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Firm location decisions, regional grants and agglomeration externalities

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Abstract

We examine whether discretionary government grants influence where domestic and multinational firms locate new plants, and how the presence of agglomeration externalities interacts with these policy instruments. We find that a region's existing industrial structure has an effect on the location of new entrants. Grants do have a small effect in attracting plants to specific geographic areas, but importantly, we find that firms are less responsive to government subsidies in areas where there are fewer existing plants in their industry. This suggests that these subsidies are less effective in influencing firms' location decisions in the face of countervailing co-location benefits.

JEL classification: R12; R3
Keywords: Firm location; Agglomeration; Selective assistance; Regional policy

1. Introduction

Governments around the world use subsidies to attract firms to relatively deprived regions in the belief that they generate positive externalities. However, firms that potentially generate the largest spillovers may themselves benefit from co-location externalities, and thus be drawn towards current centres of activity. In this paper we examine how the presence of these

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agglomeration externalities interacts with policy instruments. Specifically we ask whether potential benefits from locating near to other firms lessen the effectiveness of fiscal incentives.

Our focus throughout is on the location decisions of larger multi-plant and multinational firms setting up greenfield sites. We extend the literature by examining whether the ability of government to use subsidies to attract such firms to locate in low income per capita areas is affected by countervailing incentives for firms to concentrate geographically (usually in higher income per capita areas). We find that regions' existing industrial structures have an important effect on entrants' location decisions. Firms are less responsive to government subsidies when there are few other plants in their industry located in the region, but become more responsive as the number of plants already there increases.

A second innovative aspect of the paper is that we analyse the impact of discretionary grants. The fact that the government agency has discretion over the value of the grant it offers presents an identification problem in estimating the impact of the grant on the firm's location choice, since factors that determine the size of the grant may also affect the location decision. Our identification strategy relies on the fact that variation in firm and industry characteristics do not enter a model of location choice, (characteristics that vary *only* at the firm or industry level are the same across potential geographic locations and so drop out), but will, through the structure of the grant award process, affect the likelihood that a firm receives a grant offer and the value of the offer made.

We use plant-level data for Great Britain, along with individual grant offers under the Regional Selective Assistance (RSA) scheme. RSA grants are offered to firms in designated low income per capita 'Assisted Areas', which are typically located in regions with low growth rates.[1] While we examine this specific scheme, our results should be applicable more generally across the wide range of countries that operate similar discretionary schemes targeted at attracting foreign multinationals.

Agglomeration externalities are one factor that may influence where economic activity locates. Marshall (1890) identifies knowledge spillovers, labour market risk pooling, and vertical linkages as the main sources of localisation economies.[2] This suggests that firms that use similar technologies, inputs, and types of workers may have incentives to co-locate. For example, firms that require similarly skilled labour, and workers that possess those skills may locate together in order to insure themselves against hiring and firing costs. Empirical evidence exists in support of all three potential sources of localisation economies.[3]

In contrast to localisation externalities, Jacobs (1969) argues that firms may benefit from externalities arising in regions with a diverse industrial structure, or from urbanisation economies. For example, innovative firms may benefit from technological developments in industries other than their own, or from a local, varied science base. This may make diversified regions more attractive than specialised regions. Firms may also benefit from locating in areas where the mass or density of economic activity is high.[4]

Recent empirical work has examined both the location decisions of firms, and the resulting distribution of productive activity; the role of both localisation and urbanisation economies has

[1] The UK government has recently re-orientated the RSA scheme to promote productivity growth and the quality of jobs in these areas, and has introduced a target to reduce the disparity in regional growth rates within Great Britain.

[2] These have been classified as MAR (Marshall–Arrow–Romer) externalities in a dynamic context. See Henderson (2003), David and Rosenbloom (1990), Arthur (1994), Krugman et al. (1999), Rosenthal and Strange (2004) for a survey.

[3] See Rosenthal and Strange (2004) for a survey of evidence, and Ellison and Glaeser (1999), Jaffe et al. (1993), Holmes (1999) for evidence on labour market pooling, knowledge spillovers and vertical linkages respectively.

[4] See, for example Ciccone and Hall (1996). See Henderson (1986, 2003) for examples of studies examining the relative impacts of localisation and urbanisation economies.

been studied in both contexts. For example, it is now well established that the geographic distribution of plants is concentrated, both across sectors and within individual industries.[5] Recent empirical work on the location decisions of firms also suggests that agglomeration externalities may be significant.[6] There have also been a number of empirical studies examining the effects of policy, in the form of taxes or subsidies, on location decisions. These studies typically find that taxes on corporate profit, or regional subsidies, play a significant role in location choices.[7]

In this paper we focus on how government grants affect the location of new plants set up by foreign-owned multinationals or by existing UK-owned firms. We focus on these entrants as they are the most likely to be geographically mobile and because a substantial amount of the total value of RSA grants is directed towards foreign-owned multinationals.[8] The choice of location is modelled in a discrete choice framework as a function of characteristics of each region, plant and industrial sector. We use detailed plant-level information on grant offers to model the influence of government grants on location decisions. We find that grants do have a small effect in attracting plants to specific areas. But our results suggest that these subsidies are less effective in influencing firms' location decisions in the face of alternative locations offering countervailing co-location benefits or natural advantages.

The structure of this paper is as follows. In the next section we describe the Regional Selective Assistance scheme. In Section 3 we outline a model of firm location choice. In Section 4 we describe the data and in Section 5 we present our empirical results. Section 6 concludes.

2. The Regional Selective Assistance scheme

The Regional Selective Assistance (RSA) scheme was introduced in Great Britain in the early 1970s.[9] While the primary aim of the scheme is creating and safeguarding jobs in any type of firm, a further specific objective is attracting internationally mobile investment.[10] Over the period we consider it was the major form of investment incentive available to both inward and domestic

[5] Devereux, Griffith and Simpson (2004), henceforth DGS, and Duranton and Overman (2005) provide evidence for Great Britain. See Holmes and Stevens (2004), Combes and Overman (2004), Fujita et al. (2004) for studies of the US, the European Union and Japan and China.

[6] DGS (2004) find that in a number of the most localised industries in Great Britain, new entry was acting to re-enforce geographic concentration. Contrary to this, Dumais et al. (2002) show using US data that plant entry has acted to reduce the extent of industry agglomeration. Harhoff (1999) finds evidence of regional spillover effects in Germany; specialised regions are found to be attractive to firms in the same industry, and industry diversity within a region is found to be more important for firm formation in high-tech compared to low R&D-intensity sectors.

[7] Hines (1999), Devereux and Griffith (2002) provide surveys of the impact of fiscal incentives on firms' location. Holmes (1998) finds a significant effect of US states' pro-business policies on the location of plants. Devereux and Griffith (1998) find that corporate income taxes have an effect on a firm's decision of which country within Europe to locate in, but not on the choice between exporting, locating in Europe or not serving the foreign market at all. However, Crozet, Mayer and Mucchielli (2004) find little evidence of an impact of either European regional policy or a French national policy on the location choices of foreign multinationals within France. A number of these studies also find a significant role for agglomeration effects, see also Head et al. (1995, 1999), Head and Mayer (2004).

[8] One of the main objectives of the RSA scheme is to attract and retain internationally mobile investment, see National Audit Office (2003). Arup Economics and Planning (2000) report that around 50% of the value of offers between 1991 and 1995 went to foreign-owned firms.

[9] In England the scheme is now known as Selective Financial Assistance for Investment in England.

