FDI between regions.[19] The above grant rate term should capture this effect, but in addition we include a term for the coverage of the higher tier of Assisted Area, and this also has an expected positive sign.

Finally, the measurement of the inter-regional FDI location effect hinges on the correct identification of the counter-factual position, and the dynamic specification of (2) gives certain advantages in this respect. If the grant amount is small, then conditional on other terms, $l(n_{rt})$ - $l(n_{rt-1})$ should also be small, which is irrespective of whether the region receives a high or low share of FDI or if the grant is disbursed in a small or large part of the region (and conversely). Of course, the lagged dependent variable is correlated with the regional fixed effect in (2), and this is dealt with by estimating it with a Generalized Method of Moments (GMM) estimator. It involves first-differencing the panel data to obtain valid moment conditions, which means that the regressors must be measured by time and by region. GMM is advantageous as it is possible to instrument for the endogeneity of the grant. This, along with the various controls and terms mentioned above, should ensure the regional counter-factual is correctly identified.

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[17] It may pick-up inter-regional effects that are unrelated to grant expenditure, possibly because increased coverage of the policy areas affects the prospect of a future grant. It may also be the case that firms attracted to the Assisted Areas in the past have a greater propensity to re-invest, although this appears not to be the case for all plants (Wren and Jones, 2009a).

[18] In Tier 1 Assisted Areas in 2004/05, the ratio of offered grant to associated project costs was 18% for Great Britain, but 32% for Wales and 10% for England (*Annual Reports on the 1982 Industrial Development Act*). These data are not separately available for English regions.

[19] FDI received half the total regional grant over 1985-2000 but accounting for 10% of projects (Wren, 2005), increasing to 20% since 2000, possibly reflecting smaller project scales.

4. The Data and Variables

The FDI data were supplied by the main inward investment agency, UK Trade and Investment (UKTI), and give information on all known investments carried out by foreign-plants in Great Britain for each year over the period 1985-05. They are on a project basis and include start-up, acquisition, joint ventures and re-investments, where the latter involve a substantial upgrading of a plant, e.g. a new production line. They are used by the Government to report FDI for the UK as a whole. These kinds of data are now increasingly used in studies of FDI in the UK and elsewhere (see Alegria, 2009; Dimitropoulou *et al*, 2006).[20] Similar data are also exploited by Wren and Jones (2009a), where further discussion can be found.

The data were checked and cleaned, and give information on 11,488 FDI projects. This includes the 4-digit industrial activity and gross number of project jobs, although for the most part the data are aggregated to the regional level. These are the Government Office regions for Great Britain.[21] To gain confidence, the regional share of projects are compared with that for foreign-owned production units in the census, the *Annual Business Inquiry*, and an identical regional distribution could not be rejected, even at the 10 per cent level.[22] Changes were made to the regional boundaries in 1996 when the UK moved from Standard Regions to Government Office Regions, but mainly affecting the South East and East regions and making no qualitative

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[20] The data are based on information notified to UKTI by the regional agencies, grant bodies and from its own involvement with investors. It has advantages over the census data in the *Annual Business Inquiry*, which samples as little as 1 in 5 plants with less than 100 employees (Griffith, 1999), but most FDI start-ups fall within this size band. An alternative source is the regional summary tables in the PA1002 *Business Monitor*, but these are in net terms for 1971-97 and manufacturing only. At the European level, researchers use the *European Investment Monitor*, which is constructed on a similar basis. Detailed checking of the data for a single UKTI region indicates that virtually all of the projects go ahead (Jones and Wren, 2004).

[21] The regions are equivalent to the *Eurostat* NUTS 1 geographical classification of regions.

[22] Based on UKTI data for 1996-05 and the *Annual Business Inquiry* for the end of the period a Chi-square statistic for goodness-of-fit is 12.9, against critical values of 15.5 and 13.4 at the 5% and 10% levels. Details can be found in Jones and Wren (2008).

difference to the results.[23] Further, many of the control variables are expressed as either rates or ratios and the boundary changes make no practical difference to these.

4.1 The Structural Variables

The UKTI data are used to calculate the dependent variable, $l(n_{rt})$, and its lagged value in (2). The regressions are aggregated across industries, as space limitations means that estimation by industry is outside the paper's scope. As such, the lagged term is likely to be a weak test of the intra-industry MAR economies, but it indicates the extent to which FDI depends on past levels. The Jacobs term, $sd(n_{rt-1})$, is measured as the standard deviation of the number of jobs across two-digit industries, while for the spatial lag term, $l(n_{st})$, we use regime *(c)* on the policy status as the row-standardised spatial weights matrix. This supposes grant competition is between the Assisted Area regions and between the non-AA regions in Table 1. This makes sense as Figure 2 suggests an absence of spatial autocorrelation by either contiguity or distance.

4.2 The Grant Term

The grant (*GRANT*) is measured as the total amount of grant offered to foreign-owned plants, comprising the Regional Selective Assistance and Selective Finance for Investment in England schemes (from 2004). Grant offers are relevant to the location decision, as payments may be lagged and staged over several years. Data on the offers are published on a consistent basis by region in the *Annual Reports on the 1982 Industrial Development Act*, with gives a breakdown by domestic and foreign-owned firms. The grant is measured in £'millions at 1995 prices using a GDP deflator, and the date refers to the year in which the firm accepts the offer.

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[23] Prior to this time the North East region included Cumbria (now in the North West), which is a rural county and attracted relatively little FDI, and South East region included the counties of Bedfordshire, Hertfordshire and Essex, which are now in the East region. For these regions the FDI data were rescaled over 1985-95 according to the mean over 1996-98.

According to the discussion of Section 3.2 several other terms are included to pick-up specific effects. The first is for differences in the grant rate between regions, which is captured by the share of total grant in each region going to FDI (*GTRATE*). It has an expected negative sign. The second is for other non-financial support received by firms to secure location, which lowers the investment cost. We do not have data on all other forms of support, but we know if UKTI was involved with an investment project (*SUPPORT*), which is indicative of this other assistance.[24] In total, UKTI was involved with 20% of projects over 1985-05.

Third, it is difficult to obtain quantitative and historical data on the areal coverage of the Assisted Areas by region, but in any case these areas may contain large rural tracts of land. The total claimant unemployed count is available for these areas and this is used to measure the proportion of each region covered by the Assisted Areas (*AREA*). This is for 1985 and for the years when a new map came into force. The use of unemployment is useful as it measures the economic coverage of the Assisted Areas in each region. The unemployment data are available for the higher tier of Assisted Area for which a similar term is constructed (*TIER*).

4.3   Control Variables

The other terms are for the revenue and costs, *R* and *C*, in (3), which form control variables for the analysis. It is not possible to list all such variables (Head *et al*, 1995), and the strategy is to include four or so terms to capture each component, taking comfort from the fact that there are significant terms for each of these. Since investment is forward-looking we also include terms for regional prospects. These variables are not our main concern, but in choosing them we are guided by the plant location literature. The variables are measured by both region and year, and further details can be found in the Data Appendix. Briefly, they are as follows.

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[24] Formally, an involvement occurs if two of the following are satisfied: an arrangement of regional tour; a location search; provision of substantial information; or the preparation of a tailor-made presentation. The agency applies rigid criteria in determining these.

Revenue: This includes market size (Barrell and Pain, 1999; Billington, 1999; Wei *et al*, 1999), which is measured by the population size (*POP*) and by income (*INCOME*). The other terms are suggested by theory.[25] They include a variable for the distance to the other regional economic centres, weighted by the respective market size (*DISTANCE*). The new economic geography finds transport costs are important to regional development, and proxies are based on distance (Combes and Lafourcade, 2005). A term for knowledge is also included as an input to production (*KNOWLEDGE*), which is suggested by the new growth theory.

Cost: These classical location factors include labour costs (*WAGE*) and the availability of skilled (*SKILL*) and unskilled (*UNSKILL*) labour. Barrell and Pain (1999), Coughlin *et al* (1991) and Wei *et al* (1999) all find that unit labour costs negatively affect FDI location, while Billington (1999) and Friedman *et al* (1992) find that unemployment has a positive effect. The correlation coefficient between *UNSKILL* and the grant term is weak ($\rho = 0.26$). To these we add the road expenditure per kilometre squared (*ROAD*), reflecting the ease of movement. Low values of this suggest rurality, but high values congestion, so it is included as a quadratic.

Prospects: These terms are the regional growth rate (*GROWTH*), and three measures of risk, comprising the unemployment rate squared (*DEPRESSED*), the days lost from industrial action (*STRIKE*) and expenditure under EU regional funds (*EUFUND*). Taylor (1993) finds that unemployment has a negative effect on location if it is too high, signalling that an area is depressed, so the quadratic term is included for this. Labour disputes play a similar role, while for EU regional policy no control is made for selection, so that this term simply picks-up the depressed areas that are unattractive to FDI and a negative coefficient is expected.

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[25] Alternatives to these were considered, i.e. distance to the core market of South East England and the share of the top 30 Universities by region (based on the 2001 UK Research Assessment Exercise), but these are time invariant and they drop out of the GMM estimation.

5. Regression Results

Substituting for π_{rt-1} using (3), equation (2) is estimated as a panel using annual data for British regions over 1985-05. It has the form of a 'time-space simultaneous model' (Anselin, 2001), more generally known as a dynamic spatial model. Elhorst (2003) notes that methods exist for dynamic non-spatial panel models and spatial non-dynamic panel models, but combining these can give biased and inconsistent estimates due to the contemporaneous nature of the spatial lag term. Kukenova and Monteiro (2008) use Monte-Carlo methods to compare dynamic panel methods in the presence of a spatial lag and an endogenous term, but they find that the systems Generalised Methods of Moments (GMM) estimator of Blundell and Bond (1998) is preferred. The difference GMM estimator first-differences the data, but the systems GMM augments this by estimating it simultaneously with the model in levels (see Bond, 2002).