[10] See PA Cambridge Economic Consultants (1993), Arup Economics and Planning (2000). See discussion in Swales (1997) and the "ambiguity over the official rationale for UK regional policy and RSA in particular." Also see Harris and Robinson (2002) for a survey of industrial support policies in Britain.

investors. RSA grants can be paid to both new entrants and to existing firms within designated ‘Assisted Areas’. These areas are chosen on the basis of low GDP per capita relative to the EU average, low labour market participation or high unemployment rates. There are two tiers of Assisted Areas. During the period we consider these were designated as ‘Development Areas’ and ‘Intermediate Areas’, with Development Areas being areas of greater economic need with higher ‘cost-per-job’ limits in terms of the value of grants offered.[11]

We use information on grants offered under the scheme during the late 1980s and early 1990s. During this time grants were awarded to companies opening a new plant, or expanding or modernising an existing plant, and were available for up to 15% of eligible project costs, including plant and machinery, land, site preparation and buildings. RSA is targeted at marginal projects; for a grant to be awarded it must be demonstrated that the project would not go ahead in the planned form without the grant, and the government agency seeks to award the minimum amount necessary for the project to go ahead.

While the criteria for awarding grant offers do not vary by industry or by the nationality of the investor, in practice the amount of grants offered does. The amount of the grant offered depends on factors including whether the area is designated as Development or Intermediate, the level of investment expenditure undertaken and the number of jobs safeguarded or created. PA Consultants (1993) report that over the period 1985 to 1988 foreign-owned firms received significantly higher per-job offers than UK-owned firms, and that there was significant variation in the average offer per job expected across sectors, with the chemicals and motor vehicle manufacturing sectors receiving the highest average per-job offers.[12] We use the variation in grant offers that arises from these factors to identify the impact of grants on firms’ location decisions.

3. A model of firm location choice

We are interested in identifying how government subsidies, in the form of RSA grants, and co-location externalities affect where a firm chooses to locate a new greenfield plant within Great Britain. The basic framework we use is straightforward: we assume that the firm will choose to locate its new plant in the most profitable location, taking into account any RSA grant which it expects to receive, and any benefits it receives from locating near similar firms. Implementing this approach empirically raises a number of issues, which we discuss below.

3.1. Location choice model

Let y_{ijkt} be a variable indicating whether firm i in industry j chooses to locate its plant in region k at time t. Assuming that firms are risk neutral, we can define y_{ijkt} as

$$y_{ijkt} = \left\{ \begin{matrix} 1 & \text{if } \pi_{ijkt} + g_{ijkt} > \pi_{ijnt} + g_{ijnt}, \quad \forall n \neq k \\ 0 & \text{otherwise} \end{matrix} \right\} \tag{1}$$

where π_{ijkt} reflects the profit that the firm expects to earn if it locates in region k, and g_{ijkt} reflects the expected grant in region k, conditional on the firm applying for a grant in that region. Neither π_{ijkt} nor g_{ijkt} is observable, even for the region chosen. Empirically, we proxy π_{ijkt} with variables

[11] See PA Cambridge Economic Consultants (1993). These are now termed Tier 1 and Tier 2 areas and are designated under Article 87(3)a and Article 87(3)c of the EC Treaty respectively.

[12] See PA Cambridge Economic Consultants (1993) Tables 2.4 and 2.5.

that reflect firms' expectations of their profit. We describe our construction of g_{ijkt} below. We assume a linear approximation of profits for each firm in each location, which implies:

$$\pi_{ijkt} = \alpha + z_{kt}\beta_1 + h_{jkt}\beta_2 + f_{ikt}\beta_3 + x_{ijt}\beta_4 + e_{ijkt} \tag{2}$$

Factors that influence expected profit reflect both demand and cost conditions and include region-specific variables (z_{kt}), factors that vary at the industry-region (h_{jkt}) and firm-region level (f_{ikt}), as well as factors that vary at the firm-industry level (x_{ijt}). Note that we do not use any information on the plant itself – this would reflect the realisation of the location and grant decisions, and would thus clearly be endogenous – but we do include characteristics of the *firm* that is opening the new plant, such as whether or not it is foreign-owned. Any factors that only vary over firms, industries or time, and not across regions, drop out of the location decision (under the assumption that their impact on profits is the same across regions, that is that β_4 does not vary across k).

We capture variation in local demand conditions by variation in GDP, population and manufacturing employment. These also control for the fact that the regions cover different sized geographic areas. Variation in the costs that firms face is captured by the skilled and unskilled wage, the unemployment rate and measures reflecting industrial geographic concentration (potential co-location benefits). We capture localisation effects by including measures of the number of plants at the 4-digit industry level (or foreign-owned plants) in each region-year and, following Maurel and Sédillot (1999), by including a measure of how localised, or geographically concentrated, employment is in that industry. We capture the presence of urbanisation externalities using the measures of region size described above, and a measure of the extent of diversification of manufacturing employment within each region and year.

To implement this empirically we estimate a conditional logit model across 88 potential locations (discussed below).[13] We enter all of the variables that reflect potential profit opportunities in the model with a one-year lag, to reflect the information upon which expectations were formed. To control for unobservable characteristics, such as transport infrastructure, we include area fixed effects. We treat all these factors as exogenous in the location choice model.

3.2. Estimating the expected grant

We model a grant as a lump sum payment to the firm. The size of any grant offered to firm i with respect to its new plant p is decided by the relevant government agency and is conditional on the firm making an application in region k. The RSA rules stipulate that firms can apply for a grant in only one region in Great Britain. Conditional on receiving an application, the agency decides whether to offer a grant, taking into account its assessment of the benefits that the project will have to the region, and the likelihood that the project would go ahead in the absence of the grant. The size of the grant offer depends on a number of factors, including the characteristics of the firm, industry and region.

The rules governing the RSA scheme mean that the size of the grant is related to the following factors: the expected employment generated by the new plant, the expected investment expenditure in the new plant, and the economic conditions in the region in which the firm applies. Given that one objective of the scheme is to attract internationally mobile investment, we observe

[13] The conditional logit specification can be derived from the random utility maximisation framework of McFadden (1974). An underlying assumption is independence of the error terms across location choices. See Guimarães et al. (2003, 2004) for discussion of empirical approaches to modelling location decisions.

that foreign-owned plants typically receive higher grant offers per job created, and also that policy makers award higher grant offers in particular industries.[14]

We use variables reflecting this policy stance to estimate the expected grant offers. As above, we do not include direct measures of plant size or investment expenditure because they will be direct outcomes of the grant. We can, however, include information on the firm *i* and its other plants which are already in operation. To capture characteristics of the firm, and the potential size of the new plant, we use an indicator of whether a new plant is part of a foreign-owned multinational, and total employment in all other manufacturing plants within the firm. To capture the likely investment intensity of the new plant we include a measure of real investment per employee in the average establishment in the same 4-digit industry and year.[15] We also include a set of broad industry dummies.

To capture area characteristics we include a dummy variable for whether or not an Assisted Area is classified as a Development versus an Intermediate area, a measure of the unemployment rate, and a set of dummy variables for broad administrative regions *r*. These will capture the overall regional policy stance towards grants. Finally we include a set of time dummies.

We use the estimated coefficients to generate a measure of the expected grant for every plant in each of the 88 location choices, setting the expected grant to zero in areas where RSA grants are not available; these predicted values are then used in the conditional logit model.

An additional problem we face is selecting the set of plants on which we estimate the expected grant equation. Our main approach is to use information on a set of plants (and their associated firms) to which we have matched information on grant offers (described further in Section 4.2). The combined dataset allows us to estimate the effects of firm-specific and industry-specific variables, as well as regional variables, on the size of the grant. However, we can only carry out this estimation on plants that receive a grant offer. In estimating the expected grant, we therefore need to control for the sample selection that this implies.

We use a standard Heckman selection equation to control for the fact that we estimate the grant equation using only firms that applied for and received a grant.[16] We estimate this selection equation using data on a broad set of potential applicants, (not just multi-plant and multinational firms). In the selection equation we include variables that determine whether a particular firm is likely to make an application in any region.[17] The choice depends on characteristics of the firm and of the industry.

Specifically, in the selection equation, we include firm-specific variables which we do not think determine the amount of grant that the government agency offers, and hence do not appear in the expected grant equation. We include measures that can proxy for the cost of making an application, such as whether or not the plant is part of a larger group, and whether the firm is already active in other Assisted Areas, which could reflect some expertise of the RSA system, and

[14] See also PA Cambridge Economic Consultants (1993) Tables 2.4 and 2.5.