The GMM estimator tends to be applied to short-wide panels, but for a long time-series Roodman (2007) finds that the instruments may over-fit the endogenous variables, even if they are small in number.[26] This means that parsimony is required both in the terms that are treated as endogenous and in the use of lags. For a similar number of time periods as here, Judson and Owen (1999) find that this procedure does not materially affect the performance of GMM. As such, the grant terms, *GRANT* and *GTRATE*, are treated as endogenous and instrumented using a single lagged value.[27] The policy area terms, *AREA* and *TIER*, depend on past events and are exogenous, while treating *SUPPORT* as exogenous does not materially affect the estimates.[28] We separately report the results in which the spatial lag term is also instrumented.

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[26] Over-fitting the endogenous variables can bias the coefficient estimates towards those of a non-instrumented estimator, even though the Hansen-Sargan test is satisfied.

[27] Two lags generate similar estimates on *GRANT* and the standard errors are smaller, but the number of instruments exceeds 200. Lags of three periods over-fit the endogenous variables, and the difference GMM estimator simply reproduces the OLS results.

[28] Treating *SUPPORT* as endogenous and instrumenting it in the same way as the grant terms the estimate on *GRANT* is 4.574 (z-value of 2.98), which can be compared with that for column (3) of Table 2. Likewise, treating *EUFUND* as endogenous makes no difference to the results.

5.1 Main Results

The regression results are reported in Table 2. The first column gives the results for the least squares dummy variable (LSDV) estimator. This pre-dates GMM, but is consistent for a large number of observations over time, and Judson and Owen (1999) find that it performs as well as viable alternatives. Column (2) has the result for the GMM difference estimator of Arellano and Bond (1991) and columns (3) to (6) report those for the preferred systems GMM estimator. For this last estimator, results are given for all plants, manufacturing and 'greenfield' start-up plants, where the latter includes services, but not re-investments or acquisitions. Column (6) gives the results for all plants in which the spatial lag term is instrumented.

Overall, the regression results in Table 2 provide a good fit to the data, and in each case there are significant terms for each component of equation (3). The signs and significance of the coefficients are broadly consistent across estimators, and tests on the residuals indicate an absence of spatial autocorrelation.[29] In the GMM regressions the diagnostics suggest that the own-lagged terms serve as valid instruments. Each regression has time fixed effects that allow for the constant term in equation (1) to vary by year, and as a group these are significant.[30] The attention focuses on the results for the preferred systems GMM estimator in Table 2.

The estimates of the lagged dependent variable are highly significant and suggest a high degree of persistence in FDI location, but like elsewhere the Jacobs term is insignificant. The spatial lag $l(n_{st})$ indicates the presence of grant competition for FDI, but when instrumented in column (6) it is insignificant, although the number of the instruments is large and it may over-fit this equation. The results for start-ups are generally less good, but for which service FDI is much more important over time, especially in the South East region. Those for all plants and

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[29] This is based on the Moran's *I* for all plants for each of the three weighting regimes outlined above, but carried out for the years 1990 and 2000 only. Again, these are asymptotic tests.

[30] For the time dummies as a group in column (3) we get $\chi^2(18) = 33.9$ ($\chi^2_{0.05}(18) = 9.4$).

manufacturing show that FDI increases with non-financial support (*SUPPORT*) and the policy area coverage (*AREA* and *TIER*). The combined effect for the latter is 0.018 in column (3).

5.2   Control Variables

As a group the control variables are strongly significant ($\chi^2(13) = 53.2$ in column (3); $\chi^2_{0.05}(13) = 5.9$). On the revenue side, each term is significant (at the 10% level or better) in columns (3) and (4) of Table 2, although the population term has a consistent negative sign. This is one of the few variables that is not measured as a rate or ratio, and it suggests that larger regions get less FDI than would be expected, but that per capita income is important for FDI location. The distance term pick-ups the peripherality of regions in terms of markets and the knowledge term comes through strongly. On the cost side, the important factor is the availability of unskilled labour, which is usually found to be the case for FDI location. For the start-ups the wage rate seems to signal a high-skilled economy better than *SKILL*, while road infrastructure suggests they favour the regions that are neither too congested nor too sparsely populated.

On the regional prospects, the regional growth rate is important for location, although if the unemployment rate is too high (*DEPRESSED*) this suggests that a region is less attractive. The term for EU regional funds (*EUFUND*) comes through only in the equations for all plants, for which there is a negative sign, as expected. Other studies find a generally weak effect for EU regional policy (Crozet *et al*, 2004), which is mainly infrastructure related. In the case of manufacturing it may be that this FDI benefited from this spend, so that the net effect is zero. Terms were included for the employment share of manufacturing and services in each region, but the coefficients were always insignificant and they are omitted from the regressions.

5.3   The Grant Term

In the case of the *GRANT* term a key issue is the appropriate lag length, which to some extent is an empirical matter. The grant is correlated over time, with a correlation coefficient of about

0.75 for successive lags up to the third lag. When entered together in the LSDV equation in Table 2 the t-statistics on the *GRANT* term are 0.51, 0.23, 1.70 and -0.21 for time lags of 0, 1, 2 and 3 years respectively. No attempt is made to correct for endogeneity here, and more FDI may mean more grant irrespective of its effect, but it indicates a 2-year grant lag.