[15] Calculated using capital expenditure and employment information from the ARD establishment-level sample using sampling weights.

[16] Strictly we do not observe unsuccessful applications, and are estimating the expected grant on a set of *successful* applicants that have also taken up the grant. But we rely on the fact that this group corresponds closely to the group of applicants, as 89% of applicants receive an offer, and only a very small proportion of offers are not taken up. PA Cambridge Economic Consultants (1993), Table 2.1 shows that over 1985-1988 there were 7953 applications, 1513 were withdrawn and 5732 offers were made, of which, by 1991 only 6% had not been taken up.

[17] We implicitly make a simplifying assumption that if an applicant did not make an application in region *k*, it would instead have made an application in another Assisted Area, (i.e. the next best region for it to locate in would also have been an Assisted Area given the expected grant offer), rather than choosing not to apply. This means that the choice of whether or not to apply does not depend on the specific characteristics of the area in which we observe the grant being offered.

hence a lower cost. In addition, note that the size of the grant awarded depends on the size of the proposed plant; the larger the proposed plant, the lower is the relative cost, and hence the more likely the firm is to make an application. We proxy the size of the proposed plant by various firm characteristics, such as whether the new plant is part of an existing group of firms, and total employment in the existing firm. The cost to the firm of making the application is irrelevant for the government agency, and so in estimating the expected grant equation, we exclude those variables that reflect only the firm's costs.

Thus the selection equation is estimated on a set of potential applicants as a probit model of the form,

$$p(a_{pjt} = 1) = \Phi(\alpha + q_i\gamma_1 + w_j\gamma_2 + t_t + e_{pjt}) \tag{3}$$

where p indexes a plant which is part of firm i, q_i and w_j are firm and industry-level variables respectively, and t_t is a set of time dummies. The grant equation, estimated only on successful applicants, then takes the form,

$$g_{pjkt} = \alpha + q_i^*\delta_1 + w_j\delta_2 + l_k\delta_3 + ar_r + t_t + \lambda_{pjt} + e_{pjkt} \tag{4}$$

where q_i^* are a subset of the firm-level variables in Eq. (3), l_k are area-level characteristics, ar_r are a set of broader administrative region dummies, and λ_{pjt} is the selection correction derived from Eq. (3).

Our main analysis uses the matched dataset. As a robustness check, we also estimate the grant equation without a selection correction using the full sample of grant offers and a restricted set of explanatory variables. This permits us to use more observations, but at the cost of not being able to use any firm-specific variables, nor being able to separate out grants made to new entrants as opposed to existing plants. We do include an indicator of whether or not the grant is designated for job creation as opposed to safeguard existing employment, which may proxy for new entrants. We can also use industry-level and area-level variables.

Our identification strategy is effectively summarised in Table 2, which shows the variables included in each stage of the analysis (the descriptive statistics are discussed in the next section). The first column shows the variables that enter into the firm's application decision. The second and third columns show the variables that enter into the government agencies' decisions on the size of the grant (the grant offer is the dependent variable).[18] The final column shows the variables that enter the firm's location decision (choose this location is the dependent variable), in addition to the expected grant (as described in Table 4).

Our identification strategy relies on the fact that in the conditional logit model any variables that do not vary across regions drop out of the estimation. For example, the industry in which a plant is operating is common to all regions and therefore drops out of the conditional logit model. However, the industry in which a plant is operating, and other firm characteristics, may be a factor in determining the size of its grant offer. This means that we can identify the effect of the expected grant in the conditional logit model by using a range of firm-specific and industry-specific variables to determine the expected grant itself.

4. Data and descriptive statistics

Our data come from two main sources. We use information from the Office for National Statistics Annual Respondents Database (ARD) for Great Britain over the period 1986 to

[18] As a further robustness check, we also estimate a specification for the expected grant where we include additionally all the regionally varying factors from the conditional logit model.

1992.[19] For this period the ARD contains basic information on the population of manufacturing plants and also information on a wider range of characteristics for a random stratified sample at the establishment level.[20] As described below, we use information on the population of manufacturing *plant*s to identify greenfield entrants and to construct measures of agglomeration, and we also use information on wages and investment from the ARD establishment-level sample. Our second data source is the list of all grant offers of £75,000 or more that is published by the Department of Trade and Industry.[21] As described below we match these two datasets using the postcode and industry code of the plant. We use these data at the level of the plant, the firm, the industry, the location area and the location area- industry.

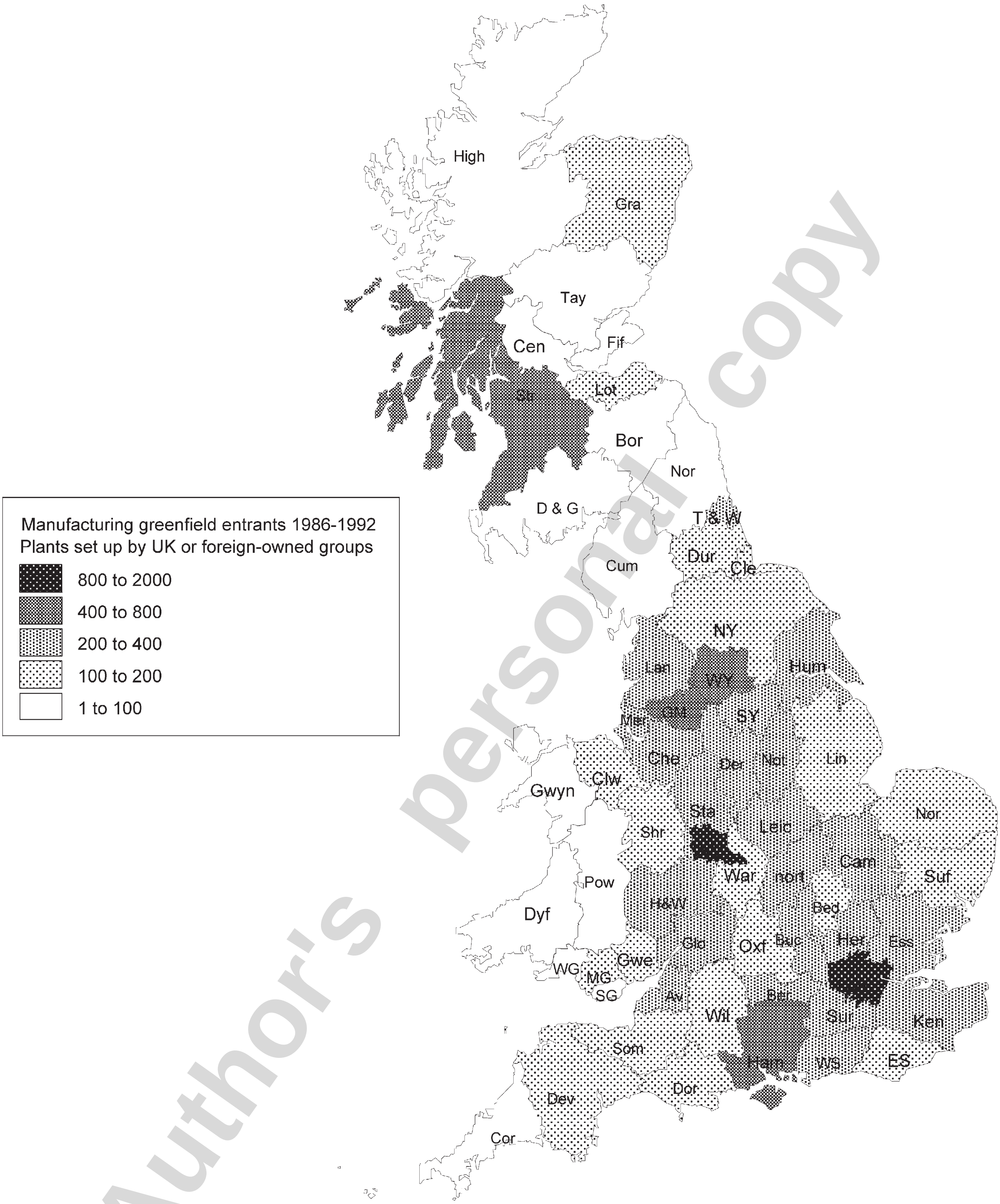
4.1. Variable definitions

We consider firms' location choices at the level of the 64 counties and Scottish regions within Great Britain, 38 of which include at least some areas that are classified as Assisted Areas.[22] In estimation we split counties that contain both Assisted and non-Assisted Areas into two potential locations, generating a total of 88 location choices for each plant.[23] We use the plant-level population to identify greenfield entrants, and in line with our model outlined above, we focus on those plants that are likely to be geographically mobile, i.e. those that are either affiliates of foreign multinationals, or are part of an existing UK group. Fig. 1 shows the distribution of these entrants over the period 1986 to 1992 across the 64 counties.

New entry follows the geographic distribution of existing plants closely, and is skewed towards major cities. On average around 30% of these new entrants locate in counties in the South East of England, which over this period contained no areas classified as Assisted. Only around 15% of these greenfield plants were located in counties in the North East of England, Wales and Scotland. However, within these regions, plants were more likely to locate in areas that were classified as Assisted compared to non-Assisted. As we discuss below, these regions account for the highest total value of grant offers over this period.

Our measures of industry localisation and diversification are calculated at the county-year level from the ARD plant-level population. Our measures of industry-county localisation are: (i) the number of plants in each industry in each county-year; and (ii) the number of foreign-owned plants in each industry in each county-year. These are calculated at the 4-digit industry level for each of the 64 counties.[24] We also calculate an *industry-level*

[19] For more information on the ARD see Barnes and Martin (2002). We use the plant-level population between 1986 and 1992 as changes to plant identifiers in 1984–85 and 1993–94 present problems for reliably identifying greenfield entry.
[20] An establishment can comprise one or several plants operating in the same industry under common ownership.
[21] Labour Market Trends (various years). Data on offers of less than £75,000 are not published. Hence we cannot use information on these smaller grant offers in our analysis. We verify that the regional and sector distribution of our sample of grant offers over £75,000 mirrors that of all grant offers over the same period (Appendix available on request). We assume that there is no systematic difference in the determinants of the decisions to apply for a grant, make a grant offer, and choose a location according to whether a grant is above of below £75,000.
[22] For brevity we refer to both the counties of England and Wales and the regions of Scotland as counties.
[23] We exclude a small number of location choices where we observe fewer than ten greenfield entrants over the period 1986–1992 that are part of foreign multinationals and existing UK groups, for example the Shetland and Orkney Islands.
[24] We also experimented with using the proportion of total industry (and industry foreign-owned) plants in each county-year. Using these measures does not change the overall pattern of results.



Source: author's calculations using the ARD (source: ONS)

Fig. 1. Geographic distribution of greenfield plants set up by UK or foreign-owned groups across counties, 1986–1992.

measure of agglomeration following Maurel and Sédillot (1999), denoted γ^{MS}, that measures the extent of geographic concentration conditional on industrial concentration in the industry, and takes into account the underlying geographic distribution of manufacturing activity.[25] We use this measure calculated at the 4-digit industry level to differentiate between more and less agglomerated industries. This index varies between −1 and +1, with higher values indicating more agglomerated industries. It is worth noting that while our measures of industrial agglomeration may be capturing co-location externalities, localisation may also occur due to natural advantages of specific areas.

We measure the extent of county diversification using a locational Herfindahl index, calculated using employment shares of 4-digit manufacturing industries for each county in each year, excluding a plant's own industry. We subtract this measure from 1, producing an index that varies between 0 and 1: the higher the value of the index, the more diverse is a county's industrial structure.[26] Finally, we also use the plant-level population to construct a measure of the size of each of the 88 location choices, given by total manufacturing employment in each area in each year.

We use the ARD establishment-level sample with appropriate sampling weights to construct average wages for both skilled (administrative, technical and clerical) and unskilled (operative) workers at the 2-digit industry-county-year level. These are deflated using a national-level retail price index. We use data on the total working age population in each county and year and the total number of unemployed individuals in each county and year from the Office for National Statistics NOMIS database. Finally, we use information on regional Gross Domestic Product for each of the ten broad administrative regions of Great Britain and year taken from Regional Trends (1995), and deflated using a GDP deflator, to capture demand conditions.

4.2. Matched grant and plant-level data

We now turn to our data on RSA grant offers. Fig. 2 uses data on offers to both new entrants and existing plants to show the geographic distribution of grant offers across counties over the period 1986 to 1992. Plants located in counties in Scotland, Wales and the North East region of England received the highest total value of grant offers over the period. Over 90% of grant offers, by value, were given to plants in manufacturing industries. The industries receiving the highest values of grants were the motor vehicles, radio, TV and communication, machinery and equipment, chemicals and food and drink industries.

As would be expected, the geographic distribution of grant offers differs substantially from the geographic distribution of new entrants shown in Fig. 1. However, counties containing major cities (e.g. West Midlands, Greater Manchester and Strathclyde) tend to have high values of grant offers and to exhibit relatively high levels of entry.

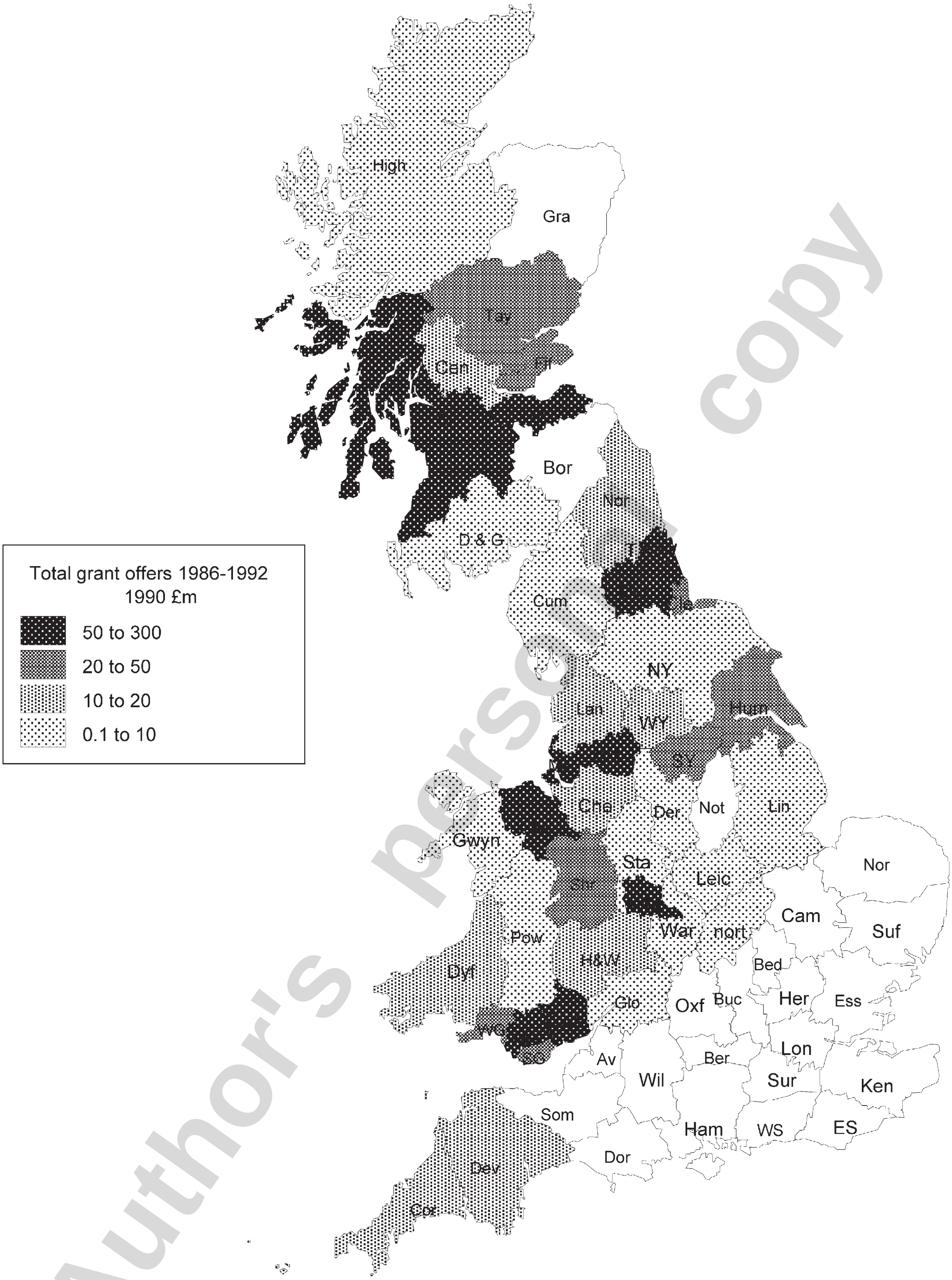
We match the information on RSA grant offers made between 1983 and 1992 to the population of all manufacturing plants in existence in England, Wales and Scotland.[27] We have data on the postcode of the plant which receives the offer, its industry, the amount of the offer, and the year the offer was received. We match the data at the plant level using the full postcode and industry information (4-digit sic92).[28] We distinguish greenfield