The grant terms, *GRANT* and *GTRATE*, are each lagged two years, and the regression diagnostics in Table 2 indicate that the own-lagged values serve as valid instruments for these. The key result is that the estimated coefficient on *GRANT* is significant for each regression in Table 2, and at the 1% level for all plants and manufacturing in columns (3) and (4). The grant rate term *GTRATE* is significant and has the expected negative sign in each of these equations. The grant also comes through in column (6) in which the spatial lag term is instrumented, and it is also the case when the spatial lag is omitted altogether (the *GRANT* estimate is 4.069×10^{-3} with a z-value of 2.42 in column (3)). The *GRANT* term continues to be significant when the time dummies are excluded, but it is insignificant when the control variables are omitted.

To further examine for a significant effect tests were made using the LSDV regression. The first was simply to sum the *GRANT* in each region over the entire period, but giving a t-ratio on this term of 2.99. The second test was to instead include a dummy variable for the six Assisted Area regions, which was significant at the 1% level. Finally, *GRANT* was measured as a three-year moving average, which dampens the reverse causality, and the t-ratios were 2.02, 1.62 and 1.16 for lags of 1, 2 and 3 years, again indicating a significant grant effect.

5.4   Interpreting the Policy Effect

These results suggest that the investment grants have had a significant effect on FDI location at the UK regional level. Evaluating the *GRANT* coefficient for all plants in column (3) of Table 2 at the mean regional FDI share (of a tenth) indicates that £23.6 million of grant increases the regional FDI share by 1%, from 10% to 11% (supposing the grant is held constant elsewhere).

To interpret this, the mean regional number of FDI projects is 56.6 per year, which indicates an extra 5.66 projects. Each project has a mean of about 150 jobs (40 jobs at the median), so that £23.6m of grant generates 850 jobs. This works out at £27,500 for each job on average (1995 prices), which seems high, but the jobs last for many years. Evaluations of UK regional policy using an industrial survey approach put the cost of a job *created* in the range £8,000 to £25,000 at 1995 prices (see AEP, 2000; NAO, 2003; Wren, 2005), which is in the same ballpark.

Of course, the grant is not the only policy term, and the terms to measure the coverage of the Assisted Areas are significant for all and manufacturing plants in columns (3) and (4) of Table 2. Evaluating the coefficient on *AREA* at the mean for all plants indicates a strong effect, such that a 9.3% increase in the Assisted Areas (measured by the numbers unemployed) gives a 1% increase in the FDI share. For the higher tier, the combined coefficient on *AREA* and *TIER* indicates that a 6.2% increase in its coverage has the same effect. These are unrelated to the grant, but according to our discussion they may pick-up sub-regional effects, i.e. the greater is the policy area the greater is FDI as firms select locations over short distances, although they could potentially capture other effects, such as the prospect of a future grant.

To explore this, the regressions in columns (3) and (4) of Table 2 were re-estimated, but omitting the *AREA* and *TIER* terms. In each case the coefficient on the *GRANT* term continued to be significant at the 1% level, although with higher estimates of 6.313×10^{-3} and 7.837×10^{-3} respectively.[31] This suggests that the grant term picks-up some of the effect that is otherwise captured by the policy area terms, although since the correlation between *GRANT* and *AREA* is reasonably high ($\rho = 0.64$), it could just mean that the grant estimate is biased if the other terms are not included. Certainly, it suggests that the coverage of the Assisted Areas within a region does have an impact on FDI location, which is addition to the amount of grant disbursed.

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[31] For all plants, the grant effect falls to £17.6m for a 1% FDI increase and to £20,700 for each job created on average, compared to £23.6m and £27,500 reported above.

5.5   The Regional Grant Impact

Finally, it is useful to get a handle on the regional policy impact in relation to FDI location. For this, we focus on the grant effect, while recognising that there is an additional effect related to the policy areas. As a first step, given the revisions to policy in 1993 and 2000, it is of interest to see if the grant estimate has changed over time. Slope dummies were placed on *GRANT* by sub-period and the results are shown in Table 3. This is done in such a way as to test the grant effect over 2000-05 with that for 1987-92 and 1993-99, so that each column of Table 3 reports the results from two regressions. In each column the diagnostics and estimated coefficients are otherwise the same, except for the estimate on the *GRANT* term for 2000-05.[32]

Columns (1) to (3) of Table 3 show that the grant coefficient is invariant by sub-period, although there is a weaker effect over 1993-99 in column (1) for all plants at the 10% level and related to the start-up plants.[33] The grants mainly go to manufacturing and here the difference is strongly rejected. It is also the case in column (4) that omits the *AREA* and *TIER* terms, and in column (5) that in addition omits the grant rate *GTRATE*. A similar test was conducted for the constancy of the *AREA* and *TIER* terms between sub-periods in column (3) of Table 2, but it cannot be rejected ($\chi^2(4) = 4.8$; $\chi^2_{0.05}(4) = 9.5$), although if anything *AREA* is weaker and *TIER* is stronger over time. Overall, it suggests that despite the changes to policy in 1993 and 2000 the grant effect is invariant. This offers support for the methodology, as these revisions mainly affected the coverage of the Assisted Areas map, leaving the grant unchanged.

To conclude this study, the grant effect on the number of FDI locations across regions is calculated in Table 4. This supposes that the average grant effect is the same as the marginal effect, and the estimated impact is based on the mean grant amount and number of projects in

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[32] In the first the *GRANT* is included for the periods 1987-05, 1993-*99* and 2000-05, and in the second for 1987-05, 1993-*05* and 2000-05.

[33] The difference GMM estimator in Jones and Wren (2008) yields a different result by sub-period to that reported here, but it may be a weak estimator, as the project data relate to flows, which is regressed in difference form by the dynamic form of equation (2) and then differenced again in estimation, for which instruments in levels lagged one period is likely to be poor.

each cell of the table. Since the six Assisted Area regions and four non-AA regions in Table 1 received markedly different grant amounts and FDI, it is separately calculated for these, where the findings make better intuitive sense. The final row of Table 4 shows that *on average* the grant caused 7.5 projects to locate to each region in each year, which is 11.6 projects for the Assisted Area regions but just 1.1 projects for the non-AA regions.[34]

These results suggest that the total regional grant impact is roughly constant, although the bias in favour of the Assisted Area regions has weakened over time. Thus, initially, 66 FDI projects were attracted to these regions each year (i.e. 6 x 11.0), but the net number of projects is about 50 over 2000-05, i.e. (6 x 10.3) - (4 x 3.0). This effect is modest, and it has not kept pace with the increase in UK FDI, which has increased from 200 projects a year over 1987-92 to 500 a year over 2000-05. Coupled with the reduction in the coverage of the Assisted Areas it suggests that regional policy has had a diminishing impact on the overall distribution of UK FDI. This may explain why the regions ceased to be related in their grant status after 2000 in Figure 2, and help account for the shift in FDI to the south (see Wren and Jones, 2009b).

6. Conclusions

The paper implements a methodology for assessing the impact of regional investment grants on FDI location in which both the policy and outcome are measured at the regional level. This is for UK regional policy over 1985-05. Data problems have bedevilled research in this area, but several features of the approach indicate a successful implementation, and it provides insights into the operation of this policy. Overall, the key finding is that of a strongly significant grant effect on FDI location across British regions, which is invariant over time despite changes to the areas in which these grants are available. When calculated at the mean the paper finds that

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[34] Given the method of calculation the effects do not add-up, i.e. 10 x 7.5 ≠ 6 x 11.6 + 4 x 1.1.

£25m in grant is associated with an extra 6 FDI projects, and that the grants have altered the location of about 75 projects per year across regions (1995 prices). This suggests an estimated job effect that is in the ballpark of other regional policy estimates. However, when set against the scale of FDI as a whole the impact is relatively small, and it suggests UK regional policy is no longer able to alter the distribution of incoming FDI across British regions.

In terms of the broader implications, in addition to the grant, the paper finds a policy effect that is related to the proportion of each region that is designated for grants (not included in the above estimates). Potentially, this is a sub-regional location effect of policy, as the firms are likely to have a greater preference for nearby locations, so that this effect will increase as the areas increase in their regional coverage. It suggests that if anything the estimates presented in this paper may understate the true location effect of policy, although this is quite contrary to recent plant-based studies that at best find only a weak effect for regional grants. In terms of future research, as grant data becomes available for smaller geographical units over a long time period it would be useful to repeat the analysis, but at a finer level of spatial disaggregation, in order to confirm the grant effect but also to explore the role of the designated policy areas.

Table 1: Summary Statistics for Regions, 1985-05

	Grant (%)[1]		FDI (%)		Unemployment (%)	
	All	FDI	All	Manufacturing	1985	2005
Assisted Area regions						
Scotland	31.2	31.8	11.0	13.2	12.9	5.9
Wales	25.8	31.9	10.2	14.5	13.8	4.5
North East[2]	11.5	11.8	8.0	9.8	15.5	6.4
North West	11.4	8.4	9.9	11.3	13.7	4.3
West Midlands	8.6	7.2	13.5	17.5	12.7	4.4
Yorks. and Humber	5.6	3.0	6.7	8.5	12.1	5.1
Non-Assisted Area regions						
South West	2.6	2.4	4.4	4.5	9.3	3.3
East Midlands	1.4	1.3	4.4	5.0	9.9	4.1
South East	1.3	1.7	27.6	12.7	8.1	5.3
East[2]	0.4	0.5	4.3	3.0	8.1	3.7

Sources: *Annual Reports on the 1982 Industrial Development Act* and *Regional Trends*.
Notes: Grant by value of offers and FDI by number of projects; both for period 1985-05. 1: Regional Selective Assistance and Selective Finance for Investment in England. 'All' includes UK and foreign-owned plants. 2: Prior to 1996 the North East includes Cumbria (now in North West), and the South East includes the counties of Bedfordshire, Hertfordshire and Essex (now in East region).