[25] For further details see Maurel and Sédillot (1999) and DGS (2004), who implement the measure on UK data.

[26] $1-H$, where $H=\sum s_j^2$ and s_j is the share of employment in industry j in total manufacturing employment in the county-year, excluding employment in the plant's own industry. We restrict ourselves to a measure of the diversification of manufacturing employment as information at the 4-digit level is not available for service sector activities for this time period in our data. The extent to which different counties contain (non-time varying) service sector activity will be captured by the inclusion of county fixed effects.

[27] We allow the grant offer to be made up to three years before a plant is observed in the population as we would expect a lag between an offer being made and a greenfield plant being established.

[28] Full details on the matching procedure are given in an Appendix, available on request from the authors.



Source: authors' calculations using grant offers over £75,000.

Fig. 2. Geographic distribution of value of grant offers across countries, 1986–1992.

entrants that received an offer from plants that existed prior to the offer being made. Table 1 shows the number of greenfield plants locating in Assisted Areas, the proportion of those which we match as receiving grant offers, and the average grant offer they received

Table 1
New greenfield plants by ownership nationality, 1986–1992

	All	UK Group	Foreign
Total number	79,337	13,588	1376
% located in Assisted Areas	33%	35%	36%
% in Assisted Areas receiving offer[a]	1.2%	2.2%	3.5%
Average offer (1990 £000) [a]	407	473	866

Source: authors' calculations using the ARD (Source: ONS) and RSA grant offers data.
[a] Authors' calculations using sample of RSA grants matched to entrants in the ARD (Source: ONS). The proportion of entrants receiving grants will be an understatement as our sample only contains offers greater than £75,000, and we do not match all grant offers to the ARD. Excludes entrants with fewer than 3 employees in the first year.

by type.[29] Across all types, around one third locate in Assisted Areas, and between one and 3.5% receive grant offers, with affiliates of foreign-owned firms being most likely to receive one. The average grant offer is around £400,000, but is higher for entrants that are part of a UK group, and more than twice as high for entrants that are owned by a foreign firm.

4.3. Descriptive statistics

Table 2 shows the means and standard deviations of all the variables across the samples used in estimation. The first column shows the variables used to estimate whether or not a firm applies for an RSA grant. The second and third columns show the variables we use to capture the policy stance in estimating the determinants of the expected grant. Column 2 is based on entrants for which we have matched grant offers, and therefore includes firm-level variables from the ARD; column 3 is based only on the grant offers data, and excludes firm-level variables. The final two columns show the means of the variables used in estimating the entry-location decisions. The fourth column presents the means of the actual entry decisions for the 14,964 greenfield entrants that are part of UK or foreign-owned groups. The final column shows means of the variables we use when estimating the conditional logit model, that is for each entrant choosing between 88 locations.

These columns provide descriptive information on our measures of localisation and urbanisation. For example, in the average county an entrant in our sample will observe around 30 existing plants in its own industry, and only one foreign-owned plant. There is considerable geographic variation in these measures. On average the mean values of the industry-county localisation measures are highest in the South East of England - on average an entrant would observe 70 existing plants in its own industry in a county in the South East. But not all industries are geographically concentrated in the South East. Indeed some of the most agglomerated industries, such as cutlery, lace and hosiery, are geographically concentrated outside of the South East, in Yorkshire and in the East Midlands. Examples of agglomerated industries include the ceramics industry where 47% of plants and 35% of new entrants are located in Staffordshire ($\gamma^{MS}=0.471$), and publishing of journals and magazines where 47% of plants and 45% of new entrants are located in Greater London ($\gamma^{MS}=0.237$).[30] There is also considerable geographic variation in our measure of diversification. The most diversified counties are centred around

[29] In estimating the expected grant we use only entrants where both the postcode and industry code match. We exclude a set of plants from the selection equation which we are unsure whether or not they received an offer (i.e. they match to an offer on the basis of their postcode but not their industry code).
[30] DGS (2004) provides a more detailed analysis.

major cities such as Greater Manchester and Greater London, and the least diversified areas are the Borders and Highland Scottish regions.

5. Empirical results

We start by estimating the determinants of the grant offer, and then use this to investigate the effect of expected grants and co-location effects on the location choices of greenfield plants that are either part of existing UK groups or part of foreign-owned multinationals. We also present a number of robustness checks.

5.1. Expected grant

Our main measure of the expected grant offer is estimated using our matched grant offer-plant data, which has the advantage that we can include firm-level characteristics. We begin by estimating a Heckman selection equation. We estimate the first stage on all greenfield plants that could in principle have applied for an RSA grant. These include (a) all entrants that are part of a UK or foreign-owned group, whether or not they subsequently enter into an Assisted Area (we assume these types of new entrants are geographically mobile), and (b) stand-alone greenfield plants that are located in Assisted Areas (these are less likely to be mobile and hence we only include those in Assisted Areas as they definitely could have applied). The second stage is estimated on all greenfield entrants that receive a grant offer, and includes the selection correction from the first stage. The estimates are shown in columns (1) and (2) of Table 3.

Column (1) shows the estimates of whether the firm applies and receives a grant offer. We find that plants that are part of groups are less likely to apply than single plant firms, but that conditional on being part of a group, plants that are part of foreign-owned groups are more likely to apply. The size of the group in terms of employment is not related to the likelihood of applying for a grant, nor is whether or not the firm has other plants located in Assisted Areas. Plants in relatively high-tech sectors, chemicals, high-tech manufacturing and motor vehicles are more likely to apply.

In column (2) we present the estimates from the expected grant offer equation (controlling for selection). Three of the firm-level variables from the selection equation are not relevant for the agencies' rules determining the size of the offer, and we exclude them from this stage of the estimation.[31] While being part of a group does not seem to affect the amount of grant offer received, the size of the group (which we interpret as a proxy for the potential (relative) size of the greenfield site) is positively related to the amount offered. We also find that foreign-owned plants, and those in high-tech manufacturing industries, receive higher grant offers. Hence a number of our firm and industry-level variables that form the basis of our identification strategy have a significant effect on the size of the grant offer. We also find a positive but insignificant relationship between investment intensity and the size of the grant offer, and between the amount of grant offered in Development Assisted Areas (which are areas of greater economic need, compared to Intermediate Assisted Areas the omitted category).