Table 2: Regression Results for FDI Location

	(1) LSDV	(2) GMM (D)	(3) GMM (S)	(4)	(5)	(6)
	All	All	All	Manufacturing	Start-ups	All (instr.)
Constant term	-10.717	8.538	-11.549***	-13.575***	-15.240***	-9.473***
$l(n_{t-1})$	0.415***	0.294**	0.509***	0.310***	0.360**	0.488***
$sd(n_{t-1})$	0.015	0.050	-0.038	-0.004	0.061	-0.037
$l(n_{st})$	-0.140	-0.468**	-0.222*	-0.289**	-0.118	0.034
$SUPPORT_{t-2}$	0.422	0.722**	0.620**	0.577**	0.559	0.521**
$AREA_{t-1}$	0.018***	0.020**	0.012***	0.019***	0.004	0.011***
$TIER_{t-1}$	0.001	-0.001	0.006**	0.005*	0.005	0.004*
Revenue						
POP_{t-1}	-0.074	-1.387	-0.170***	-0.273***	-0.204	-0.108*
$INCOME_{t-1}$	0.351**	0.446*	0.236**	0.467***	0.197	0.209*
$DISTANCE_{t-1}$ (x 10^{-3})	-0.221	-0.676	-0.014*	-0.015*	0.0002	-0.012*
$KNOWLEDGE_{t-1}$	0.196	0.780**	0.679***	0.554***	0.546*	0.481**
Cost						
$WAGE_{t-1}$	0.0003	-0.001	0.005	0.005	0.016**	0.004
$SKILL_{t-1}$	0.045*	0.062**	0.010	0.001	0.009	0.010
$UNSKILL_{t-1}$	0.266***	0.328***	0.284***	0.349***	0.349***	0.261***
$ROAD_{t-1}$	0.013	0.001	0.018	0.017	0.036**	0.015
$ROAD_{t-1}^2$ (x 10^{-3})	-0.139	-0.101	-0.203	-0.161	-0.355**	-0.181
Prospects						
$GROWTH_{t-1}$	0.054**	0.057**	0.059***	0.064**	0.028	0.063***
$DEPRESSED_{t-1}$	-0.015***	-0.019***	-0.012**	-0.019***	-0.016**	-0.011**
$STRIKE_{t-1}$	-0.015	-0.011	-0.046	-0.056	-0.003	-0.045
$EUFUND_{t-1}$ (x 10^{-3})	-2.170**	-4.339***	-2.305**	-1.408	-2.459	-1.581
Grant terms						
$GRANT_{t-2}$ (x 10^{-3})	2.434*	4.579**	4.718***	5.099***	5.610**	3.486**
$GTRATE_{t-2}$	-0.279**	-0.775***	-0.328*	-0.379**	-0.267	-0.115
n	190	180	190	190	190	190
$\overline{R}^2$	0.85	-	-	-	-	-
Wald χ^2	-	186.8	441.9	317.9	232.4	782.7
Hansen-Sargan χ^2	-	66.9	120.0	127.3	104.7	119.7
AR(2)	-	-0.33	-0.83	0.56	-0.65	-1.00

Notes: Estimation of equations (2) with (3) and annual data for 1985-05 using LSDV, GMM difference (D) and GMM systems (S) estimators. Dependent variable is logit of share of FDI projects, $l(n_t)$. Data Appendix and text outline variables. Time fixed effects included throughout and regional fixed effects in LSDV. All terms are lagged one year apart from grant terms, *GRANT* and *GTRATE*, which are lagged two years and instrumented using a single lag value in GMM. Spatial lag term is also instrumented in column (6). Degrees are freedom is 51 in column (2), 108 in columns (3) to (5) and 142 in column (6). *** = significant at 1, ** = 5 and * = 10% level.

Table 3: The Grant Effect by Sub-Period

|	(1)	(2)	(3)	(4)	(5)
	All	Manuf.	Start-ups	Manuf.	Manuf.
AREA	0.011**	0.019***	0.004	-	-
	(0.005)	(0.005)	(0.005)		
TIER	0.006*	0.006*	0.006	-	-
	(0.003)	(0.003)	(0.004)		
GTRATE	-0.234	-0.383*	-0.215	-0.155	-
	(0.198)	(0.214)	(0.292)	(0.233)	
GRANT: 1987-05	7.345***	4.988**	7.571**	9.059***	10.578***
	(2.369)	(2.548)	(3.210)	(2.708)	(3.062)
GRANT: 1993-99	-3.886*	-0.216	-3.110	-2.105	-3.217
	(2.337)	(2.465)	(3.129)	(2.726)	(2.908)
Comparison with initial period, 1987-92:					
GRANT: 2000-05	-2.588	1.976	0.059	-0.673	-1.799
	(3.260)	(3.491)	(4.38)	(3.781)	(4.127)
Comparison with preceding period, 1993-99:					
GRANT: 2000-05	1.299	2.192	3.051	1.431	1.418
	(2.450)	(2.680)	(3.305)	(2.959)	(3.215)
n	190	190	190	190	190
Hansen-Sargan (χ^2)	114.8	123.7	100.3	110.3	80.9
AR(2)	0.40	0.14	0.69	0.63	0.66

Notes: Re-estimation of equations (3) to (5) in Table 2, with coefficient on *GRANT* varying by sub-period. All other terms included, but not shown. Grant estimates multiplied by 1000. Separate regressions for each *GRANT* estimate over 2000-05, but other estimates and diagnostics unchanged. Standard errors in parentheses. *** = significant at the 1, ** = 5 and * = 10% level.