We carry out two robustness checks in estimating the expected grant. First, as shown in the final column of Table 3 we estimate the predicted grant using all the grant offers (not just those matched to plants). The main difference here is that we cannot include any firm-level characteristics. Instead we include an indicator of whether the grant was awarded to create

[31] They are insignificant if included in the regression.

Table 2
Descriptive statistics

Number observations	Apply	Expected grant		Location of Entrants	
		Matched entrants	Unmatched	In actual location	In all potential locations
	34,617	316	2135	14,964	1,316,832
Plant level variables:					
Grant offer (1990 £000)	–	407 (693)	571 (1742)	–	–
Grant to create jobs dummy	–	–	0.772 (0.419)	–	–
Choose this location				1 (0)	0.011 (0.106)
Firm level variables:					
Foreign-owned dummy	0.038 (0.192)	0.054 (0.226)	n/a	–	–
Part of a group dummy	0.414 (0.493)	–	n/a	–	–
No. plants in group in Assisted Areas	5.510 (23.360)	–	n/a	–	–
No. plants in group in Assisted Areas * foreign-owned	0.201 (2.510)	–			
Employment in rest of plants in group	1262 (6269)	1319 (6948)	n/a	–	–
Industry level variables:					
Investment intensity $t-1$ (1980 £000s per employee)	1.568 (1.232)	1.638 (1.068)	1.830 (1.504)	–	–
Food, drink, textiles dummy	0.186 (0.390)	0.165 (0.371)	0.176 (0.381)	–	–
Chemicals, rubber and plastics dummy	0.096 (0.294)	0.241 (0.428)	0.157 (0.364)	–	–
Metal manufacturing dummy	0.282 (0.450)	0.180 (0.385)	0.190 (0.393)	–	–
High-tech manufacturing dummy	0.077 (0.267)	0.108 (0.310)	0.147 (0.354)	–	–
Motor vehicles and parts dummy	0.026 (0.158)	0.057 (0.232)	0.065 (0.246)	–	–
Area level variables:					
Administrative region GDP (1990 £bn) $t-1$	–	–	–	72.010 (58.246)	50.294 (45.395)
County working age population $t-1$ (1000s)	–	–	–	250.369 (196.975)	146.754 (132.906)
County no. unemployed $t-1$ (1000s)	–	–	–	17.817 (18.513)	9.723 (12.347)
Unemployment rate $t-1$	–	0.082 (0.025)	0.078 (0.025)	–	–
County–Assisted Area manufacturing employment $t-1$ (1000s)	–	–	–	136.544 (139.362)	50.711 (66.017)
Assisted Area dummy	–	–	–	0.349 (0.476)	0.431 (0.495)

Table 2 (*continued*)

Number observations	Apply	Expected grant		Location of Entrants	
		Matched entrants	Unmatched	In actual location	In all potential locations
	34,617	316	2135	14,964	1,316,832
Area level variables:					
Development Assisted Area dummy	–	0.573 (0.495)	0.521 (0.500)	0.119 (0.323)	0.148 (0.355)
Area industry level variables:					
Industry plants $t-1$	–	–	–	173.427 (580.587)	30.961 (116.397)
Industry plants $t-1$ * γ^{MS}				11.031 (41.094)	1.195 (7.618)
Industry foreign–owned plants $t-1$	–	–	–	3.176 (9.155)	0.686 (2.039)
Industry foreign–owned plants $t-1$ * foreign–owned dummy				0.317 (2.617)	0.073 (0.642)
Diversification index $t-1$	–	–	–	0.913 (0.187)	0.812 (0.323)
Unskilled wage $t-1$ (1980 £000s)	–	–	–	5.877 (1.981)	5.513 (1.289)
Skilled wage $t-1$ (1980 £000s)	–	–	–	7.618 (1.612)	7.262 (1.409)
Administrative region dummies	No	Yes	Yes	–	–
County dummies	No	No	No	–	Yes
Year dummies	Yes	Yes	Yes	–	Yes

Notes: unskilled and skilled wages are measured at the 2-digit industry level. Investment intensity and all other area-industry level variables are measured at the 4-digit level. Omitted industry dummy is 'Other manufacturing'. n/a=not available.

Source: authors' calculations using the ARD (Source: ONS) and RSA grant offers data.

jobs,[32] as opposed to safeguarding jobs.[33] We find that, conditional on the other factors, on average, grants offered to create jobs are lower than those offered to safeguard employment. Here we do find that grants offered in Development Areas are significantly higher than those offered in Intermediate Areas. As a second robustness check (not reported in the table), we additionally include all of the variables from our location choice model (columns 4 and 5, Table 2) in our estimation using the matched grant offers. These additional variables are all individually insignificant in the expected grant equation.[34]

We use the estimated parameters to obtain an expected grant for each entrant in each location. We set the expected grant to zero outside Assisted Areas. Column (1) of Table 4 shows the

[32] These are known as category A grants and are appropriate for entrants as well as pre-existing plants that are expanding.

[33] These are known as category B grants and are only appropriate for pre-existing plants. This indicator cannot be included in the first approach, as we only estimate on entrants in the first two columns, so it would equal 1 for all observations. It is set to unity for all entrants when predicting the expected grant using the coefficients from column 3 for use in the location model.

[34] The coefficients on the number of industry plants and number of industry foreign owned plants variables are both negative in the expected grant offer equation (although statistically insignificant), which points in the direction of policy makers offering lower grants in more industrially agglomerated areas.

Table 3
Grant equation

	(1)	(2)	(3)
Dependent variable	Makes grant application	Grant offer	Grant offer
Number observations	34,617	316	2,135
Plant level			
Grant to create jobs dummy	–	–	−325.8
			(77.1)
Firm level variables:			
Foreign-owned dummy	0.225	535.7	n/a
	(0.116)	(186.3)	
Part of a group dummy	−0.152	–	n/a
	(0.048)		
No. plants in group in Assisted Areas	0.0002	–	n/a
	(0.0012)		
No. plants in group in Assisted Areas * foreign-owned	−0.059	–	n/a
	(0.043)		
Employment in rest of plants in group	0.000002	0.0133	n/a
	(0.000003)	(0.0055)	
Industry level variables:			
Investment intensity in 4-digit industry $t-1$	−0.027	28.1	70.9
	(0.021)	(43.8)	(35.1)
Food, drink, textiles	0.032	−103.4	9.79
	(0.066)	(124.4)	(44.9)
Chemicals, rubber and plastics	0.486	191.9	73.3
	(0.066)	(262.9)	(83.2)
Metal manufacturing	−0.082	−128.6	−42.1
	(0.062)	(131.7)	(44.1)
High-tech manufacturing	0.235	555.2	682.8
	(0.078)	(186.6)	(179.4)
Motor vehicles and parts	0.413	348.8	836.2
	(0.106)	(267.7)	(341.1)
Area level variables:			
Development Assisted Area dummy	–	142.5	220.7
		(111.0)	(70.6)
Unemployment rate $t-1$	–	−2421.9	755.4
		(2509.2)	(2931.5)
Inverse mills ratio	–	671.9	n/a
		(575.8)	
Administrative region dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes

Notes: omitted industry dummy is 'Other manufacturing'. Numbers in parentheses are standard errors. Heckman selection model: column (1) estimates whether or not firm makes an application, column (2) estimates the amount of grant received, conditional on having applied.
Source: authors' calculations using RSA grant offers data and the ARD (Source: ONS).

average expected grant offer within Assisted Areas by broad administrative regions, applying the estimated coefficients from column (2) of Table 3 to data for each potential location for each entrant (i.e. averaging across entrants in each possible location that has Assisted status). For

Table 4
Predicted grant (1990 £000)

	Mean predicted grant from columns 1+2 Table 3	Mean grant (matched to entrants)	Mean predicted grant from column 3 Table 3	Mean grant (all category A)
Administrative region–Assisted Area				
South West	376.4	446.8	198.0	356.4
West Midlands	417.6	257.4	234.1	341.4
East Midlands	379.9	232.2	115.3	150.7
Yorkshire and Humberside	1135.4	973.6	435.9	385.2
North West	642.3	442.5	391.6	257.9
Northern	501.9	360.5	564.1	678.4
Wales	489.4	492.9	407.1	521.7
Scotland	396.3	342.2	447.3	640.9
Ownership				
UK-owned	456.0	381.2	357.8	95.0 *
Foreign-owned	1055.3	866.3	445.3	818.0 *
Mean	511.1	407.3	365.8	498.0

Notes: category A grant offers are those offered to plants to create jobs. Columns (1) and (3) are averages across predicted grants for the 14,964 entrants over all possible location choices with Assisted Area status.
Source: authors' calculations using RSA grant offers data and the ARD (Source: ONS), * Source: PA Cambridge Economic Consultants (1993). These two figures include grant offers of less than £75,000 for both jobs created and safeguarded, over the period 1985 to 1988.

comparison, Column (2) of Table 4 shows the mean across our sample of matched entrants. These are similar with a correlation coefficient of 0.95, despite being averages over different samples of entrants in each column. The estimates in column (1) of Table 4 use information on firm ownership, and therefore give a good prediction of the difference in the level of grant typically received by foreign versus domestic-owned plants.

Column (3) of Table 4 shows the mean predicted grant based on our robustness check in column (3) of Table 3, again averaged across entrants across each possible location that has Assisted status. To generate these predicted grants we assume that the entrant will create jobs, and therefore set the dummy for category A (job creation) grant offers equal to 1. For comparison, column (4) shows the mean of actual category A grant offers made in each region. The correlation coefficient is again high at 0.80.

5.2. Location choice

To consider the impact of grants and agglomeration on location we estimate a fixed effects conditional logit model. The results are reported in Table 5 where the values shown are the mean of the calculated marginal effects across all observations. The numbers in parentheses are z-ratios associated with the estimated coefficients.[35] In column (1) we begin by including measures of area size, and various demand and cost conditions in the different locations. We find evidence that firms are more likely to locate greenfield plants near larger markets, i.e. we find a positive

[35] The marginal effect with respect to X_1 when it is not interacted with any other variable is $\hat{P}(1-\hat{P})\beta_1$, where β_1 is the coefficient. The z-ratio indicates the significance of the coefficient: a value of 1.96 or greater indicates significance at the 5% level, a value of 1.65 or greater at the 10% level.

Table 5
Location choice, marginal effects

Dep var = 1 if entrant chooses region	(1)	(2)	(3)	(4)	(5)
Assisted Area dummy			−0.003	−0.003	−0.003
			(−6.79)	(−6.58)	(−6.85)
Development Assisted Area dummy			0.002	0.002	0.002
			(2.34)	(2.34)	(2.84)
Expected grant columns 1+2 (matched)				0.0001	0.0003
				(2.02)	(0.51)
Expected grant * industry plants $t-1$					0.000002
					(8.00)
Regional GDP $t-1$	0.000005	0.00004	0.00004	0.00004	0.00004
	(0.25)	(2.00)	(1.95)	(1.89)	(1.69)
Total working age pop $t-1$	0.000006	0.000005	0.000005	0.000005	0.000006
	(1.90)	(1.64)	(1.52)	(1.54)	(1.92)
Total unemployed $t-1$	−0.00003	−0.00002	−0.00002	−0.00002	−0.00004
	(−1.41)	(−0.91)	(−0.91)	(−1.01)	(−1.89)
Area size manuf emp $t-1$	0.0001	0.0001	0.0001	0.0001	0.0001
	(30.79)	(30.78)	(29.42)	(29.48)	(29.47)
Industry unskilled wage $t-1$	0.001	−0.0003	−0.0003	−0.0003	−0.0002
	(13.93)	(−2.93)	(−2.90)	(−2.89)	(−2.26)
Industry skilled wage $t-1$	0.0006	0.0003	0.0003	0.0003	0.0003
	(7.26)	*(3.22)*	*(3.21)*	*(3.19)*	*(3.12)*
Industry plants $t-1$		0.000001	0.000001	0.000001	0.000001
		(−4.02)	(−4.00)	(−4.00)	(−3.92)
Industry plants $t-1$ * γ^{MS}		0.0001	0.0001	0.0001	0.0001
		(11.15)	(11.11)	(11.09)	(10.08)
Industry foreign-owned plants $t-1$		0.0003	0.0003	0.0003	0.0003
		(5.60)	(5.62)	(5.64)	(6.34)
Industry foreign-owned plants $t-1$ * Fo		0.0002	0.0002	0.0002	0.0002
		(3.37)	(3.37)	(3.45)	(3.44)
Diversification index $t-1$		0.016	0.016	0.016	0.016
		(24.24)	(24.23)	(24.25)	(24.41)
County dummies	Yes	Yes	Yes	Yes	Yes
Log likelihood	−59311	−58438	−58415	−58413	−58384

Notes: expected grant (1990 £100,000); regional GDP (1990 £bn); total working age population, unemployment and manufacturing employment (1000s); wages (1980 £1000). Fo = foreign-owned dummy. Figures in parentheses are z-ratios associated with the estimated coefficients; 1,316,832 obs, 14,964 new plants owned by foreign multinational and UK groups. Source: authors' calculations using the ARD (Source: ONS).

relationship with the amount of manufacturing activity that is already taking place and the total working age population in the county.

From column (1) it also appears that firms are more likely to locate new plants in regions with higher wages. However, in column (2), we condition on our measures of localisation and urbanisation. In this case we find (as would be expected) that firms are more likely to choose locations where unskilled wages are lower. But we still find a positive relationship with the skilled wage.[36] The results in column (2) – and indeed all the remaining columns in the table – confirm

[36] Reasons why wages might vary across regions include productivity differences and differences in costs of living, which have not been accounted for in our measures. A positive relationship between the probability of location and skilled wages may therefore indicate productivity differences across regions — firms being attracted to regions where the marginal product of skilled workers is higher.

that firms locate near demand as measured by regional GDP. In column (2), and also in subsequent columns, diversification of industrial structure enters positively and significantly.

Turning to the industry localisation measures, we find that plants within the same industry tend to co-locate, and to a greater extent when that industry is agglomerated — i.e. we find a positive and significant relationship once we interact the number of plants in the industry-county with our index of how agglomerated employment is in that industry. To calculate the marginal effects of the interaction terms, which are shown in the Table, we follow Ai and Norton (2003).[37] On average, the marginal effect of the number of plants in the industry in a location on the probability of locating there is very small. However the size of this effect increases markedly with the agglomeration index; for example, an increase in the index of only 0.01 doubles the marginal effect of the number of plants in a location.

The number of foreign-owned plants in the 4-digit industry in the county also has a positive effect on the probability of location. In addition, a greater foreign presence makes a location even more attractive for greenfield plants set up by foreign-owned multinationals, compared to those that are part of UK groups. This result accords with other studies.[38] However, the estimated marginal effects on all these industry localisation measures are also low.[39] For example, an increase in the number of foreign-owned plants in a county from 1 to 2 (i.e. a 100% increase), increases the average probability of choosing a particular location by around 3%, i.e. from around 1% to 1.03%.

In column (3) we introduce a dummy variable to indicate whether or not a location is classified as an Assisted Area, and a second dummy variable that differentiates Development Assisted Areas (where higher grant offers are made) from Intermediate Assisted Areas. We find that, conditional on the other factors already discussed, on average greenfield entrants are less likely to locate in Assisted compared to non-Assisted Areas, but that they are more likely to locate in Development compared to Intermediate Areas. This is as expected, these regions are designated as Assisted precisely because they have low levels of economic activity.

In column (4) we find some evidence that grant offers influence where existing firms choose to locate new plants. The marginal effect is very low at 0.0001, implying that an increase in the expected grant of £100,000 is associated with a 1% increase in the probability of location, i.e. from 1% to 1.01%. In column (5) we interact the expected grant with our measure of the number of existing plants in the entrant's industry in that county. We find evidence that grant offers have a greater effect on location incentives in areas where there is more existing economic activity in the entrants' industry.