Table 4: The Inter-Regional Grant Effect

Period	All regions	Assisted Area regions	Non-AA regions
1987-92	4.8	11.0	0.2
1993-99	7.6	12.9	1.0
2000-05	9.5	10.3	3.0
1987-05	7.5	11.6	1.1

Notes: Mean annual *GRANT* effect on number of FDI project locations at regional level using estimate for all plants in column (3) of Table 2. Calculated at mean according to number of projects and grant amount in each cell, assuming average effect = marginal effect. The six Assisted Area and four non-AA regions defined in Table 1.

Figure 1: Grant Expenditure and FDI in the Assisted Area Regions, 1985-05
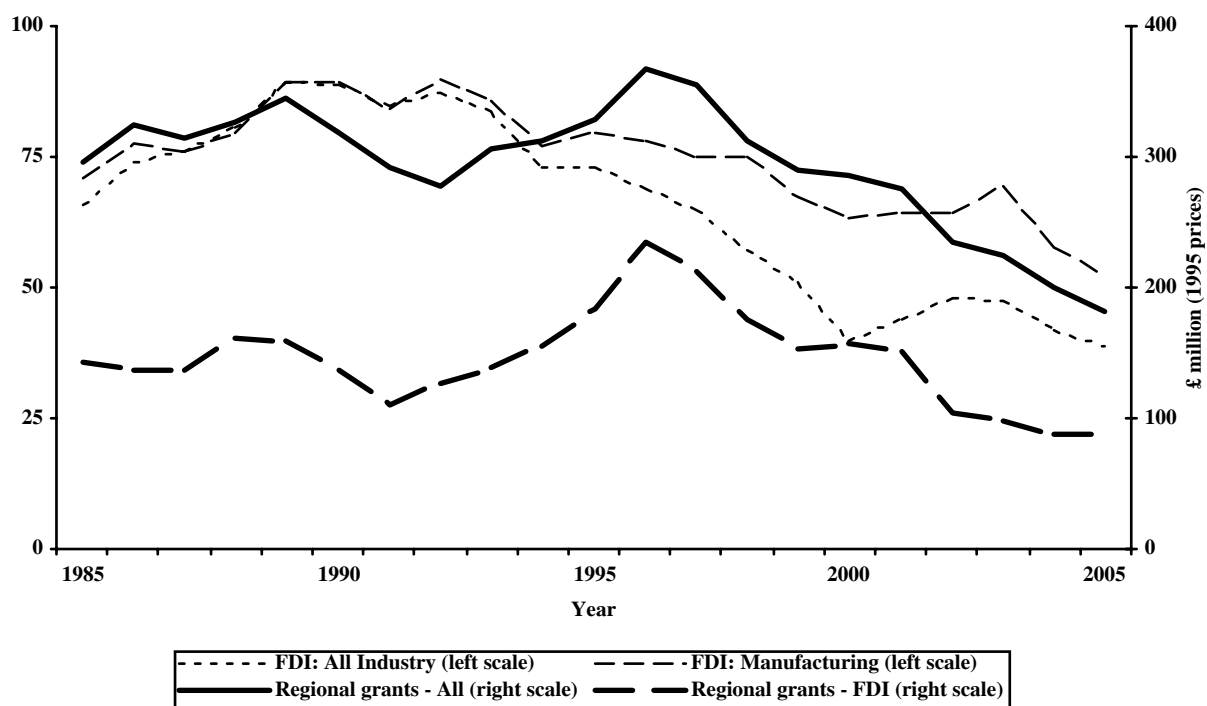
Notes: FDI is the share of total projects in the six Assisted Area regions (Table 1). Grants offers are for Great Britain, comprising Regional Selective Assistance and Selective Finance for Investment in England (1995 prices). FDI and grant series smoothed using a 3-year moving average.
Source: Authors' own dataset and *Annual Reports on the 1982 Industrial Development Act*.