[37] The marginal effect of X_1 when it is interacted with X_2 is $\hat{P}(1-\hat{P})[\beta_1+\beta_{12}X_2]$ where β_{12} is the coefficient on the interaction term. What Ai and Norton (2003) call the "interaction effect" is the impact of a change in X_2 on the marginal effect of X_1 (or equivalently, vice versa). This is the marginal effect reported in the Table, given by $\hat{P}(1-\hat{P})\beta_{12}+\hat{P}(1-\hat{P})(1-2\hat{P})[\beta_1+\beta_{12}X_2][\beta_2+\beta_{12}X_1]$. The z-statistic shown in the Table refers to the significance of β_{12}, rather than the whole marginal effect. Given the size of the dataset used in estimation it is not practical to calculate standard errors for the marginal effects. Note that the sign of the estimated coefficient on an interaction term can differ from the sign of the marginal effect, and hence the sign of the z-ratios can differ from the sign of the marginal effect at the mean as is the case in some instances in Tables 5 and 6.

[38] See for example, Crozet, Mayer and Mucchielli (2004), Head et al. (1999), Ford and Strange (1999).

[39] Our findings on localisation may be sensitive to the geographic boundaries used in estimation. We therefore ascertained that our results were robust to using alternative boundaries in the form of 109 postcode areas (the first two letters of the postcode) that are based around centres of economic activity (towns and cities). For example, using postcode areas the marginal effects (z-ratios) associated with the number of industry plants variable and the interaction of this with γ^{MS} are 0.000018 (7.10) and 0.00025 (10.76) respectively.

Table 6
Robustness checks, marginal effects

	Expected grant derived from column (3) Table 3	Expected grant including all regional variables	Sample including stand-alone entrants 1992
Dep var=1 if entrant chooses region	(1)	(2)	(3)
Assisted Area dummy	−0.002	−0.003	−0.003
	(−5.53)	(−6.03)	(−9.79)
Development Assisted Area dummy	0.002	0.002	0.002
	(2.91)	(2.83)	(5.98)
Expected grant	0.0001	0.0002	0.0004
	(−3.18)	(−0.86)	(1.68)
Expected grant * Industry plants $t-1$	0.000003	0.000002	0.000002
	(5.20)	(7.77)	(3.10)
Regional GDP $t-1$	0.00004	0.00004	0.00004
	(1.82)	(1.77)	(20.65)
Total working age pop $t-1$	0.000006	0.000007	0.00003
	(1.78)	(2.21)	(9.36)
Total unemployed $t-1$	−0.00003	−0.00003	−0.0002
	(−1.59)	(−1.50)	(−5.60)
Area Size manuf emp $t-1$	0.0001	0.0001	0.00003
	(29.30)	(29.48)	(61.57)
Industry unskilled wage $t-1$	−0.0002	−0.0002	−0.0007
	(−2.57)	(−2.38)	(−7.91)
Industry skilled wage $t-1$	0.0003	0.0002	0.0003
	(3.19)	(3.06)	(3.81)
Industry plants $t-1$	0.000001	0.000001	0.000007
	(−3.83)	(−3.47)	(6.12)
Industry plants $t-1$ * γ^{MS}	0.0001	0.0001	0.0002
	(10.97)	(9.53)	(9.95)
Industry foreign owned plants $t-1$	0.0003	0.0003	−0.0004
	(5.60)	(6.54)	(−7.48)
Industry foreign owned plants $t-1$ *Fo	0.0002	0.0002	0.0004
	(3.37)	(3.64)	(2.11)
Diversification index $t-1$	0.016	0.016	0.014
	(24.30)	(24.37)	(31.15)
County dummies	Yes	Yes	No
Log likelihood	−58,400	−58,388	−70,199
No. observations	1,316,832	1,316,832	1,594,870

Notes: expected grant (1990 £100,000); regional GDP (1990 £bn); Total working age population, unemployment and manufacturing employment (1000s); wages (1980 £1000). Fo=foreign-owned dummy. Figures in parentheses are z-ratios associated with the estimated coefficients.
Column (1) uses the expected grant derived from column (3) of (Table 3). Column (2) uses an expected grant derived using the matched data and including all regionally varying variables from the conditional logit model in the expected grant equation. Column (3) uses our main method of estimating the expected grant and uses a single year cross-section of greenfield entrants including single plant firms.
Source: authors' calculations using the ARD (Source: ONS).

Including the interaction term, the average marginal effect of the expected grant is three times higher — so that an increase in the expected grant of £100,000 increases the probability of location to 3% (from 1% to 1.03%). In addition, the interaction term indicates that as the number of plants rises, the marginal effect of the expected grant rises: for example, an increase of 10 plants increases the marginal effect of an increase of £100,000 in the expected grant on the probability of location by 6.7% (i.e. the probability increases to 1.032%). Put another way, our results imply that higher grant offers are needed to attract greenfield entrants to locations where industry agglomeration or natural resource benefits are weaker.

5.3. Robustness

We examine the robustness of these results to three concerns: the sample used in the estimation of the predicted grant; the inclusion of all regional variables in the estimation of the predicted grant; and the inclusion of stand-alone greenfield startups that are not part of pre-existing groups. The results for each of these are shown in Table 6. In each case, the specification is comparable with column 5 of Table 5.

The first two robustness checks use two different methods of calculating the expected grant. In column (1) we use our first alternative measure of the expected grant, derived from the estimates in column (3) of Table 3, and outlined further in Table 4. Using this alternative method has virtually no statistically significant effect on the results. At the mean the marginal effects on the expected grant and the interaction term remain positive and very low, (although the estimated coefficient associated with the expected grant is negative). In column (2) we return to using the matched data to predict the expected grant, but in the grant offer equation we include all of the regional variables from our conditional logit model. This has very little impact on the results, compared to column 5 of Table 5.

In column 3 we include stand-alone plants in our sample. Due to very large sample sizes we are only able to estimate this model for a single year at a time, and hence exclude the county fixed effects from this specification. The results shown are for 1992 and are based on 18,545 greenfield entrants. The magnitude of the marginal effects on the industry localisation measures increases somewhat, perhaps indicating that agglomeration externalities are more important for single stand-alone plants,[40] (although note that county fixed effects are not included). However, the presence of own industry foreign-owned plants appears to be less of an attraction once we include single plant entrants, except for plants that are owned by foreign multinationals.

In all cases the marginal effects associated with the expected grant remain economically small, and in all cases we continue to find that the expected grant has a greater impact on the probability of location in areas where there is greater existing activity in the entrant's own industry.

6. Conclusions

This paper investigates the determinants of where multi-plant firms choose to set up greenfield plants in Great Britain. We investigate the impact of discretionary regional grants aimed at inducing new plants to locate in specific Assisted Areas, and how this varies with potential benefits arising from co-location.

We find that firms in more agglomerated industries choose to locate new plants near to other plants within the same industry. Conditional on this, RSA grants have a small positive impact on location choices. Importantly, we find that these fiscal incentives are more effective when offered in areas that also have localisation benefits. In addition, we also find that urbanisation economies

[40] See Henderson (2003) for evidence that single plants benefit more from external economies.

have a significant impact on location decisions and that foreign-owned multinationals also favour locations with higher numbers of existing foreign-owned plants in their industry.

Our results suggest that higher grant offers are needed in the face of potential countervailing agglomeration externalities or natural advantages drawing entrants to other locations. Put another way, these policy instruments appear to have more leverage in Assisted Areas where there is already economic activity in the industries in which grants are offered, compared to in Assisted Areas where agglomeration benefits may be lower. This has implications for how government expenditure on such incentives is distributed geographically, if an aim of the policy is to reduce existing disparities in the attractiveness of different regions for mobile economic activity. A natural next question for research is to quantify the benefits arising from the successful attraction of a new plant.[41]

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[41] See Greenstone and Moretti (2004) for a recent study addressing this issue.

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