Figure 2: Moran's *I* for Total FDI Projects by Weighting Regime

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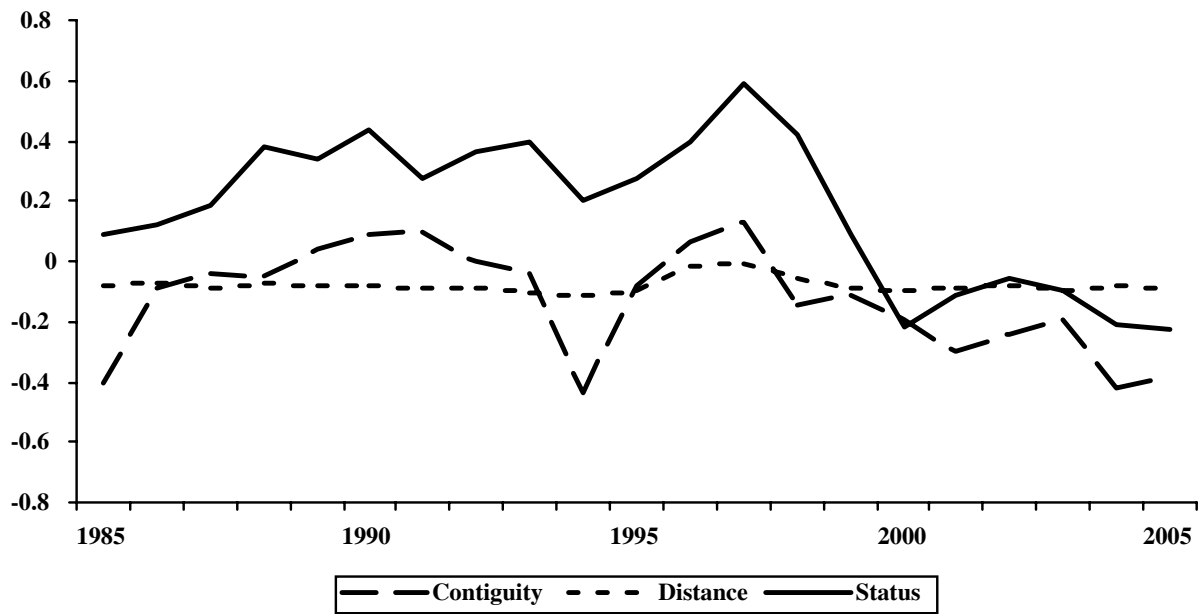
Notes: Based on number of projects in each region relative to region's share of national employment. Calculated for each year. Weighting regimes described in text.
Source: Authors' own dataset.

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Appendix

The firm-specific effects are distributed according to the logistic function, which means that an increase in non-firm-specific attractiveness, denoted $x_{rt} \equiv \pi_{rt} + \alpha + \alpha_t + \alpha_r$, of region r at time t increases the regional share of FDI projects n_{rt} according to:

$$\frac{d\,n_{rt}}{d\,x_{rt}} = n_{rt}\left(1 - n_{rt}\right). \qquad (A1)$$

This is a differential equation, which has a solution (setting constant of integration to 1) of:

$$n_{rt} = \frac{e^{x_{rt}}}{1 + e^{x_{rt}}}. \qquad (A2)$$

The natural log of the odds-ratio, $n_{rt} / 1 - n_{rt}$, gives expression (1) of the text. It is has parallels to the dichotomous logit model, in which α_i is treated as a random error term with an Extreme Value Type I distribution, leading to (1). In this the binary choice is between locating in region r or in a region other than r (see Dimitropoulou $et\ al$, 2006), which is like here. In this paper we do not treat α_i as an error term, but it is the device by which the firm location decisions are aggregated to the regional level. We later add an error term to the dynamic form of (1).

Data Appendix

Variables for each regions over 1985-05, where relevant at 1995 prices using HM Treasury GDP deflator. Data source is *Regional Trends*, and / or as indicated (various years):

Structural terms: n – share of UK FDI projects summing to unity (UK Trade and Industry); $sd(n)$ – standard deviation of number of jobs across two-digit industries (as above); n_s – spatial lag using policy status regime *(c)* for row-standardised spatial weights matrix.

Policy terms: *SUPPORT* – involvement of UKTI as a fraction of all FDI projects (source: UK Trade and Investment); *AREA* – % unemployed in all Assisted Areas (*Employment Gazette*; *Annual Reports on the 1982 Industrial Development Act*); *TIER* – % unemployed in higher tier of Assisted Areas (as above); *GRANT* – offered grant amount in £'ms accepted by firm for Regional Selective Assistance and Selective Finance for Investment in England (*Annual Reports on the 1982 Industrial Development Act*); *GTRATE* – grant offered to foreign-owned plants as a proportion of all offers (as above).

Revenue: *POP* – population in millions; *INCOME* – GDP per capita in £'000s; *DISTANCE* – sum of distance in '00s miles to economic centre of all other regions weighted by population sizes (*AA Route Planner*); *KNOWLEDGE* – numbers in higher and further education by residence in log thousands (*Scottish Abstract of Statistics, Digest of Welsh Statistics*).

Cost: *WAGE* – real average weekly earnings in £'s (*Annual Survey of Hours and Earnings*); *SKILL* – % of exam entrants achieving 5 GCSEs at grade A-C (Department of Education and Skills, *Education Statistics for the UK*, *Scottish Abstract of Statistics, Digest of Welsh Statistics*); *UNSKILL* – % unemployment rate; and *ROAD* – expenditure in £'000s per km^2 (*Regional Transport Statistics*, *Scottish Transport Statistics, Welsh Transport Statistics*).

Prospects: *GROWTH* – % GDP growth rate; *DEPRESSED* – % unemployment rate squared; *STRIKE* – log of days lost from industrial action per 1000 employees; *EUFUND* – regional spending under ERDF and EU Structural Funds (Objectives 1 and 2) in £'ms at rate 1 ECU = £0.65 (*Annual Reports on the ERDF* and *Annual Reports on the Structural Funds*).